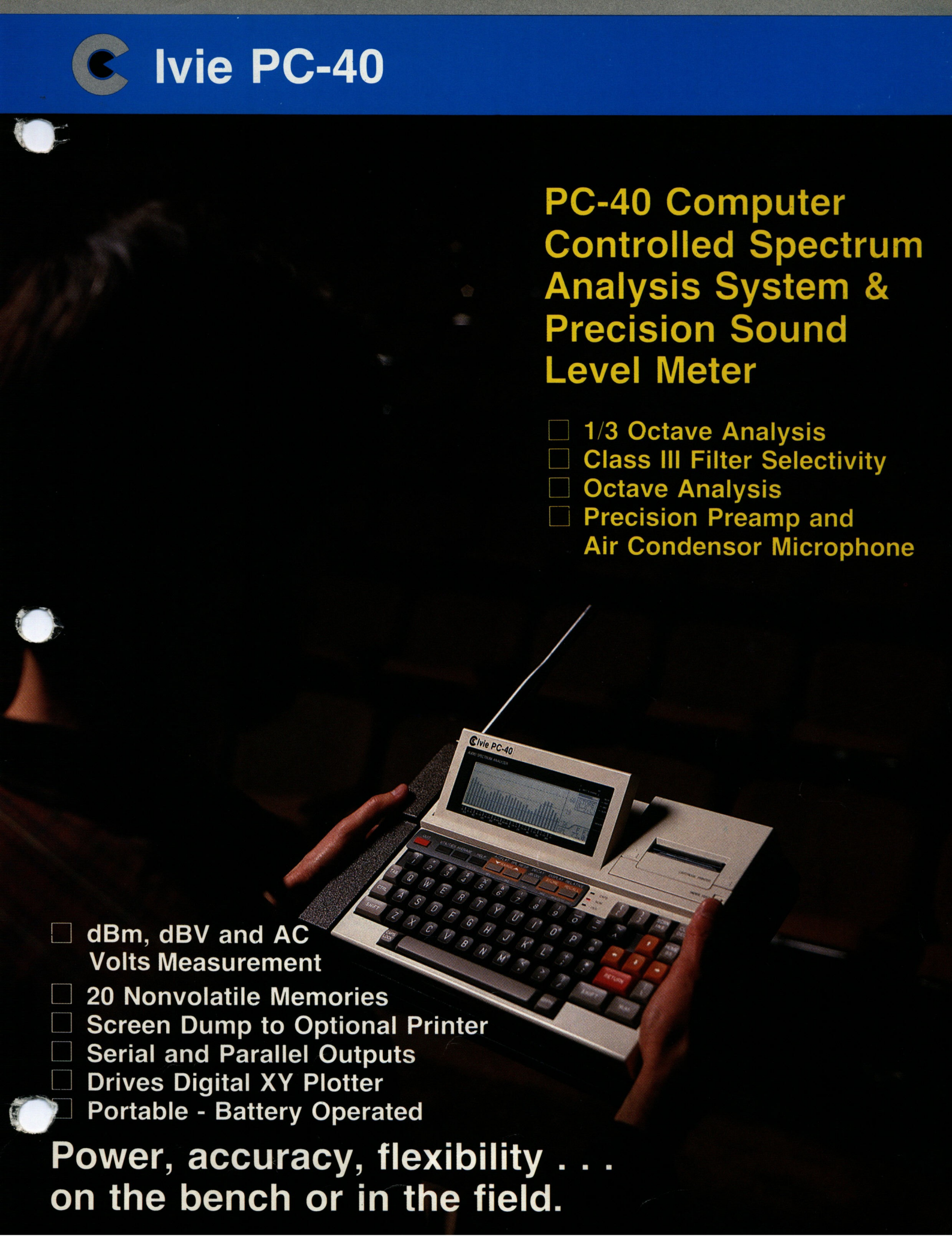
Ivie PC-40

PC-40 Computer Controlled Spectrum Analysis System & Precision Sound Level Meter

- ☐ 1/3 Octave Analysis
- ☐ Class III Filter Selectivity
- ☐ Octave Analysis
- ☐ Precision Preamp and Air Condensor Microphone



- ☐ dBm, dBV and AC Volts Measurement
- ☐ 20 Nonvolatile Memories
- ☐ Screen Dump to Optional Printer
- ☐ Serial and Parallel Outputs
- ☐ Drives Digital XY Plotter
- ☐ Portable - Battery Operated

Power, accuracy, flexibility . . . on the bench or in the field.

The computer based Ivie PC-40 represents a significant advancement in spectrum analyzer technology. Capable of making a variety of measurements both quickly and accurately, the PC-40 will handle the most demanding requirements with ease. Its 20 nonvolatile memories, and parallel and serial outputs making saving and storing data simple. In addition to its built-in functions, it is user programmable in BASIC, making its capabilities almost limitless.

Precision low noise preamp and air condensor microphone

Data and programs can be saved on optional disk drive

Up to 64 dB display range with resolutions of 1, 2, or 3 dB per step

Tilt up screen with selectable octave, 1/3 octave and weighted 1/3 octave displays

Highly selective Class III Filters

Can display 2 or more curves simultaneously

Programmable using BASIC

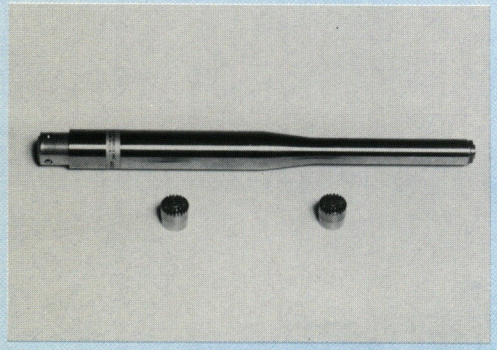
Selectable detector response time

Serial and Parallel Outputs

Type I sound level meter provides fast, slow, peak, and impulse measurements

Optional Plug-in cartridge printer, AC volt meter, tape drive, modem or PROM burner

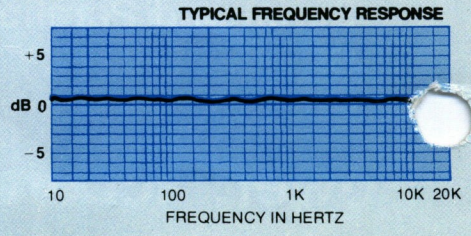
20 nonvolatile memories for storing or accumulating data

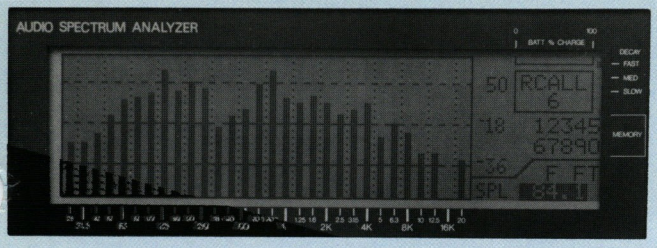


IE-2P Precision Preamp and 1133 and 1134 mic cartridges.

The PC-40 comes standard with the IE-2P precision preamplifier, and your choice of the 1133 free field response microphone, or the 1134 random response microphone. Both mics are laboratory quality, air condensor microphones. The IE-2P is also compatible with other high quality, air condensor microphones such as Brüel and Kjaer.

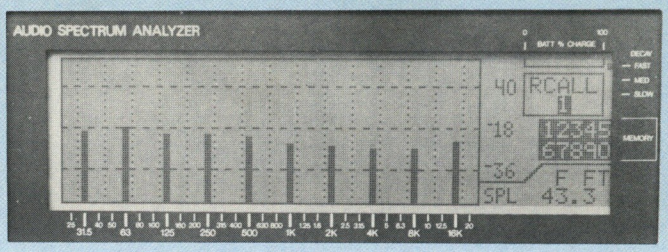
The typical frequency response of the 1133 or 1134 microphone is shown below.





STANDARD 1/3 OCTAVE DISPLAY

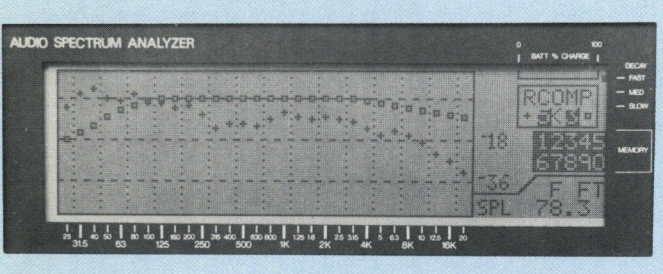
The PC-40 is capable of making a wide variety of 1/3 octave measurements and storing them in memory for later analysis. In this illustration, the first ten memories are shown in standard video. In addition to its twenty memories, the PC-40 is capable of "snapshot" entry of screens into memory (472 screens expandable to 8100 screens). The sample rate is also variable from 1 to 100 screens per second.



OCTAVE DISPLAY

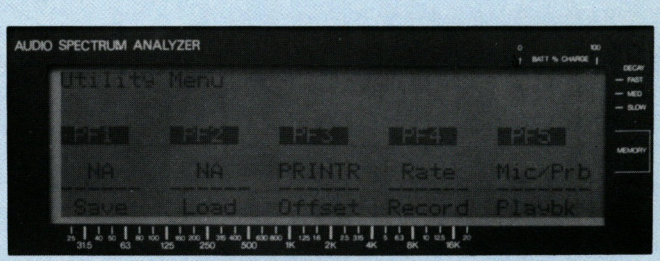
In this illustration, the PC-40 is being used in the octave mode to generate an NC curve. With the 1133 or 1134 microphone cartridges supplied with the PC-40, curves as low as NC 30 can be measured. By using other microphones with lower noise floors, such as the 1 inch B&K 4164 microphone, curves as low as NC 15 can be measured.

Notice that the second ten memories are shown in this illustration as indicated by the reverse video.



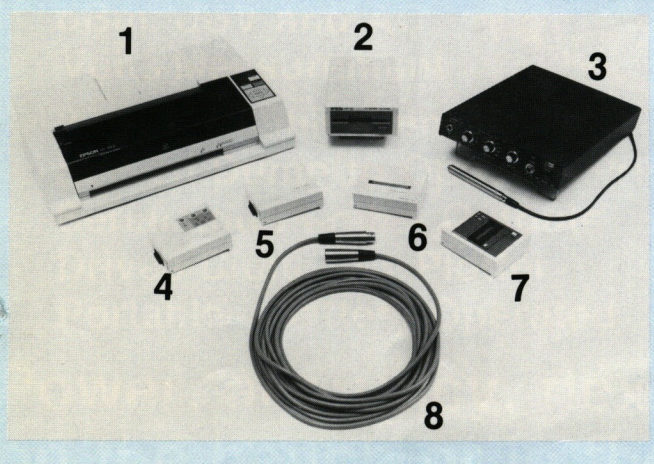
DISPLAYING MULTIPLE MEMORIES

In this illustration, two memories are being displayed; in this case a "before" equalization and an "after" equalization curve. Multiple curves may also be displayed to show an envelope. An "offset" curve can also be entered, and other curves shown as a comparison against that offset. Memory information can be subjected to the PC-40's averaging capability, and can, of course, be dumped onto a disk or tape cartridge for storage.



THE UTILITIES MENU

The Utilities Menu should help give you a feel for how many of the options mentioned in the three illustrations can be initiated. This menu allows functions to be performed such as saving data to a disk or cartridge, or loading data from these sources. An offset curve may be entered, or a printer selected. Screen sample rate can be selected, and the probe or the mic can be chosen as the input. The "Record" function allows successive screens to be stored into a buffer - selectable from 1 to 100 screens per second, with up to 8100 screens being stored. In "Playback," those screens can be played back one at a time, if desired.



OPTIONAL ACCESSORIES FOR THE PC-40

1. Digital XY Plotter. Provides hard copy for documentation purposes
2. Disk Drive. Provides data storage and retrieval. Disks are 320 k, 3 1/2 inch, single sided, single density.
3. Ivie Model 1200 Preamp and Model 1300 Power Supply & Low Noise Amplifier. Provides ultra low-noise front end for PC-40 or any other system using condensor microphones. The 1200 is a low-noise preamp which can be used with the 1300 only. The 1300 provides microphone bias voltage of 0, 28, and 200 VDC. Among its many features are filtering capabilities, and an 800 VDC output for use in electrostatic sweeping of condensor microphones.
4. Digital Multimeter. Multimeter is computer controlled by BASIC.
5. Modem Cartridge.
6. Printer Cartridge. Provides 40 column, hard copy for documentation purposes.
7. Cassette Cartridge. Provides data storage and retrieval on micro-cassette tapes.
8. MC-25 Microphone Extension Cable. Also comes in 50 foot (MC-50), 75 foot, 100 foot, 150 foot, and 200 foot lengths. The microphone on the PC-40 can be remoted up to several hundred feet without effecting system accuracy or performance.

Ivie PC-40

TANDARD ACCESSORIES

he Ivie PC-40 comes with
"Fast Charge" nickel cadmium batteries.

Manual with instructions and illustrations.

AC adaptor/charger

IE-2P Precision Preamp.

1133 or 1134 microphone

IE-1036B Test Probe

PC-40 Carrying Case

ECHNICAL DATA:

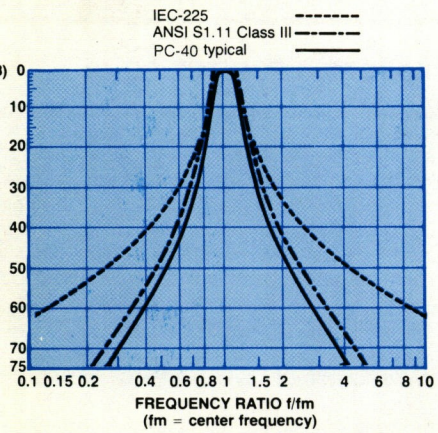
EAL TIME ANALAYZER

1/3-octave operation provided from 25 Hz to 20k Hz in thirty ISO bands.

Highly selective three pole-pair filters exceed ANSI SI.11-1966 Class III, B.S. 2475-1964 DIN 45652, and IEC225-1966.

Relative filter flatness ± 0.5 dB.

1/3-octave filter display can be "weighted" with A,C, or Flat filters.



One-octave operation provided from 25Hz to 20k Hz in ten ISO bands.

Octave filter skirt selectively satisfies ANSI S1.11-1966 Class II, BS 2475-1964, DIN 45652, and IEC225-1966.

SOUND LEVEL METER

- Response modes: *Fast, Slow, Impulse,* and *Peak.*
- Instrument Range 10dBA SPL to 149dBA SPL re 20 μ N M²
- Microphone Noise Floor: 22 dBA using the standard IE-2P and either the 1133 or 1134 microphones.
- Selectable true rms or peak detectors.
- 20 dB crest factor for full scale reading.
- Four digit LCD readout with 0.1 dB SLM resolution.
- Digital display modes for continuous sample or display hold.
- Overload and underrange indicators.
- Filter weights A,C and Flat.
- Flat filter bandwidth 7Hz-35KHz.
- Calibration microphone is remoteable.
- Meets requirements of:
  ANSI SI.4-1971 TYPE S1A, S1C
  BS 4197-1967
  DIN 45633 B1.1, B1.2 (Impulse)
  IEC 179-1973

MICROPHONE

- Element: Air Condensor. 200 VDC Polarization.
- Directional Patern: Omnidirectional.
- Dynamic Range: Greater than 120 dB with supplied electronics.
- Response: Either Free Field or Random Response is available.
- Frequency Response: 10Hz to 20kHz, as illustrated.

PREAMPLIFIER/ATTENUATOR

- 100K ohm input impedance.
- Headroom: + 40dB (above display screen) with sine wave input.
- Selectable filter weighting A,C or Flat
- Bandwidth 7Hz-35KHz.
- Flatness ±0.5dB (20Hz-20KHz).
- THD ≤ 0.3% @ 2.0V output level.
- Input damage level + 100 VDC or 300 VAC (above 20 Hz.)
- Output short circuit protected.

DISPLAY

- 240 by 64 pixel LCD display.
- Display ranges of 16, 32, and 64 dB are selectable with resolutions of 1, 2, or 3 dB per step (.25, .5, or 1 dB per pixel).
- Screen viewing angle is adjustable.

MECHANICAL

- All modular construction provides dependable operation with ease of maintenance.
- Dimensions: 13 1/4 x 8 1/2 x 3 1/4 inches.
- Aluminum chasis with ABS outer shell.
- Hardshell, foam padded travel case included.
- Weight: Net 10 lbs., shipping: 21 lbs.

ENVIRONMENTAL

- All circuits temperature compensated.
- Operating temperature + 5°C to + 35° C. 41°F 95°F
- Nonoperating tem − 25°C to + 60°C.
- Operating humidity 10 to 80%.

POWER

- Battery operation; nickel cadmium, rechargeable.
- Operating time approximately 4 1/2 hours.
- Fast charge cycle of 5 1/2 hours.
- Battery level indicator.
- AC line operation from AC adaptor/charger.
- 115 VAC or 230 VAC operation from 50 to 60 Hz.
- Charge indicator light.

WARRANTY

The PC-40 is warranted against defects in materials and workmanship for one (1) year from the date of shipment. During the warranty period, Cetec Ivie will repair or, at its option replace, components which prove to be defective provided the unit is returned, shipping prepaid to an authorized Cetec Ivie service facility. Defects caused by modifications, misuse or accidents are not covered by this warranty. No other warranties are expressed or implied. Cetec Ivie is not liable for consequential damages. All requests for repairs and information should include the instrument serial number to assure rapid service.

Cetec Ivie

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Orem, Utah 84057
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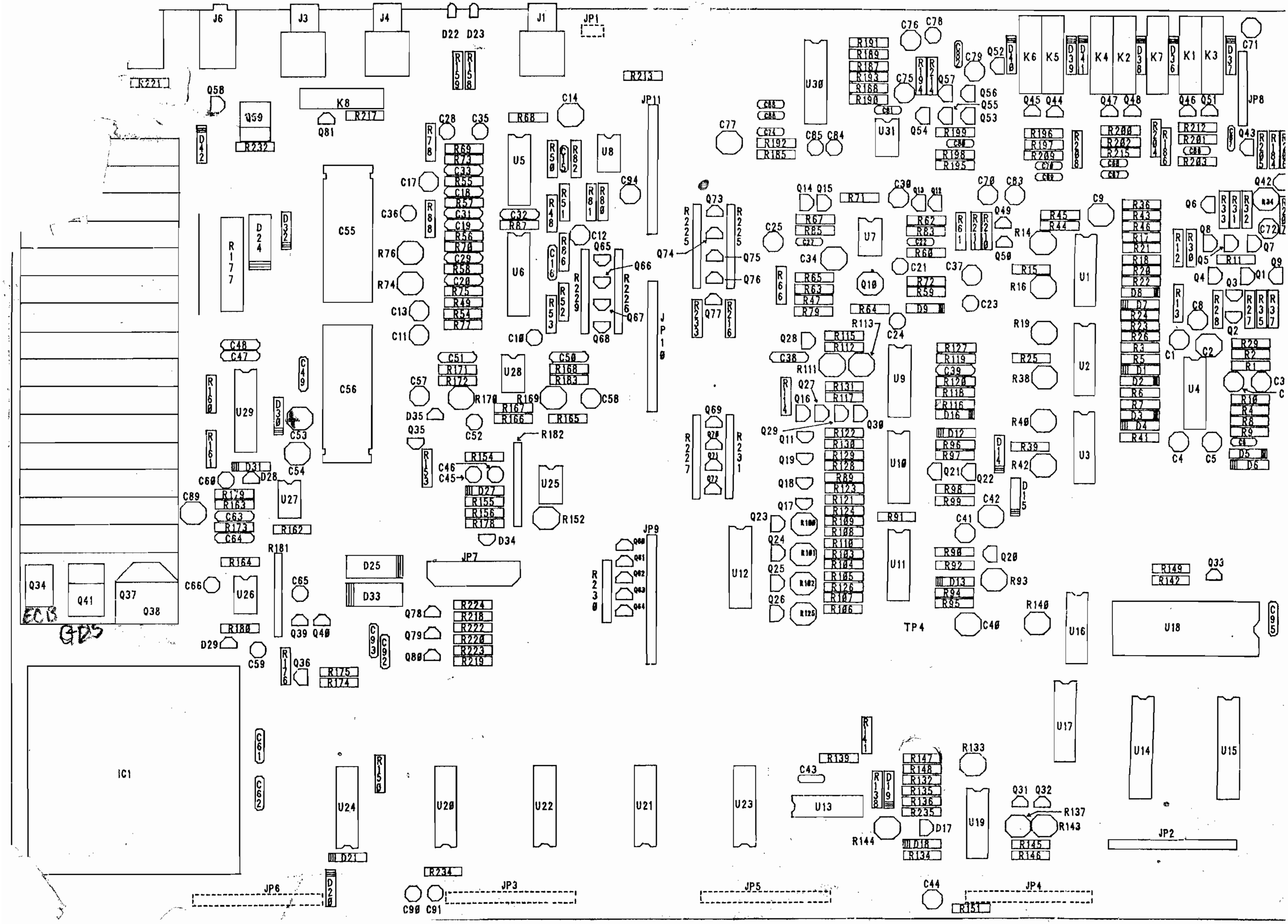
TELEX or TWX 910-971-5884
FAX 801-224-7526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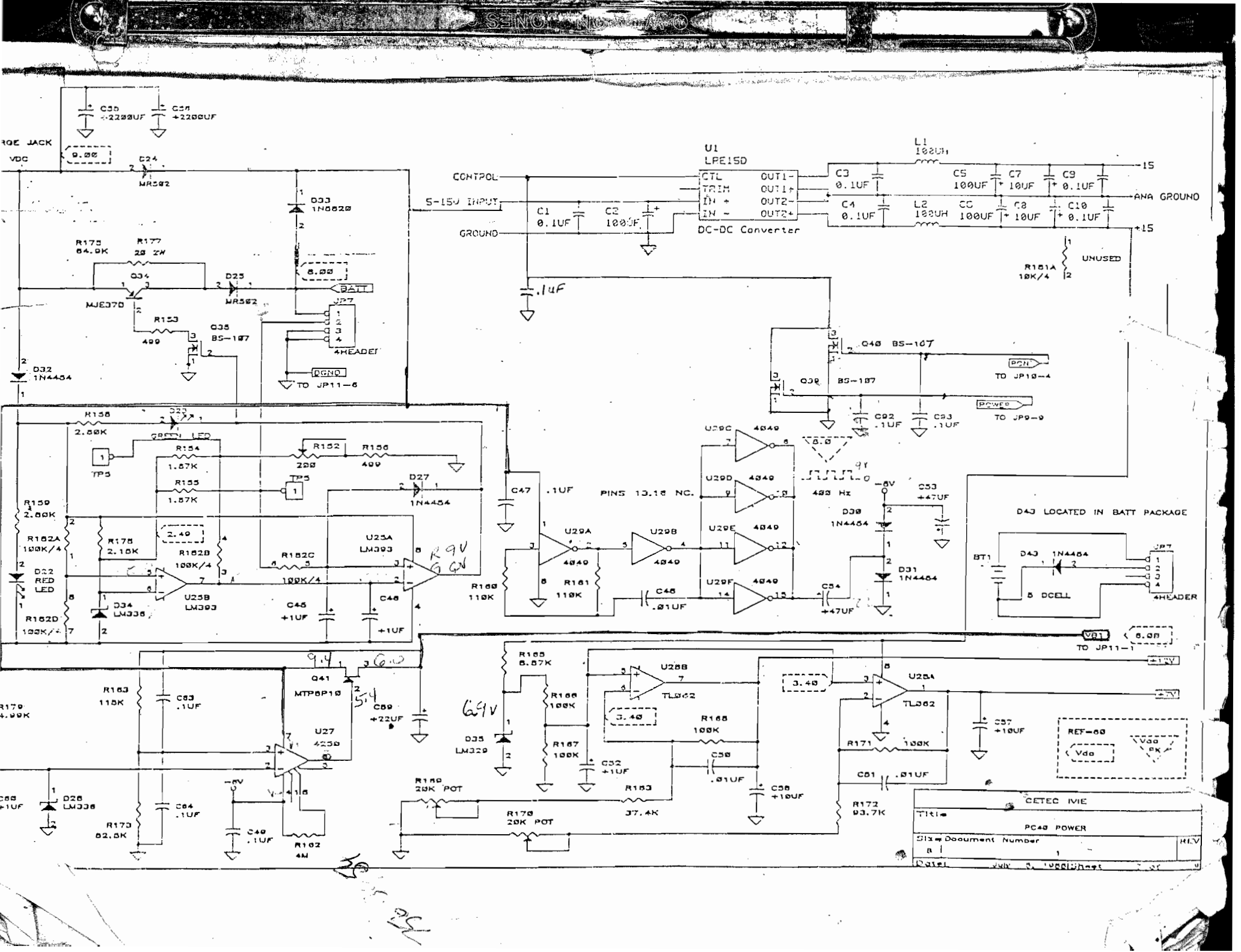
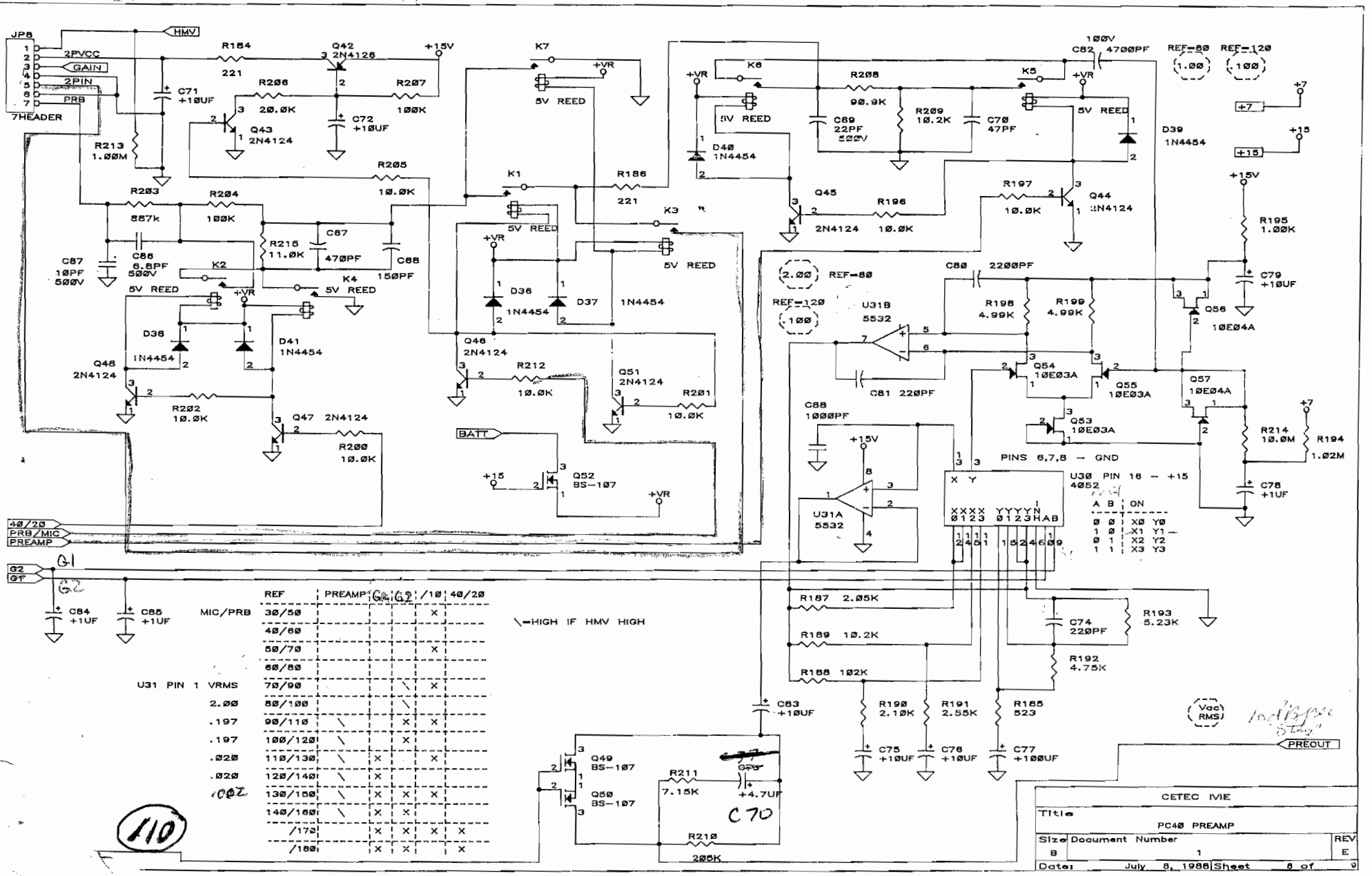
R221 Q58 Q59 K8 R217 Q81 R232 D42
R213 JP11 C14 R68 C28 C35 R78
R69 R73 C33 R55 C18 R57 C31 C19 R56 R70 C29 R58 C20 R75 R49 R54 R77
U5 U8 R50 C15 R82 C17 C36 R88 R76 R74 C13 C11
C32 R87 R48 R51 R81 R80 C94 C12 Q65 Q66 Q67 Q68 U6 C16 R86 R229 R226 R52 R53
C55 C56 R177 D24 D32
C48 C47 C49 R160 R161 U29 D30 C53 C54
C51 R171 R172 U28 C50 R168 R183 C57 R170 R169 C58 D35 Q35 C52 R167 R166 R165 R182 R153
C46 C45 R154 D27 R155 R156 R178 D34 U25 R152 JP10
D31 C60 D28 C89 R179 R163 C63 R173 C64 U27 R162 R181
R164 C66 U26 C65 R180 Q39 Q40 D29 C59 R176 Q36 R175 R174
D25 D33 JP7 Q78 Q79 Q80 C93 C92 R224 R218 R222 R220 R223 R219
Q34 Q41 Q37 Q38 ECB
IC1 C61 C62 U24 D21 R150 U20 U22 U21 U23 R234 D20 JP6 JP3 JP5 JP4 C90 C91
R230 JP9 R227 R231 Q69 Q74 Q73 Q75 Q76 Q77 R225 R233 R216
C77 C85 C84 U30 U31 R192 R185 R191 R189 R187 R193 R188 R190
C76 C78 C75 C79 Q52 Q57 Q56 Q55 Q53 Q54 R194 R199 R198 R195
K6 K5 K4 K2 K7 K1 K3 D40 D39 D41 D38 D36 D37 C71 JP8
Q45 Q44 Q47 Q48 Q46 Q51 Q43 Q42
R196 R197 R209 R200 R202 R215 R208 R204 R186 R212 R201 R203 R205 R184
Q14 Q15 R71 C30 C70 C83 C9 R67 R85 C25 C34 U7 R62 R83 R60 C21 Q49 Q50 R14 R45 R44
R66 R65 R63 R47 R79 Q10 R72 R59 C37 C23 R64 D9 R15 R16 U1
Q28 C38 R111 R113 R115 R112 C24 U9 R127 R119 C39 R120 R118 R116 D16
R114 Q27 Q16 R131 R117 Q29 Q30 Q11 Q19 Q18 Q17 R122 R130 R129 R128 R89 R123 R121 R124 R109 R108 R110 R103 R104 R105 R126 R107 R106
Q23 Q24 Q25 Q26 U12 U10 U11 R91 D12 R96 R97 Q21 Q22 R98 R99 D14 D15 C42 C41 R90 R92 Q20 R93 D13 R94 R95 C40 TP4
R19 R25 R38 R40 R39 R42 U2 U3 R140 U16
R36 R43 R46 R17 R21 R18 R20 R22 D8 D7 R24 R23 R26 R3 R5 D1 D2 R6 R7 D3 D4 R41
Q6 Q8 Q5 Q7 R11 Q9 Q4 Q3 Q1 R12 R30 R13 C8 R28 R27 R33 R37 Q2 C72 R32 R31
C1 C2 U4 R29 R2 R1 C3 R10 R4 R8 R9 D5 D6 C4 C5
R149 R142 Q33 U18 C95
U17 U14 U15 R141 R139 C43 U13 R138 D19 R147 R148 R132 R135 R136 R235 R133
Q31 Q32 R137 R143 U19 R144 D17 D18 R134 R145 R146 C44 R151


U1
LPE15D
CONTROL
5-15V INPUT
GROUND
CTL
TRIM
IN +
IN -
OUT1-
OUT1+
OUT2-
OUT2+
DC-DC Converter
C1 0.1UF
C2 100UF
C3 0.1UF
C4 0.1UF
C5 100UF
C6 100UF
C7 10UF
C8 10UF
C9 0.1UF
C10 0.1UF
L1 100UH
L2 100UH
+15
-15
ANA GROUND
R161A 10K/4
UNUSED
.1uF
C35 +2200UF
C37 +2200UF
9.00
D24 MR502
D33 1N5820
R175 64.9K
R177 20 2W
Q34 MJE370
D25 MR502
8.00
BATT
R153 499
Q35 BS-107
J27
4HEADER
DGND
TO JP11-6
D32 1N4454
Q40 BS-107
Q39 BS-107
PGN
TO JP10-4
POWER
TO JP9-9
C92 .1UF
C93 .1UF
R156 2.80K
D23 GREEN LED
TP5
R154 1.87K
R152 200
R156 499
R155 1.87K
D27 1N4454
R159 2.80K
R162A 100K/4
D22 RED LED
R162D 100K/4
R178 2.15K
2.49
R162B 100K/4
R162C 100K/4
U25A LM393
U25B LM393
D34 LM336
C46 +1UF
C48 +1UF
9.4V
6.0V
U29C 4049
U29D 4049
U29A 4049
U29B 4049
U29E 4049
U29F 4049
PINS 13,15 NC.
8.0
491 Hz
9V
-8V
C53 +47UF
D30 1N4454
D31 1N4454
C54 +47UF
C47 .1UF
R160 110K
R161 110K
C45 .01UF
D43 LOCATED IN BATT PACKAGE
BT1
D43 1N4454
5 DCELL
J28
4HEADER
V81
8.08
TO JP11-1
+12V
+5V
R163 115K
C63 .1UF
Q41 MTP6P10
6.0
5.4
C69 +22UF
U27 4250
6.9V
D35 LM329
R165 6.87K
R166 100K
R167 100K
U28B TL062
3.40
R168 100K
C32 +1UF
C58 .01UF
C56 +10UF
R169 20K POT
R170 20K POT
R163 37.4K
R172 93.7K
U28A TL062
R171 100K
C61 .01UF
C57 +10UF
REF=6.0
Vdo
Vdo PK
D26 LM336
C64 .1UF
R173 82.5K
C49 .1UF
R162 4M
-8V
4.16
CETEC IMIE
Title
PC40 POWER
Size
Document Number
REV
Date
Sheet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PRB
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R184 221
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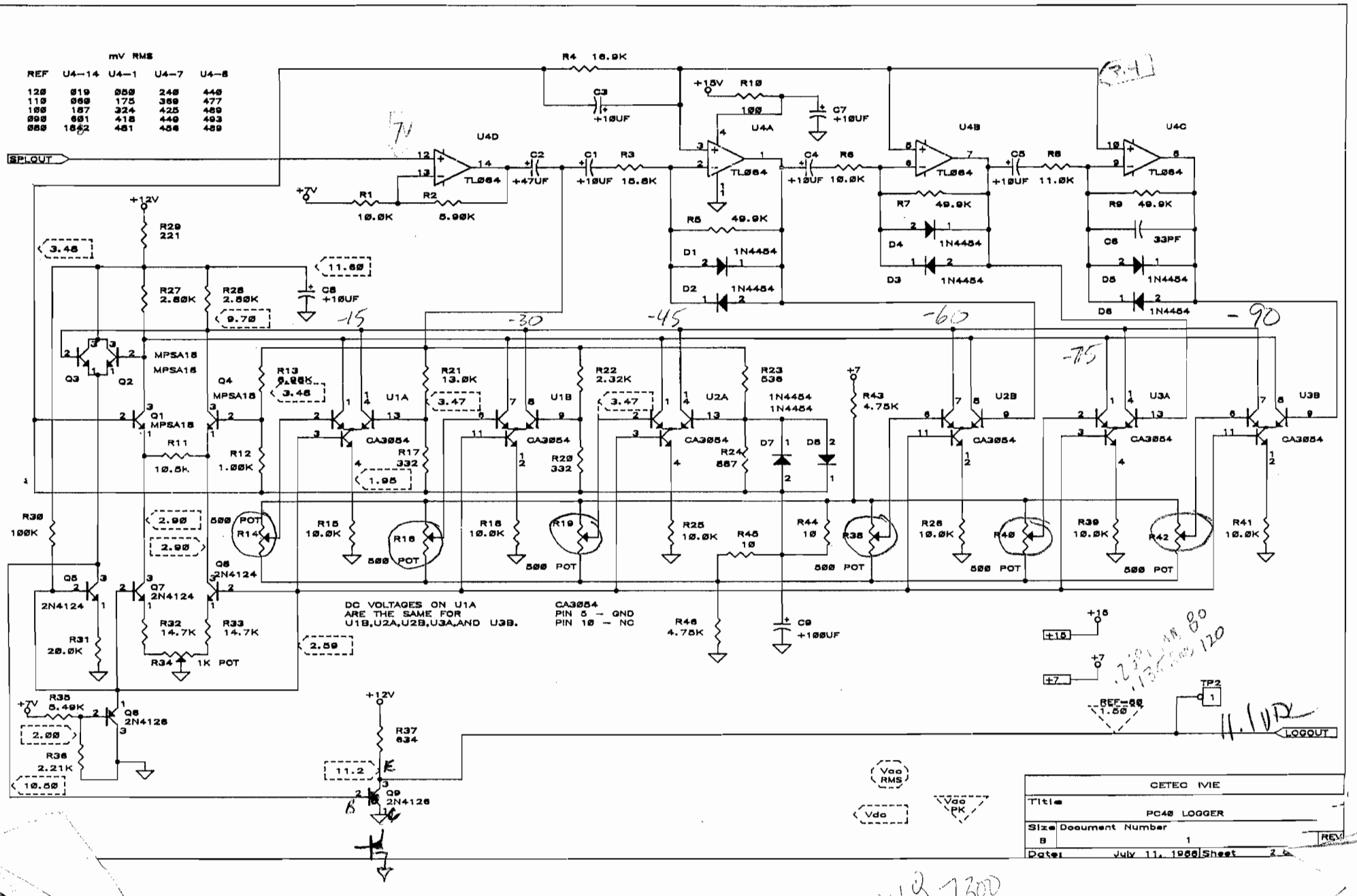
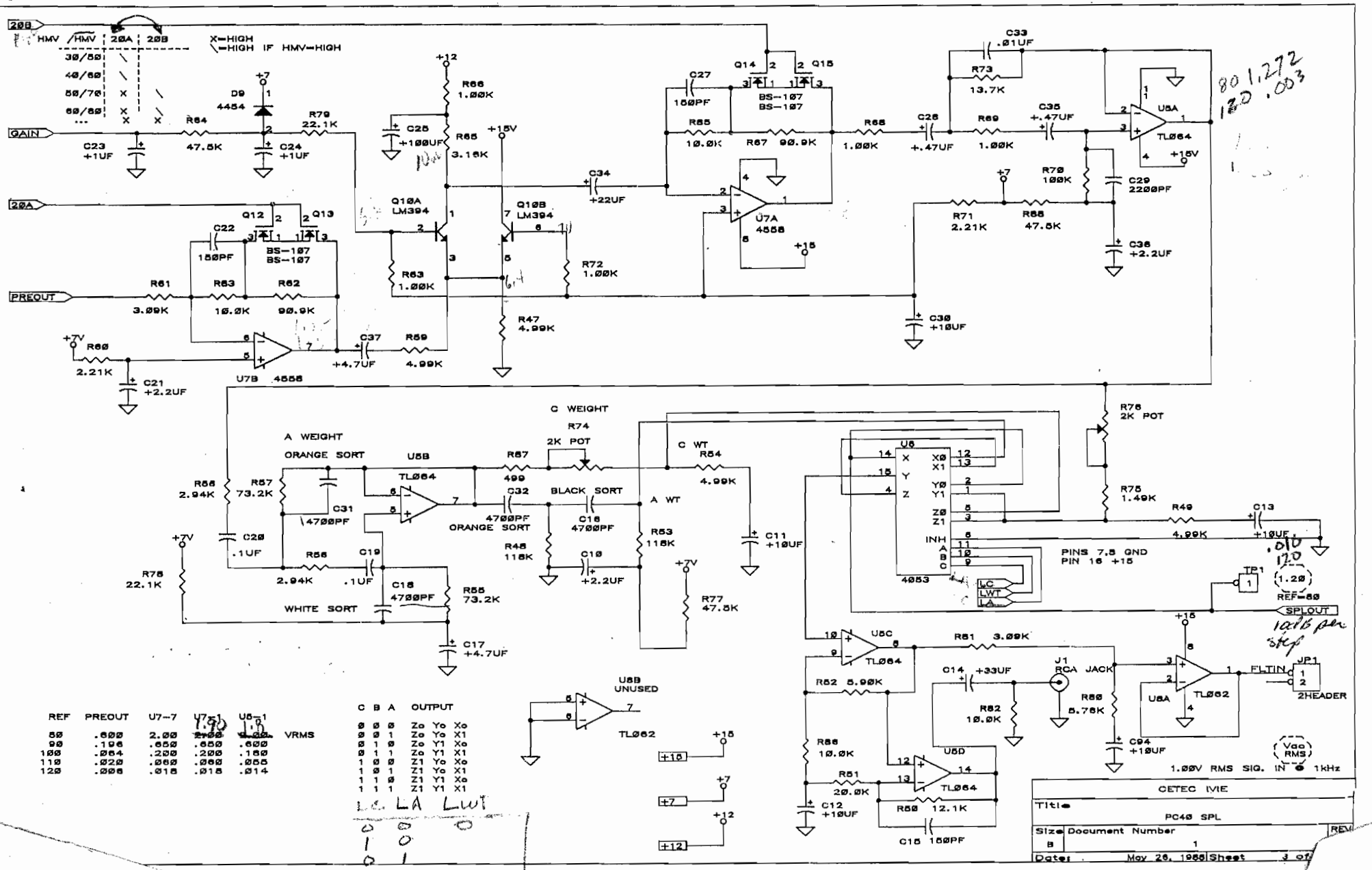
+15V
R206 20.0K
Q43 2N4124
R207 100K
C71 +10UF
C72 +10UF
R205 10.0K
R203 887k
R204 100K
C87 10PF 500V
C86 6.8PF 500V
R215 11.0K
C87 470PF
C88 150PF
K2
K4
5V REED
+VR
D38 1N4454
D41 1N4454
Q48 2N4124
R202 10.0K
Q47 2N4124
R200 10.0K
K7
K1
K3
K6
K5
R186 221
D36 1N4454
D37 1N4454
Q46 2N4124
R212 10.0K
Q51 2N4124
R201 10.0K
BATT
Q52 BS-107
D40 1N4454
R208 90.9K
C69 22PF 500V
R209 10.2K
C70 47PF
D39 1N4454
Q45 2N4124
R196 10.0K
R197 10.0K
Q44 2N4124
100V
C82 4700PF
REF-80
REF-120
1.00
100
+7
+15
R195 1.00K
C79 +10UF
Q56 10E04A
2.00
C80 2200PF
U31B 5532
R198 4.99K
R199 4.99K
C81 220PF
Q54 10E03A
Q55 10E03A
Q53 10E03A
Q57 10E04A
C88 1000PF
PINS 8,7,8 — GND
U30 PIN 16 — +15
4052
A B ON
0 0 X0 Y0
1 0 X1 Y1
0 1 X2 Y2
1 1 X3 Y3
U31A 5532
R214 10.0M
R194 1.02M
C78 +1UF
40/20
PRB/MIC
PREAMP
G1
G2
GT
C84 +1UF
C85 +1UF
MIC/PRB
U31 PIN 1 VRMS
2.00
.197
.197
.020
.002
REF PREAMP G1 G2 /10 40/20
30/50 X
40/60
50/70 X
60/80
70/90 \ X
80/100 \
90/110 \ X X
100/120 \ X
110/130 \ X X
120/140 \ X
130/150 \ X X X
140/160 \ X X
/170 X X X X
/180 X X X
\=HIGH IF HMV HIGH
R187 2.05K
R189 10.2K
R188 102K
C74 220PF
R193 5.23K
R192 4.75K
C83 +10UF
R190 2.10K
R191 2.55K
R185 523
C75 +10UF
C76 +10UF
C77 +100UF
Vac RMS
PREOUT
Q49 BS-107
Q50 BS-107
R211 7.15K
+4.7UF
C70
R210 205K
110
CETEC IVIE
Title
PC40 PREAMP
Size B
Document Number 1
REV E
Date: July 8, 1986 Sheet 8 of 9


mV RMS
REF U4-14 U4-1 U4-7 U4-8
120 819 850 240 440
110 860 175 360 477
100 187 324 425 469
090 601 416 440 493
080 1842 481 456 459
SPLOUT
U4D
U4A
U4B
U4C
TL064
R4 16.9K
C3 +10UF
+15V
R10 100
C7 +10UF
C2 +47UF
C1 +10UF
R3 15.8K
C4 +10UF
R6 10.0K
C5 +10UF
R8 11.0K
R1 10.0K
R2 5.90K
R5 49.9K
R7 49.9K
R9 49.9K
C6 33PF
D1 1N4454
D2 1N4454
D3 1N4454
D4 1N4454
D5 1N4454
D6 1N4454
+12V
R29 221
R27 2.80K
R28 2.80K
C8 +10UF
-15
-30
-45
-60
-75
-90
MPSA18
Q1
Q2
Q3
Q4
R11 10.5K
R12 1.00K
R13 9.88K
R17 332
R20 332
R21 13.0K
R22 2.32K
R23 536
R24 887
1N4454
CA3054
U1A
U1B
U2A
U2B
U3A
U3B
R43 4.75K
R30 100K
R31 20.0K
R32 14.7K
R33 14.7K
R34 1K POT
R35 5.49K
R36 2.21K
Q5 2N4124
Q6 2N4124
Q7 2N4124
Q8 2N4124
Q9 2N4126
R14 500 POT
R15 10.0K
R16 500 POT
R18 10.0K
R19 500 POT
R25 10.0K
R45 10
R44 10
R38 500 POT
R26 10.0K
R40 500 POT
R39 10.0K
R42 500 POT
R41 10.0K
R46 4.75K
C9 +100UF
DC VOLTAGES ON U1A ARE THE SAME FOR U1B,U2A,U2B,U3A,AND U3B.
CA3054 PIN 5 — GND PIN 10 — NC
R37 634
TP2
LOGOUT
REF=00 1.50
Vac RMS
Vdc
Vac PK
CETEC IVIE
Title
PC40 LOGGER
Size B
Document Number 1
REV
Date: July 11, 1988 Sheet 2 of

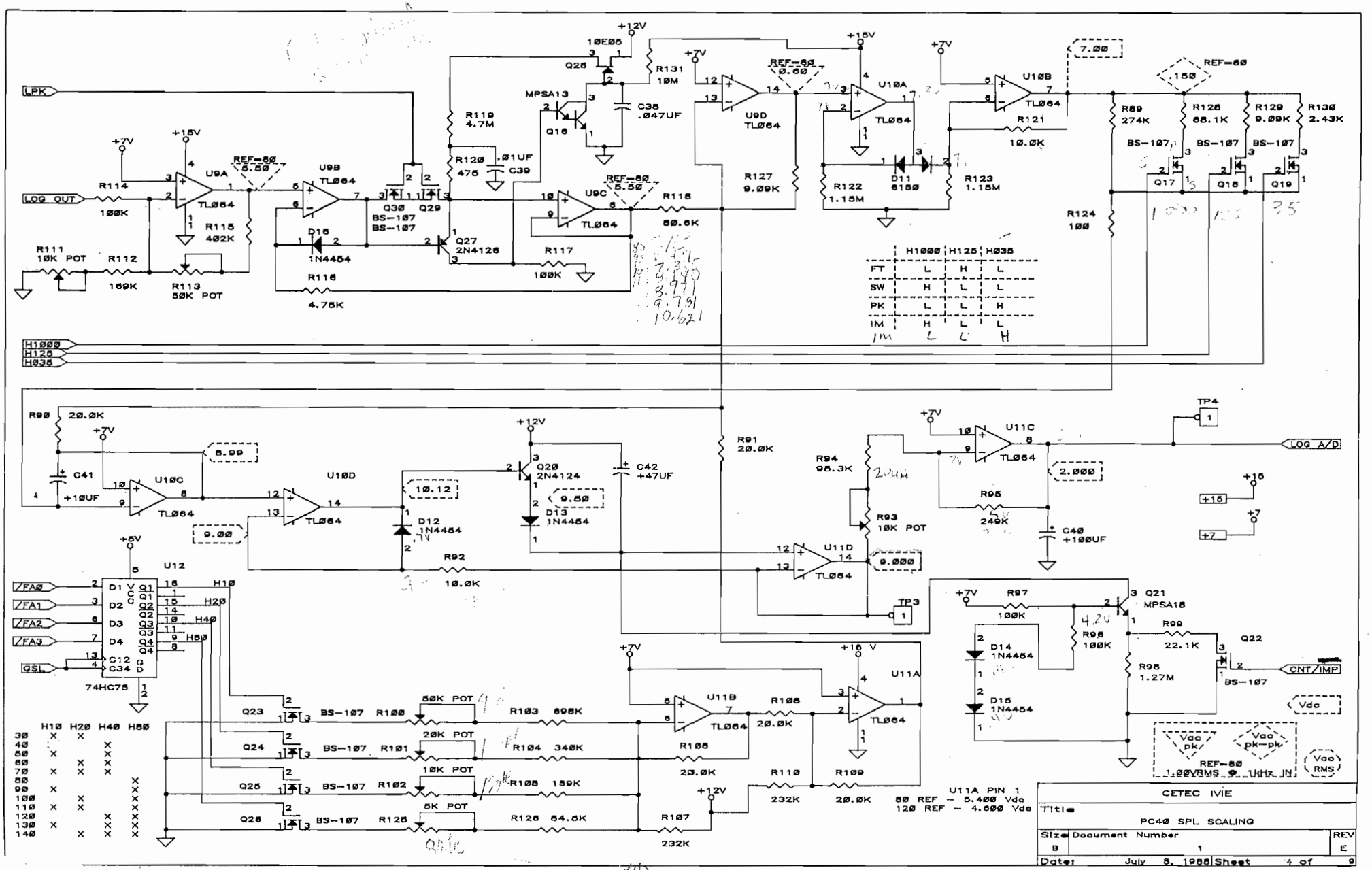


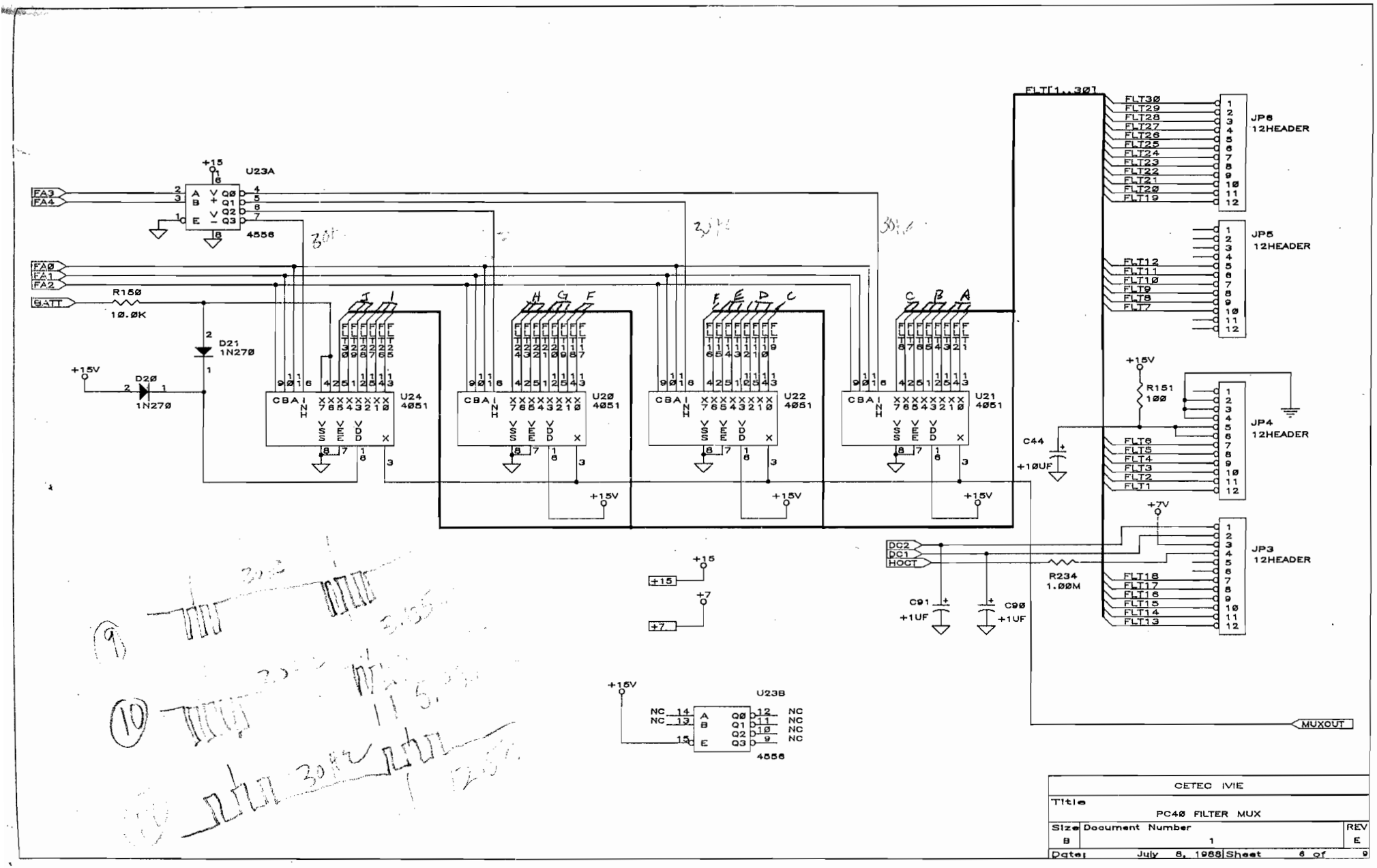
REF	PREOUT	U7-7	U7-1	U8-1	
50	.600	2.00	~~2.00~~	~~2.00~~	VRMS
90	.196	.650	.650	.600	
100	.064	.200	.200	.180	
110	.020	.060	.060	.055	
120	.006	.018	.018	.014	

C	B	A	OUTPUT
0	0	0	Zo Yo Xo
0	0	1	Zo Yo X1
0	1	0	Zo Y1 Xo
0	1	1	Zo Y1 X1
1	0	0	Z1 Yo Xo
1	0	1	Z1 Yo X1
1	1	0	Z1 Y1 Xo
1	1	1	Z1 Y1 X1

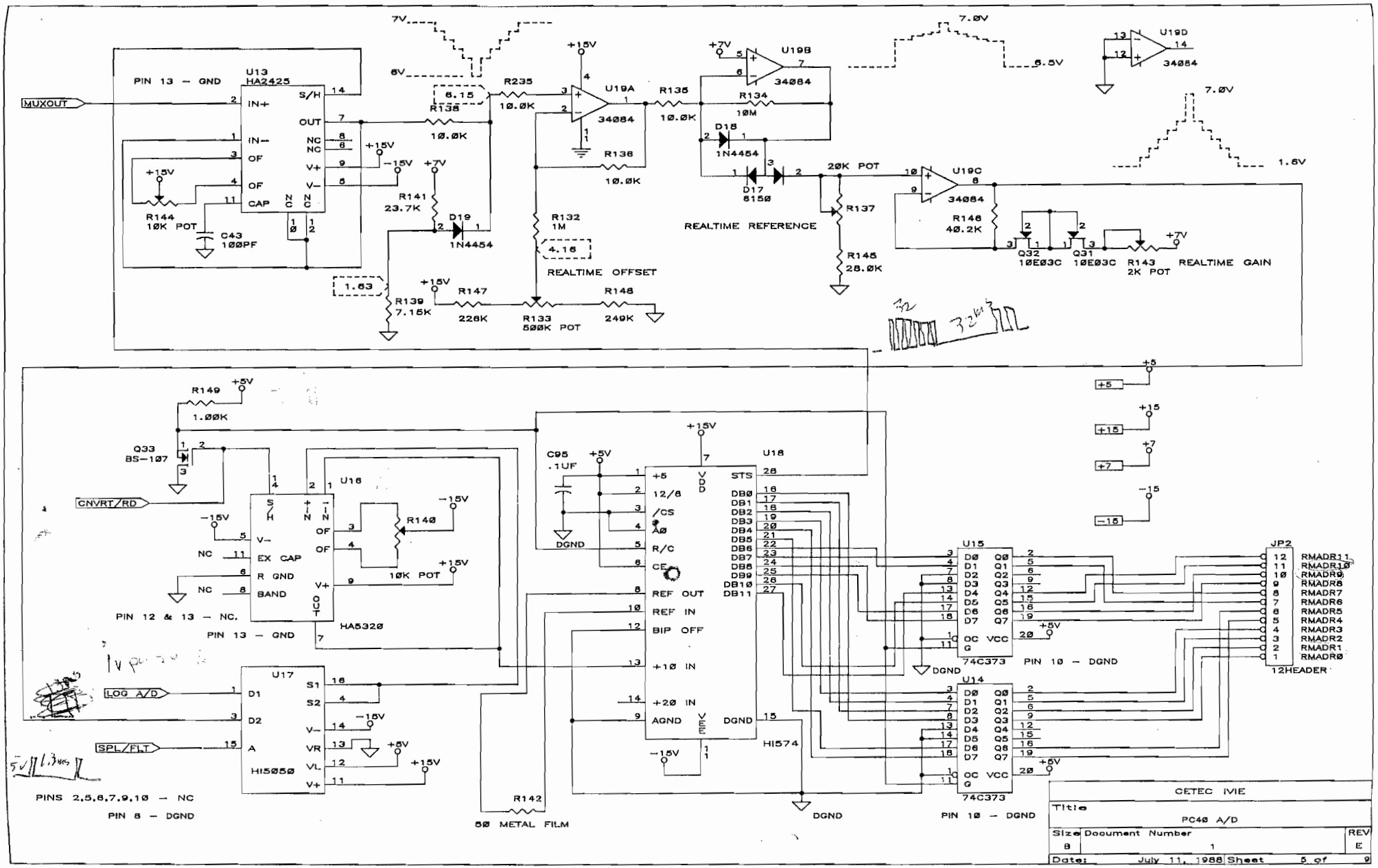
LC LA LWT
0 0 0
1 0 1
0 1 0
1 1 1

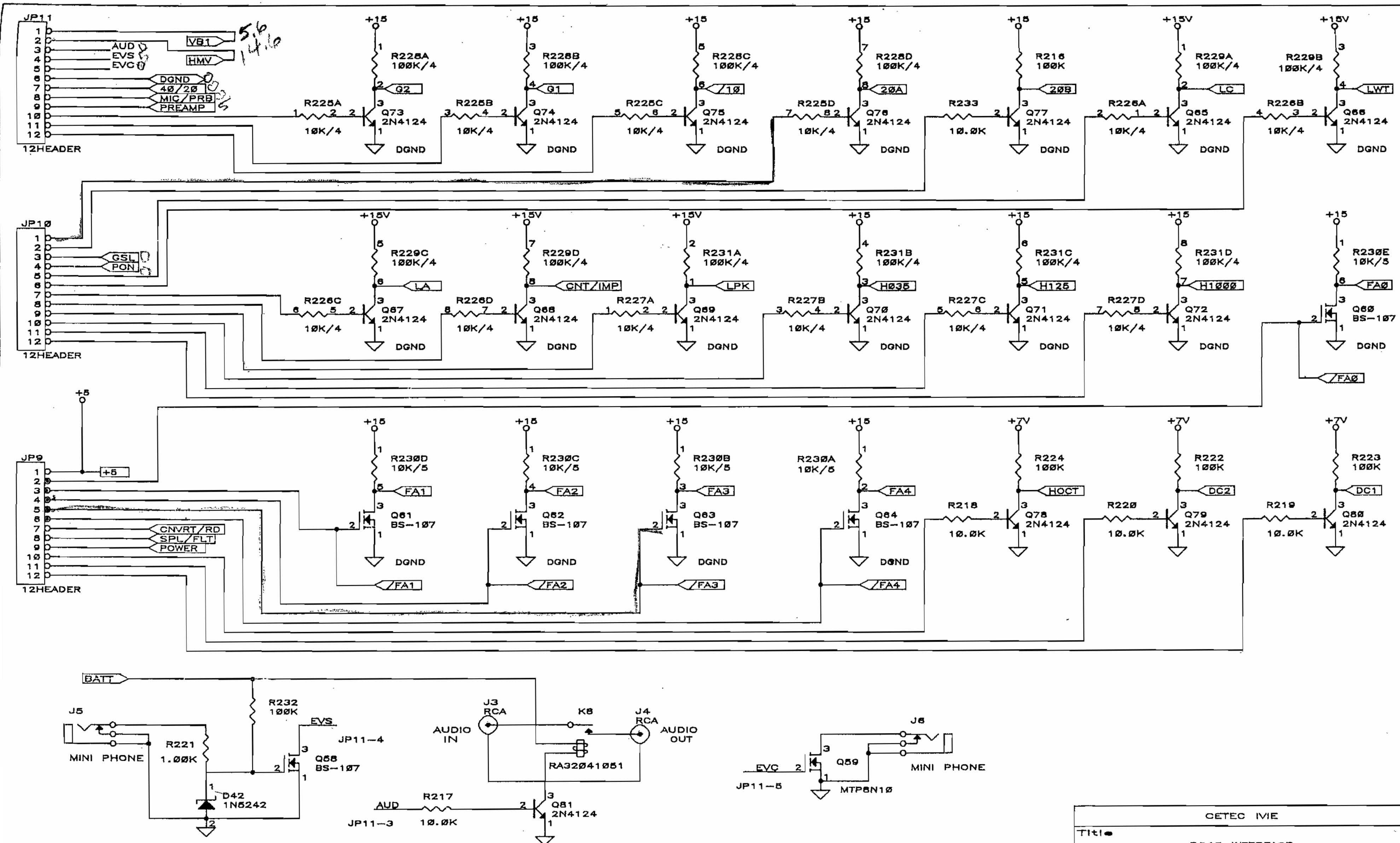
CETEC IVIE			
Title: PC40 SPL			
Size: B	Document Number: 1		REV
Date: May 26, 1988	Sheet 3 of		


LPK
LOG OUT
+12V
+15V
+7V
+5V
10E05
Q28
R131 10M
MPSA13
Q16
C38 .047UF
R119 4.7M
R120 475
.01UF C39
U9A TL064
U9B TL064
U9C TL064
U9D TL064
U10A TL064
U10B TL064
U10C TL064
U10D TL064
U11A TL064
U11B TL064
U11C TL064
U11D TL064
R114 100K
R115 402K
R111 10K POT
R112 169K
R113 50K POT
R116 4.75K
D16 1N4454
Q30 BS-107
Q29 BS-107
Q27 2N4126
R117 100K
R118 80.6K
R127 9.09K
R122 1.15M
D11 6150
R123 1.15M
R121 10.0K
R124 100
R89 274K
R126 68.1K
R129 9.09K
R130 2.43K
Q17 BS-107
Q18 BS-107
Q19 BS-107
REF-60 5.50
REF-60 .60
REF-60 .150
7.000
H1000
H125
H035
FT L H L
SW H L L
PK L L H
IM H L L
R90 20.0K
C41 +10UF
8.99
9.00
10.12
9.50
Q20 2N4124
D12 1N4454
D13 1N4454
C42 +47UF
R92 10.0K
R91 20.0K
R94 95.3K
R93 10K POT
R95 249K
C40 +100UF
2.000
9.000
TP4
TP3
LOG A/D
+15
+7
U12
74HC75
/FA0
/FA1
/FA2
/FA3
GSL
H10
H20
H40
H80
Q23 BS-107 R100 50K POT R103 698K
Q24 BS-107 R101 20K POT R104 340K
Q25 BS-107 R102 10K POT R105 150K
Q26 BS-107 R125 5K POT R126 64.5K
R106 20.0K
R107 232K
R108 20.0K
R110 232K
R109 20.0K
U11A PIN 1
80 REF - 5.400 Vdc
120 REF - 4.600 Vdc
R97 100K
R98 100K
4.20
Q21 MPSA18
R99 22.1K
R96 1.27M
Q22 BS-107
D14 1N4454
D15 1N4454
CNT/IMP
Vdc
Vac pk
Vac pk-pk
Vac RMS
REF-80
1.00VRMS @ 1KHz IN
CETEC IVIE
Title
PC40 SPL SCALING
Size B
Document Number 1
REV E
Date: July 8, 1988
Sheet 4 of 9



CETEC IVIE		
Title: PC40 FILTER MUX		
Size: B	Document Number: 1	REV: E
Date: July 8, 1988	Sheet 6 of 9	

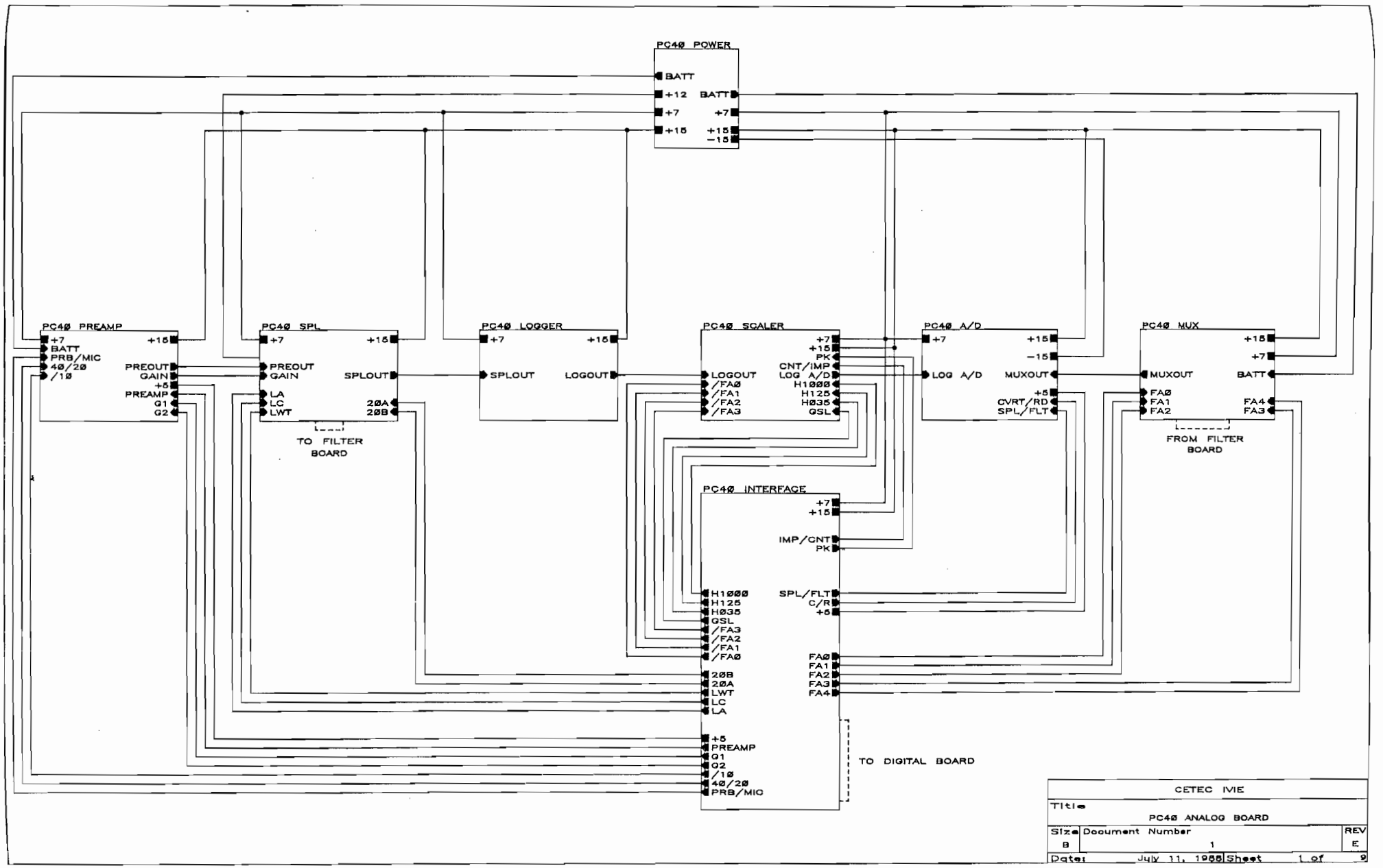

MUXOUT
U13
HA2425
PIN 13 — GND
R144
10K POT
C43
100PF
R141
23.7K
D19
1N4454
R135
10.0K
R134
10M
D18
1N4454
D17
6150
20K POT
R137
R145
28.0K
REALTIME REFERENCE
U19A
U19B
U19C
U19D
34084
R146
40.2K
Q32
10E03C
Q31
10E03C
R143
2K POT
REALTIME GAIN
R132
1M
4.16
REALTIME OFFSET
R139
7.15K
R147
226K
R133
500K POT
R148
249K
7V
6V
6.15
1.63
7.0V
6.5V
1.6V
R149
1.00K
Q33
BS-107
CNVRT/RD
U16
HA5320
R140
10K POT
PIN 12 & 13 — NC.
PIN 13 — GND
U17
HI5050
LOG A/D
SPL/FLT
PINS 2,5,6,7,9,10 — NC
PIN 8 — DGND
C95
.1UF
U18
HI574
R142
50 METAL FILM
DGND
U15
U14
74C373
PIN 10 — DGND
JP2
12HEADER
RMADR11
RMADR10
RMADR9
RMADR8
RMADR7
RMADR6
RMADR5
RMADR4
RMADR3
RMADR2
RMADR1
RMADR0
CETEC IVIE
Title
PC40 A/D
Size B
Document Number 1
REV E
Date: July 11, 1988
Sheet 5 of 9

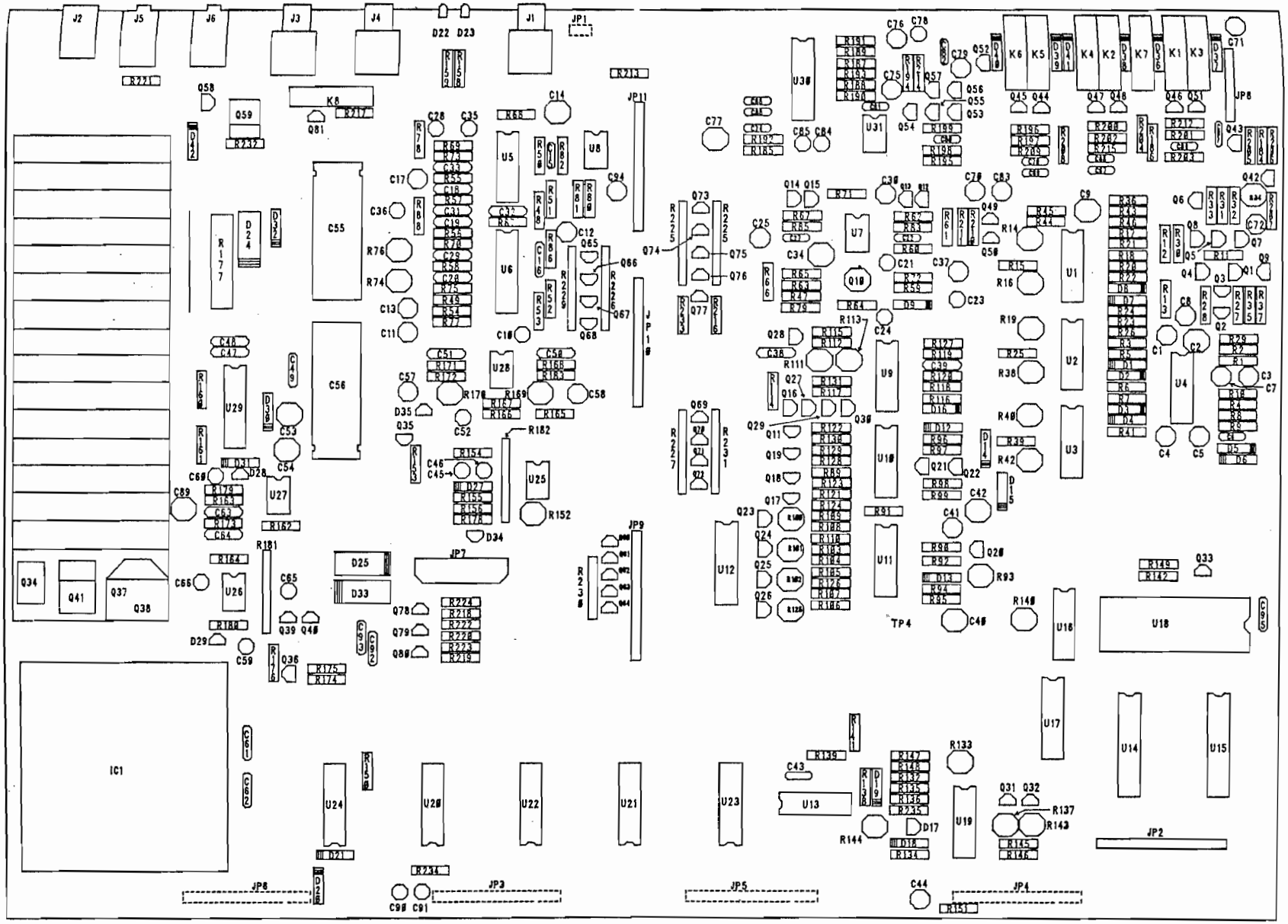


CETEC IVIE

Title	PC40 INTERFACE	
Size B	Document Number	REV E
Date: July 12, 1988	Sheet 9 of 9	

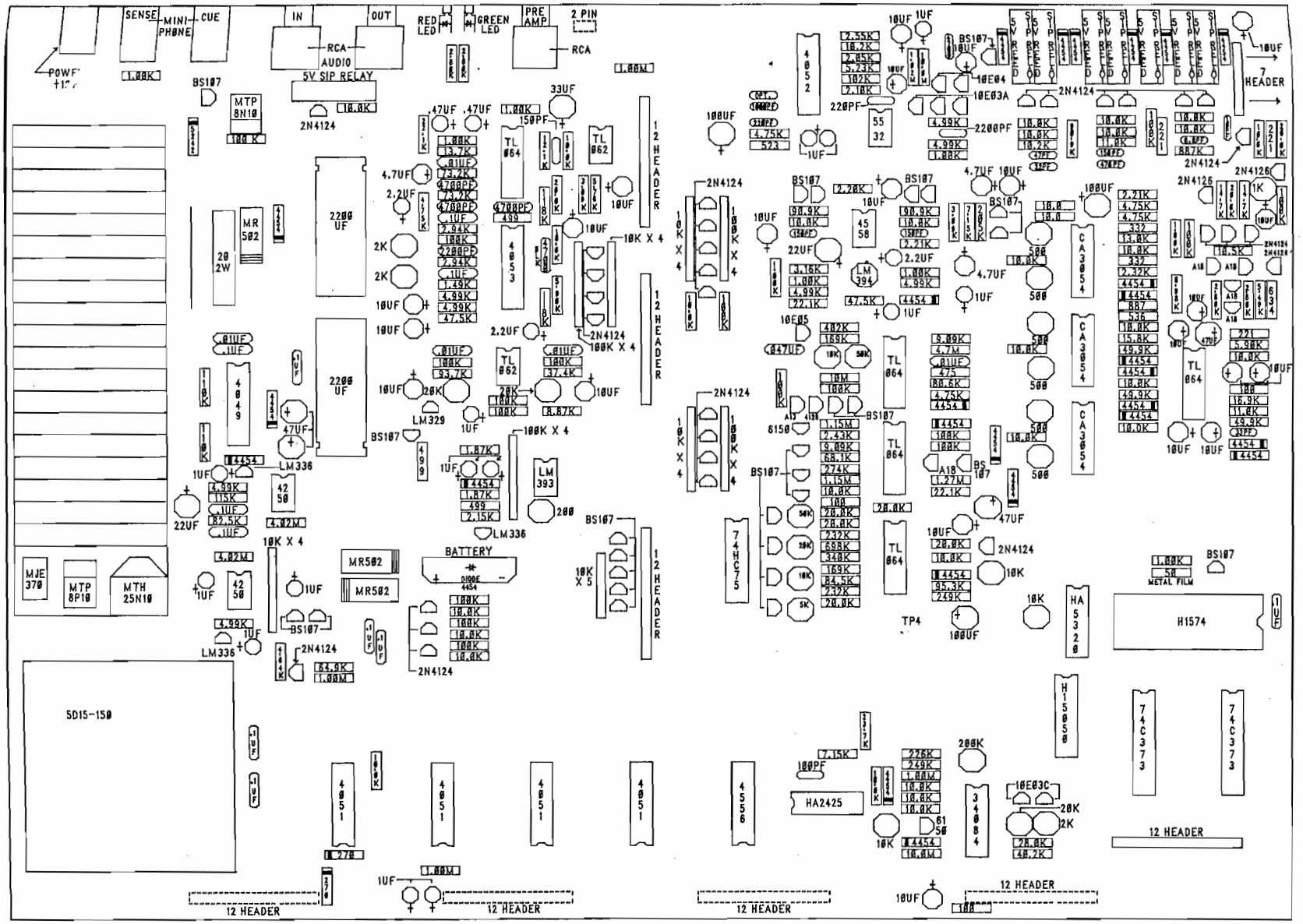
BS107 ... turn on


PC40 POWER
BATT
+12
+7
+15
BATT
+7
+15
-15
PC40 PREAMP
+7
BATT
PRB/MIC
40/20
/10
+15
PREOUT
GAIN
+5
PREAMP
G1
G2
PC40 SPL
+7
PREOUT
GAIN
LA
LC
LWT
+15
SPLOUT
20A
20B
TO FILTER BOARD
PC40 LOGGER
+7
SPLOUT
+15
LOGOUT
PC40 SCALER
LOGOUT
/FA0
/FA1
/FA2
/FA3
+7
+15
PK
CNT/IMP
LOG A/D
H1000
H125
H035
GSL
PC40 A/D
+7
LOG A/D
+15
-15
MUXOUT
+5
CVRT/RD
SPL/FLT
PC40 MUX
MUXOUT
FA0
FA1
FA2
+15
+7
BATT
FA4
FA3
FROM FILTER BOARD
PC40 INTERFACE
+7
+15
IMP/CNT
PK
H1000
H125
H035
GSL
/FA3
/FA2
/FA1
/FA0
20B
20A
LWT
LC
LA
SPL/FLT
C/R
+5
FA0
FA1
FA2
FA3
FA4
+5
PREAMP
G1
G2
/10
40/20
PRB/MIC
TO DIGITAL BOARD
CETEC IVIE
Title
PC40 ANALOG BOARD
Size
B
Document Number
1
REV
E
Date: July 11, 1988 Sheet 1 of 9



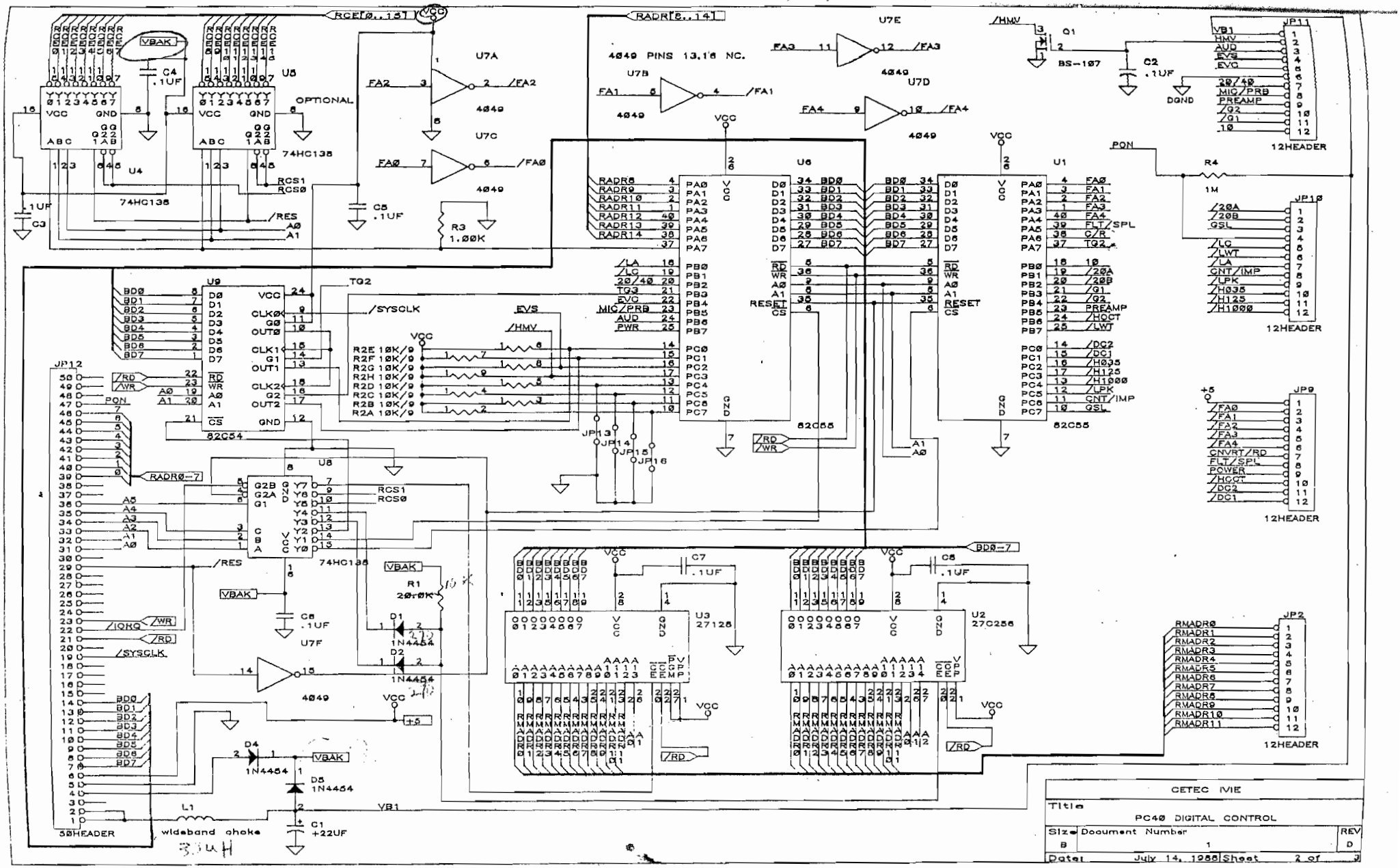
ANALOG REF
Thu, Jun 9, 1988 8:38 AM
Scale 1:1

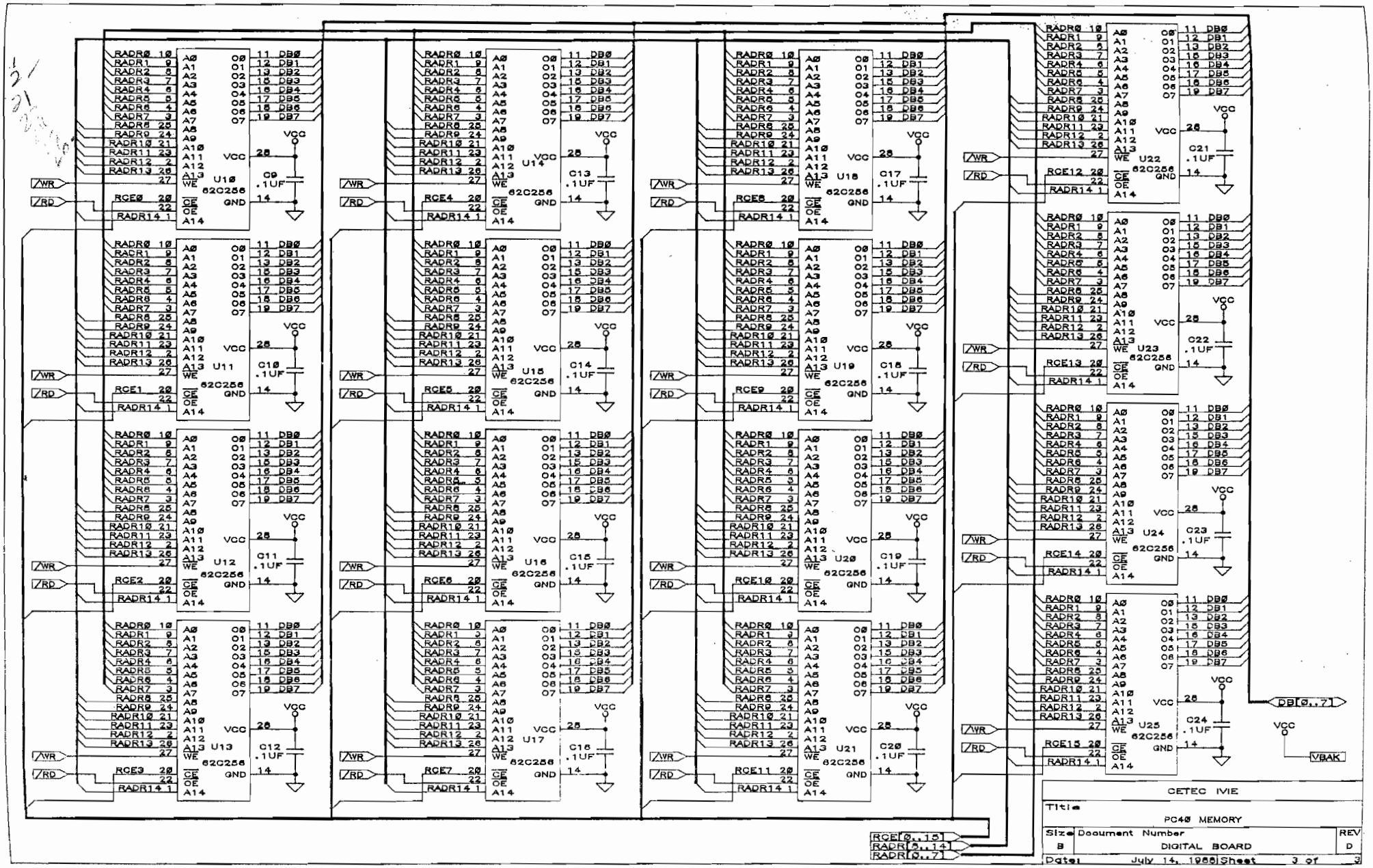
CETEC IVIE	
PC40 / ANALOG REFERENCE DIAGRAM	
#065-1210	REV. E
DATE:5-26-88	



CETEC IVIE
PC40 / ANALOG LOADING DIAGRAM
065-1210 REV. E
DATE: 5-26-88

ANALOG LOAD
Thu, Jul 21, 1988 8:22 AM
Scale 1:1


RCE[0..13]
RADR[6..14]
VBAK
VCC
U5
74HC138
OPTIONAL
U4
74HC138
C4 .1UF
C5 .1UF
C3 .1UF
U7A
U7B
U7C
U7D
U7E
4049
4049 PINS 13,16 NC.
FA2
/FA2
FA1
/FA1
FA0
/FA0
FA3
/FA3
FA4
/FA4
R3 1.00K
RCS1
RCS0
/RES
A0
A1
U6
U1
82C55
PON
R4 1M
/HMV
Q1
BS-107
C2 .1UF
DGND
JP11
12HEADER
JP10
JP9
JP12
30HEADER
U9
82C54
TG2
/SYSCLK
EVS
/HMV
R2E 10K/9
R2F 10K/9
R2G 10K/9
R2H 10K/9
R2D 10K/9
R2C 10K/9
R2B 10K/9
R2A 10K/9
JP13
JP14
JP15
JP16
U8
74HC138
RADR0-7
/IORQ
/WR
/RD
/SYSCLK
R1 20r0K
D1 1N4454
D2 1N4454
D4 1N4454
D5 1N4454
U7F
C6 .1UF
C7 .1UF
C8 .1UF
U3 27128
U2 27C256
BD0-7
RMADR0
RMADR1
RMADR2
RMADR3
RMADR4
RMADR5
RMADR6
RMADR7
RMADR8
RMADR9
RMADR10
RMADR11
JP2
L1 wideband choke
C1 +22UF
VB1
CETEC VIE
Title
PC40 DIGITAL CONTROL
Size B
Document Number 1
REV D
Date: July 14, 1988 Sheet 2 of 3



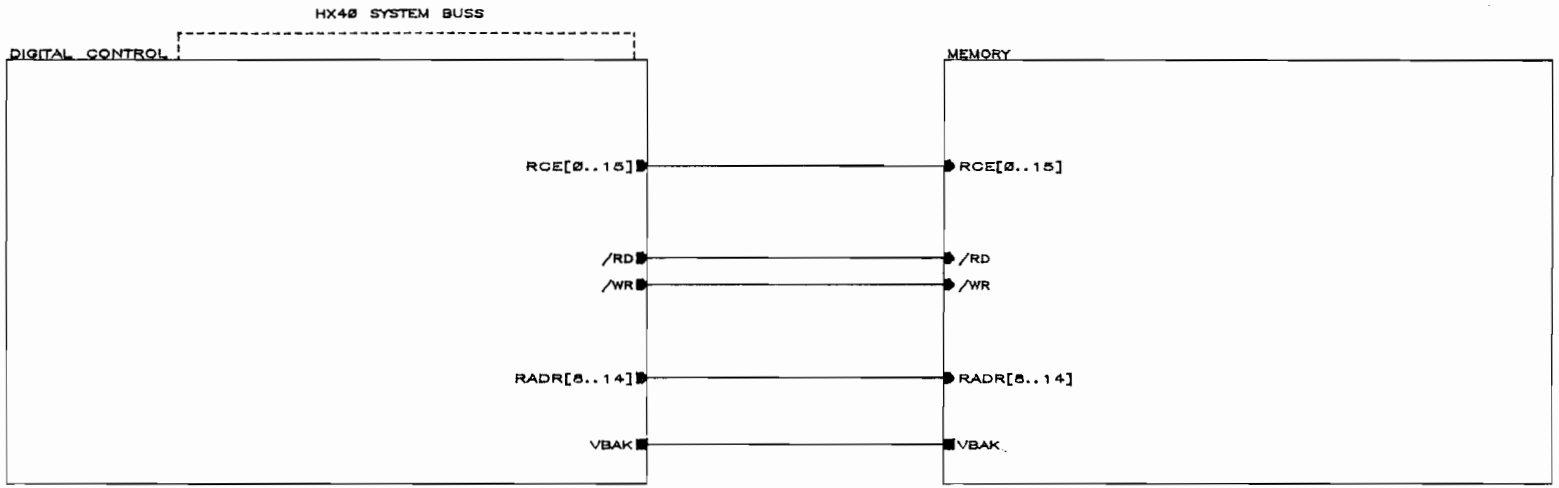
CETEC IVIE

Title

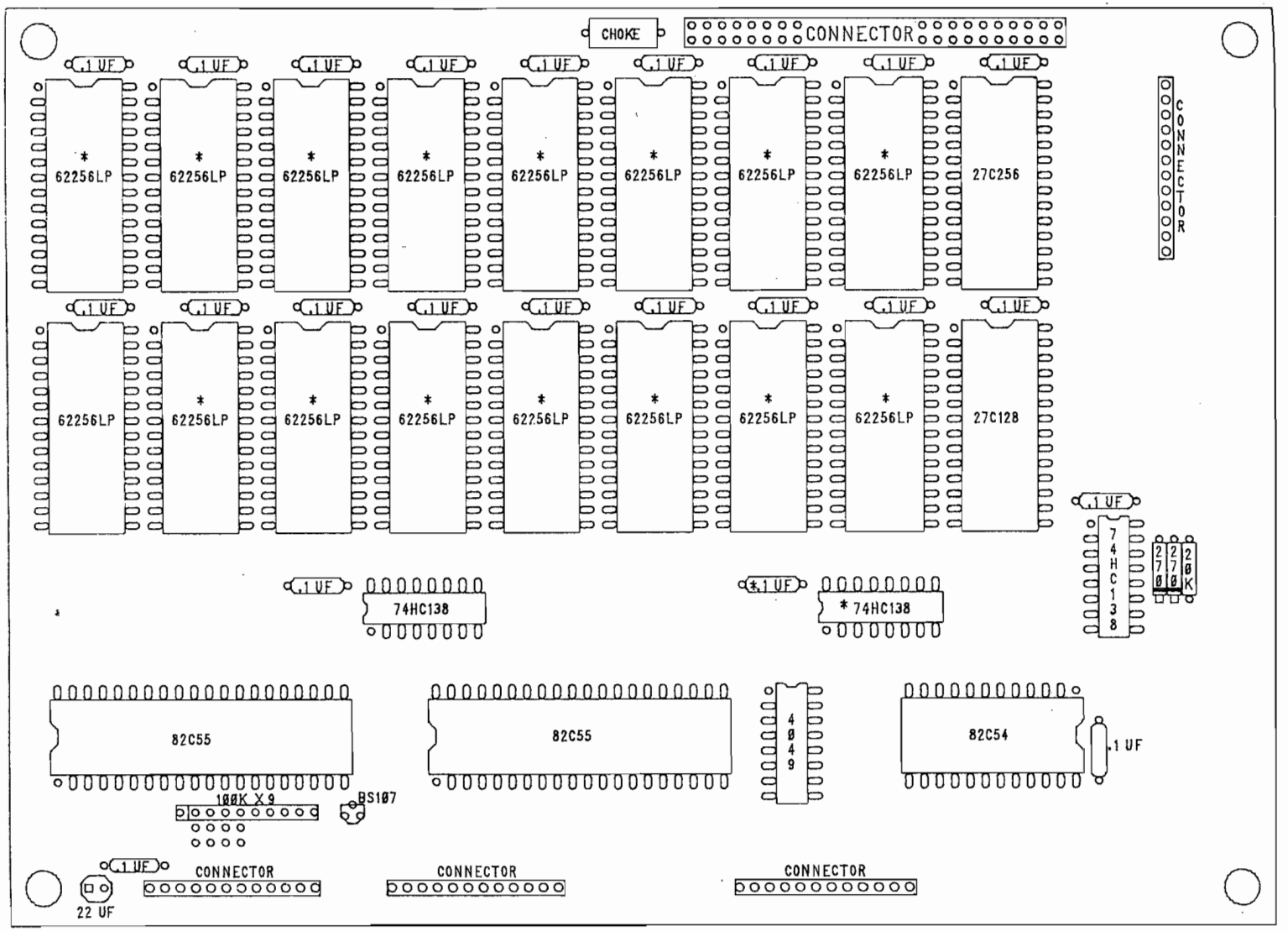
PC40 MEMORY

Size	Document Number	REV
B	DIGITAL BOARD	D

Date: July 14, 1988 Sheet 3 of 3

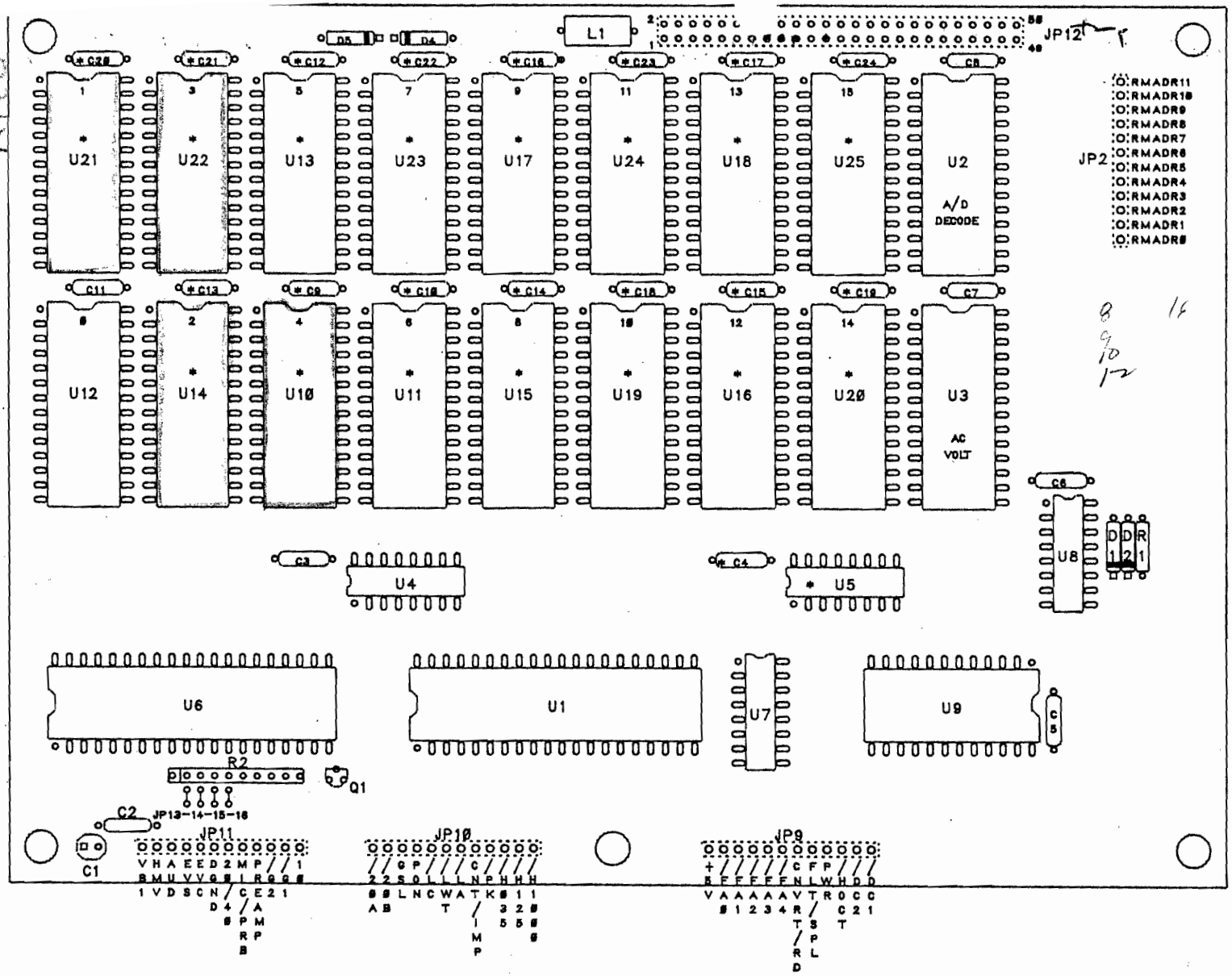


Size	Document Number	REV
B		
Date: April 7, 1988	Sheet 1 of 3	



* = OPTIONAL

CETEC IVIE	
PROJECT: PC40 DIGITAL BOARD	
TITLE: LOADING DIAGRAM	
DRWN BY: DCN	APRVD BY:
DATE: 5-19-87	REV. C



1. VCH	26. NC
2. VB1	27. NC
3. NC	28. NC
4. VBAK	29. /RESET
5. GND	30. NC
6. +5V	31. A0
7. BD7	32. A1
8. BD6	33. A2
9. BD5	34. A3
10. BD4	35. A4
11. BD3	36. A5
12. BD2	37. NC
13. BD1	38. NC
14. BD0	39. RADR1
15. NC	40. RADR0
16. NC	41. RADR3
17. NC	42. RADR2
18. NC	43. RADR5
19. /SYSCLK	44. RADR4
20. NC	45. RADR7
21. /~~WR~~ RD	46. RADR6
22. /IORQ	47. PON
23. /~~RD~~ WR	48. NC
24. NC	49. NC
25. NC	50. NC

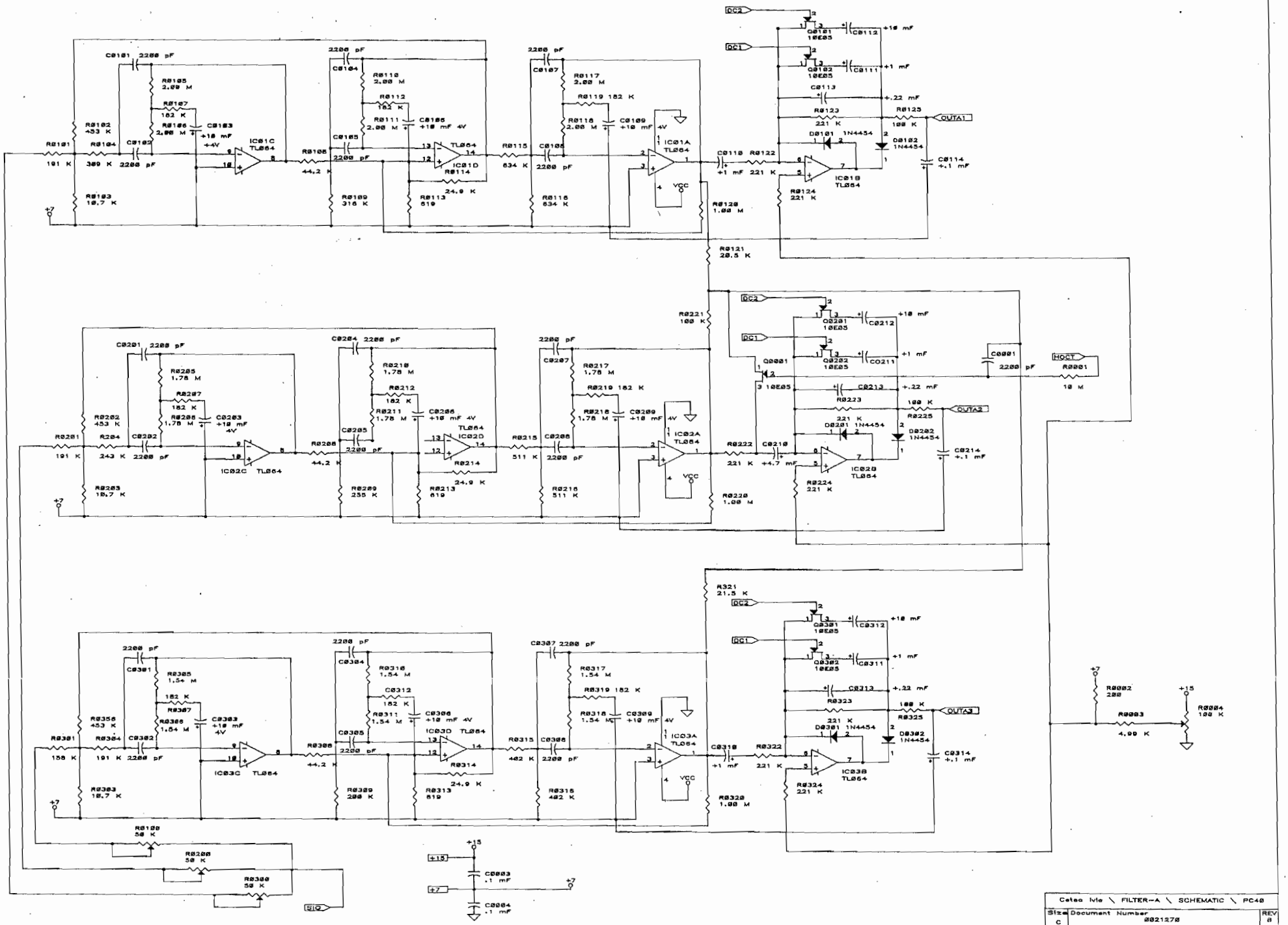
* = OPTIONAL

CETEC IVIE	
PROJECT: PC40 DIGITAL BOARD	
TITLE: REFERENCE DIAGRAM	
DRWN BY: DPS	APRVD BY:
DATE: 7-13-88	REV. F

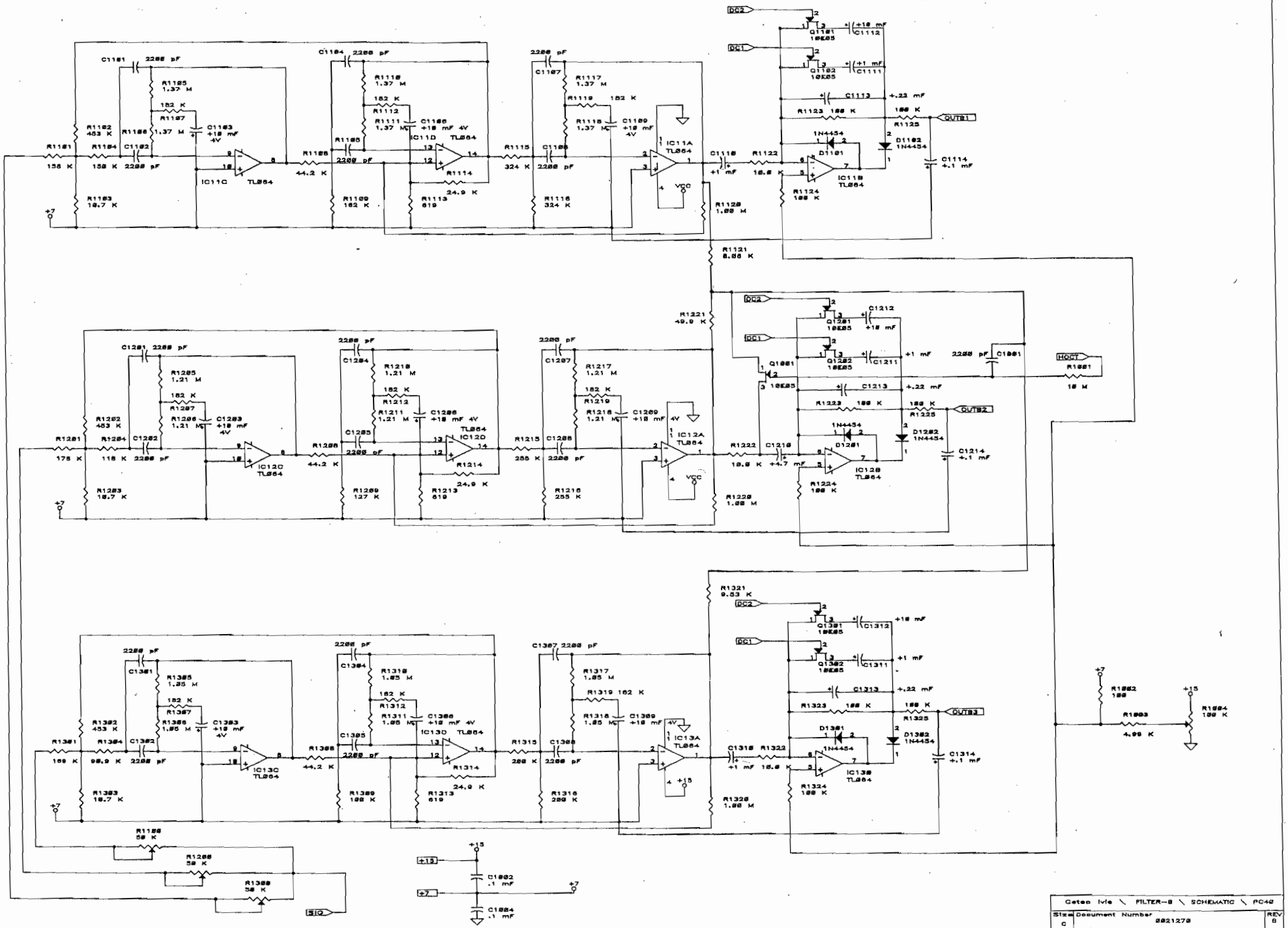
PC40 D REF

Mon, Jul 18, 1988 8:11 AM

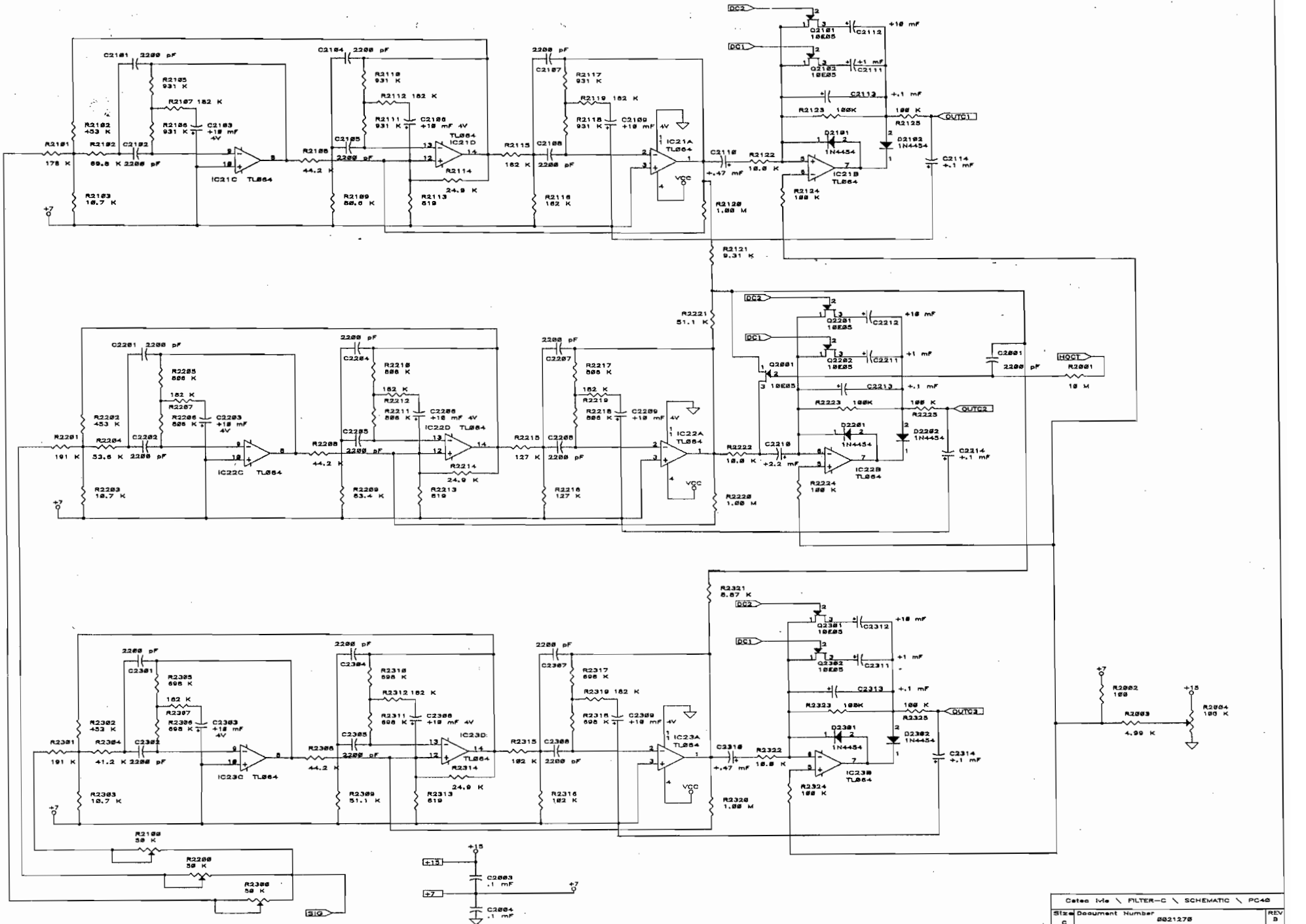
Scale 1:1



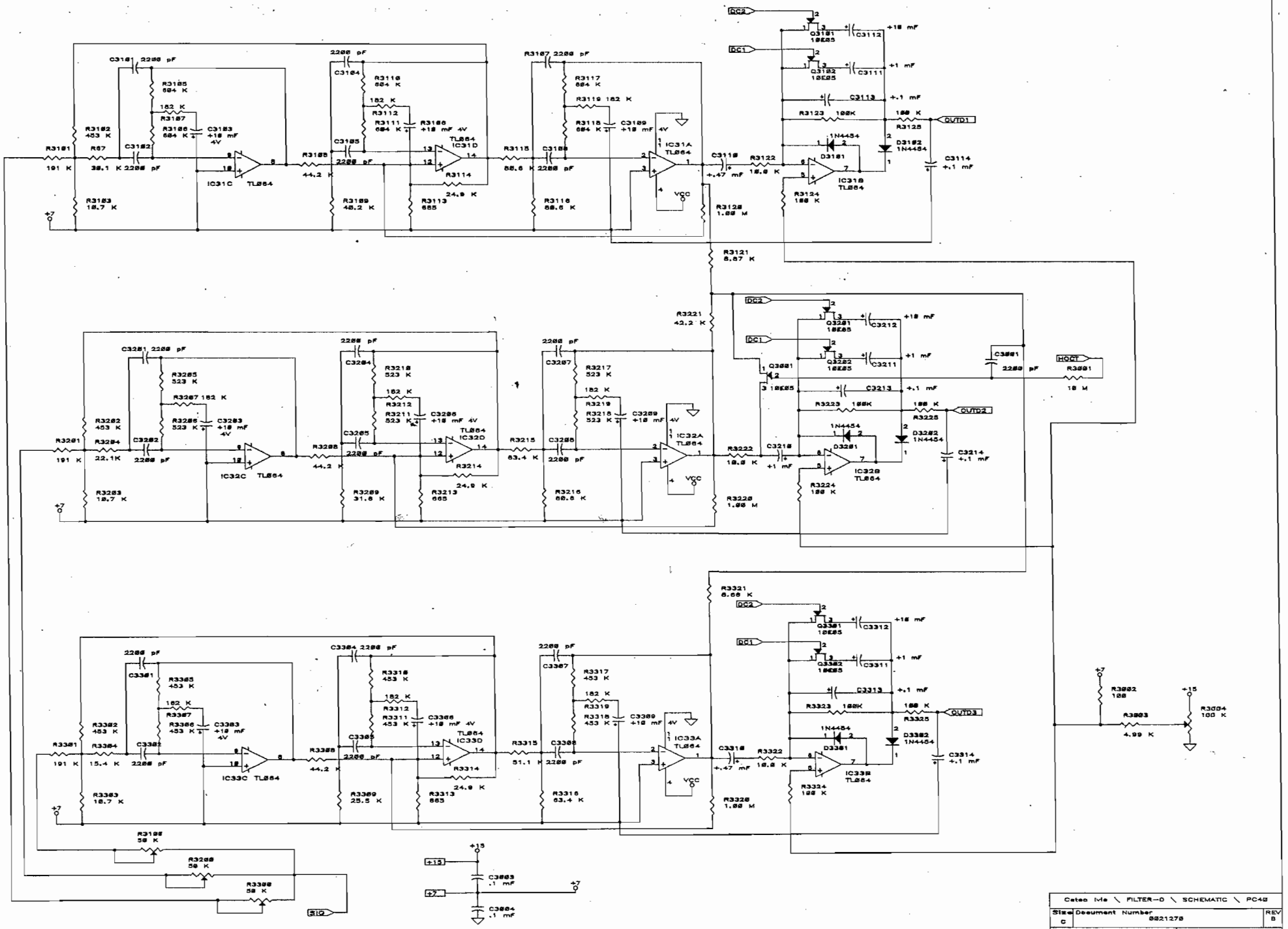
Cetec Vic \ FILTER-A \ SCHEMATIC \ PC40		
Size C	Document Number 0021270	REV B
Date: January 4, 1988	Sheet 6 of 11	



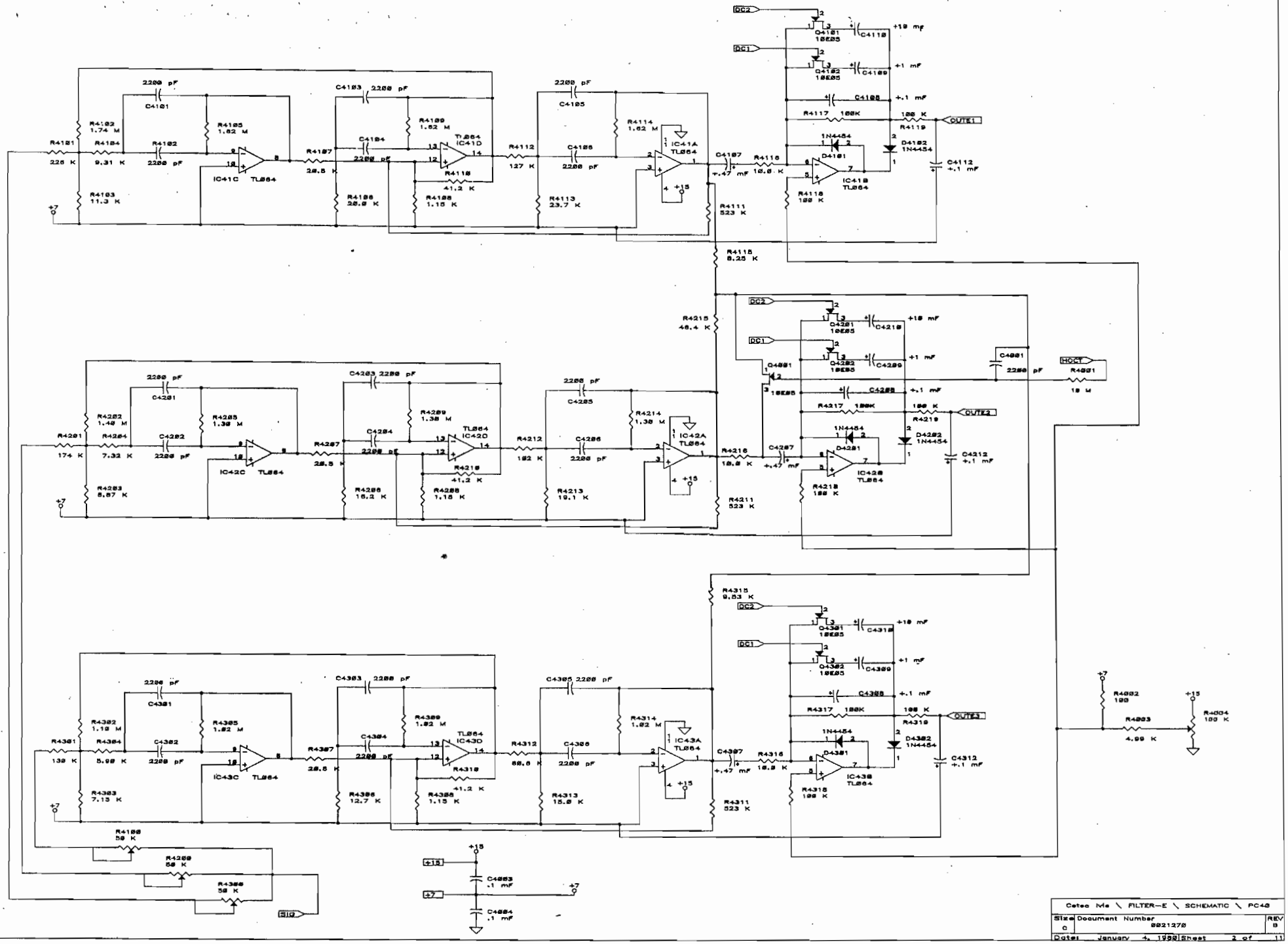
Gates.lvs \ FILTER-B \ SCHEMATIC \ PC40		
Size C	Document Number 8021270	REV B
Date: January 4, 1990	Sheet 3 of 11	



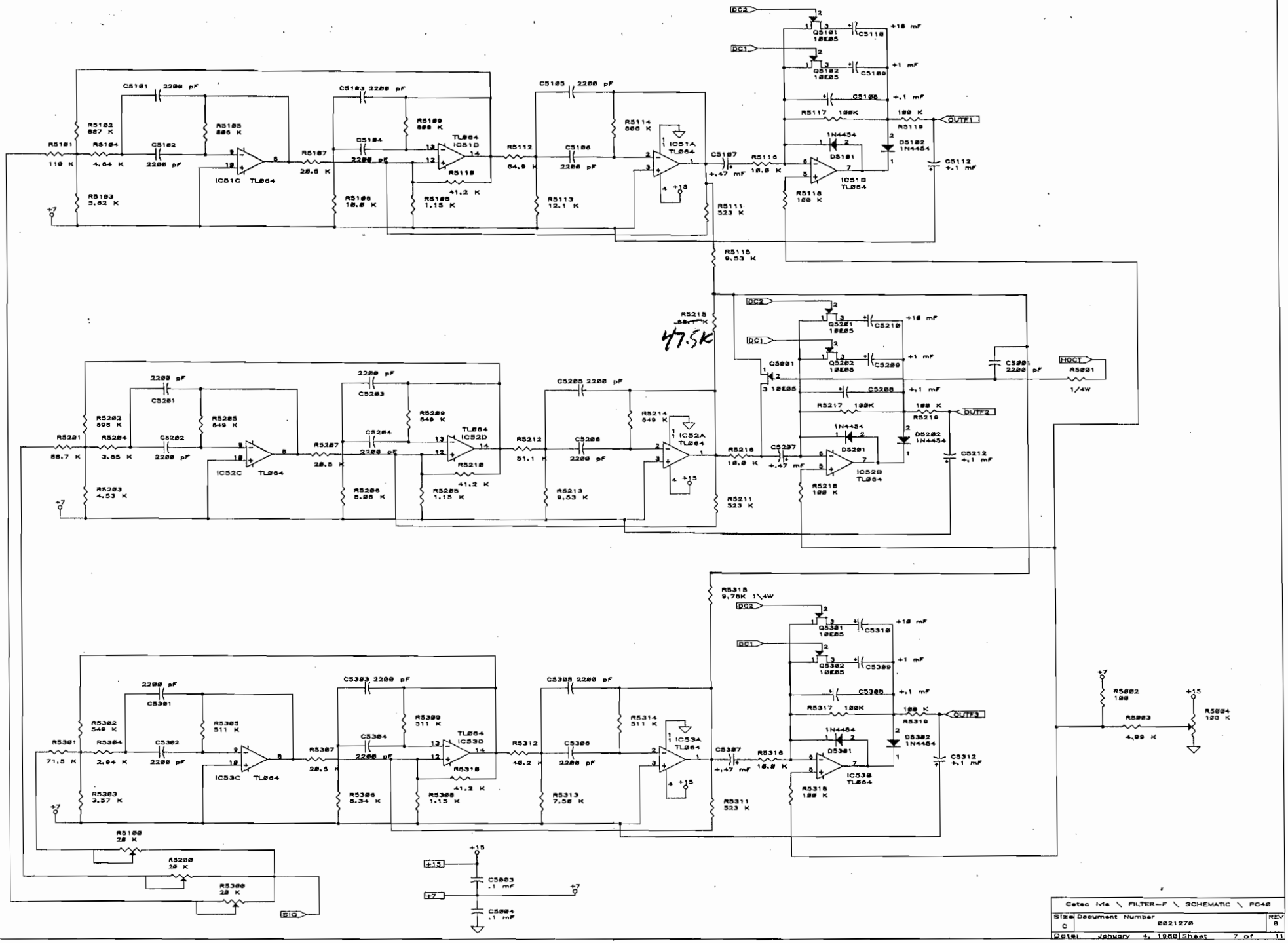
Catec Inc \ FILTER-C \ SCHEMATIC \ PC40			
Size C	Document Number 8021270		REV B
Date: January 4, 1990	Sheet 4 of 11		



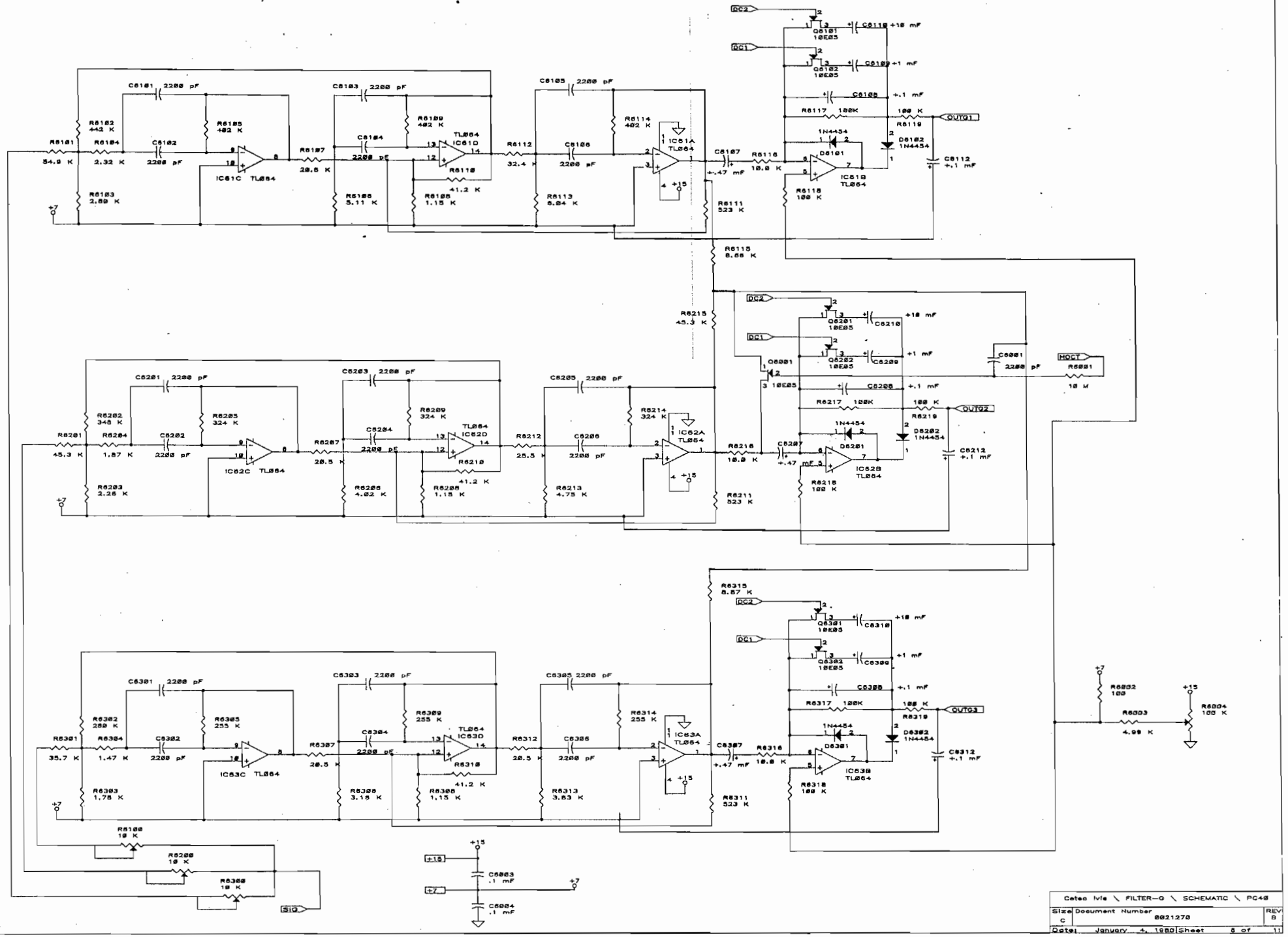
Cateo Me \ FILTER-D \ SCHEMATIC \ PC4B		
Size C	Document Number 8821278	REV B
Date: January 4, 1988	Sheet 3 of 11	



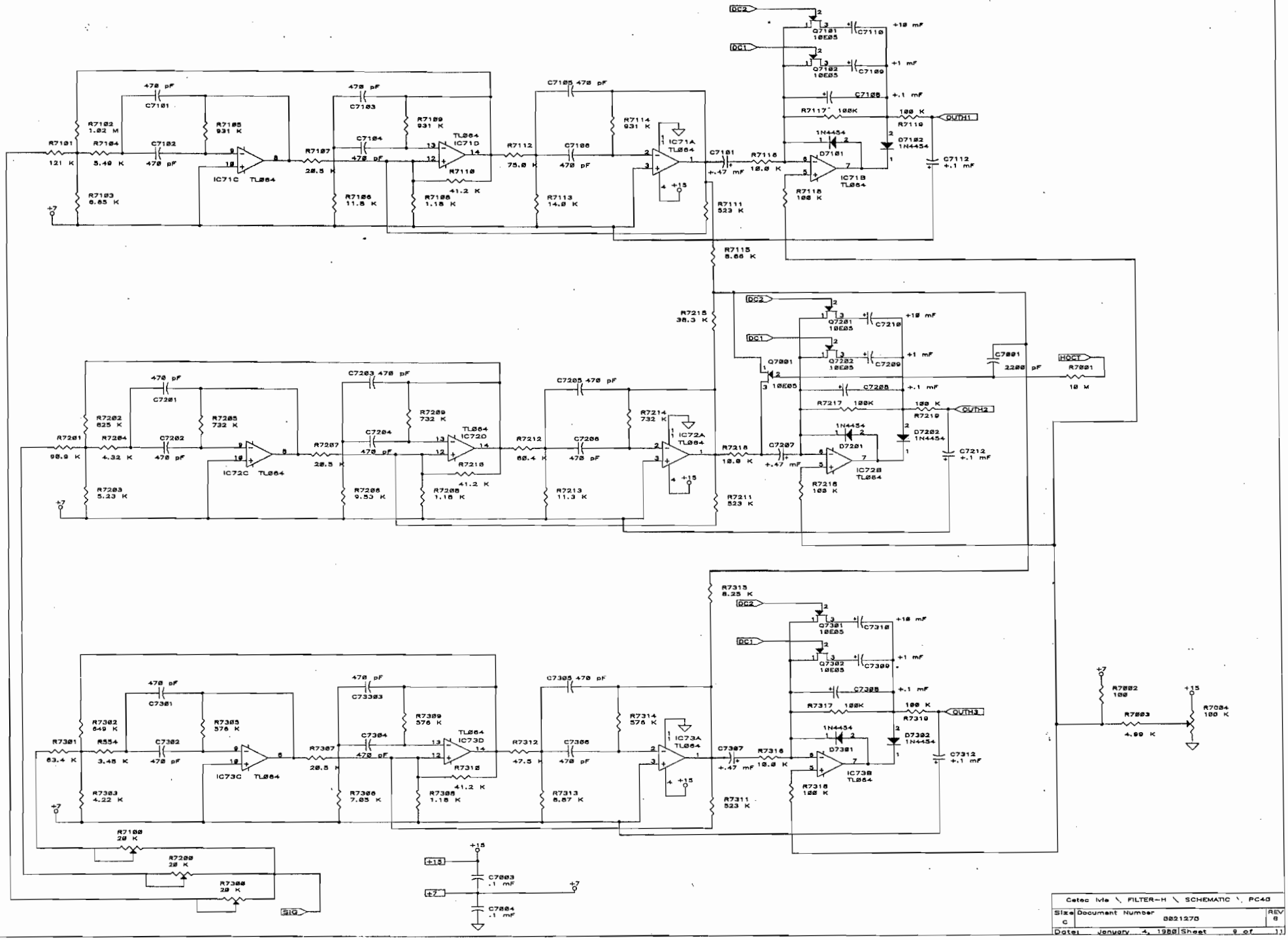
Cetec Mia \ FILTER-E \ SCHEMATIC \ PC48			
Size C	Document Number 9021270		REV B
Date: January 4, 1990	Sheet 2 of 11		



Cetec Mx \ FILTER-F \ SCHEMATIC \ PC48			
Size C	Document Number 8021270		REV B
Date: January 4, 1988	Sheet 7 of 11		



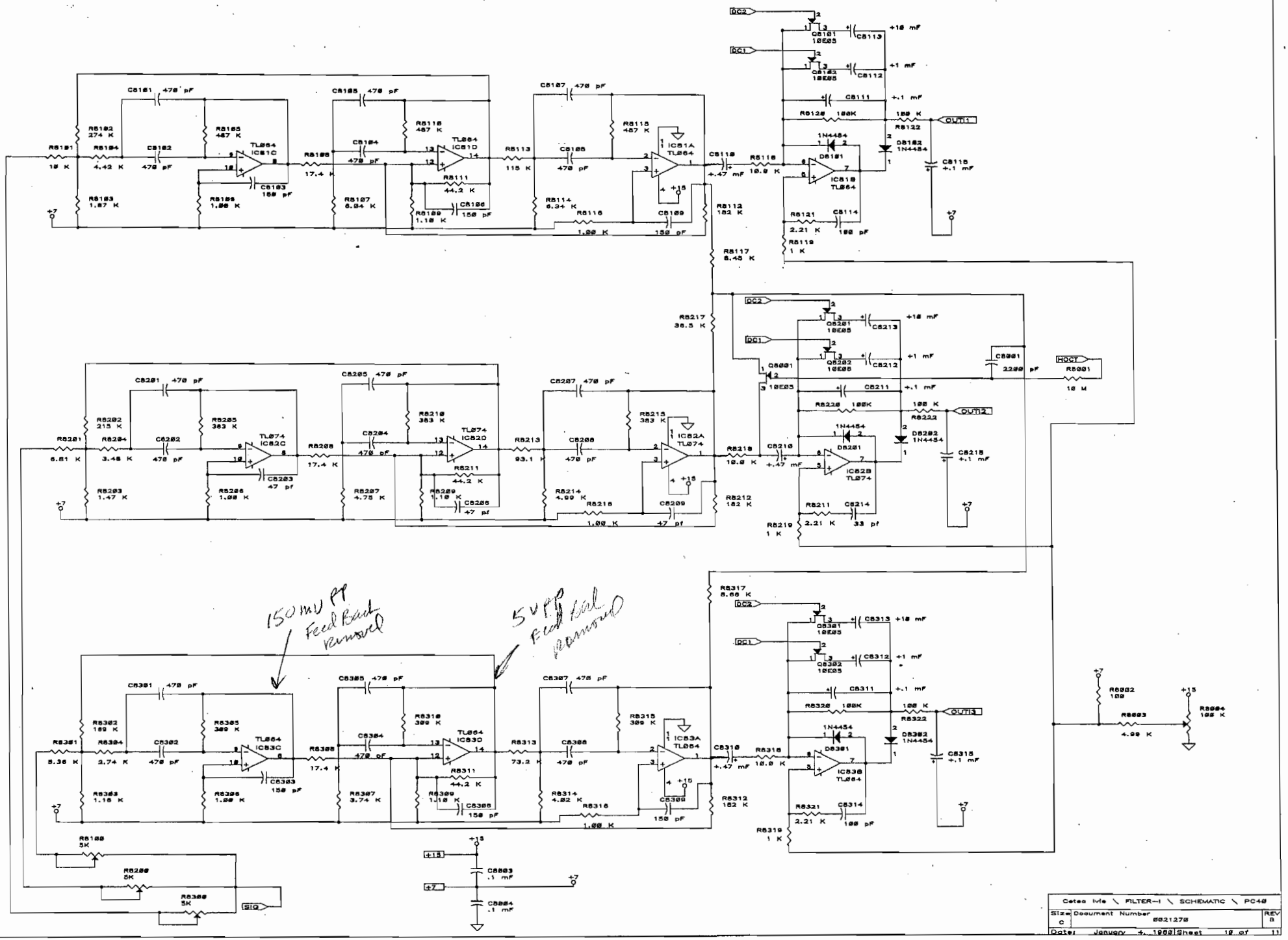
Cetec Ivie \ FILTER-G \ SCHEMATIC \ PC48		
Size C	Document Number 8021270	REV B
Date: January 4, 1980	Sheet 8 of 11	



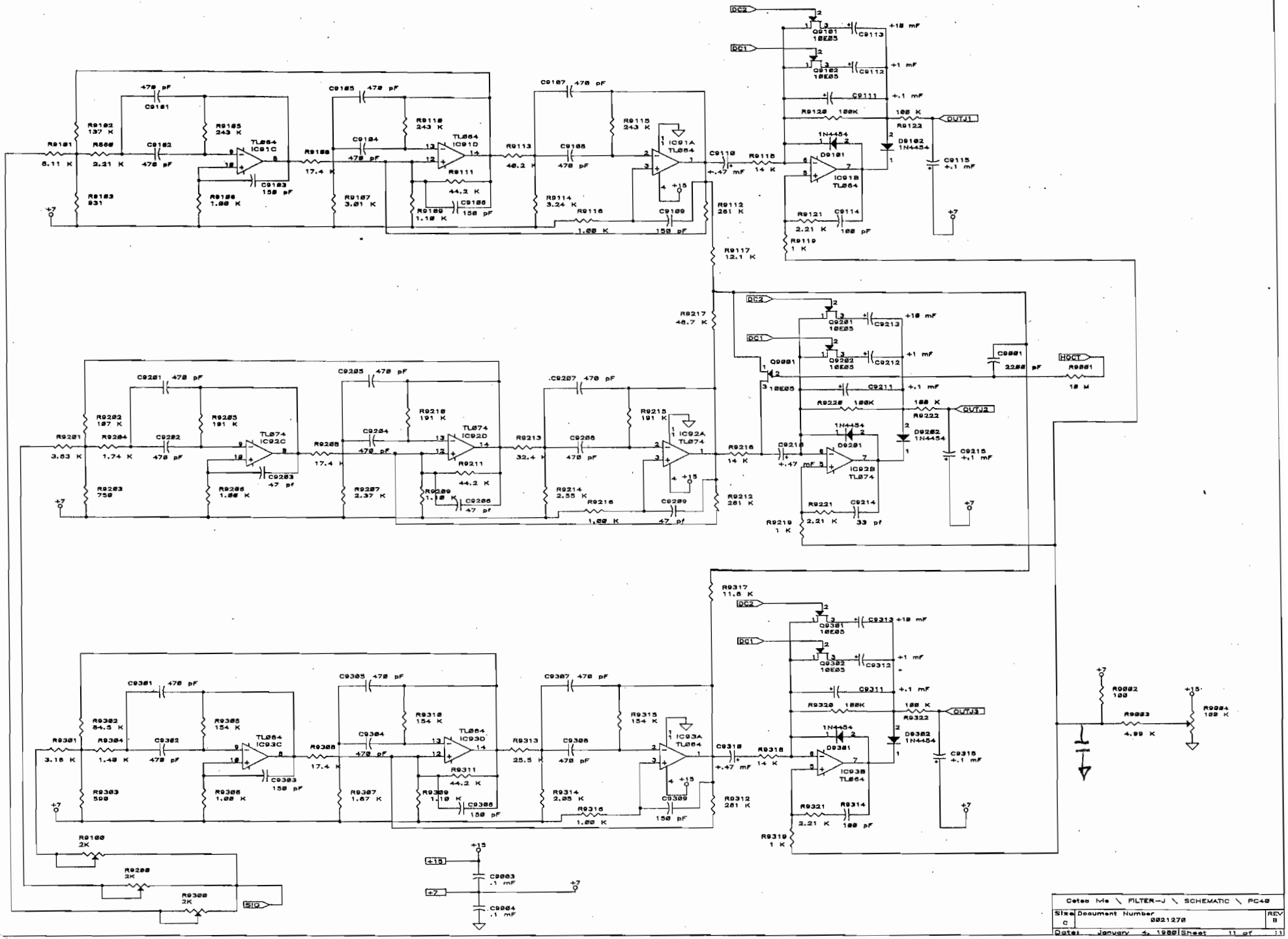
Cetec Vle \ FILTER-H \ SCHEMATIC \, PC40

Size	Document Number	REV
C	8821270	B

Date: January 4, 1988 Sheet 9 of 11



Cetec Vie \ FILTER-I \ SCHEMATIC \ PC48			
Size: C	Document Number: 8021278		REV: B
Date: January 4, 1988	Sheet 10 of 11		



Cetec Mx \ FILTER-J \ SCHEMATIC \ PC48

Size	Document Number	REV
C	9021270	B

Date: January 4, 1988 Sheet 11 of 11

ENGINEERING CHANGE ORDER NO. 79

REASON: Nicad's Short to case of the PC40 and Cause damage to the PC40 Analog Board

EFFECTIVITY: PC40 Nicad Battery Packs

ARTWORK CHNG?	YES (NO)
B/M CHNG? ONLY	YES (NO)
DRILLING CHNG?	YES (NO)

DISPOSITION OF PARTS

IN PROCESS	IN STOCK	IN FIELD
☑ CHANGE	☑ CHANGE	☐ CHANGE
☐ NO CHNG	☐ NO CHNG	☐ NO CHNG
☐ SCRAP	☐ SCRAP	☐ OPTIONAL

OTHER:

APPROVAL	DATE
INITIATED BY:	11-5-98
ENGR	11-5-98
PROD	11/6/98
PRCH	11-6-98
MRKT	11-6-98
COMP	
STRS	
FINAL	

DOCUMENT NO. AFFECTED	REV	CGD BY	CHK BY
	-		
Assembly Dwg	- A		
	-		
	-		
	-		
	-		
	-		
	-		

DESCRIPTION:

Vendor will add Pico II Fast acting 5A 125V Fuse Digikey Part # F833-ND to the PC40 Nicad Battery Pack as shown on Page 2 of ECO.

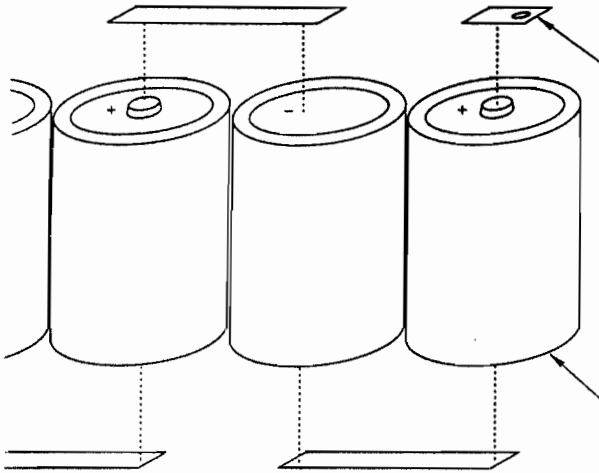
In house Nicad Battery Packs will have Fuse added to the ground wire outside the Pack.

2/20/10

PAGE 1 OF 2

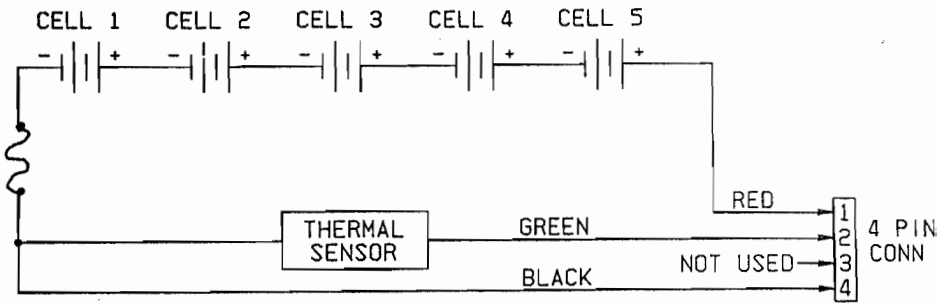
FORM MUST BE COMPLETED IN FULL OR IT WILL BE RETURNED.

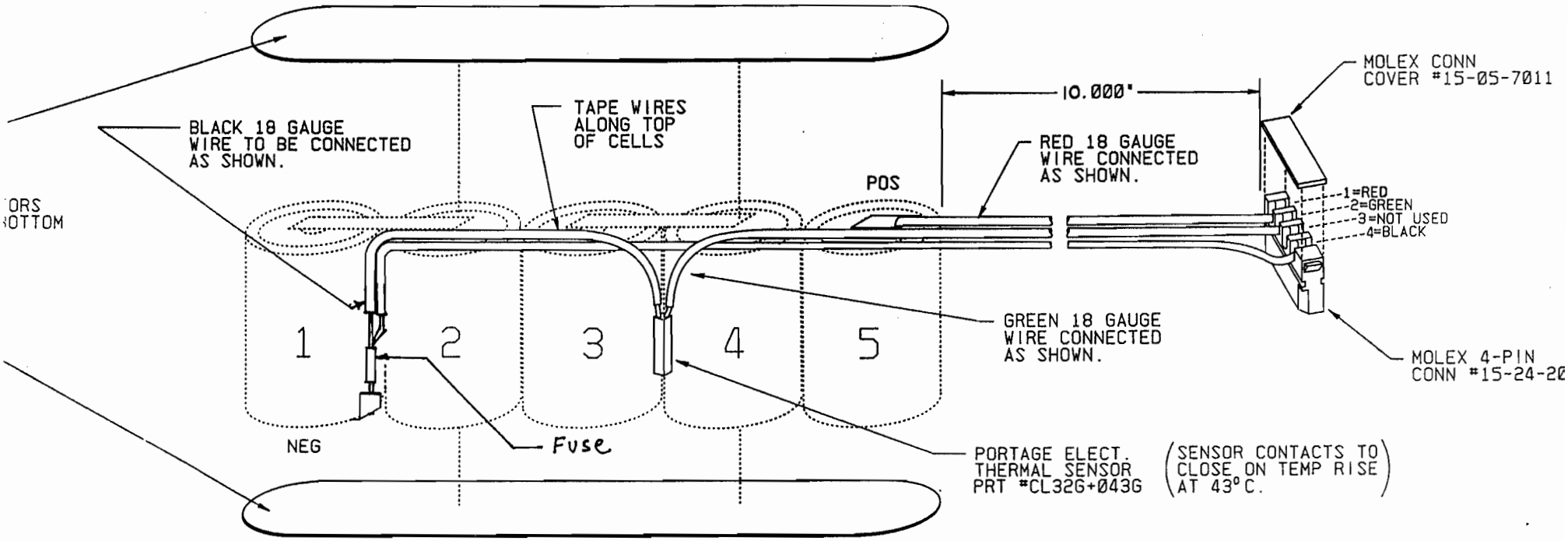
212-0110 RE 4.



Pico II
Fast Acting
5A 125v
Fuse
DigiKey F833-ND

SCHEMATIC





PC-40 First Aid

On rare occasions, for reasons still a mystery, the PC-40 software can be afflicted by a bug. This is not a resident bug, but somehow gets added to the software and causes a problem. We have never been able to cause the problem intentionally, so we can't explain the series of events or combination of key strokes that cause the bug, but we know how to fix it and it is simple.

The bug symptoms are a reference line that will go above 140 or below 30, or incomplete characters at the reference line or in other places. Sometimes the bars of the graphic display will be broken or irregular, or the display will be partially "erased." Any combination of these symptoms may occur.

The fix is easy, but erases any memory information stored, so memories should be saved or printed, if needed, before executing the "fix."

Here is what to do:

1. Push the red QUIT button on the upper left of the key board. The menu screen should now be displayed.

2. Using the cursor arrows, select the menu item "B:BASIC COM" and press the return key. This should display the BASIC menu and another press of the return key should cause the display of the Ok prompt and flashing cursor.

3. Type the following command: OUT 39,137 (the "O" in OUT is the letter "O" and not a zero. There must be a space between T and 3). Press the return key. The OK prompt will reappear.

4. Type the following command: OUT 52,0 (again, "OUT" is the letter "O", but following 52, is a zero, not the letter "O." Press the return key to get the Ok prompt.

5. Type the word SYSTEM and press the return key. This should return the PC-40 to the main menu with the PC-40 software program being highlighted. Press the return key to start the PC-40 program.

6. Smile smugly because you have just solved the problem! If the problem should remain - perish the thought! - try the procedure once more to make sure nothing was missed. If it still doesn't work, call the factory at 801-224-1800 and let us try to help.

Ivie
Technologies Inc.

1366 West Center St.
Orem, Utah 84057
Tel: 801-224-1800

FAX TRANSMITTAL LETTER

Reply FAX: 801-224-7526

Number of pages (including this one) 1

12 Oct 1995
To: B. Leroux @ Mesureur
From: Craig Berry

RE: SPL versus PC-40 display - Thompson Angers

SPL cannot be exactly calculated from the spectral display of the PC-40. It can be approximated, but it is like trying to make an apple from an orange.

SPL, by definition, has a bandwidth from 20 Hz to 40 kHz. The SPL meter section of the PC-40 measures to 40 kHz as required, but the display screen of the PC-40 goes out only to 20 kHz.

The measurement of SPL, by definition, requires RMS detectors. The SPL detectors in the PC-40 are RMS, (or peak detectors if "Peak" is selected) but the detectors of the analyzer display are averaging detectors.

The SPL meter and the analyzer sections of the PC-40 are completely different electronics. The only thing they share is the signal input stage - same mic and preamp. After that, the signal is processed completely differently, as required by international standard. One cannot be exactly converted to the other by calculation, it can only be approximated. What you are seeing is completely normal.

Signals from a calibrator are very close in level to one another when measured in SPL and converted to SPL from the display by calculation because some of the variables are eliminated. Only one frequency is observed, so the biggest differences that remain are the detectors used to make the measurements, and the interaction of the filter skirts in the analyzer section (although only one frequency is being input, adjacent filters still register some signal). The results can get very close, but an exact conversion by calculation is still not possible. We hope this explanation helps.

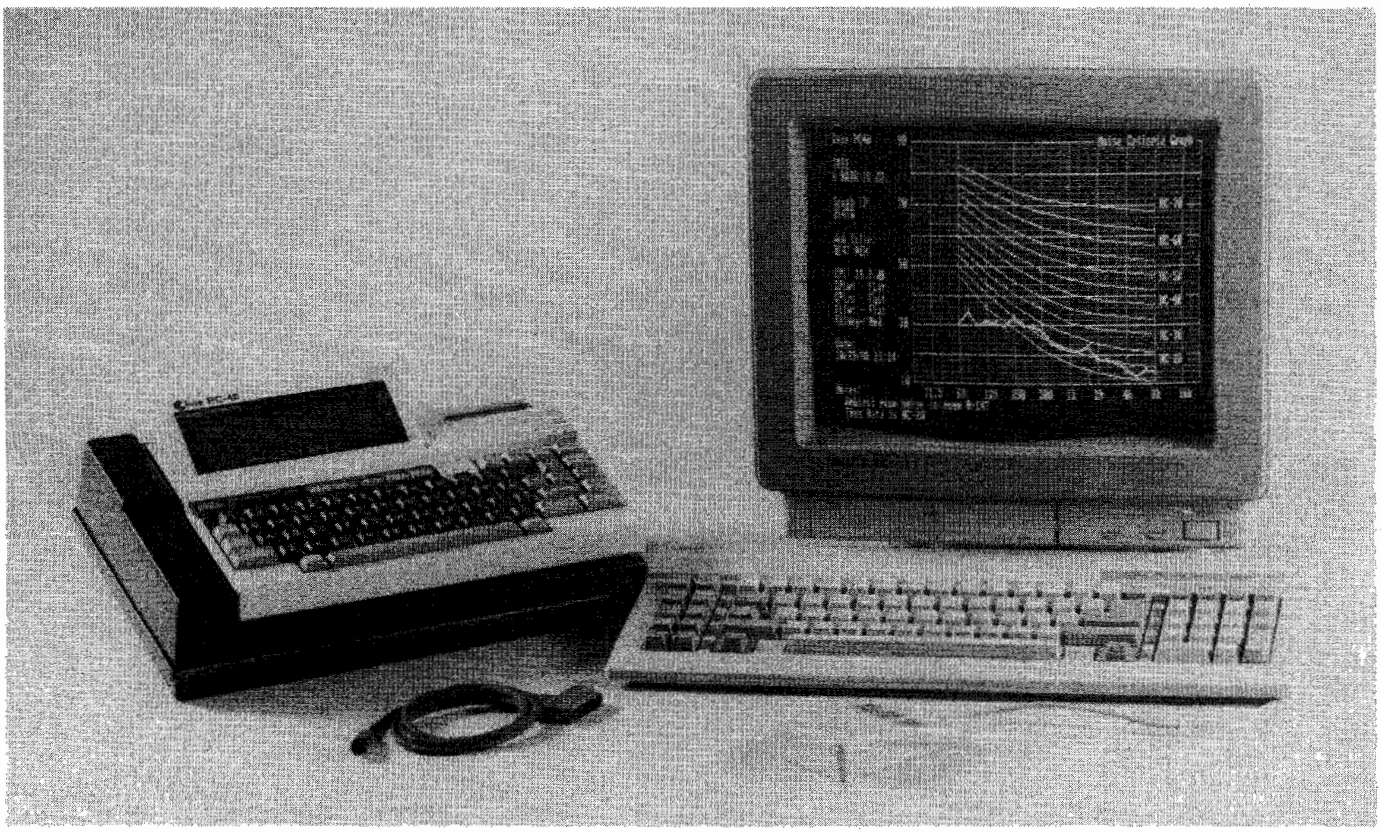
Highest regards,

Craig Berry

Ivie
a MARK IV company

1366 West Center St.
Orem, Utah 84057
Tel. 801-224-1800
Fax: 801-224-7526

Owner's and Operator's Manual for the PC-40 Audio Spectrum Analyzer



PC-40 Manual Table of Contents

Introduction

Congratulations! With your purchase of the Ivie PC-40, you not only have one of the most powerful, versatile, and accurate audio spectrum analyzers available, but in addition you have an analysis system that is capable of expanding as your needs expand.

This manual is intended to familiarize you with the basic operations of the PC-40 Analyzer, and to whet your appetite concerning some of its possibilities. It is in no way intended to be the total description of all the possibilities of the PC-40. Since its on-board computer is easily programmed using BASIC, the possibilities for using the PC-40, and tailoring it to your specific application needs are almost limitless.

The PC-40 on-board computer is a 64K, CPM 2.2 machine. It has a parallel port and two serial ports (RS 232, and high speed serial, both capable of up to 38.5k BAUD). This manual is not intended to familiarize you with the operation of the computer, but is intended to teach the operation of the PC-40 Analyzer. A complete manual on the computer itself is enclosed for your reference.

With reasonable care, the PC-40 will provide a long period of useful service. Great pains have been taken to assure performance, quality, and reliability. We suggest that this manual be read thoroughly, and that it always be available as a reference. The "Theory of Operation" section which follows is of particular importance in understanding how the PC-40 operates, and why it operates as it does.

Theory of Operation

The PC-40 hardware is actually comprised of two sections, the precise analyzer electronics, and the computer section. These hardware sections may even be physically separated - the computer actually snaps away from the analyzer. Since the analyzer is under the control of the computer, and will, in fact, not work without the computer, it is easiest to think of the analyzer functions as software functions. Each time a command is given the the PC-40, either by use of the function buttons or through the use of the QWERTY keyboard, that command is software executed.

Since the analyzer functions are software based, it gives us some interesting

flexibility. We can make multiple measurements within a given function, or compare and process data from different measurements, or even create our own desired functions, using BASIC. The possibilities are extensive.

Such a broad menu of functions can also create some difficulties. For instance, there are only 5 function buttons available on the PC-40. We were able to double that number using the "shift" button in conjunction with the function buttons. Still, 10 functions is far fewer than are already resident in the PC-40. A difficult question is, "Which functions should we assign to the ten function buttons?" The answer, as it turns out, follows a rather natural delineation.

Some functions we naturally want to be able to perform or change while the analyzer is in operation. These would include changing the reference level, or the filter decay time, or writing into or reading from memory. A single function button is most convenient for initiating these kinds of functions. Other functions don't need to be performed or changed in "real time," such as assigning output data to a particular interface port. These latter types of functions can be addressed from the QWERTY keyboard without inconvenience. As you operate the PC-40, you will find that those functions you use most often, and execute in "real time" are the functions that will be addressed by the function buttons directly.

Getting to Know the PC-40

Installing Cartridge Accessories (The H409A Cartridge Printer etc.)

For complete instructions on installing cartridge accessories, refer to Appendix I of this manual which shows PC-40 disassembly and cartridge loading.

The PC-40 Microphone and Preamp

The PC-40 comes standard with a 1/2 inch air condenser microphone (your choice of a free field or a random response microphone), and the IE-2P Precision Preamplifier. 1/4 inch, 1/8 inch, and 1 inch air condenser microphones are available on a special order basis.

Providing such a quality front-end with your PC-40 is not an inexpensive proposition. You will discover that if you lose your microphone and preamp, it

will cost more than a thousand dollars to replace them. However, we feel strongly that an analyzer and sound level meter can not be more accurate or reliable than the microphone that comes with it. If you look at other analyzers on the market today, you will find that many come without microphones, and many others come with relatively inexpensive commercial microphones. Providing laboratory quality microphones and preamplifiers with analyzers is almost unique to Ivie.

The PC-40 is a Type I sound level meter, and has the accuracy of Class III filters in the analyzer section (in SLM Types, low numbers are best; in filter Classes, high numbers are best). As long as you use the microphone and preamp that came with your analyzer, its accuracy and performance to specifications is assured. You may easily use other microphones with your PC-40 as long as you remember that all readings are then relative, and are not absolute. You must further remember that the spectral information shown on the analyzer will be colored by the response of the microphone you are using.

Other air condenser microphones which conform to international dimension and thread specifications can be used with your PC-40 by simply removing the microphone cartridge from the end of the IE-2P and replacing it with the air condenser cartridge you wish to use. Many air condenser microphones, including those made by B & K, ACO Pacific, and Rion are compatible with the IE-2P. If a one inch, quarter inch, or eighth inch microphone is to be used, adaptors will be needed to adapt to the half inch barrel of the IE-2P. Some one inch microphones require a polarization voltage of 28 volts instead of the 200 volts which is most common. In this case, the polarization voltage of the IE-2P will need to be switched. Some may require the use of the 20dB pad available in the IE-2P, and, of course, changing the microphone will always require recalibration of the system. (For information on changing polarization voltage, the 20dB pad, and recalibration, refer to the IE-2P manual and the section in this manual entitled "System Calibration for OSHA Measurements," under the heading of "Sound Level Testing."

When using another microphone, it is important to know the frequency response of the microphone in order to interpret the display information of the PC-40. The typical frequency response of the standard microphones for the PC-40 (the 1133 Free Field and the 1134 Random Response or Pressure Response) are shown on the following page:

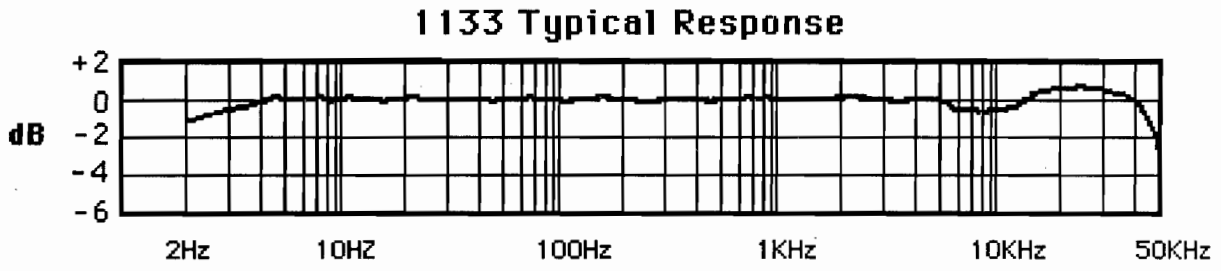


Figure I

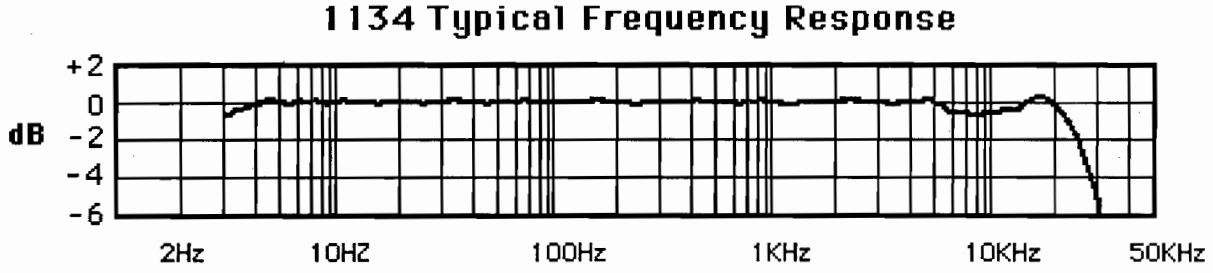


Figure II

As can be seen, these microphones have been chosen for their excellent response characteristics, and their ability to provide maximum accuracy to the measurement capability of the PC-40. Should you have questions about microphones, or their application in analyzer measurements, please don't hesitate to contact us at the factory.

Inputs and Outputs -The PC-40 Microphone Input Plug and the PC-40 I/O Panel

The Microphone Input Plug

The microphone input plug on the PC-40 is a six pin XLR-type connector. Following is an illustration of the pinout of this connector:

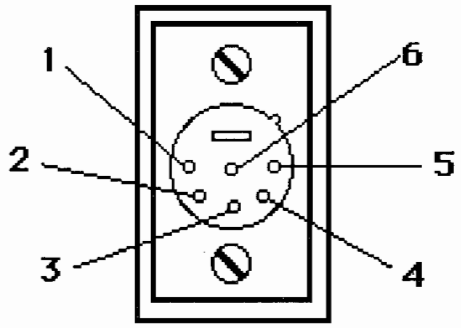


Figure III

Pin 1: Input pin. The input impedance is 100 kΩ. The maximum direct DC input before damage is 100VDC. The maximum direct AC input is 300VAC from 20Hz to 4kHz. For frequencies above 4kHz, derate maximum AC input by 6dB/octave (e.g. 150VAC @ 8kHz, 75VAC @ 16kHz, 6VAC @ 20kHz)

Pin 2: Gain Trim pin. Varying the pin voltage between 8VDC and 0VDC varies the gain of the PC-40 over a 15dB range. This pin is not to be used for AGC purposes, but only as a long term gain adjustment for calibration requirements.

Pin 3: No connection.

Pin 4: Power (V_{CC}) for microphone preamplifier. It provides 10mA (maximum current) at 12VDC.

Pin 5: Calibration pin. Pin 5 is normally tied to pin 4, which sets the PC-40 calibration for dBμV.* IF pin 5 is not tied to pin 4, calibration is set for dB.1μV.†

Pin 6: Ground.

*0dBμV = 1.0μV † 0dB.1μV = 0.1μV

Microphone Extension Cords

It is helpful to know the microphone input pinout, especially if you plan to make your own extension cord. Extension cords are available from Ivie in lengths from 25 ft. to 200 ft. in 25 ft. increments, but should you choose to make you own cord, that can be easily done using a minimum of three conductor shielded cable, and one male and one female 6 pin XLR-type connector. Pin 1 must be

brought through, as well as pins 2, and 4. The shield should be tied to pin 6. Pins 4 & 5 should be tied together at the female XLR which plugs into the PC-40. If you tie them together at the male XLR connector at the other end of your extension cable, no conductors will be tied to them, so they will not be tied together at the PC-40. A highly supple (and therefore, usually expensive) cable is recommended.

The PC-40 I/O Panel

The PC-40 I/O Panel is located at the top of the PC-40 and looks like this:

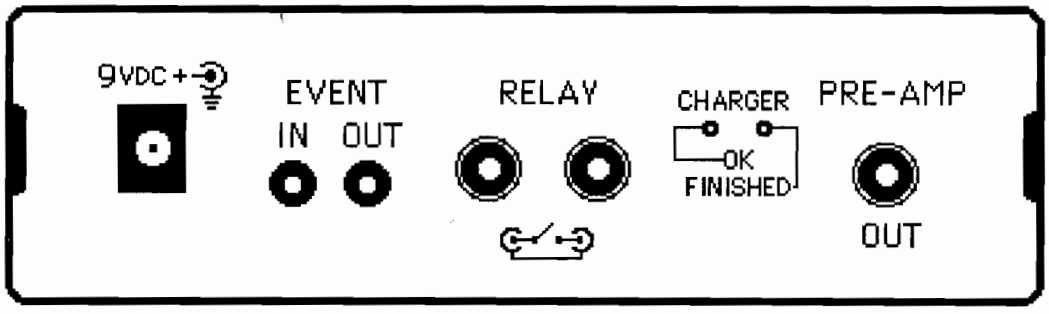


Figure IV

The first item that should be noted is the battery charger input. As can be seen, it is a 9 volt DC input with the center pin positive. Do not plug the PC-40 charger (CH 40) into a disk drive or into the computer section of the PC-40. These inputs are center pin negative, and you will destroy your disk drive, or damage your computer! The battery charger input of the computer has been covered to prevent accidental insertion of the CH 40 Charger. In the unlikely event that the cover should come off, it should be reattached. If it is lost, another is available upon request from Ivie at no cost.

Battery and Line Operation

When fully charged, the PC-40 will operate for at least five hours continuously. In some applications, is will last longer since the analyzer section is "slept" while the computer section processes data. The computer alone will operate for 12 to 14 hours between charges.

Charging the PC-40 completely takes about 5 hours if the unit is off, or about 7

hours if the unit is on. It can be operated continuously while charging with no problem. It will toggle into trickle charge when the batteries reach a full charge. When in the "fast charge" mode, the red LED in the Patch Panel labeled "OK" will be illuminated. (See illustration below.)

Figure V

After toggling into trickle charge, the red "OK" LED, and the green "Finished" LED will illumninate.

In emergency situations, the PC-40 can be powered from an external 9 Volt DC battery. The battery can be fed into the PC-40 charger input plug. Make sure to observe proper polarity - center pin positive. Length of operation will depend on size of external battery, and application of the PC-40. The current draw of the PC-40 will not exceed one amp, so the time of operation on any external battery can be easily estimated.

The Preamp Output

Figure VI

The preamp output of the PC-40, located at the far, right side of the I\O Panel, is a straight analog output. It provides from 30dB of attenuation to 80dB of gain, relative to the input, in 10dB increments - a total range of 110dB. The gain of the preamp is controlled by the RANGE buttons of the PC-40 which are used to raise or lower the Reference Level of the analyzer.

The output impedance of the preamp is 600 ohms. 600 ohm headphones can be directly driven from the preamp output. The preamp input can be switched

between the PC-40 microphone and the probe, so it can be used as either an audio or an electrical preamp.

The weighting of the preamp output also follows the weighting of the PC-40 SPL meter. If, for example, the SPL meter is set for "A" weighting, the preamp output will be "A" weighted, regardless of whether making audio or electrical measurements. The preamp, then, could be used all by itself as a weighted preamp.

The Audio Relay

Figure VII

The Audio Relay of the PC-40 is a dry contact switch, so it doesn't care which port is the input or which one is the output. The Audio Relay can be accessed via the PC-40 keyboard, or through BASIC or Machine Language programming, and is used in specialized functions of the PC-40, such as RT_{60}. When performing an RT_{60} measurement, the signal source would be fed into the Audio Relay and out to the "house" sound system.

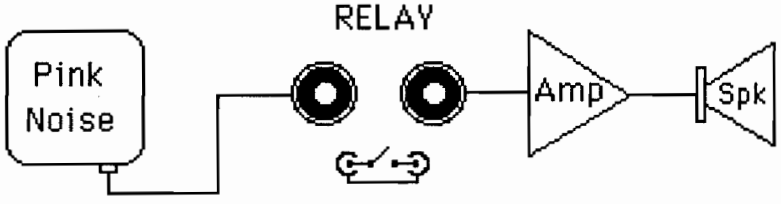


Figure VIII

When performing the RT_{60} measurement, the function of the Audio Relay would be to shut off the audio signal in the room to begin the test. The Audio Relay can be used in any test setup where a programmable audio relay is necessary.

To access the audio relay via the PC-40 keyboard, hold down the **CTRL** key

and press **A** for "Audio." This toggles the relay between open and closed. When the relay is closed, the INS LED on the PC-40 keyboard will illuminate to indicate relay closure.

The Event In/Out

Figure IX

The purpose of the PC-40 Event In/Out is to allow the analyzer to be controlled (ie. turned on or off) by an external event, or to allow an external event to be controlled by the analyzer. The "Event IN" port is used when we want to control the analyzer by some external event. The "Event OUT" port is used when we want the analyzer to control some external event. Below is an illustration detailing the electronics and voltage requirements for using the Event trigger.

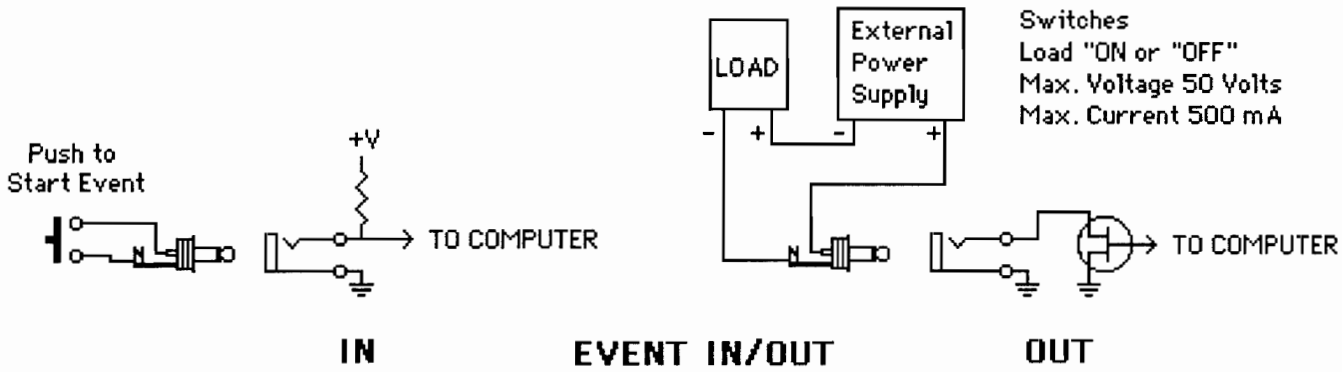


Figure X

The Event trigger is accessible only through BASIC or Machine Language programming, and is not utilized by the resident PC-40 software.

The PC-40 Display Screen

On the following page is an illustration of the PC-40 display screen. The screen is quite self explanatory, but a few items should be noted.

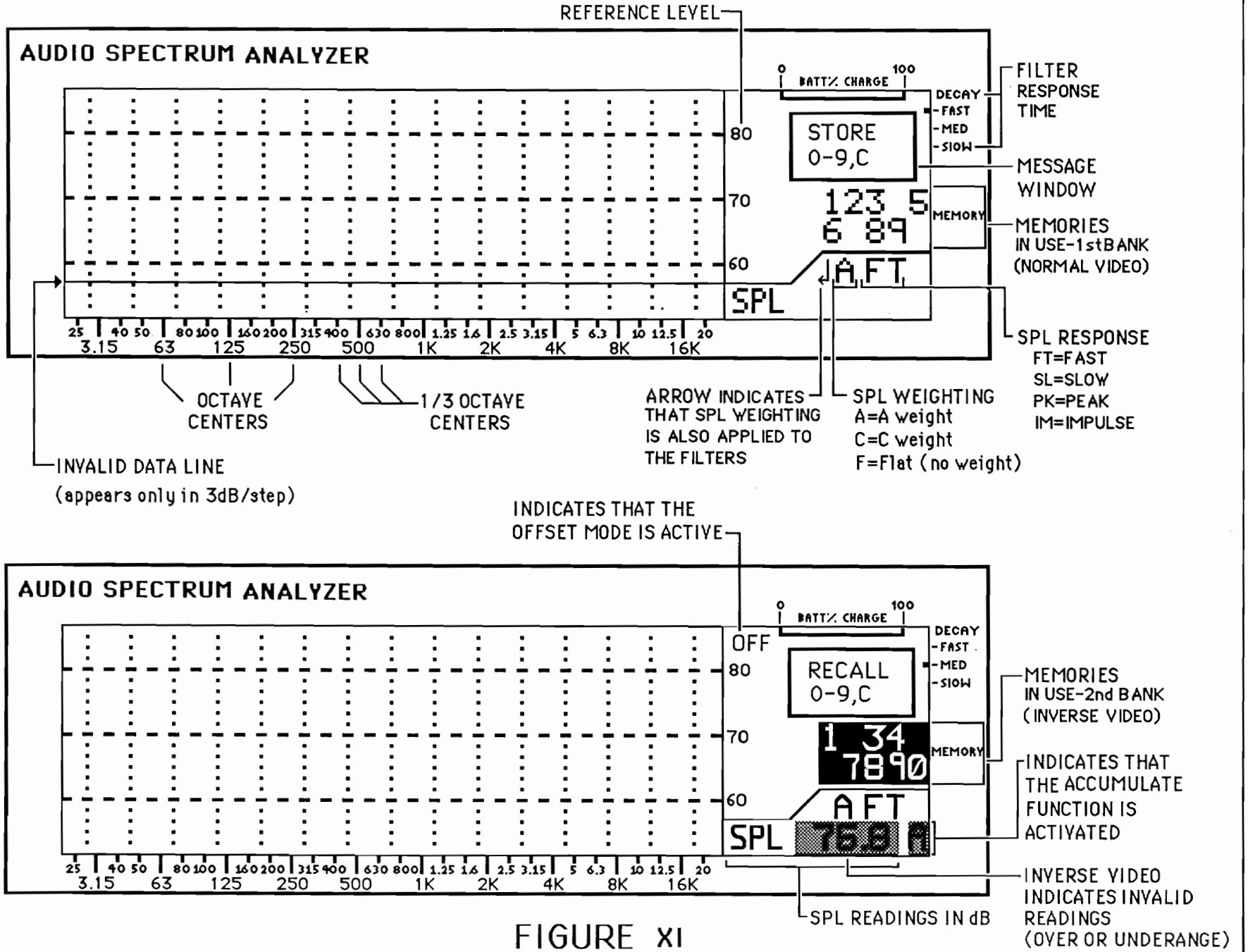

REFERENCE LEVEL
AUDIO SPECTRUM ANALYZER
0
BATT% CHARGE
100
DECAY
-FAST
-MED
-SLOW
FILTER RESPONSE TIME
STORE 0-9,C
MESSAGE WINDOW
80
70
60
123 5
6 89
MEMORY
MEMORIES IN USE-1stBANK (NORMAL VIDEO)
A FT
SPL
SPL RESPONSE
FT=FAST
SL=SLOW
PK=PEAK
IM=IMPULSE
25 40 50 80 100 160 200 315 400 630 800 1.25 1.6 2.5 3.15 5 6.3 10 12.5 20
3.15 63 125 250 500 1K 2K 4K 8K 16K
OCTAVE CENTERS
1/3 OCTAVE CENTERS
ARROW INDICATES THAT SPL WEIGHTING IS ALSO APPLIED TO THE FILTERS
SPL WEIGHTING
A=A weight
C=C weight
F=Flat (no weight)
INVALID DATA LINE
(appears only in 3dB/step)
INDICATES THAT THE OFFSET MODE IS ACTIVE
AUDIO SPECTRUM ANALYZER
0
BATT% CHARGE
100
OFF
DECAY
-FAST
-MED
-SLOW
RECALL 0-9,C
80
70
60
1 34
7890
MEMORY
MEMORIES IN USE-2nd BANK (INVERSE VIDEO)
A FT
SPL
76.8
A
INDICATES THAT THE ACCUMULATE FUNCTION IS ACTIVATED
25 40 50 80 100 160 200 315 400 630 800 1.25 1.6 2.5 3.15 5 6.3 10 12.5 20
3.15 63 125 250 500 1K 2K 4K 8K 16K
INVERSE VIDEO INDICATES INVALID READINGS (OVER OR UNDERANGE)
SPL READINGS IN dB

FIGURE XI

The screen itself may be tilted to approximately 30° to facilitate viewing. To tilt the screen, press the release button on top of the PC-40, and pull the top of the screen toward you.

The memory section and other screen display sections of the PC-40 are identified in the preceding illustration. It should be noted that the memories are divided into two banks of ten each. The first ten are displayed in standard video (black letters on white background), and the second ten are displayed in inverse video (white letters on black background).

****Important Note****

Near the bottom of the display screen, a line appears all the way across the screen when in the 3dB per step mode only. (See the illustration.) This is called the "Invalid Data Line." Because of the number of pixels in a column on the display screen, it works out best to show an "on screen" dynamic range exceeding 60dB - this allows us to work in even numbers of pixels, not having to cut any in halves or thirds, which would be impossible to display. While this works out fine in terms of the pixels in the display, the greater than 60dB of dynamic range actually exceeds the true dynamic range of the filters - that is, we begin to run into the actual noise of the filters themselves when we look that many dB down.

The Invalid Data Line represents the limits of the safe area of the display. Any data below that line may be actual sound, or could be filter noise. Therefore, information below the invalid data line should not be regarded as accurate. The Reference Level should be adjusted so that all data rises above the Invalid Data Line to prevent errors in readings. Information below the Invalid Data Line will not be stored in memory. For further information on this matter, consult the section of this manual entitled, "The PC-40 Memory Functions."

Several references will be made to Figure XI in the next pages of this manual as we explore further the functions of the PC-40.

Individual Filter Display - Graphic & Numeric

You have already had a chance to look at the illustration of the PC-40 display on page 12, and have probably even turned on your PC-40 to see the real-time display for yourself. You are most likely already familiar with the kind of bar graph display presented by the PC-40. Overall SPL is shown numerically, and

the amplitude of each of the octave or 1/3 octave channels is shown graphically. You can't tell it by looking at the graphic display, but the PC-40 actually maintains a resolution of .1dB on individual filter amplitudes. Your eye can't detect that kind of resolution, but, as you will learn later in this manual, it is possible to obtain tabular (numerical) printouts which indicate individual filter amplitudes to a tenth of a dB.

It is also possible to view numerically the amplitude of any given channel in real-time. This is a very useful function, and access to it is easy.

The illustration below is a normal real-time display showing overall SPL numerically, and individual filter amplitude graphically:

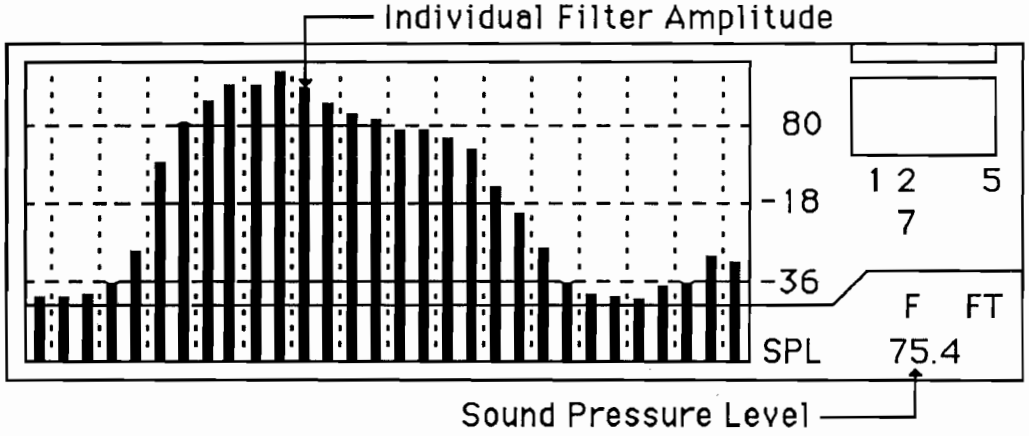


Figure XII

Notice that the Message Window is blank during real-time operation. If you have trouble finding the Message Window, refer back to Figure XI on page 12. The PC-40 can numerically display the amplitude of any filter you choose in the Message Window. To activate this feature, simply press the letter **F** for "Filters." If we pressed the letter **F** while viewing the above display, we would get a display that looked something like the illustration shown on the following page. Compare the Message Window on the two illustrations.

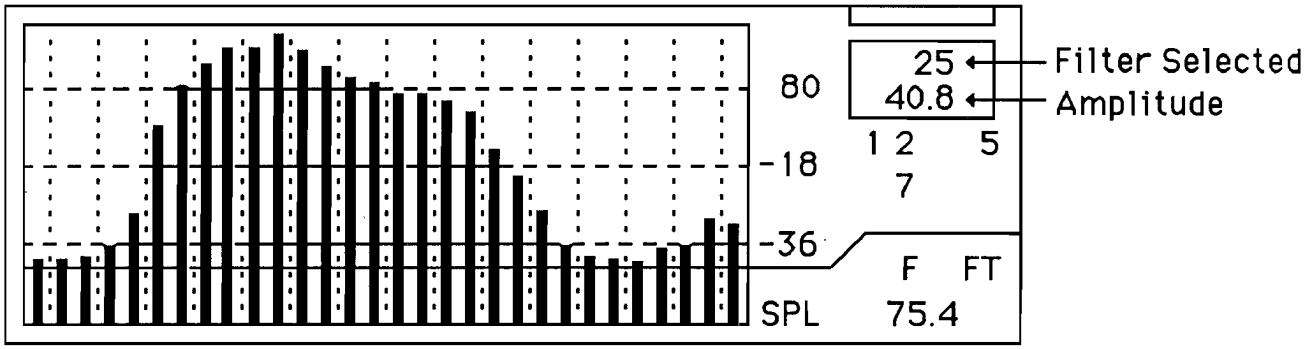


Figure XIII

The first number in the Message Window indicates the frequency of the filter that has been selected. In Figure XIII, it is the 25 Hz filter. The number below indicates the amplitude of the 25 Hz channel - in this case, 40.8 dB. The resolution is .1dB. This is a real-time function just as the graphic display is, so this number will be constantly updating as the amplitude in the channel changes.

In the above example, we looked at the 25 Hz channel, but we could look at any channel we want to. To select a different channel for viewing, use the left and right **Cursor** keys. These are the keys with arrows on them located on the right hand side of the keyboard. The left one will move lower in frequency, and the right one will move higher in frequency. There are up and down **Cursor** keys as well as left and right ones. The up and down **Cursor** keys, and the left and right ones are used in many PC-40 functions.

To get out of this display mode, simply press the letter **F** again and it will return the PC-40 to a standard, real-time display.

Now that you have a little taste of some of the PC-40's exciting capability, let's move on and examine the functions accessed by the function buttons.

The PC-40 Function Buttons and the Accumulate Function

In the highly unlikely event that you haven't already had your PC-40 on, you may turn it on now. The OFF/ON switch is located on the right side of the unit below the keyboard, (See Figure XIV below).

The Function Buttons of the PC-40 are located directly below the display screen of the PC-40, (See Figure XIV below). The rest of the keys are fairly standard.

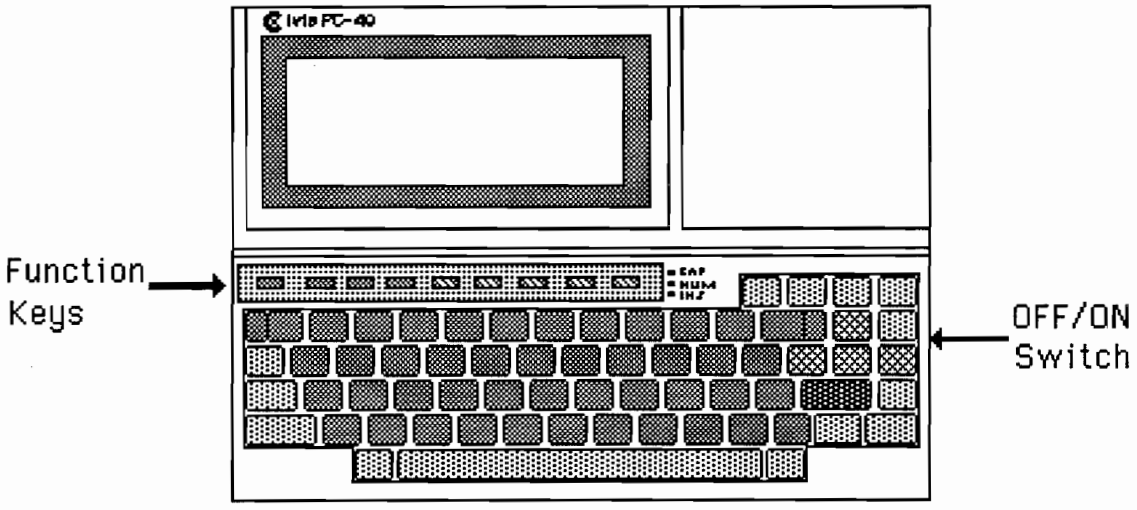


Figure XIV

Before we discuss the function keys, let's talk about the **Accumulate Function** which is activiated by pressing the letter **A**. This could save some frustration later. When the letter **A** is pushed, the PC-40 display screen and the SPL readout go into a peak hold mode - that is, the highest level recorded at each filter is displayed and "frozen" on screen until something higher displaces it. The same is true of the SPL display. If you don't know you are in this mode, the PC-40 screen appears to have "frozen up," and yelling and thumping the PC-40 only makes the display rise a little further, with no other apparent effect.

Actually, **Accumulate** is a very useful function, especially if you want to determine a peak envelope of some program material, or walk an auditorium listening to pink noise and accumulating the peaks. We call this function the "Accumulate" function, and you can always tell you are in this mode by the inverse video "A" that appears next to the SPL readout at the bottom-right of the PC-40 display screen (see Figure XI). To get out of the "Accumulate" function, just press the letter **A** again. Now let's discuss the function keys.

The purpose of the function keys is to simplify operation of the PC-40 without having to make commands from the keyboard. The five right-most keys (labeled **PF1** through **PF5**) will be used most often since they control the basic analyzer functions. These keys have more than one function which can be addressed by using the **Shift** key in conjunction with the function key, or in some cases the **Ctrl** key with the function key.

PF1 and PF2
(The Range Function & Selecting SPL Detectors and Weightings)

Let's examine each key and its functions beginning with **PF1** and **PF2**. These keys have this annotation above them:

The PC-40 screen display has a reference level (See Figure XI) which is adjustable from 30 to 140dB, when using the microphone as the input, or from 50 to 180dB μvolts when using the probe as the input. In either case, the reference level steps in 10dB increments. As the keyboard graphics indicate, pushing **PF1** (the "down" arrow) lowers the reference level by 10dB, and pushing **PF2** (the "up" arrow) increases the reference level by 10dB. This is called the "RANGE" function because raising or lowering the reference level of the PC-40 changes its reading range.

PF1 and **PF2** also perform additional functions which are related to the SPL meter section of the PC-40. Since the PC-40 is a Type I SPL Meter, it must, by definition, be able to perform a number of different measurements. **PF1** allows you to select either "A" weighted (dBA) measurements, "C" weighted measurements, or "Flat" (unweighted) measurements. (For more information on these types of measurements, refer to the manual section on SPL Measurements). To choose "A," "C," or "Flat" measurements, first push and hold the **Shift** key and then, while holding the **Shift** key, push **PF1**. Holding down the **Shift** key while pressing **PF1** will cause the PC-40 to toggle through "A," "C," and "F" weightings. An A,C, or F will appear at the bottom right of the PC-40's screen display to indicate what SPL weighting has been selected (See Figure XI).

The PC-40 also contains all the SPL detector responses necessary to qualify it

for Type I measurements. These include Fast, Slow, Peak and Impulse. These detectors can be selected by pressing and holding **Shift** while pressing **PF2.** The PC-40 will step through "FT," "SL," "PK," and "IM" in the same manner as described for changing SPL weighting. Also, visual indication of the selected detector is given in the lower right corner of the PC-40 display screen (See Figure XI). (For further information on detector responses, refer to the manual section on SPL Measurements.)

PF3
(The dB per Division, and Filter Decay Functions)

Like **PF1** and **PF2**, **PF3** performs a dual function. Pushing just **PF3** will allow you to select 1, 2, or 3dB per division on the PC40 display screen. A screen resolution of 1dB per step (.25 dB per pixel) provides a 16dB display range. 2dB per step (.5 dB per pixel) gives a 32dB display range, and 3dB per step (1dB per pixel) yields a 64dB dynamic display range.

The **Shift/PF3** function is labeled "DECAY." Pressing **Shift/PF3** will allow you to select a filter decay time of "Fast," "Medium" or "Slow." At the top, right hand side, next to the display screen, you will find the words "fast," "medium," and "slow" represented (See Figure XI). The PC-40 will display a small, darkened square beside the filter decay time selected. "Fast" is intended for monitoring signals or program material and will respond to relatively short spikes of information. "Slow," on the other hand, is intended for pink noise use only. Its averaging time is sufficiently long to hold pink noise flutter of the low frequency filters to an acceptable minimum (about plus or minus 1dB).

PF4 and PF5
(Memory Functions and the Display and Relative Functions)

PF4 and **PF5** access the 20 memories of the PC-40. To store a screen of information in one of the memories, simply press **PF4.** The screen will freeze with current data, and await your selection of one of the 20 memories for storage. The Message Window of the PC-40 (See Figure XI) will indicate that you have entered the storage mode. If you wish to store the data in memory #1, for example, press **PF4** (**STORE**) and then press the number **1** on the QWERTY keyboard. If there is already something in memory #1, it will be replaced by what you have just entered. Data stays in a given memory until it is replaced by something else, or until you clear that memory.

After you have pressed **STORE, 1**, the PC-40 screen will appear to do a carriage return, and a date and time code along with a cursor will appear at the bottom of the screen. You may now type in from the keyboard up to one full line (40 characters) of annotation to document the screen you are storing. This note will be stored with the screen data and will be printed out in full if you choose to print the information in memory. In addition to storing the screen and your note, the PC-40 also enters the date and time that the data was stored (Of course, for the proper date and time to be stored, the PC-40 will have to have been properly set. It leaves the factory initialized for the Mountain Time Zone, but may have to be corrected for your area. (Information on setting the time/date code in the PC-40 can be found later in this section of the manual under the heading, "The Other 4 Function Buttons," and the subheading "Utilities." The specific "Utilities" function relating to this is called "Time.") Again, if you print the memory, the screen, the note, and the date and time it was stored will be printed. As you can see, the possibilities for complete documentation are provided. Figure XV below demonstrates the things we have discussed.

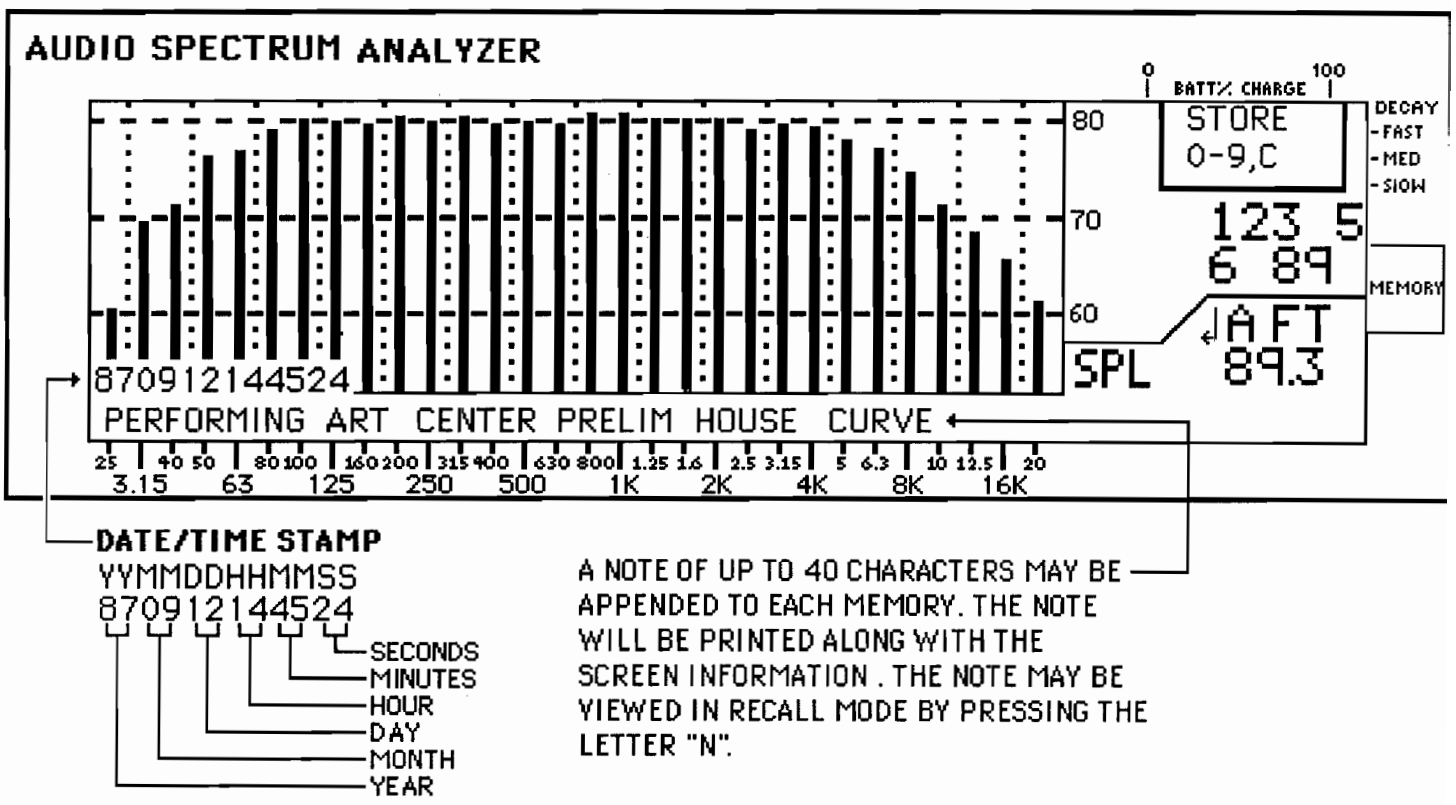


Figure XV

Whenever a memory is occupied by data, that memory number will appear in the memory section located on the right hand, center of the PC-40 display screen (See Figure XI, and Figure XV above). The first ten memories are indicated by standard video (black lettering on a white background) and the second ten memories are indicated by inverse video (white lettering on a black background).

To clear a memory, store something over the top of it, or press **STORE**, then **C**. The word "Clear" will appear in the Message Window. Next press the number of the memory you wish to clear. That memory will be cleared, and the PC-40 will return to real-time operation.

To recall a memory, simply press **PF5** (**RECALL**) and then the number of the memory you want to recall. Only those memories with data stored in them may be recalled. Notice that when recalling a memory, the "Note" does not automatically appear. To get the note to appear on screen, press the keyboard letter **N**, and the note will appear at the bottom of the screen. Pressing **RETURN** will then get you back into real-time.

Some important points to remember are:

1: The "Note" in a memory may be viewed and/or changed at any time by pressing the letter **N** (for "Note") while viewing the desired memory.

2: A recalled memory is recalled completely, and that data in the memory is subject to software manipulation. For example, if we recall a memory, we can change the Reference Level, or the dB per step, and the display will accurately reflect the changes we have made. However, when we return a recalled memory back into memory, it will return in the same format it had before we recalled and manipulated it.

3: As was mentioned earlier, the 20 memories of the PC-40 are divided into two banks of 10 each. The first 10 are indicated on the display screen by standard video, and the second 10 are indicated by inverse video. You can toggle back and forth between the two banks of memories by hitting the letter **M** for "memory" while in either the "Store" or the "Recall" mode. For example, if you want to store a memory in one of the second ten memories (inverse video), and you have pressed the **STORE** button and the first ten memories (standard video) are being displayed in the memory box, press **M**, on the keyboard. This will cause the second ten memories to be displayed. Pressing **M** again, will cause the first ten memories to be displayed once more.

This same thing is true when selecting **RECALL**. Pressing **M** will cause the PC-40 to toggle between displaying the first ten and the second ten memories. Memories can be quickly recalled and displayed one after another by simply pressing their numbers when in the Recall Mode.

4: It is first necessary to press either **STORE** or **RECALL** **before** pressing **M** to get the PC-40 to toggle between displaying the two banks of memories.

*****Important Feature---Displaying More Than One Memory*****

More than one memory may be displayed at a time by the PC-40. To display two memories at once, press **RECALL**, then the letter **C**. The keyboard **C** stands for "Composite." Now let's look at Figure XVI below and the Message Window:

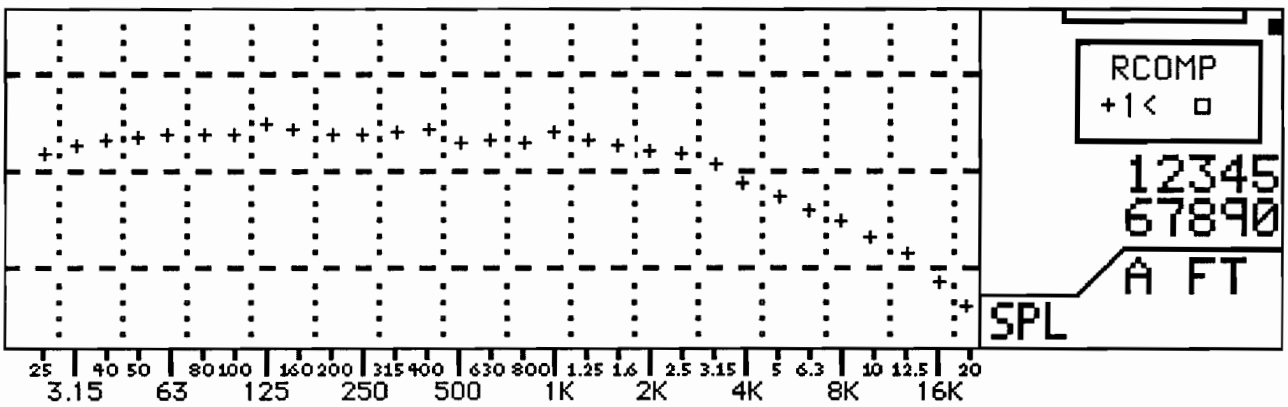


Figure XVI

Notice that the Message Window says RCOMP for "Recall Composite." Below that notation in the Message Window a cursor arrow (<) and a plus (+) and a box (❑) are located. In this illustration, the cursor arrow is pointing toward the plus sign, and the number "1" has been printed. This means that the operator has pressed the following keys: **RECALL**, **C**, **1**; for recall composite, display memory #1. Memory #1 has been displayed as plus signs because the cursor arrow is pointing at the plus sign. If we now wanted to display memory #2 as boxes to discriminate it from memory #1, we would point the cursor arrow toward the box sign by pressing the PC-40 keyboard arrow which points right to select boxes, and then press **2** to display memory 2. The number "2" would appear in the message window next to the box symbol, and memory #2 would

be displayed.

Note: If we had made an error in selecting memory #2, and really wanted to display memory #3, we could just push **3** and memory #2 would be replaced by memory #3 on the display screen.

More that two memories can be displayed also, but in this mode, all memories are displayed as dashes. This mode is usually used to display a frequency response window, since one memory display cannot easily be distinguished from another. To display more than two memories in this mode, push **RECALL**, **C**. Next hit **Ctrl**, and while holding the Control button down, press the numbers of all the memories you want to display. Each one will be displayed as dashes ---. More information on displaying multiple memories and subtracting one memory from another is contained in the section of this manual entitled "PC-40 Memory Functions."

PF4 also has a shift function called "DISPLAY." The PC-40 provides four possible screen displays. These include octave, 1/3 octave, octave weighted, and 1/3 octave weighted. Whether the PC-40 is in the octave mode (10 bars on the display screen) or 1/3 octave (thirty bars on the display screen) is immediately obvious from looking at the display. However, either octave or 1/3 octave displays may be weighted. The weighting follows the "A," "C" or "F" weighting of the SPL meter. As previously discussed, an A, C, or F appear in the SPL section of the PC-40 display screen. If an arrow appears next to the A, the C, or the F, the screen is weighted correspondingly (However, F or "Flat" weighted is the same as unweighted). A quick look at Figure XI on page 12 will easily help locate the position of the arrow.

Shift/PF4 (**DISPLAY**), then allows you to toggle between selecting octave, 1/3 octave, weighted octave, and weighted 1/3 octave. To select the type of weighting, **Shift/PF1** is used.

PF5 has a **Shift** function which is called "RELATIVE." This is an especially nice function to use when doing seat-to-seat variation in SPL readings in an auditorium. To activate this function, press **Shift/PF5**. When this is done, the PC-40 locks into memory the SPL reading that was occurring the moment the "RELATIVE" function was activated. From that point forward, until "RELATIVE" is deactivated by pressing **Shift/PF5** again, the message window will display the word "REL" and the SPL either above or below the SPL that was locked into

memory. The SPL display will continue to display standard SPL, as shown below:

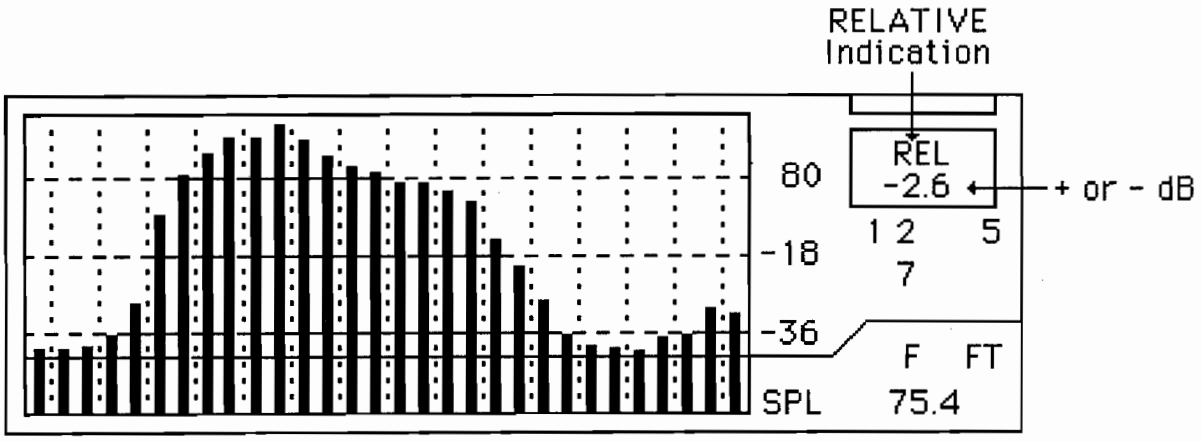


Figure XVII

The RELATIVE function also works when viewing the amplitude of a single channel (see pages 13 through 15 in this manual). When in RELATIVE, you can press the letter **F** (or when viewing individual filter amplitude, you may press **Shift/PF5** for RELATIVE) and the Message Window will display the channel frequency and relative amplitude, instead of relative SPL, as shown in the illustration below:

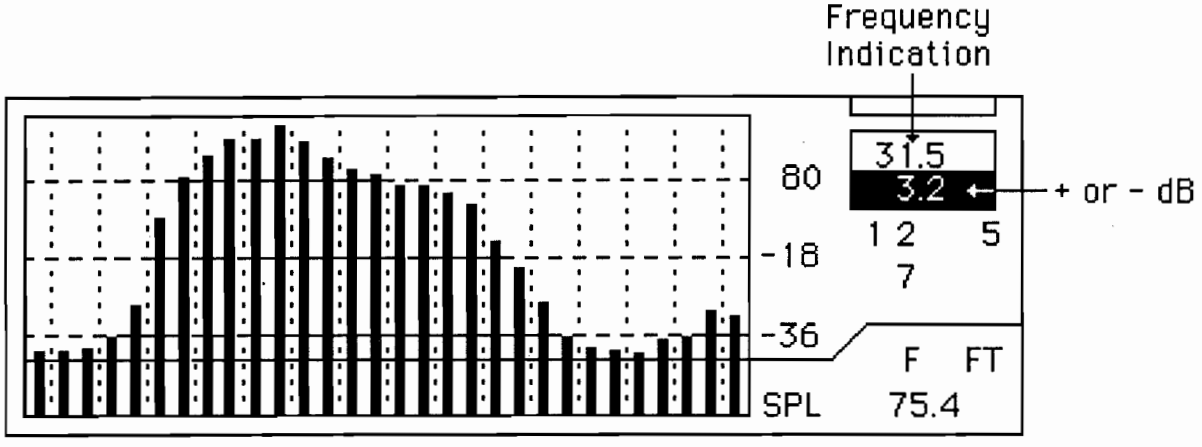


Figure XVIII

Notice that plus or minus dB is now shown in inverse video so that you know you are looking at a single channel, and not broadband SPL.

In our auditorium example, if we didn't want the seat to seat SPL variation at

4kHz to be greater than plus or minus 3dB, we could feed pink noise into the system at some fixed level, select the 4kHz channel for amplitude viewing, then activate the RELATIVE function and walk the auditorium while monitoring the PC-40 Message Window to make sure the relative reading at 4kHz was not swinging more than plus or minus 3dB.

*****Important Function - The "Screen Dump" Print*****

In addition to the above functions, **PF5** also performs a "screen dump" printing function. After we have selected our printer or port option (for more information on selecting a printer, or port option, see the section of this manual entitled "Printing Options"), we simply hold down the **Ctrl** key and hit **PF5** for a "screen dump" printout. When we do this, whatever is currently displayed on the PC-40 screen will be printed. If we recall a memory and print it, the note we have attached will be printed also, as well as the date/time code indicating when the data was put into memory. These memories are nonvolatile and can be saved as long as needed.

*****Important Note***** If you try to activate the "Screen Dump" routine and no printer is connected to the PC-40, or the printer port assignment is incorrect, the computer will "lock up." If this happens, press **Ctrl** and **QUIT** simultaneously to stop the print function, and then check printer connections and port assignments.

The Other 4 Function Buttons

There are four more function buttons on the PC-40. In order, from left to right, they are labeled **QUIT**, **UTILITIES**, **AVERAGE**, and **HELP**. The last three are also labeled ESC (Escape), PAUSE, and SYSTEM. These last labels do not apply to the analyzer operation, but do apply to the computer when using BASIC or the CPM operating system (Refer to page 2-22 of the HX-40 operating manual). ESC, PAUSE, and SYSTEM will not be covered in this manual, but are covered in the computer operation manual.

HELP

We are going to discuss the **HELP** button first, because it applies to all the functions we have previously described, as well as those to follow. The **HELP**

button accesses a context sensitive help screen. Here is the way it works: The PC-40 always knows what function it is performing, and what it is doing within that function. In most instances, when you want to know where you are within a function, or what options are available from there, the "Help" function can do just that - help you. Pressing **HELP** will cause information to appear on the display screen to help you understand where you are and where you may go from there. The best way to describe it is a built-in mini-reference manual. The **HELP** button is your friend and you will want to use it often. As with most other functions, you push **HELP** to get in and you push **HELP** again to get out of the function. In the event you fail to press **HELP** again to get out of this function, the "help" screen will go away on its own after 45 seconds.

QUIT

The red **QUIT** button has a simple function. In most analyzer modes, pressing **QUIT** will drop the analyzer software out of working memory and return you to the menu in the CP/M operating system. From this menu, you may choose what function you desire to perform (BASIC, or back to the PC-40 ROM). There are a few functions, such as "Store" and "Recall," that will not allow you to "Quit" until they have been completed.

UTILITIES

"UTILITIES" allows us to address a number of important and useful functions. (We will introduce them here, but not go into them in detail. The section of this manual entitled "Utilities Functions" goes into great depth, and should be read carefully.) To get into this function, press the **UTILITIES** key. (To get out, press the **UTILITIES** key again. The PC-40 is designed this way on all major functions. To get out of any function, push the same button that got you in.) After you press **UTILITIES**, a menu will appear on the PC-40 display screen. There are ten items on this menu which can be accessed by pressing **PF1** through **PF5**, or **Shift/PF1** through **Shift/PF5**. In essence, the function keys are reassigned to perform utility functions, when in the "Utilities" mode.

Let's quickly examine these items one at a time. The first menu item is "Save." (Unless you have the RT_{60} software, in which case it will be listed first.) To access "Save," press **PF1**. This function allow you to save data to a microcassette, a disk drive, etc., and allows you to select the data you wish to save. To get out, press **PF1** again (unless the menu requests another key to

perform an exit command. This is generally true for getting out of all the "UTILITIES" menus, that is, push the same key to get out that got you in, unless the menu states otherwise.).

The second menu item is called "Time," and allows you to initialize with date and time information. Push **Shift/PF2** to get into this function. The menu here is quite self-explanatory.

The third menu item, "Load," and allows you to load data into the PC-40 from some selected external source, such as a disk.

The next menu item is called "Printr," for Printer, and allows you to select the printer port you wish to use for printing. If the optional cartridge printer (the H409A) for the PC-40 is used, three size printing formats are available, and this utility function allows you to select which size format you desire.

"Offset" is the next utility function and in this mode you may enter a desired curve into the PC-40. After a curve has been entered, and the "Offset" function is active, the displayed information on the PC-40 screen will be relative to the entered offset curve. For example, if we enter a desired house curve as our offset, and then equalize a sound system such that we have a flat display on the PC-40, we will have equalized to our offset curve. (In this case our desired house curve.) Whenever the "Offset" function is activated, the word "Off" will appear to the left of the Message Window on the PC-40 display screen (See Figure XI).

The next utility function is called "Rate," but before we talk about it, we are going to discuss the function before it called "Record," so it will make better sense. The PC-40 has the ability to store successive screens of information into buffer memory. It can store them at a rate of from 1 screen per second up to 100 screens per second (100 is displayed as "00"in the "Rate" menu.) If you want to record into buffer, and you want to select a different record rate, the "Rate" function allows you to do this using the cursor keys (arrow keys) on the PC-40. The "Rate" menu explains how to do it.

*****Important Note - - - "Rate" Affects "Real Time" Data *****
Setting the "Rate" will also affect the real time display of the PC-40. If, for example, you set the sample rate to 1 screen per second and then return to "real time," you will see the filter display of the PC-40 update once each second.

The SPL display upgrades once for every 10 filter display updates, so you would see it display only once each 10 seconds. Being able to slow down the display is a real advantage for some applications. In real time, the PC-40 is capable of displaying up to about 18 or 20 samples per second. If you set the "Rate slower than this, it will slow the display down. If you set the "Rate" higher than this, the PC-40 will still display only as fast as it can - about 18 to 20 samples per second. The SPL meter in the PC-40 can handle a rate of up to 75 samples per second before it tops out. If you set a "Rate" less than 75 samples per second, the SPL meter will be slowed accordingly. For "Rates" above 75 screens per second, the SPL meter simply does what it can - about 75. (If you are using the SPL meter to capture short duration phenomenon, the sample rate should be set for 30 or higher so that no data will be colored because the display is slowed.)

You may ask why we allow the setting of a sample rate that exceeds the analyzer's ability to display the information, and that is a good question. The answer is that while we may not be able to view the samples in real time, we can still write them into memory at these high rates, and then recall them to view. Let's explore that a little further. The illustration below shows the "Rate" menu.

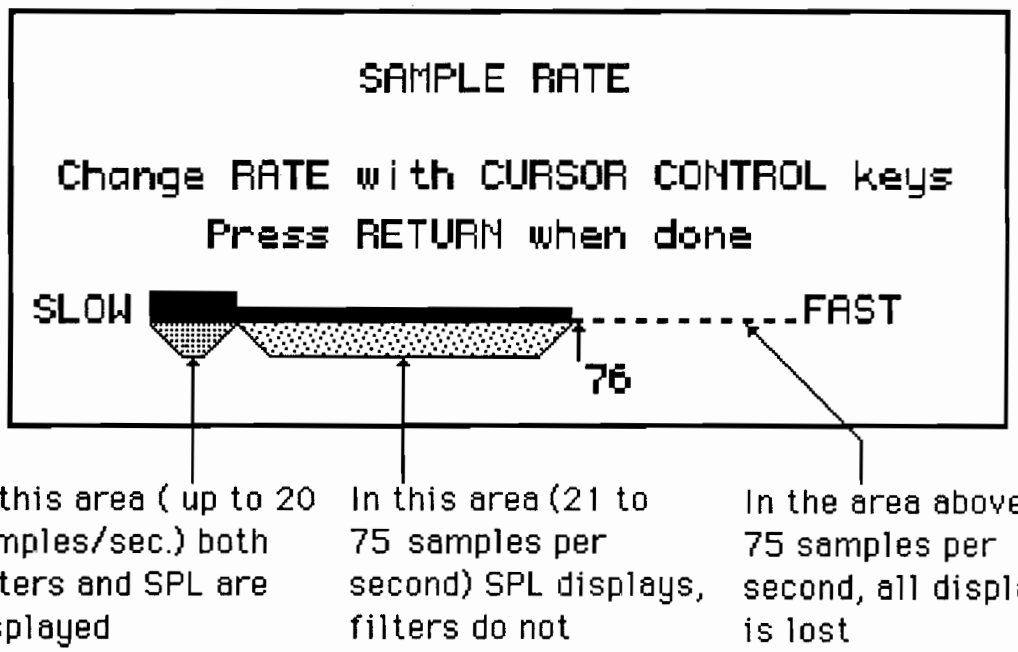


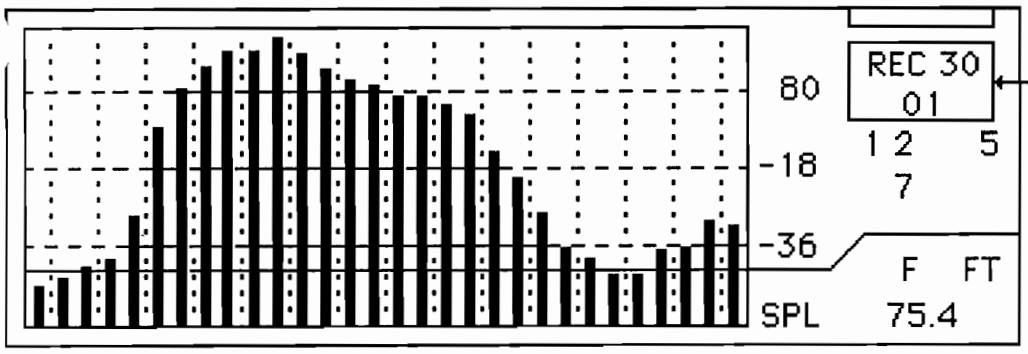
Figure XIX

The bar in the above menu represents the number of samples per second you select. You change the "Rate" by using the left and right cursor arrows on the PC-40 keyboard. The small arrow below the bar with the number by it always tells you how many samples per second have selected. In the example on the preceding page, we have selected 76 samples per second.

The bar is divided into three sections which represent the display capability of the PC-40. If we are in the "Record" function, and have selected a speed of 20 or less samples per second to be written into buffer memory, all the sample screens will be displayed as they are recorded. If we select a speed above 20 screens per second, but less than 75, the filter screen will not display the samples as they are taken (the screen goes blank while recording), but the SPL meter will continue to display samples as they are taken. If we exceed 75 samples per second, both the screen and the SPL display will go blank as samples are written into memory because neither display is fast enough to keep up with the sample recording rate. Those screens are in memory, however, and we can recall and display them.

We have talked about getting into the "Record" function, but that needs further discussion. Getting into and out of the "Record" function is different than the other functions of the PC-40. When you want to get into the "Record" function, first press the **UTILITIES** key. Next, select the "Rate" function by pressing **Shift/PF4**, and, using the cursor keys, select the number of screens per second you want to dump into memory. The menu will request you to hit **Return** to get out of the "Rate" function and back into the "Utilities" menu.

When viewing the "Utilities" menu, you may activate the "Record" function by pressing **PF4** (If you have already been in the "Record " function and there is data in the buffer, the screen will prompt you indicating that data will be lost if you continue. You can choose to continue and overwrite the data, or choose not to continue). When you activate the "Record" function, the PC-40 will revert back to a real time display screen. The Message Window will indicate that you are in the "Record" function, and the number of screens per second you have selected will be printed in the Message Window as well. Note the illustration on the next page:



The PC-40 is in the Record Mode, set for 30 samples/sec. The 01 indicates sample #1, which will be taken when the "A" key is pressed.

Figure XX

The system is now armed and ready to begin recording. Recording is started and stopped by pressing the **A** key (the same as for starting and stopping the AVERAGE function). When you press the **A** key, recording will begin and will continue until you hit theA key again, or until internal memory is filled (up to 472 screens, which is expandable to 8150 screens by adding extra memory as a factory option). The bottom number in the Message Window indicates the number of samples taken, or identifies a particular sample screen by number. Also, in the playback mode, the sample number will identify time displacement. In our illustration above, for example, we are set for 30 screens per second. If we were looking at the samples we had taken under this setup, sample #60 would be displaced in time exactly two seconds after we began our sample process. This leads to some interesting possibilities for time domain measurements.

To get out of the "Record" function, you must press **UTILITIES** to bring up the "Utilities" menu, then press **PF4** (the "Record" function) to toggle out. Following this procedure will allow you to toggle in and out of the "Record" function. When you exit the "Record" function, the PC-40 will prompt you and give you an opportunity to add a note the record buffer file. Adding a note to the file is optional, but it is helpful when you are trying to identify the data at some later time. To add a note, type the information you choose and press **Return**. If you do not wish to add notation, simply press **Return.**

The "Playbk" (Playback) function allows you to play back the screens of information you have stored in the "Record" function. When in "Playbk," the cursor keys of the PC-40 will allow you to step forward or backward through the screens of data, either one at a time by tapping the cursor keys, or a rapid scroll by hold a cursor key down. You may also step through the samples in multiples of 10 by holding down the **Shift** key while pressing the arrow keys. If you try to

enter the "Playbk" mode when nothing has been recorded into buffer memory, the menu prompt will let you know you have made an error.

The final "Utilities" function is called "Mic/Prb" (Microphone/Probe). This function simply allows you to select the microphone for acoustical measurements, or the probe as the input source to the analyzer for making electrical measurements. If the probe is used, AC volts can be measured, or dBm or dB volts. When making dBm or dB volts measurements, the resolution is .1dB.

AVERAGE

"AVERAGE" is the last function we will discuss, and it is a somewhat specialized, but very useful function. Basically, it allows you to average a number of screens of information together and display that average, enter it into a memory, or print it. Screens of information can be added to the accumulator for averaging one at a time, or in groups. This is how it works. To enter the "Averaging" mode, press **AVERAGE.** The PC-40 Message Window will indicate that the "Averaging" function has been activated, and the letters "R," "S," and "M" will appear in the window as well. (If you press **HELP** at this point, the menu will provide the same explanation we are about to undertake.) Pressing **R** will reset the accumulators to zero and will ready the PC-40 to begin a new measurement. If you wish to take screen "snapshots" one at a time, push **S** for "Single Samples." You may now take a "snapshot" by pressing the **A** (for "Average) key which will freeze a screen of information. You can then choose to enter this "snapshot" into the accumulators for averaging, or not enter it if you don't like it for some reason. To enter it into the accumulators, hit **Return** and it will be entered. If you don't want to enter the screen for averaging, hit any other key. This will erase the screen, and return the PC-40 to a real time display. When you are ready to take another "snapshot," press the **A** key again. This will freeze the screen as before. If you enter this screen into the accumulator, the number 01 will appear in the Message Window to let you know you have one screen entered. You can continue to enter single screens in this manner to average as many as you wish (up to 9999 samples). You may view the average of the screens you have taken at any time by pushing **V** for "View." Push **V** again to get back to the "Averaging" mode.

If you want to take continuous samples at a rate of about 8 to 10 screens per second , enter the "Average" function by pressing **AVERAGE** and then **M** for

"multiple." (If you are already in the "Average" mode taking single frames of information, you will still need to push **AVERAGE** and then **M** to change to the multiple frames mode of the "Average" function. Furthermore, if frames of information are in the accumulators, they will still be there until you press **R** to reset the system and clear the accumulators.) If you want your new data to be averaged with data already in the accumulators, it will not be necessary to clear them before you begin new measurements. The new data will be automatically averaged with the existing data in the accumulators.

The sample rate of 8 to 10 screens per second is a maximum; fewer samples per second may be selected by using the "Rate" function, but if you select a higher sample rate than 8 to 10, the "Average" function will still take only 8 to 10 samples per second.

In the multiple frame mode of the "Average" function, sample taking starts and stops with the press of the **A** key. In this mode, when samples are not being taken, the display of the PC-40 is a real time display. When samples are being taken, what is being displayed is the average which is constantly being updated as new screens are added. Again, the display is not real time, but is a displayed average of data taken. This means, for example, that if you fed pink noise into the PC-40, and began to take samples in the multiple screen mode of the "Averaging" function, the display would move around quite a bit as you began because of the random nature of pink noise. However, with continuous samples being taken and averaged, the screen would settle down in time to where it didn't move at all since pink noise, averaged over a sufficiently long time, is very flat.

Of course, if you want to view accumulated average without having to take more samples at the same time, you can stop taking samples (which returns the PC-40 display to a real time display) and press **V** to view your average. As you can see, "Average" provides some very interesting possibilities. In doing STC, or NIC measurements, for example, average readings are required. In entirely different applications, such as equalization, using both a microphone multiplexer and the PC-40 averaging capability would give you results that are both time and spacially averaged.

We have now completed a cursory examination of many of the PC-40 functions. We can now move on to a more in depth look at the PC-40 Utility Functions.

Using the PC-40

The Utilities Functions in Depth

The purpose of this section of the PC-40 manual is to explore more of the power and capabilities of the functions found in the Utilities Menu. Some of the functions such as "Rate," or "Time" need no further explanation. However, some of the functions, "Offset," for example, deserve substantial discussion. In this section of the manual, we will cover only those items in the Utilities Menu which deserve further treatment.

Save and Load

The first Utilities Menu item, "Save," which allows you to save data to some external storage device - such as a disk, operates very much like the storage function on any other computer. You may choose what items or blocks of information you wish to save - a single memory, a block of 20 memories, or an entire block of information from the record buffer. Data in the record buffer is stored in the form of complete screens of information, and is accumulated into buffer by use of the "Record" function. When selecting a single memory for saving, the first 10 memories are selected by using keyboard keys 0-9 (0 being memory 10), and memories 11 through 20 are selected by using the shift key in conjunction with keys 0-9 (Shift 0 being memory 20). All data is stored as data files. These files may be saved to various storage devices called drives. The computer utilities CP/M operating system and all files occur under CP/M.

After selecting the information you desire to save, you must select a location to have it saved. It may be saved to Ram disk (Drive A), or floppy disk (recognized by the system software as drive D, E, F, or G), or to a microcassette cartridge (recognized by the system software as drive H). Complete instructions for saving to the optional cassette drive are in the Epson manual which you should have received with your PC-40. In the event you purchase an optional external disk drive, a complete manual from Ivie will be shipped with it, including a utilities disk. Between the Epson manual and the Ivie manual, you should have all the information needed to both read and write to external disks.

After selecting the material to be saved, and the drive to be used, you must name your file. The file name is specified by a field of up to 8 alphanumeric characters. The appropriate file name extension will be appended to the file by

the computer. Only letters and numbers, not spaces, should be used for file names. File name extensions used by the computer are: MEM for a single memory, MBK for a block of 20 memories, and REC for the record buffer. The PC-40 will prompt you through all of the above operations. Once you enter the file name to be saved, pressing the **Return** key will initiate the saving process. The exception to this occurs when you give you file a name that has already been used. When this happens, the PC-40 will prompt to ask whether you want to overwrite the file you have already saved. Pressing **Y** for "Yes" begins the overwrite process, and pressing **N** for "No" aborts the saving process.

Once you have saved some data, the PC-40 will return to the beginning "Save" prompt - it assumes you will want to save something else while in the "Save" mode. If you want to save something else, follow the same steps as above, but if you are through, hit the **UTILITIES** key to exit the "Save" mode.

The "Load" function works very much like the "Save" function. After selecting the "Load" function from the Utilities menu, the PC-40 will prompt you, and you must choose the drive from which you desire to load data. You must next choose where you want the data loaded - into the record buffer, or into one or more of the PC-40 twenty memory locations, for example. Again, the PC-40 will prompt and require an answer. As in the "Save" function, selection of single memories 11 through 20 are accomplished by using the shift key in conjunction with the number keys. To Erase Files when A drive is full go to CPM ERA A: Name.Ext Return

MBK
MEM

Printer and Printing

Selecting "Printer" from the Utilities Menu allows us to select a printer port, or the optional cartridge printer. The cartridge printer prints in three size formats, and we therefore must select the size to be printed.

Cables are available for external printers. External printers print the same size as the optional cartridge printer in the Large Printout format, but print faster.

If you select a port to which a printer is not attached, and then give the PC-40 a print command, it will go off into Never-Never Land looking for the nonexistent printer. To bring it out of this "lock up," you will have to hold down the **Ctrl** key and hit the red **Quit** button. You may even have to take a pointed object (pen or pencil) and press the recessed reset button on the right side of the computer. This action may or may not cost you the screen you wanted to print, so treat your

PC-40 with kindly printing commands, and it will respond with affection.

If you want to abort printing that is in progress, holding down the **Ctrl** key and hitting the red **Quit** button will accomplish this.

Offset

Offset is a very powerful and flexible function. It may appear to be confusing at first glance, but it is really very easy to use. Conceptually, we can look at "Offset" as an internal memory location to which real-time data is compared and then displayed. Earlier in the manual, we used the example of a preferred house curve being stored in the "Offset" memory. We would equalize the PC-40 display "flat" - visually easy to do - and once done would have equalized to our preferred house curve. The Offset mode works in 1,2,or 3dB per step resolution.

To perform an "Offset" function, we need three things: First a way to get into and out of the "Offset" mode, second a way to create the curves or data that we want to put into the "Offset" memory location, and last a way to get that data into the "Offset" memory.

Let's take them one at a time. Firstly, you don't need to use the Utilities Menu at all to put the PC-40 into the Offset mode, or to get it out. All you need is the **O** key on the keyboard. Hitting **O** (for "Offset") will toggle the PC-40 into or out of the Offset mode. It is easy to tell if you are in the Offset mode, because the letters OFF will appear on the Offset mode. Notice the illustration below:

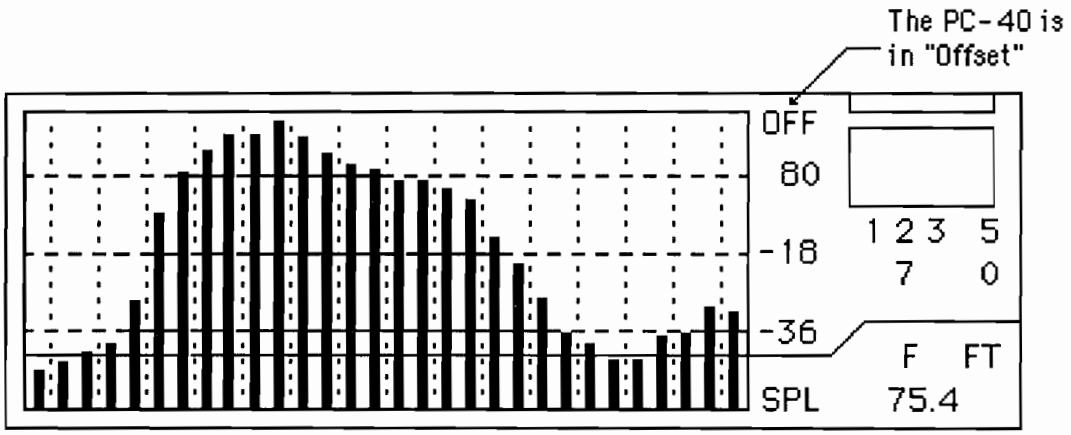


Figure XXI

When the PC-40 is in the Offset mode, it is comparing real-time data to the data in its Offset memory and displaying the difference, between the Offset memory and real-time - that's why it is called the Offset mode. However, there may or may not be any data in the Offset memory. If there is not a curve there to make a comparison to, switching the PC-40 into Offset will not change the display at all. Next, then, let's explore how to create the data your want to put into the Offset memory, and how to get it into the Offset memory.

To create a curve for Offset use, and to get that curve into the Offset memory, we select the function "Offset" from the Utilities Menu. When we have done this, we should get a display that looks like Figure XXII below. If it does not look like this, hold down the **Ctrl** button and press **R**. This will reset the display.

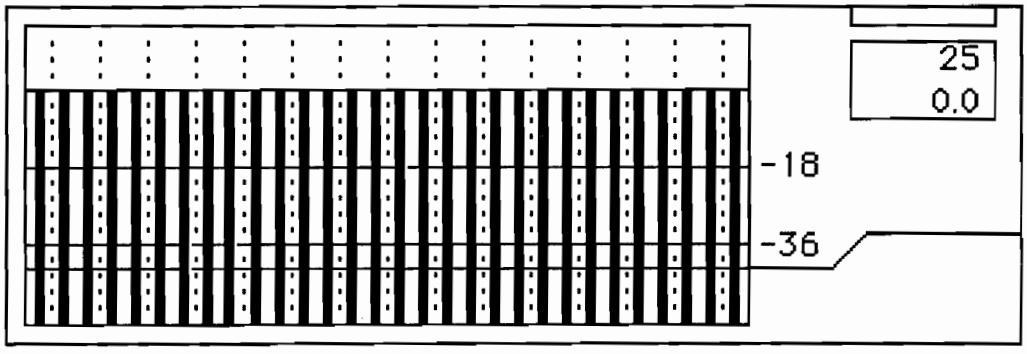


Figure XXII

This curve can be manipulated using the cursor keys of the PC-40. The left and right arrows select a frequency band, and the up and down arrows change amplitude. In our illustration above, the Message Window tells us that we have selected the 25Hz channel, and that the amplitude at this channel is at 0.0dB relative to the reference line - in other words, it is right on the reference line. If we press the down cursor arrow, the 25Hz channel will drop in 1dB increments, and the Message Window will tell us how far below the reference we have dropped (We could go above the reference, too, by using the up cursor arrow). If we want finer resolution, holding down the **Shift** button while using the cursor will move us in .1dB increments.

After we have adjusted the 25Hz channel to our satisfaction, we use the right cursor arrow to move to the next channel, and then we adjust it - and so on, and continuing through all the channels until we have the curve we desire. The

Message window will always tell us what channel we are working on, and how many dB above or below the reference we are.

Let's suppose that we have followed the above procedure, and have created the curve below:

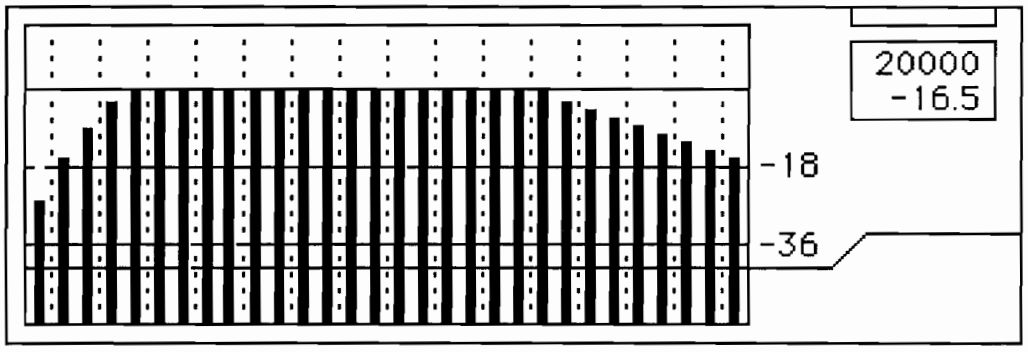


Figure XXIII

We have now created a curve that we may wish to place in the Offset memory, and/or we may wish to store it in one of the 20 memories of the PC-40 for later use, or we may want to entirely discard it because we've decided we don't like it. We can easily do any of these things. Here is how we do it.

To store the curve for future use, simply hit the **STORE** button and store it the way you would any other memory - complete with annotation if you desire. The Reference Level of this stored curve will be the Reference Level the PC-40 showed before you entered the Offset mode. After completing the annotation, hit **Return** to exit the "Store" mode. The curve has now been stored into memory, but not into the Offset memory.

To place the curve into the Offset memory, hit **Return.** When in the Utilities function "Offset," hitting **Return** will place the curve on screen into the Offset memory. If there is already another curve in Offset memory, it will be overwritten.

If you want to both store the curve in memory, and place it into Offset memory, first store it into one of the 20 memories as outlined above. After it is stored, it will still be on screen, and you may then hit the **Return** button to place it into Offset memory as well.

If you want to discard the curve you have created, simply hit the **Utilities**

button. This will place you back into the Utilities menu and your curve will be gone. If you would rather stay in the Offset function and create a new curve, follow this procedure: Instead of hitting the **Utilities** button to exit the program, hold down the **Ctrl** button and hit **R** for "Reset." This will discard your old curve, and initialize your screen as shown in Figure XXII. This is especially useful if you want to create several curves and put them into the PC-40 memories for later use. You simply create a curve, store it in a memory, hit **Ctrl/R** to reset, and create your next curve to be stored.

One thing that should be noted here is that in addition to discarding the curve you may be working on, hitting **Ctrl/R** also clears the Offset memory. If you have had a curve in the Offset memory, and have gone back into the Offset function to create additional curves, and have hit **Ctrl/R** in the process, you no longer have a curve in the Offset memory. You will have to put in back in again, if you desire to use it.

The last thing we need to examine is how to get a curve from one of the PC-40's twenty memories into the Offset memory. It is very simple. First enter the Offset function via the Utilities menu. The "flat" curve shown in Figure XXII will appear. Next, hit **RECALL**, followed by the number of the memory you wish to recall. The memory will appear on screen. Hit **RECALL** again to get out of the Recall mode. The memory curve will still be on screen. You may now hit **Return** to put the curve into Offset memory.

Important Feature

The Offset function can be used to closely examine any curve you may have in memory, not just curves you have created. For example, if we want to take a very close look at a response curve that we have earlier placed in one of the PC-40 memories, we can select the Offset function from the Utilities menu and recall our memory as described above. We hit **RECALL** again to get us out of the Recall mode, and our memory still stays on screen as though we were going to put it into the Offset memory. Instead of putting it into Offset memory, we can use the left and right cursor arrows to scroll through the channels. The Message Window will print the channel selected, and the amplitude in that channel to a resolution of .1dB.

As can be seen, the Offset function presents some very interesting possibilities.

Mic/Probe

The Mic/Probe Utility is a fairly self-explanatory function, but a few items should be noted. It is important, or example, to have the probe selected for making electrical measurements, and the microphone selected for making acoustic measurements. If you try to make acoustic measurements and have selected dBm, dbV, or AC V from the menu, the PC-40 will be looking at the electrical input for signal (the BNC connector on the PC-40), not the microphone input. What you will see displayed in this situation will be cross-talk between the two inputs, and it will look like nothing you are trying to measure. The closest thing it will resemble is white noise. If you are getting strange readings that don't seem to make sense, it's a good idea to check the Mic/Probe Utility to make sure you have the proper input selected.

The second thing you need to be aware of is that the reference level settings are different when using the microphone as opposed to using the probe. The mic reference level ranges from 30dB to 140dB in 10dB increments. This 110dB range represents from 30dB of attenuation to 80dB of gain.

For electrical measurements, the reference level ranges from 50dB to 180dB. The same preamp is used - a range of 30dB of attenuation to 80dB of gain, but a probe pad of either 20dB or 40dB is automatically inserted. The 20dB pad is inserted on the low end; hence we can get down to 50dB instead of 30dB as in acoustic measurements. At the high end, the 40dB pad is inserted so we can get up to 180dB, instead of just 140dB. On previous Ivie instruments, the 20/40dB pad was on the probe itself, and one had to mentally correct measurements. The PC-40 has the pad internally so the reading you see is the reading you have.

The reason for the pad in the first place is to more closely match the measurement capability to the range of signals which are normally measured.

The probe itself has a 1MΩ input impedance and is rated for up to 600VDC (includes peak AC).

Sound Level Testing

Introduction

The decibel (dB) scale has been adopted internationally for use with sound level meter testing. The scale begins at a reference of 0 dB in sound pressure level (0 dB SPL) which corresponds to the smallest sound that can be heard by a healthy human ear, and is equal to $2\mu N/m^2$, or perhaps more commonly, $20\mu Pa$. Following is a chart which shows some various sound pressure levels (SPL's) relative to typical environmental sounds:

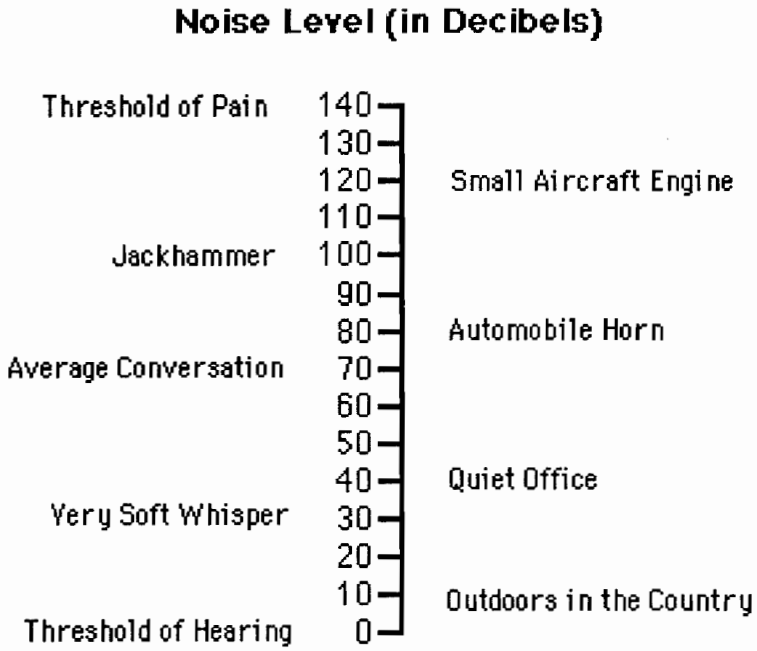


Figure XXIV

When studying sound level measurements, it is of major importance to understand the response characteristics of the human ear. Our ears do not respond equally to all the frequencies of the audio spectrum - in other words, they are not "flat" in their response. To further complicate matters, the response characteristics of human ears change with different SPL's. At relatively quiet

SPL's, our ears attenuate high frequency sounds to some degree, and drastically attenuate low frequency sounds. As SPL's increase, our ears get more efficient at low frequencies and their response to sound becomes more "flat," although they never achieve a totally "flat" response. Following is a set of curves which approximate the hearing response of human ears. The "A" curve shows how ears hear, or perceive sound at low SPL's, while the "C" curve shows how we hear at relatively high SPL's.

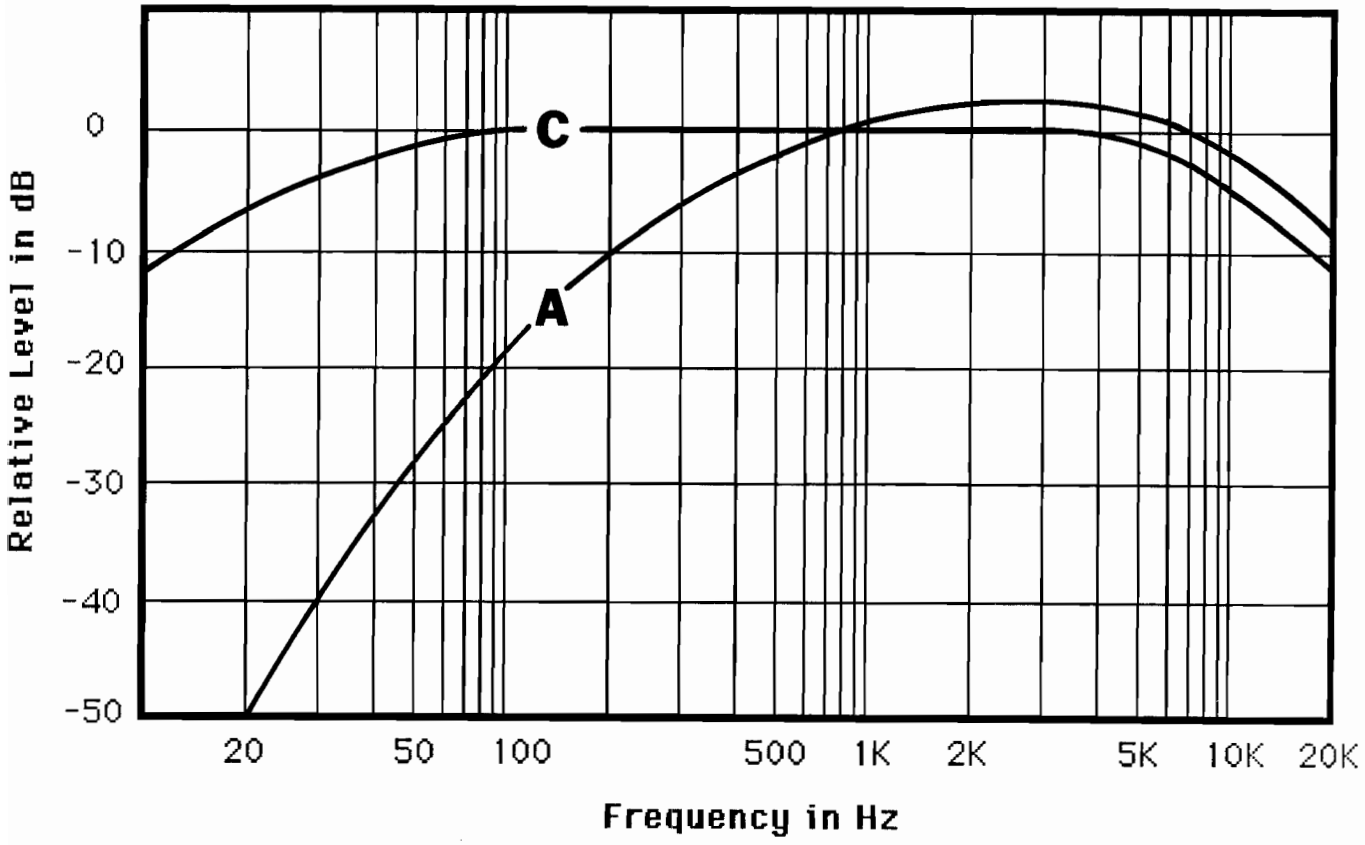


Figure XXV

These curves have been integrated into sound level meters for testing sound levels. "A" weighted (dBA) measurements use the "A" curve above, "C" weighted (dBC) use the "C" curve above, and "Flat" (dB SPL) measurements use no weighting at all.

Noise which causes hearing damage has been found to correlate most closely with the "A" curve. Consequently, OSHA requirements, and many other

government regulations are generally specified in dBA. The Walsh-Healey Public Contracts Act, for example, specifies the following permissible human exposure levels for industrial noise. Notice that all duration levels are specified in dBA.

Permissible Noise Exposures

Hours Duration Per Day	dBA SPL Slow Response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
.5	110
.25	115

Figure XXVI

In addition to being concerned about the weighting we use when we make SPL measurements, we need also to be aware of the measurement environment. Sound environments can range from near-field to free-field to diffuse-field. A free-field environment is one that is free of reflections, and is typical of anechoic chambers (sound absorbing rooms) that have acoustically padded walls, floors, and ceilings.

Diffuse (reverberant) fields are often encountered and are purposely created by reverberation chambers that have been designed to cause as much reflection between ceilings, walls, and floors as possible. A diffuse-field is one in which the sound is uniformly distributed throughout the room. Machine noise tests are more often made in reverberant chambers, as they are less costly to build than anechoic chambers.

Typical sound measurements environments, however, are usually some combination of free-fields and diffuse fields, and great care must be taken with

the measurements to help assure that accurate results are obtained. Errors can occur when determining the noise from a single source if tests are made too close (near-field) to the source being measured (See Figure XXVII below). The near-field SPL can change dramatically with small position changes of the sound level meter. To avoid near-field errors, the sound level meter should be located away from the source by at least a distance equal to one wavelength of the lowest frequency radiated from the source, or more than twice the distance of the largest dimension of the source, whichever distance is greater.

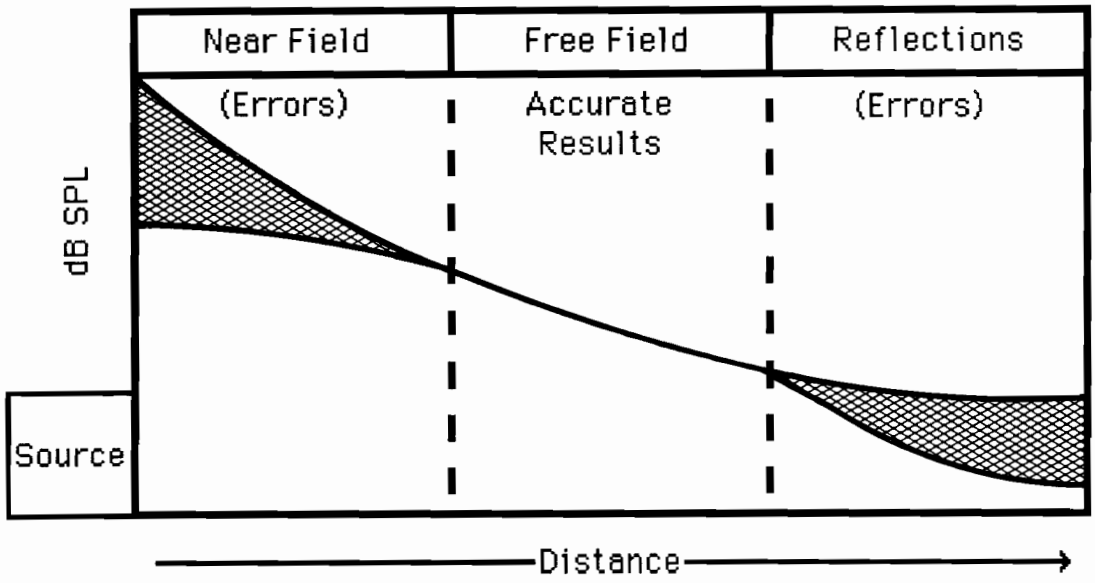
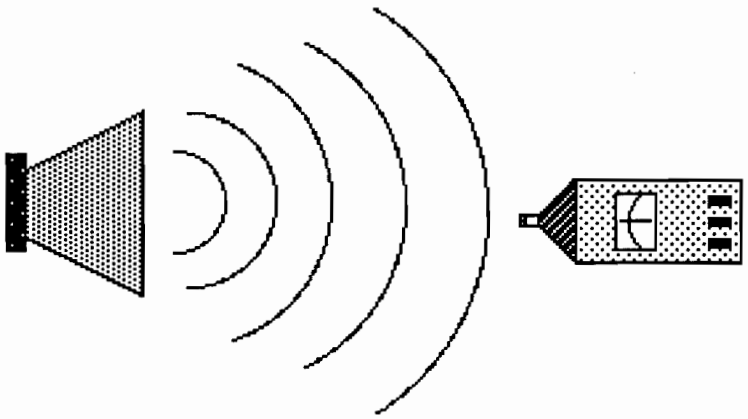


Figure XXVII

As can be seen from the above illustration, errors can occur not only when we are too close to the source, but also when we get too far from the source being measured, room reflections and other room noises may interfere with our readings. The most desirable condition for noise testing would be to perform all tests in a reverberant chamber (diffuse-field) or an anechoic chamber (free-field). Since this is usually not possible, the next best alternative is to find a free-field as close to the object being tested as possible. It is easy to identify a free-field because the inverse square law holds true there. The inverse square law describes the relationship between sound pressure level and distance in a free-field. When the distance from the sound source doubles, the SPL will drop by 6 dB. If the distance is doubled again, the SPL will drop by another 6 dB. If this relationship occurs, the sound waves are traveling unobstructed from the source to you, and by definition, you are standing in a free-field.

Free Field vs. Random Response or Pressure Response Microphones

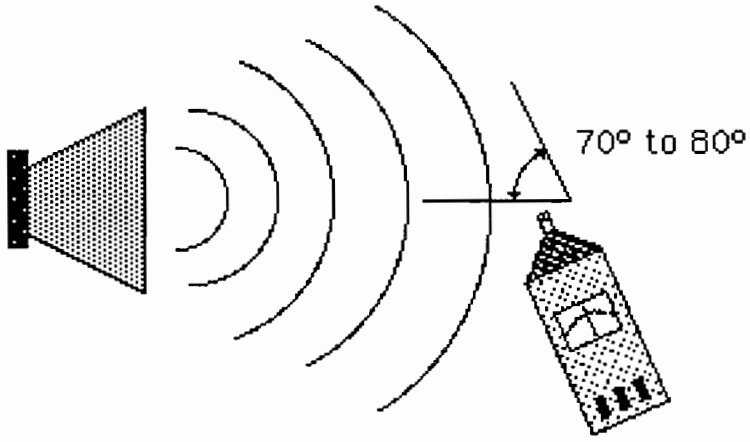
Both free field microphones and random response microphones are used to measure SPL. In Europe and other areas where IEC standards are required, a free field microphone is required. A free field microphone is intended to be used in a free field environment, and should be pointed directly at the sound source as shown below.



Using a Free Field Microphone in a Free Field Environment

Figure XXVIII

In the United States and other areas where ANSI specifications are followed, a random response microphone is normally used on a sound level meter. A random response microphone is intended to be used in a diffuse or reverberant field. However, in free field use, a random response microphone can be used to approximate the response of a free field microphone by positioning the microphone at an angle of 70 to 80 degrees to the sound source, as shown on the following page:



Using a Random Response Microphone in a Free Field Environment

Figure XXIX

Body Effects on Sound Measurements

Something that must be considered when making sound measurements with a hand-held analyzer, is the effect of the operator's body on readings. The operator's body may detract substantially from the accuracy of the measurements. At frequencies near 400 hz, sound reflecting from the body could cause up to 6 dB or error, if measurements are made within three feet of the operator. To minimize this effect, the PC-40 should be positioned as far away from the body as possible. It would also be appropriate to use a microphone extension cable in those instances when it is deemed necessary.

Correcting for Background Noise

Often the need arises to make SPL measurements in the presence of background noise. This can be easily done as long as the SPL of the primary source is at least 3 dB greater than the background noise. Following are the steps for making such a measurement.

1. Measure the total noise. (Background and primary source)

2. Turn off the primary noise source and measure the background noise only. Both tests should be made with the microphone in the same location.

3. Calculate the difference between the two readings measured. If the difference is less than 3 dB, accurate measurements cannot be made. If the difference is greater than 10dB, no correction is necessary. If the difference is between 3 dB and 10 dB, the following chart can be used to make the needed correction.

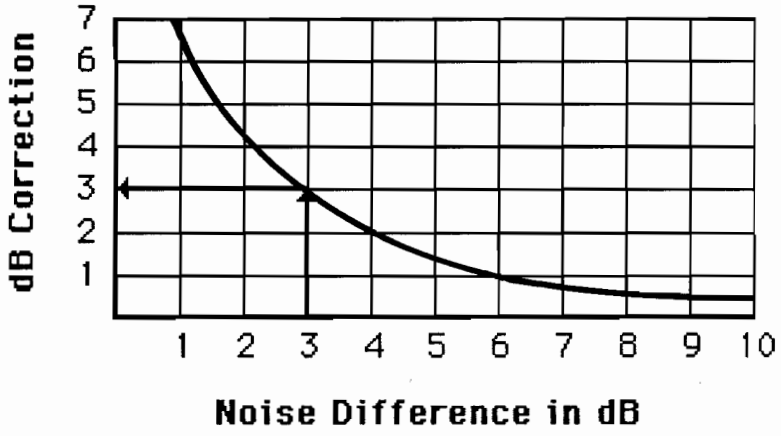


Figure XXX

To use the chart, located the difference of the two measurements on the horizontal axis. From that point, go up to intersect the curve, and then left to the vertical axis. Then subtract the value on the vertical axis from the total noise level first measured.

Example: Total noise = 75 dB. Background noise = 72 dB. Difference = 3 dB. Chart correction = 3 dB. Primary source noise = 75 dB - 3 dB = 72 dB.

There is something very interesting about this example. Notice that the background noise SPL is the same as the source noise SPL, yet when we add those equal noise levels together, the increase is only 3 dB. (72 dB of background noise plus 72 dB of primary source noise equals 75 dB total) 3 dB is only a slight change in the level of "loudness" perceived by the human ear.

This same ratio applies to amplifier power when fed to a speaker. If we double the power (watts) going to a speaker, the change in sound level is only 3 dB, a barely audible change. This gets to be pretty important if we have a huge system using 10,000 watts of power and we decide we want it just a little louder - a mere 3 dB. All we have to do to accomplish this is add another 10,000 watts!

Adding Sound Levels

Since we have just discussed an illustration of adding sound levels together, let's explore the subject further. If two primary sources are measured independently, it is possible to determine what the sound level would be if both sources were operating together. The following chart can be used to determine this, when both tests are made with the PC-40 in the same location.

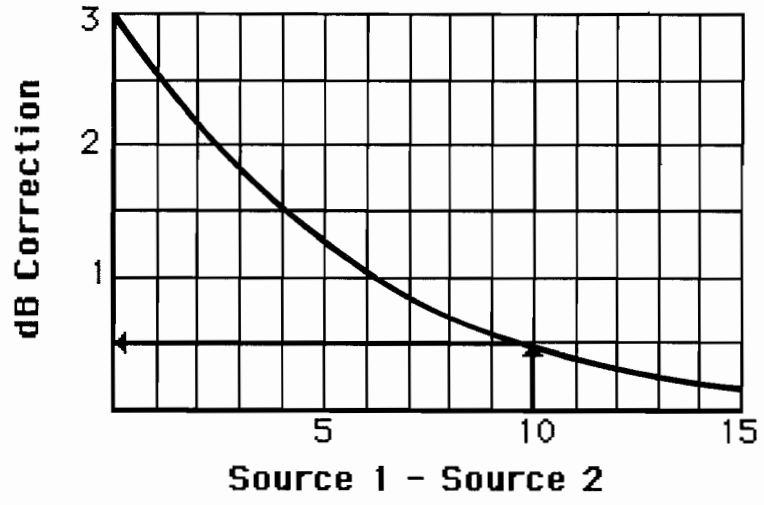


Figure XXXI

To use the chart, first measure the levels of the two sources independently and then find the difference between the two levels. Locate the difference on the bottom of the chart. Go up until the curve is intersected, and then go left to the vertical axis. Then add the correction in dB indicated by the vertical axis to the value of the highest reading made. This number indicates the combined SPL of the two sources.

In the example shown above, Source 1 equals 79 dB, and Source 2 equals 69 dB. The difference is 10 dB. Chart correction is .5 dB, so the total noise is 79.5 dB.

System Calibration for OSHA Measurements

OSHA measurements generally require equipment that meets minimum specification standards - at least an ANSI Type II sound level meter, for example. (The PC-40 is a Type I Sound Level Meter, and therefore exceeds OSHA minimum requirements). In addition to the equipment meeting minimum specification standards, it must also be properly calibrated in order for an acceptable OSHA measurement to be made.

What this normally requires is calibration prior to the measurement, and then a recheck of calibration after the measurement is made. In the case of SPL measurements, a calibration device (either a pistonphone or an acoustic calibrator) must be used. The standard PC-40 microphone is a 1/2 inch, air condenser microphone. It's size and thread specifications are the same as other internationally recognized 1/2 inch microphones. Any quality calibration device will work, if it is used properly. Most calibrators are made to accommodate a 1 inch microphone, and they have an insert to adapt them to 1/2 inch microphones. Use the 1/2 inch adapter and make sure the microphone fits snugly inside the insert.

To calibrate for OSHA measurements, fit the calibrator on to the PC-40 microphone and turn on both the calibrator and the PC-40. Following the directions that come with the calibrator, calibrate the PC-40 to the proper SPL. The PC-40 calibration potentiometer is found in the IE-2P microphone preamplifier. It is recessed inside the IE-2P tube, as shown below, and has to be accessed with a small screw driver.

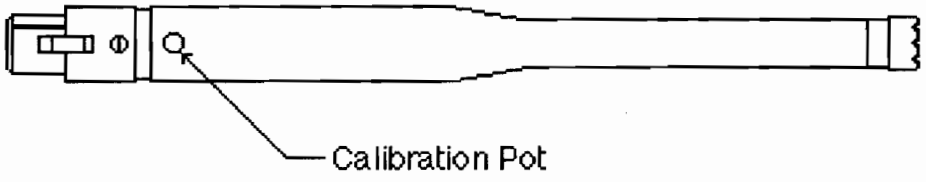


Figure XXXII

Pink Noise Testing with the PC-40

Introduction - Pink Noise Theory

When is pink noise flat? Never!

There are a few fundamentals that should be understood before doing pink noise testing. Pink noise is random noise that appears flat only after being averaged over time by special detectors on a real-time analyzer, or a true rms voltmeter. On an oscilloscope, or a standard voltmeter, pink noise appears to be a mass of random voltage spikes - which is exactly what it is. However, when averaged over time, the noise appears very flat and the output rms voltage is highly stable. When measuring with pink noise and the PC-40, the detectors in the PC-40 should always be in the pink noise averaging mode (slow).

We are often asked, "How flat is your noise generator?" That can be a misleading question, because noise is never flat. As we have said, noise is random in nature, and can be made to "appear" flat only when averaged over a sufficiently long period of time. Noise is a statistical phenomenon, and the averaging time necessary to create a "flat" appearance is mathematically predictable. Far better questions to ask are , "How flat are the filters in your noise generator?" and "What is the averaging time of the detectors in your real-time analyzer?"

To create pink noise, a noise generator first generates white noise. Our white noise generation is accomplished by a statistically accurate, shift register technique. Since white noise is equal energy per frequency, the energy content doubles each time you step up an octave. Such a signal is therefore too "hot" at high frequencies to be used as a sound system test signal. Pink noise, or equal energy per octave, is a much better test signal. To produce pink noise from white noise, we run the white noise through a 3dB per octave roll-off filter. The accuracy, or "flatness" of this filter determines the "flatness" of the pink noise produces. The filters in our noise generators are six pole filters and are very flat, which results in a very flat time-averaged output. The detectors in the PC-40 (the pink noise, or "slow" detectors) are designed to allow a maximum, ±1dB flutter when the analyzer is in the 1dB/step mode. Furthermore, this mild flutter occurs only at the lower frequencies. Since each 1/3 octave bandwidth

contains exactly twice as many discrete frequencies as the adjacent 1/3 bandwidth below it, as we increase in frequency, we increase in statistical stability. This means that as we continue to climb in frequency, we need shorter and shorter averaging times to achieve statistical stability. The PC-40 does, in fact, have shorter averaging times for the detectors at the higher frequency bandwidths. Even with these shorter averaging times, the higher frequency bandwidths are slightly more statistically stable than the lower frequency bandwidths.

You can create statistical instability in your measurement by changing the PC-40 detector response from "slow" to "medium" or even "fast." You will notice increased random movement of the display, especially at the lower frequencies. In the "fast" mode, it is virtually impossible to obtain a reasonable pink noise reading at low frequencies. It can easily be seen that making pink noise "flat" is as much a function of a good spectrum analyzer and its chosen integration time, as it is a function of a good noise generator.

What is Crest Factor?

An important aspect of a noise generator is its crest factor. The output of Ivie noise generators is calibrated in volts rms, and crest factor is the ratio of the peak voltage to the rms voltage. If a noise generator had a crest factor of 2, we could expect instantaneous voltage peaks, or spikes (either positive or negative) to reach an amplitude twice our rms output voltage. In other words, an rms voltage output of 1 volt could see peaks as high as 2 volts.

The purpose of pink noise is to provide a reference signal that approximates program material as closely as possible. If the crest factor is too low, we provide a signal with little dynamic range, which will not give us a very clear picture of how our sound system may perform with program material having normal dynamics. If our crest factor is to high, on the other hand, we will provide a signal with such a broad dynamic range that we could be causing clipping. Experimentation has shown that a crest factor of from 3.5 to 4.0 seems to work best and most closely approximate normal program material dynamics. Ivie noise generators have a crest factor of 3.75.

In conclusion, pink noise approximates actual audio signal better than any other type of signal source. It is also one of the best signal sources available for doing rigorous testing of amplifier durability, and transient signal handling

capabilities. Pink noise is used in conjunction with a real-time analyzer more widely than any other signal source. Some analyzers have pink noise generators built into them. Ivie has chosen to keep its noise generators separate from its analyzers, even though it is more expensive to do so, because experience has shown that the location where we want to inject pink noise into a system is rarely the same location where we want to have our analyzer. Additionally, having the noise generator in the same box with the analyzer generates the temptation to match one to the other, by "tweaking" the analyzer filters to match the pink noise output. Some manufacturers do in fact do this, which makes the analyzer incompatible with another pink noise source. At Ivie, we believe it is better to have both instruments independently flat, and so that is the approach we use. Any Ivie noise generator will work with any Ivie analyzer.

The last thing we wish to say about pink noise is that it **cannot** be used for gating or pulsing techniques. The random nature of pink noise (which is, in fact, its greatest asset) prevents it from being spectrally complete or repeatable in short bursts. Consistent results cannot be produced.

Room Response Testing

Pink noise is often used in conjunction with a real time analyzer for testing room response and for equalizing sound systems. Preferred equalization curve requirements differ according to the intended use of the sound system and its environment, and there are many opinions as to what those curves should look like. It is not the intent of Ivie to recommend one equalization curve or process over another, but to provide equipment with sufficient flexibility to allow the user to make his own choices.

There are, however, some useful techniques that are quite universal in application. These involve such things as system documentation, electrical testing and trouble-shooting, and measurement of acoustical performance. Some of these techniques are explored in the next section of this manual entitled "Electrical Testing and System Documentation Using Pink Noise." Acoustical testing is touched upon as well, but there is much that is left unexplored. There are many aspects of these techniques about which much has been written and argued - whether to use one microphone, or several; whether to do only time averaging, or do spacial averaging as well - this list goes on and on. The reader is encouraged to study and learn as much about all of these approaches as he can, and to make his own determination as to the techniques he prefers. The PC-40 will accommodate them.

Electrical Testing and System Documentation Using Pink Noise

One of the most useful aspects of the PC-40 Audio Spectrum Analyzer and the IE-20B Pink Noise Generator is their ability to be used in tandem to perform a great variety of of useful electrical measurements. These measurements can not only verify system specifications, but, when properly documented, can also save literally hours in trouble shooting.

The first step in making electrical measurements is calibrating the analyzer to the pink noise generator to establish a reference. The following illustration demonstrates this:

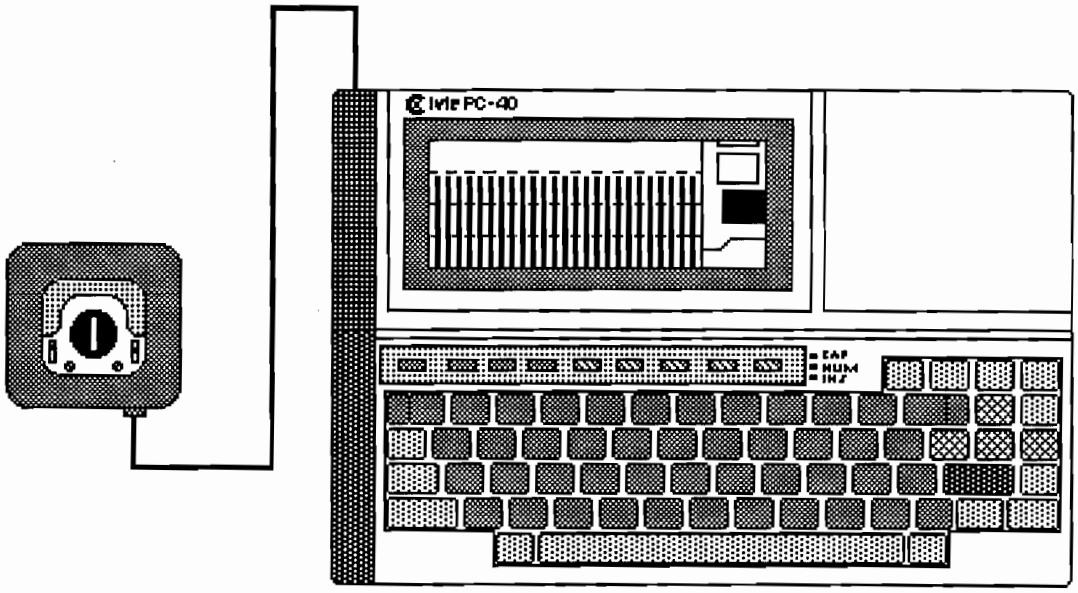


Figure XXXIII

In this example, the pink noise level has been set such that the amplitude of the display reaches a reference line. With the analyzer set to measure dB volts, an exact signal level can be read directly to a resolution of .1dB. We now have a reference spectral content, amplitude within each 1/3 octave band, and the absolute level of the input signal.

If we now insert an audio device into the circuit between the pink noise generator and the analyzer, we can measure all kinds of parameters. Let's take insertion loss as an example. We insert the device to be tested as shown below:

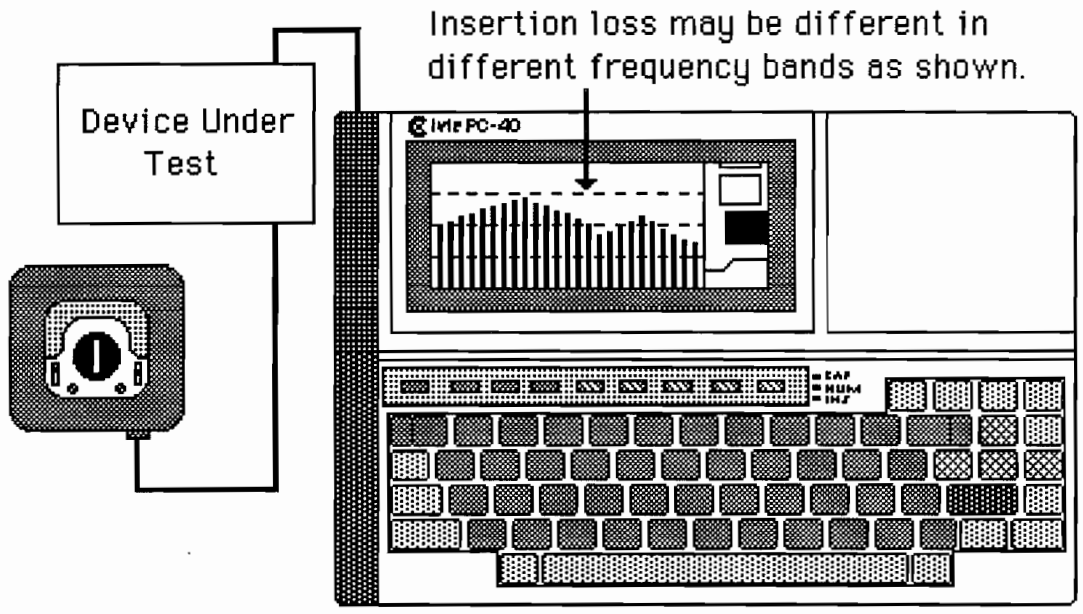


Figure XXXIV

In this measurement we can see the frequency selective nature of insertion loss. We can also measure, in dB, the exact drop in total signal level.

If our device under test were an amplifier, we could measure its 1/3 octave frequency response, and its voltage gain. If the device under test were a crossover, we could measure its gain or loss, see the frequency response of each leg, view the crossover point, and verify the roll-off associated with the band pass filters. We could measure the gain structure and frequency response of a single filter, or a whole bank of filters such as found in an equalizer.

Let's consider another interesting measurement. We can set it up feeding pink noise into the front end of our sound system. Using the PC-40 probe, we can tap into the output of our amplifier (the amplifier should be loaded) and look at the spectral display of information coming from the amplifier. Setup would be as shown on the following page:

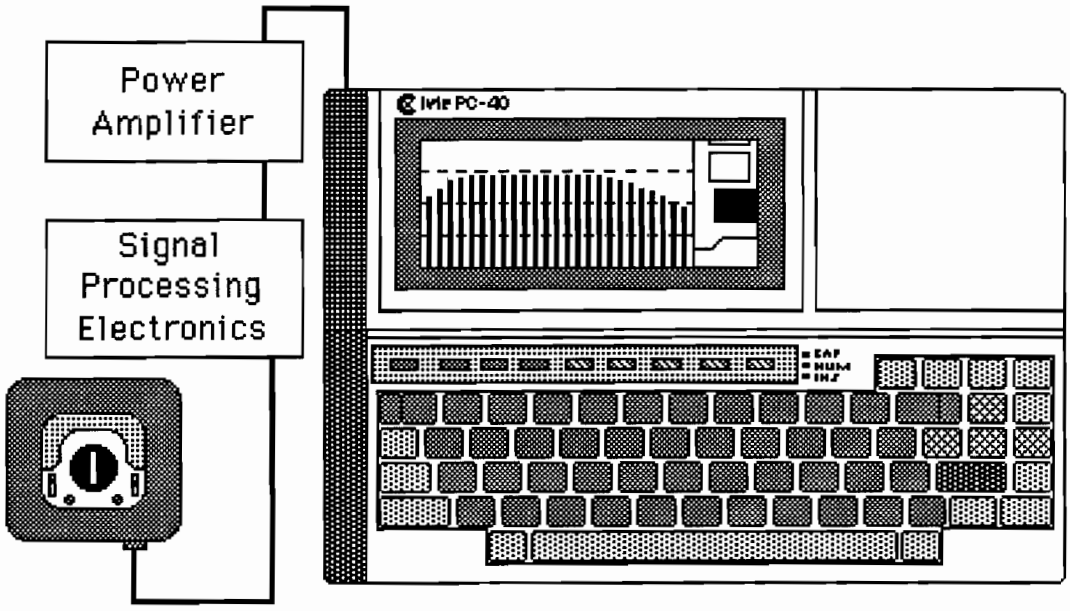


Figure XXXV

Notice that the output from the amplifier has been adjusted with both low and high end rolloff - not unlike we would expect to see. Other than that, the response looks very flat.

Next, for fun, we can look at the acoustic output of the speaker being fed by the amplifier to compare its spectral output with its electrical input. This time, instead of using the PC-40 probe, we plug in the microphone and listen to the speaker without changing our input signal. Any differences in spectral information will reflect the performance of the speaker in its environment. Incidentally, research has shown that the anechoic response of a speaker can quite accurately predict its response in an ordinary room. If we have a plot of the anechoic response, we would expect the response in our room to correlate.

At any rate, our test setup would change as shown on the following page:

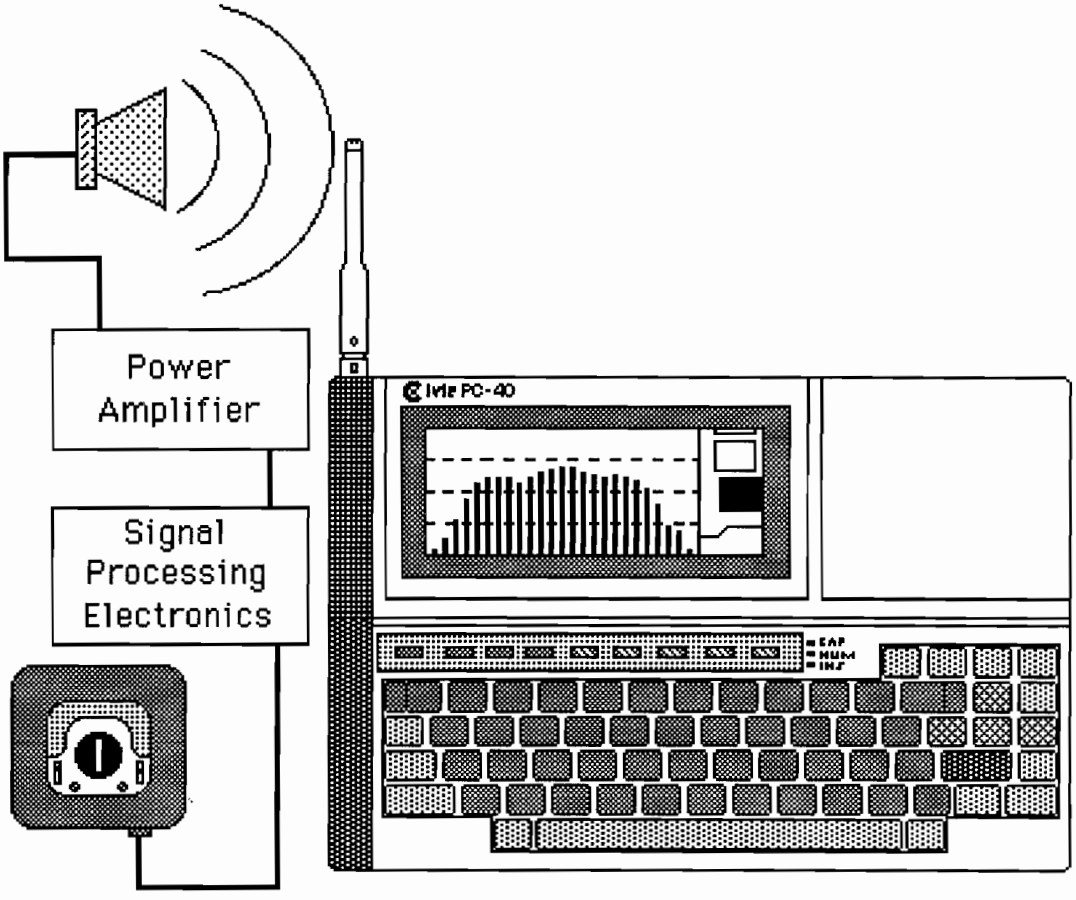


Figure XXXVI

Obviously, we would expect to see some differences in response, as this illustration shows.

The power of this simple measurement process should become somewhat evident. By adding simple variations to the above setups, the parameters we can measure or verify are extensive. Let's consider the value of this approach in trouble shooting.

We are called back to a system which is not properly operating. It's a fairly simple system - a four input automatic mixer with an aux channel for music, a 1/3 octave equalizer, a two-way crossover, two one hundred watt amps for bass, and three fifty watt amps driving the high end.

We bring our set of documentation for this job, and we plug our pink noise

generator into the music channel of the mixer. Our documentation shows the following:

1. The input level at which we should set our pink noise.
2. The settings on the mixer
3. The output level and a plot of the spectral response of the mixer (which is also the input information for the equalizer).
4. The output level of the equalizer and a spectral plot of its output.
5. The output level of each of the legs of the crossover, and a spectral plot of each one showing crossover point and filter skirts.
6. The input level, gain, and output spectral plot for each amplifier.
7. A map of the listening area for the system with several points located. For each point, there is a spectral plot and dB SPL referenced.

It is now a quick and simple matter to step through each component of the system with the analyzer and a probe. Any defective component or change in setting can be quickly detected. Setting changes can be speedily corrected. If everything checks out electrically, measurements at the documented points in the listening area can identify speaker problems. Since we know what the output and spectral content of each amplifier is, we can verify that information at the input of a speaker to make certain we have no wiring problems.

Obviously, we have not covered every sound system parameter, but it can be easily seen that spending a little time in system documentation can save a lot of time in trouble shooting and correcting system problems.

The PC-40 Memory Functions

The 3dB/Step "Invalid Data Line"

As discussed earlier in this manual, (under the section entitled "The PC-40 Display Screen") when displaying data on screen in the 3dB/step mode, the display of the PC-40 actually shows a dynamic range greater than the filter dynamic range. In simple terms, this means that before a signal could drop off the bottom of the display screen, it may run into the noise of the filters themselves. Thus, noise at the bottom of the PC-40 screen in the 3dB/step mode may or may not be valid data.

To help solve this problem, a line appears across the display screen, near the bottom, when in the 3dB/step mode. This line is called the "Invalid Data Line," and is shown in the following illustration:

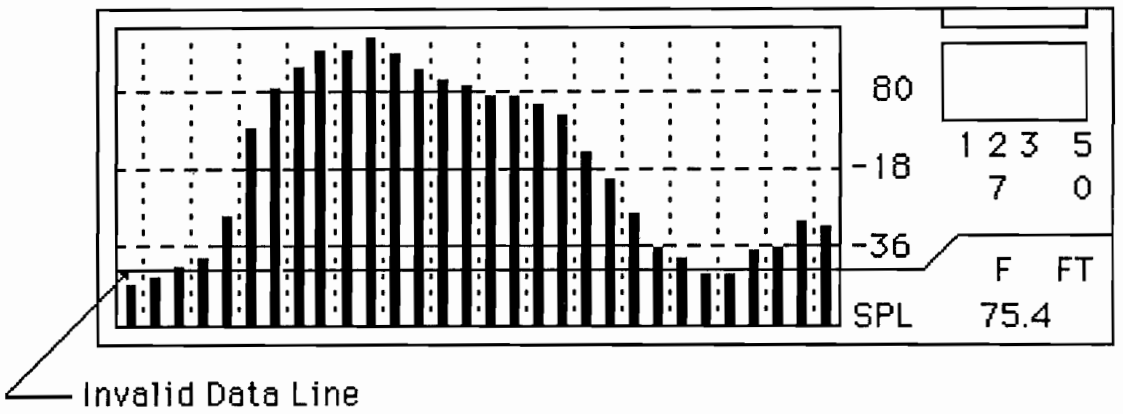


Figure XXXVII

Notice that in the above example, there are two low frequency filters and two high frequency filters that display data below the Invalid Data Line. In practice, we understand that this information may not be valid. An interesting question arises when we consider what might happen if we stored the above display into memory, recalled it, and then began to manipulate the data. If we changed the Reference Level, for example, and moved the data up on the screen, these four low filters would rise above the Invalid Data Line and would appear to be valid data.

The same thing might be asked of another display which had filter noise hanging just below the level of the display screen, so it would not be displayed.

If we stored that display, recalled it, and then began to lower the Reference Level, we could bring this noise up on screen and mistake it for real data.

To solve this potential problem, any data below the Invalid Data Line is not entered into memory during the STORE function. Let's look at the preceding example, for instance. Looking at the display tells us that several memories have been used. However, memory #8 is vacant, so let's store the display in memory #8. If we then RECALL memory #8, the following display would appear:

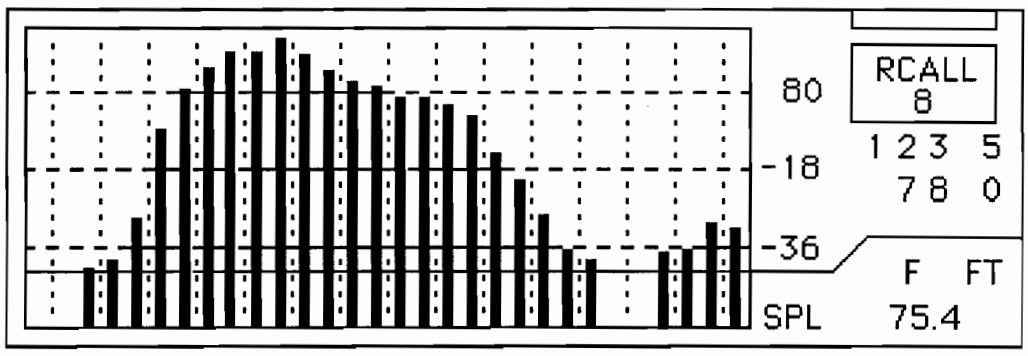


Figure XXXVIII

Notice that the four filters which were below the Invalid Data Line have disappeared. Questionable data has not been saved. Even if we change the Reference Line to raise the data up on the screen, no data will appear under the four filters in question, as shown by the following illlustration:

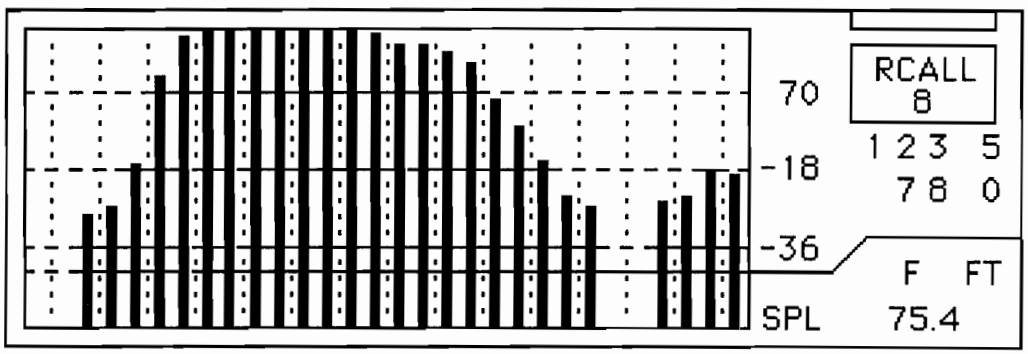


Figure XXXIX

This safeguard protects against the possibiltiy that invalid data could be raised up on the screen, or brought to the screen through manipulation of data in memory. In this manner, measurement integrity is assured. Any data that is display from a memory function will be good data.

Recalling and Displaying More Than One Memory

You have already learned that the PC-40 can recall and display any one of its twenty memories. It also has the ability to recall and display 1 or 2 memories simultaneously, or recall and display more than 2 memories simultaneoulsy. When displaying 2 memories, each is clearly differentiated from the other. When displaying several memories at once, one is not differentiated from the others and the display is intended to show an envelope only.

Let's examine this in further detail. First, let's look at displaying 2 memories. We begin by hitting the RECALL button just as if we were going to recall a single memory. The display would then look like this:

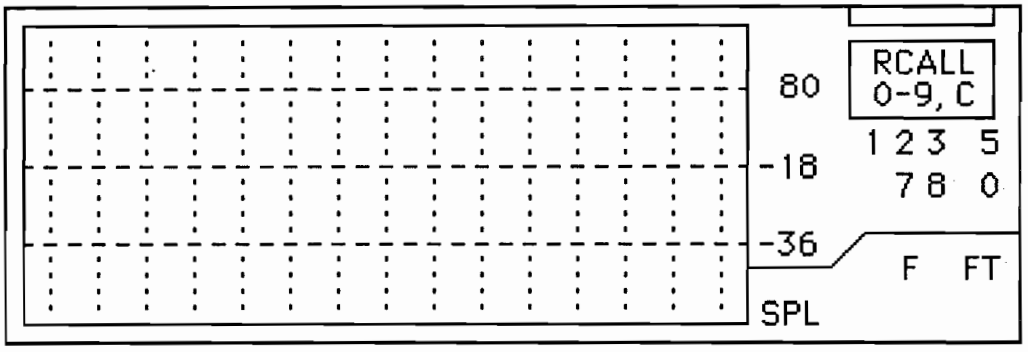


Figure XL

Notice that the PC-40 Message Window reads RCALL, signifing that we are in the Recall Function, and below RCALL, we find 0-9, C. This indicates our function key options when in the Recall Function. Hitting one of the keys from **0** to **9** will allow us to recall a single memory. However, if we want to recall more than one memory, we first hit **C**, which signifies "composite." When we hit **C**, the Message Window of the PC-40 will change as shown on the following page:

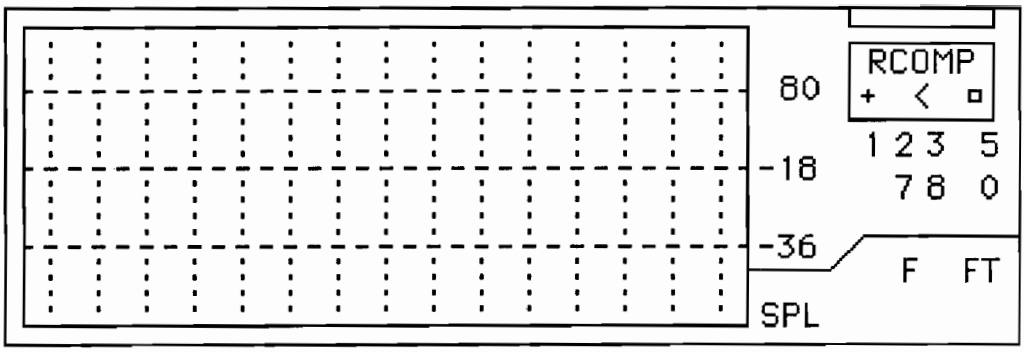


Figure XLI

Notice that the prompt "RCALL" in the message window has been replaced by the prompt "RCOMP," signifing "Recall Composite." Below that, we see a + symbol, and a □ symbol. This means we can display one memory as plus signs, and the other as boxes, to differentiate between the two. The arrow pointing at the symbol tell us which symbol we have selected for display. In the above illustration, we have selected the plus sign. If we wanted boxes instead, we could use the curser arrow on the PC-40 keyboard to select boxes. The left and right keyboard arrows can be used to change the direction of the pointer in the message window.

Let's go through the steps to finish displaying two memories simultaneously. The pointer in the above illustration has selected the plus sign for displaying the first memory. Let's say we want to display memory number 1. Since we are already in the RCOMP mode, the PC-40 is already to display our first memory. We simply need to hit the key **1**. Memory 1 will be displayed as shown below:

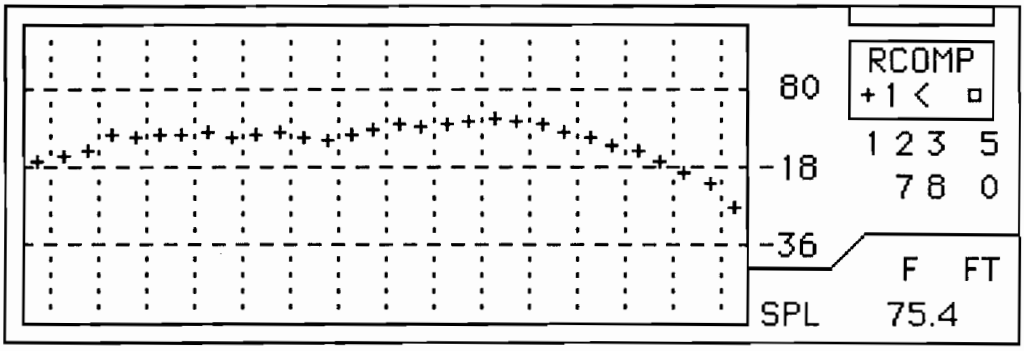


Figure XLII

Notice that the message window indicates we are displaying memory 1 as plus signs.

Now, let's display memory 2 as boxes. We first hit the right cursor arrow on the keyboard to get the pointer in the message window pointing at boxes. They we hit **2** to recall memory 2. Our display will then look like this:

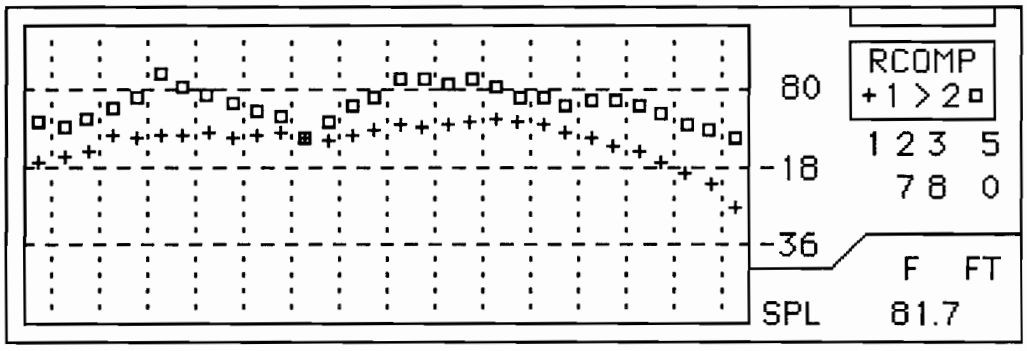


Figure XLIII

Again, the message window tells us we have displayed - in this case, memory 2 as boxes. The first memory displayed on the PC-40 screen is clearly differentiated from the second memory displayed. The SPL information showing comes the last memory displayed, memory 2.

Notice also, in the above example, that both of the curves displayed have the same amplitude at one of the filter frequencies. The plus sign and the box both show up together, making it obvious that the values are equal.

In addition to being able to display two memories simultaneously, three or more can be displayed to form and envelope display. To accomplish this, follow the same keystrokes as discussed for displaying two memories:

1. Press **RECALL** to get into the Recall mode.
2. Press **C** to get into the Recall Composite mode.

Now comes the difference.

3. Hold down the **Ctrl** (Control) key and hit the number key for each memory you wish to display. Each memory will be displayed as dashes ----, so one memory cannot be differientiated from another. This display mode is for the generation of an envelope display only.

Important Note: To get out of the Recall Composite mode, hit **RECALL**. As in most instances with the PC-40, you get out of a function using the same button that was used to get into the function.

Very Important Note: Sometimes you may recall two memories that have different Reference Levels. The first memory you recall will print the Reference Level for that memory. The second memory you recall will be automatically adjusted on the screen to be correct for the Reference Level already indicated by the first memory. For example, you may have stored two memories that were in about the same position on the PC-40 screen, but their Reference Levels were 40dB apart. If you recalled both of these memories together, the second memory may not even show up on screen because it is 40dB different in level from the first memory. You could "find" the second memory by stepping the Reference Level up or down, thus moving the second memory on screen and the first memory off screen.

Subtracting One Memory from Another (The A-B Function)

In many circumstances, such as in STC and NIC measurements, it is advantageous to be able to subtract on memory from another. This can be useful in even more simple applications such as comparing before and after equalization curves. Subtracting the before equalization curve from the after equalization curve will provide a graphic display of exactly what boost or cut had to be effected at each 1/3 octave channel to achieve the desired equalization.

Performing the A-B Function is a simple operation. Follow the same format for displaying two memories simultaneously. You may remember that in the previous example, we had recalled two memories resulting in the display shown on the following page:

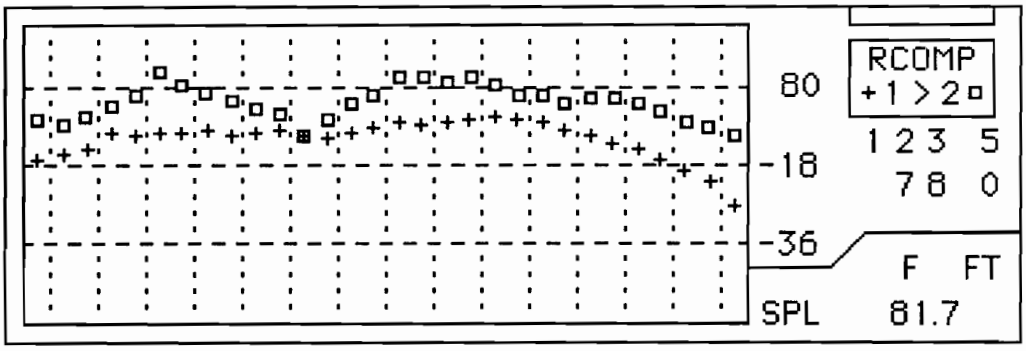


Figure XLIV

Once we reach the point of having two memories displayed, we must choose which memory is "A" and which is "B." Keep in mind that this is an A-B function, so "B" will always be subtracted from "A." We select the "A" memory with the pointer in the message window. The pointer always points at the "A" memory. In our example above, memory 2 is the "A" memory, so memory 1 is the "B" memory. We can toggle the pointer back and forth between the two memories to select our "A" memory by using the left and right cursor arrow keys on the PC-40 keyboard.

Once we have selected our "A" memory, we perform the A-B function by a single keystroke, the "**minus**" key on the PC-40 keyboard. (This key is on the top row of keys, near the right-hand side, and has an "equals" symbol and a "minus" symbol on its face).

If we follow this sequence for our example above, memory 1 will be subtracted from memory 2, and the display on the following page will result:

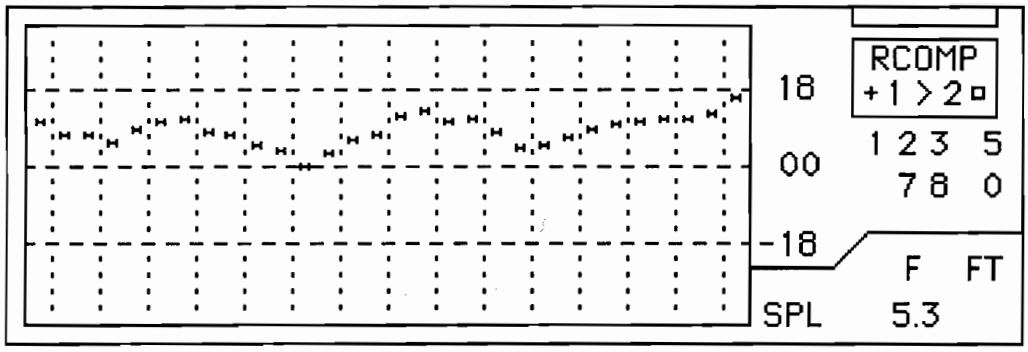


Figure XLV

The display format for the A-B function is slightly different from other display formats for the PC-40. We show a center reference of zero dB, and 18dB above and below that reference is indicated. If our A and B curves were exactly identical, subtracting one from the other would equal zero dB difference at each 1/3 octave channel. This would be displayed as a flat curve, its amplitude reaching zero at every frequency.

Since any curve may be higher in amplitude at one frequency than another curve, but lower in amplitude at another frequency, provision must be made to indicate both positive and negative numbers when subtracting one curve from the other. The A-B display format accomplishes this.

Notice also the the SPL displayed in the A-B format is the difference between the SPL's of the two curves.

Important Note #1: The A-B curve can be stored in a separate memory, if you desire. The process is the same as with any other memory storage, simply hit the STORE button and select one of the 20 memory locations.

Important Note #2: To get out of the A-B mode without storing the A-B curve, use the same keystrokes in reverse order. Hitting the **"minus"** key again will get us from the A-B display back to the two memory display. Hitting **RECALL** again will get us out of the Recall mode back into a real-time display.

A - B Printouts

As you have already learned earlier in this manual, a "screen dump" printout of

the A-B curve can be executed by pressing **PF5** while holding down the **Ctrl** button. A tabular printout of the A-B information is also available. This is executed by pressing **P** (for "print") while holding down the **Ctrl** key. For more information on tabular printouts, refer to the Appendix II of this manual entitled "PC-40 Printing Options."

Averaging Memories Together

You should already be familiar with the PC-40's ability to average many spectral samples together. The PC-40 can also average memories together, if you wish. It is done in the following manner:

Step 1: From real-time operation, select the Average Mode by pressing the **AVERAGE** button. Then press **R** to clear the accumulators. (Make sure there is nothing in them you do not want to dump!) Then exit the Average Mode by pressing the **AVERAGE** button again.

Step 2: Now enter the Recall Mode by pressing the **RECALL** button. Recall any memory you wish to have averaged by selecting its number. Simply recalling the memory will not enter it into the averaging accumulators, so you may step through the memories, if you wish, to confirm the ones you want to average.

Once you have selected a memory you wish to enter into the averaging accumulators, you may enter it by pressing the **AVERAGE** button. Notice the Message Window as you press the **AVERAGE** button. It will tell you that you are in the Recall Mode, and will list the number of the memory you have recalled. As you press the **AVERAGE** button, another number will appear momentarily next to the memory number. This number indicates the number of samples entered into the accumulators. The first time you press the **AVERAGE** button, the number 1 will appear, the second time, the number 2, and so on. You should note that you can enter a memory into the accumulators more than once. If you press the **AVERAGE** button twice while viewing the same memory, it will be entered as a sample twice. If you wish to weight an average by entering a sample several times, you may do so.

Step 3: After you have entered all the memory samples you wish to average together, exit the Recall Mode by pressing the **RECALL** button. You may now view the average of all the samples you have placed into the accumulators by pressing the letter **V** for "View." This display can be printed, graphically, or as a

tabular printout, the same as other displays. It can also be stored as a separate memory. To discontinue viewing the average display, press the **V** key again to return to real-time.

PC-40 BASIC Programming

The PC-40 has built-in BASIC, and therefore has the capability to be programmed for a number of different applications. It is not the intent of Ivie to teach programming, but we have created a number of machine language subroutines, callable in BASIC, which perform various analyzer functions that can be used as building blocks for assembling programs.

Information on these subroutines is available from the factory, and a complete manual concerning them will become available from Ivie at a nominal cost. Should more subroutines become available in the future, they will be available at no cost to those who have already purchased a manual.

Appendix I
PC-40 Mechanical

It may sometimes be necessary to remove the computer from your PC-40. This necessity will occur if you need to change the PC-40 ROM, or require a "hard" reset of the computer, or desire to change one of the cartridge accessories available for the PC-40 (printer, microcassette, modem, DMM, etc.) These accessories are described in the PC-40 brochure.

Removing the computer is a simple matter. There is a Release Tab located on the right side of the PC-40 as shown below. Lifting this tab releases the locking catch to allow the computer to be slid off to the right.

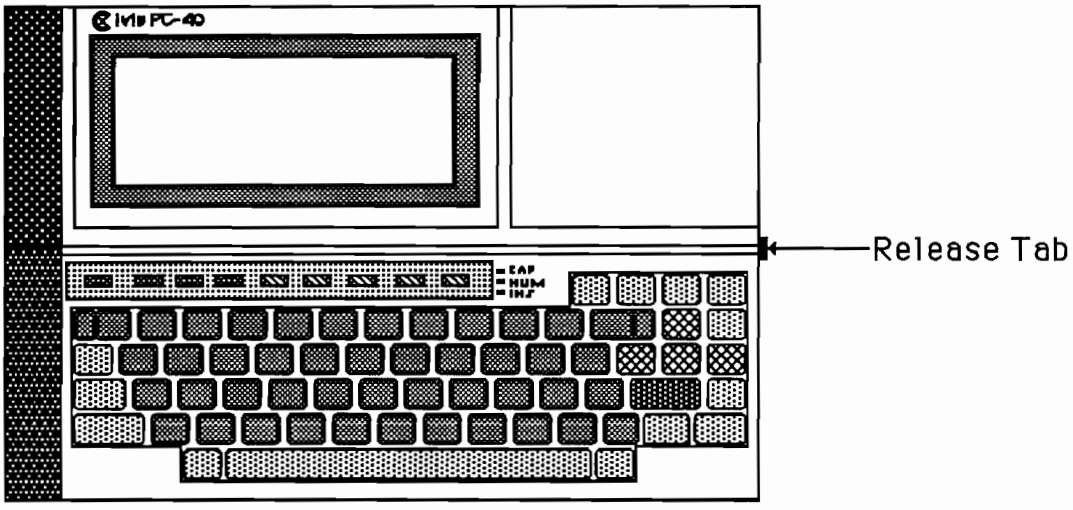


Figure A

To remove the computer, lift the release tab, then get your fingers between the computer and the dark brown PC-40 case, and slide the computer to the right as shown in Figure B. New PC-40's are usually tight and removing the computer the first few times will require firm pressure.

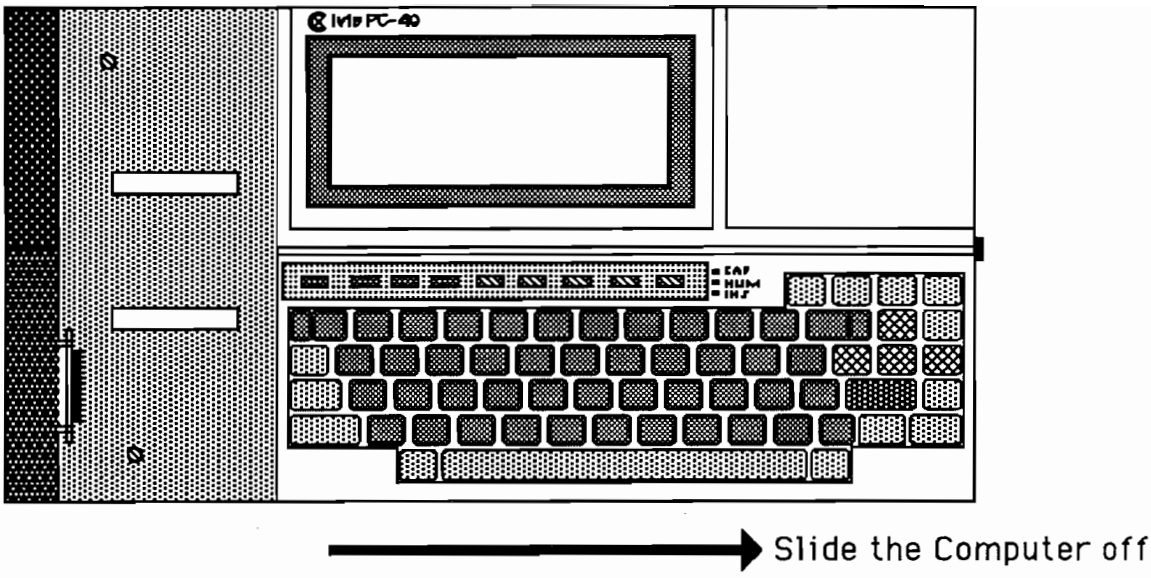


Figure B

Once the computer is off, turn it over to expose the bottom. The slide, and various compartments and switches are shown in Figure C below.

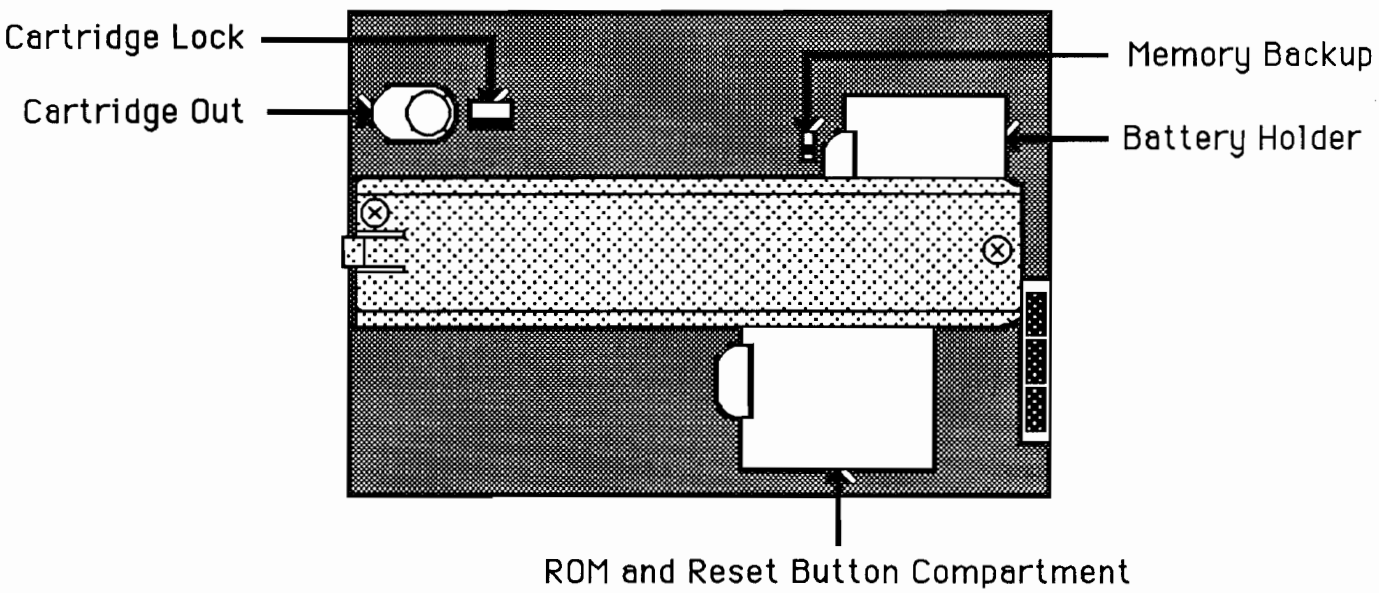


Figure C

The "Cartridge Lock" and "Cartridge Out" facilitate accessory cartridge removal

or changing.

The "Memory Backup" switch should always be in the "on" position for PC-40 operation. The "off" position may be used for other computer functions. For further details, refer to the HX-40 manual which you received with your PC-40.

The "Battery Compartment" is empty. The computer receives its power from the PC-40 mainframe. If you wish to use the computer by itself, you may install batteries, **but, to avoid damage to the computer, they must be removed before reattaching the computer to the PC-40 mainframe.**

A magnified view of the "ROM and Reset Button Compartment" is shown below.

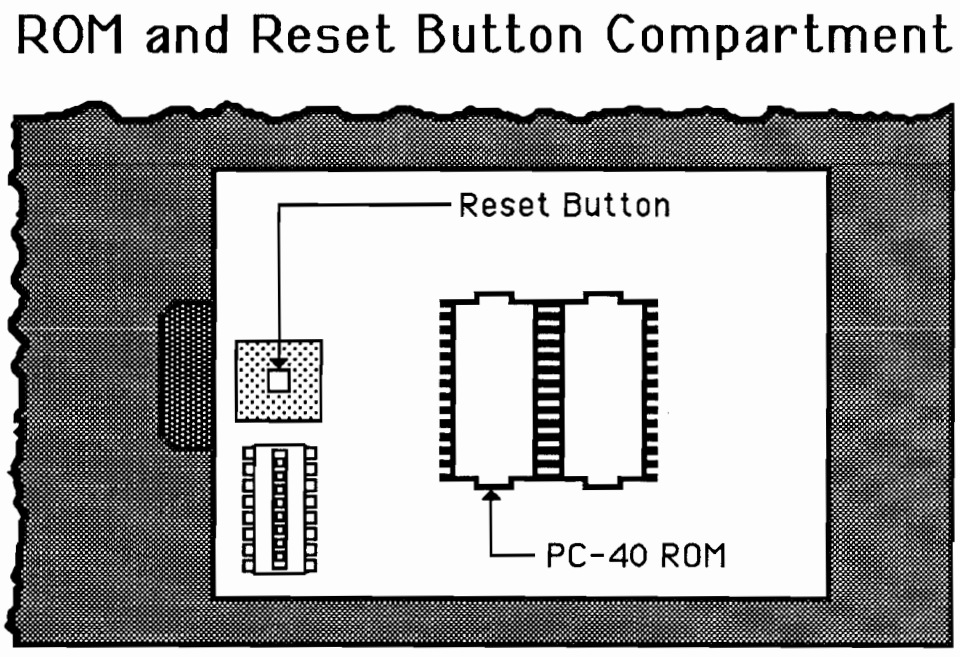


Figure D

Of course, to gain access to either the "Battery Compartment or the "ROM and Reset Button Compartment," the slide will have to be removed. In the "ROM and Reset Button Compartment" you will find the PC-40 ROM, the BASIC ROM, and a "hard" reset button. Use of the "Reset Button" is detailed in Appendix III,

entitled "Troubleshooting Your PC-40." We refer you to that section for additional information.

The PC-40 ROM is easy to identify since it will always have a paper label on it with its identifying version number hand written on the label. The ROM is in a carrier which should be removed with it. Any new ROMs from Ivie will be supplied in a carrier for easy change out.

To change a ROM, carefully remove the old one in its carrier, and observing proper polarity (the ROM carrier is keyed with different shaped tabs on each end to help insure proper polarity), carefully insert the new one. The old one should be placed in proper protective packaging and returned to Ivie, since it can be reprogrammed and used again.

Appendix II
PC-40 Printing Options

This short appendix is intended to familiarize you with the various printouts and printing options of the PC-40. Many other references to printing and printing instructions are found throughout the PC-40 manual. The information here may serve as a reference, and additional background will be provided here which is not found elsewhere in the manual.

Printer Ports

Printing can be assigned to three ports on the PC-40. The ports are the parallel port, the RS232 port (these ports are labeled and are located on the top edge of the PC-40 computer), and the cartridge printer port. The H409A Cartridge Printer is the only cartridge printer that can be used with the PC-40, and must be plugged into the cartridge slot on the PC-40 computer. Instructions for putting cartridges into the PC-40 are contained in Appendix I.

Printer ports are selected through use of the UTILITIES menu, PRINTER section, as described in the PC-40 manual. As noted there, it is very important not to send a printing command to a port where no printer is connected. This locks up the system.

Three printout sizes are available for graphic printouts when using the H409A Cartridge Printer. These are labeled in the PRINTER menu as Cartridge Tiny, Cartridge Small, and Cartridge Large. You may select the size printout that best suits your needs. Obviously, the Cartridge Tiny format prints out much faster than the Cartridge Large format.

It should be noted that there is no special printer driver software resident in the PC-40 for formating printouts sent to the RS232 or the parallel ports. Printouts from these ports will be the same size and configuration as the Cartridge Large printouts coming from the H409A Cartridge Printer. The one exception to this is when using the PC-40 to PC software package which links the PC-40 to an MS DOS computer. Printer driver software is resident within that system and printouts are formatted a little differently, with both a graphic and a tabular printout being provided.

Graphic vs. Tabular Printouts

Graphic and tabular printouts contain exactly the same information, when dumped from a PC-40, but each has its strong and its weak points. Graphic printouts provide a great overall view of what is happening spectrally, but precise amplitudes within each channel are difficult to determine visually. Tabular printouts, on the other hand, give very precise amplitude readings in each channel (to 1/10dB resolution), but do not provide a quick, visual reference to amplitude relationships throughout the spectrum. A tabular printout is especially useful for RT_{60} information when using the RT_{60} software available for the PC-40. Each type of printout has its value, so we give you the option of either or both.

Graphic printouts are executed by pressing **PF5** while holding down the **Ctrl** button, and tabular printouts are executed by pressing **P** while holding down the **Ctrl** button.

Graphic printouts ave available in all PC-40 functions, and tabular printouts are available in most PC-40 functions. Printout availability for each specific PC-40 function is detailed in the manual under the function heading.

Appendix III
Troubleshooting Your PC-40

Navigating Around Your PC-40

The Ivie PC-40 Analyzer is based on the Epson HX-40 Computer. The functions performed by the analyzer are software functions. In other words, one of the programs that can be run on the HX-40 is the PC-40 program. Physically, the bottom half of the PC-40 (that part which is not the HX-40 Computer) consists of the filters, the power supply, and other hardware which comprises the "guts" of the PC-40. This section is analog, and the information generated here is sent to an A/D interface where it can be accessed by the HX-40. When the PC-40 Analyzer program is running on the HX-40, it regularly interrogates the interface to get data it wants, and to tell the hardware what the computer wants it to do.

This procedure is nothing new. It's just standard stuff, but the point we are trying to make is that the PC-40 is not just a dedicated analyzer. It can also function as a computer. While this flexibility is a positive feature, it can also cause some problems. If you inadvertently crash the PC-40 program, or otherwise exit it, you may find yourself in some other function of the HX-40 Computer wondering how to get your PC-40 to be an analyzer again. This part of the manual is designed to help you navigate around your PC-40 and still get back to where you want to be.

One more bit of important introductory information first. The HX-40 computer has the ability to remember where it was when you turned it off, and it will return to that same point when you turn it back on. This is a great feature and is one of the reasons it was chosen for the basis of the PC-40. Most other computer systems, when they are turned on, go through a defined startup or "boot" sequence that always places the system at the same place or prompt. The HX-40 just returns to where it left off. If you are running the analyzer program and turn the PC-40 off, it will come up in the analyzer program again when you turn it back on. However, the negative side to this is also true. If you are somewhere in the computer where you don't want to be, and you turn your PC-40 off, you

will still be where you don't want to be when you turn it back on.

The CP/M Operating System Menu

Figure E below shows the PC-40 screen when you have called up the CP/M Operating System Menu. This is a happy screen. It tells you that you have returned to PC-40 access safely from wherever you were.

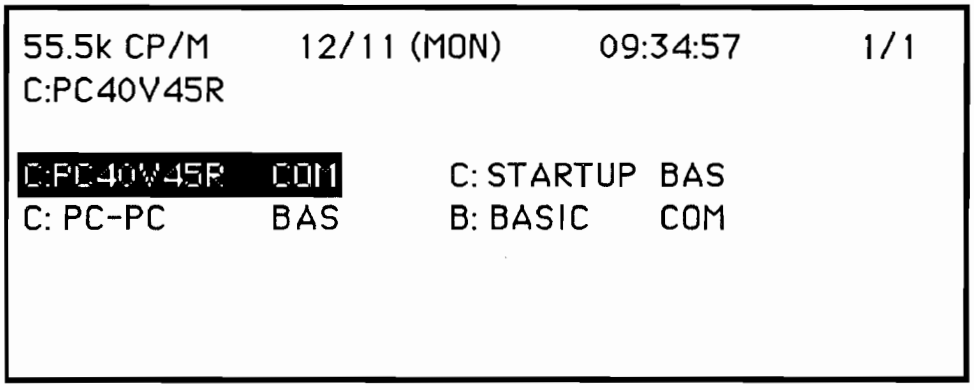


Figure E

This menu shows the programs resident in the PC-40. You may select a program shown in the menu by using the up, down, right, and left cursor arrow keys. The program selected is shown in inverse video. In the screen shown above, the selected program is the PC-40 Analyzer program. Notice that the ROM version number is shown. In our example above, the ROM is version 4.5.

Other programs that can be run are also shown in the menu. Below the PC-40 Analyzer program, the PC-40 to PC program is shown. Of course, if you do not have this optional software program, it will not show up in the menu.

To the right, the BASIC programs are are shown. B:BASIC COM is the Microsoft BASIC program, and C:STARTUP BAS is the BASIC interface program which allows you to interface BASIC programs you have written to the PC-40. Once you have selected the program you wish to run, pressing **RETURN** will run the program. For the purposes of discussion here, we will assume that you wish to run the analyzer program. What we will be discussing next is how to return to this CP/M Menu from wherever you might be in the HX-40. Once you return to this menu, you may select the PC-40 program, and then press **RETURN** to activate the PC-40 Analyzer.

Returning to the CP/M Operating System Menu from BASIC

If your PC-40 screen looks like Figure F below, you are in the BASIC program.

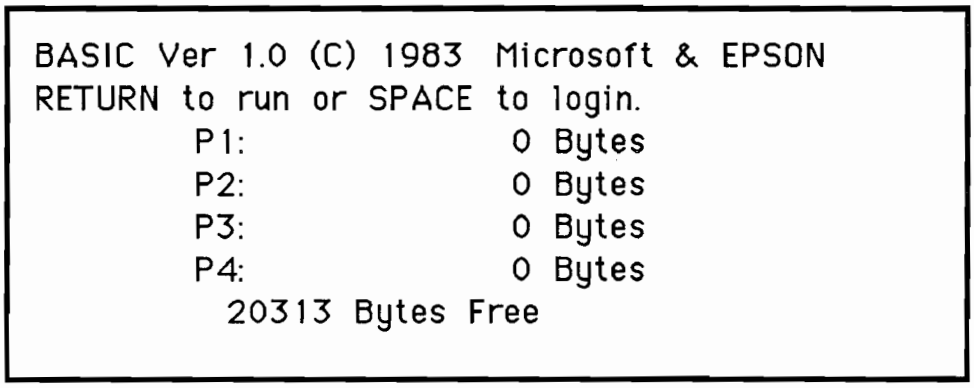


Figure F

This is the BASIC Log In Screen. The only way out of BASIC back to the CP/M Operating System Menu is to log in. This is done by pressing the **SPACE BAR**. When you press the **SPACE BAR** to log in to BASIC, you should get a screen that looks like either Figure G below, or Figure H on the following page:

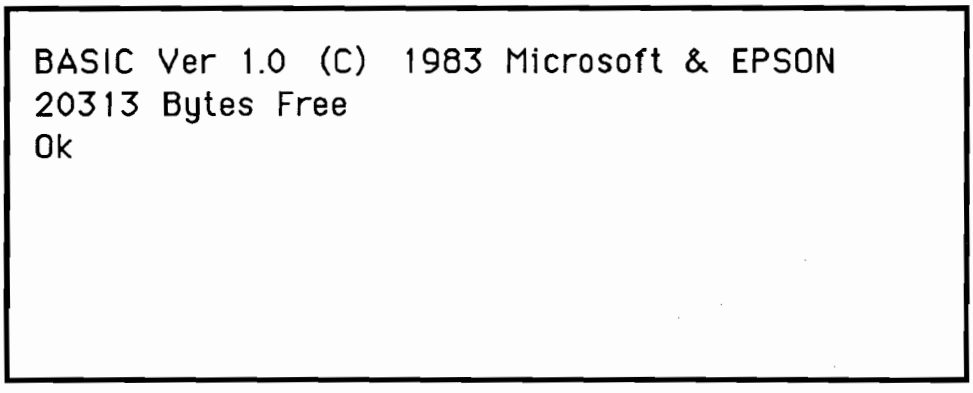


Figure G

This is a BASIC System Screen. (For further information on BASIC programming, consult your HX-40 BASIC Programming Manual which came with your PC-40).

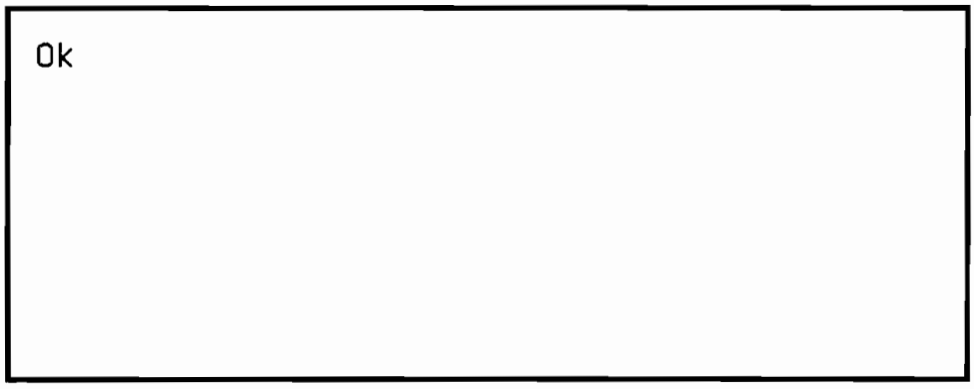


Figure H

This is also a BASIC System Screen, as is Figure G. To return to the CP/M Operating System Menu from here, type the word "**SYSTEM**" and then press the **RETURN** key.

Returning to the CP/M Operating System Menu from CP/M

When you are in the CP/M Operating System, you will get an "A" Prompt screen, if you have selected the "A" drive, or a "C" Prompt screen, if you have selected the "C" drive, etc. An "A" Prompt screen is shown is Figure I below:

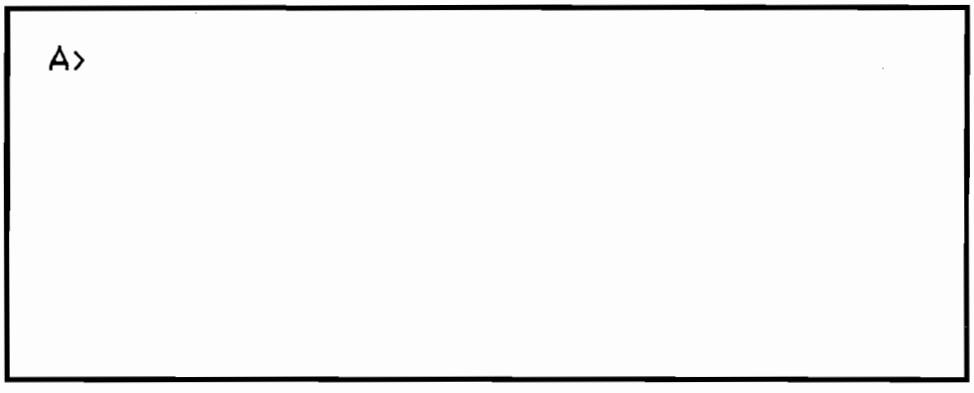


Figure I

From the CP/M Prompt screen, you may enter any CP/M command. These include commands like "**DIR**" to see a directory of files stored on a drive. You may also type the name of a program to execute it and start it running. If you typed **C:PC40V45R**, and then pressed **RETURN**, the PC-40 analyzer program would begin to run (if, of course, your ROM was version 4.5). If you

don't remember the version number of your ROM, and therefore can't type in the name of your PC-40 program, you will want to return to the CP/M Operating System Menu to reactivate the analyzer program. To do this, execute the following steps.

First, make sure that the flashing cursor is located just after the CP/M Prompt. This can be accomplished by using the **HOME/BS** key to backspace over any existing command or space. Then press the red **QUIT** button at the top, left of the keyboard. This will usually return you to the CP/M Operating System Menu.

Under some conditions, the above procedure will not return you to the CP/M Operating System Menu. If this is the case, you may need to re-boot your system by pressing the **RESET** button found near the **ON/OFF** switch, on the right side of the PC-40, as shown in Figure J below:

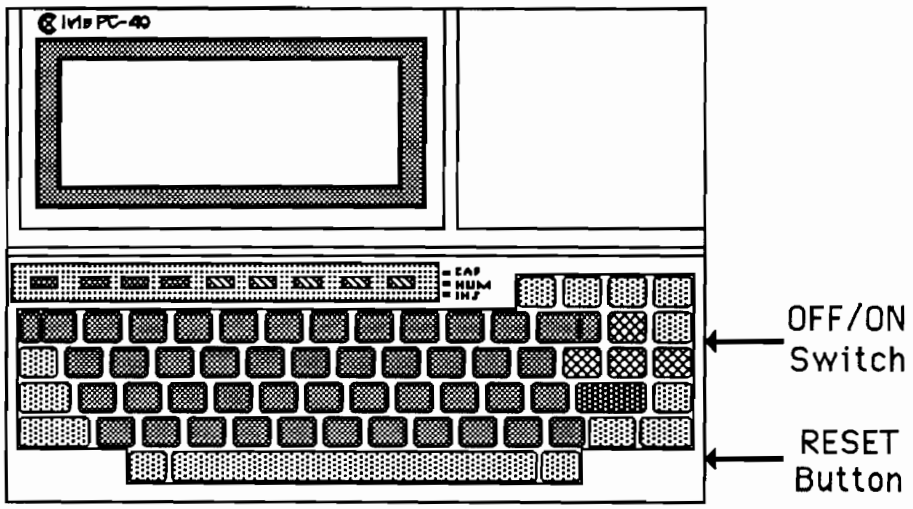


Figure J

You will need to use a pencil or ball point pen to press the **RESET** button. Re-booting you system should restore the CP/M Operating System Menu, unless the menu has somehow been turned off.

If the CP/M Operating System Menu is configured to be off, then re-booting the system will obviously not display the menu. If you are unable to get the menu to display, check its status to make sure it is on. To verify the status of the CP/M Operating System Menu, hold down the **CTRL** key while pressing the **SYSTEM** key (located just above the **4** key). This should bring up the System Display Screen as shown in Figure K on the following page:

```
* SYSTEM DISPLAY *    12/11    (MON)    10:42:53
<RAM   DISK>  26       KB      <ALRM>    OFF
<USER  BIOS> 000x256   B       <AUTO>    OFF
<MENU DRIVE> CBA               <MENU>     ON

-Select or ESC to exit.              1=RAM cartridge
2=alarm      3=auto start            4=menu
```

Figure K

In Figure K, we see that the menu (labeled <menu>) is ON. If it were not on, we would, of course, want to turn it on. To do this, press **4** to select the Menu Control screen. The Menu Control screen is shown in Figure L below:

```
* SYSTEM DISPLAY *    12/11    (MON)    10:42:53
<RAM   DISK>  26       KB      <ALRM>    OFF
<USER  BIOS> 000x256   B       <AUTO>    OFF
<MENU DRIVE> CBA               <MENU>     ON

-Select or ESC to return.
<MENU> 1=off       2=on        3=drive
       4=ext1      5=ext2      6=ext3      7=ext4
```

Figure L

Once into the Menu Control screen, the menu can be turned on by pressing the number **2**, as shown above.

One more thing should be mentioned here. Notice the <MENU DRIVE> line in the screen above. The drives associated with the menu are C, B, and A. The PC-40 Analyzer program is located in drive C. If, for some reason, the C drive were not listed, you would not be able to pull up the CP/M Operating System Menu with the PC-40 Analyzer program listed in it. In the highly unlikely event that the C drive is not listed, you may press the number **3**, as shown in Figure L, to select the Drive Control screen. Once in this screen, you may add the drives you wish, but the C drive must be one of them.

Once you have made certain that the menu is on, and have finished any other configurations you wish to make, you may return to the main CP/M Operating System display by pressing **ESC** (located just above the 2 key) once or twice as prompted. Once you have returned to the main CP/M Operating System display, you may pull up the CP/M Operating System menu by following the instruction previously outlined on pages 75 and 76. This will, of course, get you back to PC-40 Analyzer operation once again.

Recovering from Crashes, Lockups, and Other Minor Catastrophes

Sometimes things happen which result in program crashes, lockups, or other unpredictable occurrences. The following section will help you deal with most of these. We will, of course, be operating under the assumptions that nothing is wrong with the hardware, and the software is undamaged. If this is not the case, these procedures will obviously not help.

The first thing to check is battery and AC charger status. Low batteries are not usually the culprits because the system will shut itself down to computer operation only and give an on screen, written indication of low batteries. The converse may be true, however. If you are operating with the charger plugged in and the batteries are quite fully charged, a dirty AC line, or an excess AC voltage may find its way through the charger and the batteries to cause problems. The normal symptom of this is strange looking, or a locked screen, or sometimes failure of the signal amplitude on screen to change as the Reference Level is changed.

Unplugging the charger from the PC-40, and turning the unit off and then on again will normally correct this condition. Then just operate it from the batteries only until they need to be charged.

If that does not solve the problem, or if something else has occurred which is not related to the PC-40 power supply, you will need to try resetting, or re-booting the system. There are several levels of reset available to you, and the reset required is determined by the seriousness of the problem.

We refer you to page 2-62 of the Epson HX-40 manual, for a detailed explanation of the resets available. The section of the Epson manual is

entitled, **"2.5.6 Restarting the system."** For most lockups and crashes, the first two levels of reset will not help. We will therefore not discuss them here. The first level we will explore is pressing the **RESET** button. Figure J, on page 76, shows the location of the **RESET** button. In order to press it, a ball point pen or pencil is required. It has been recessed to prevent accidental actuation. Pressing the **RESET** button will cure the majority of PC-40 problems. Always try this level of reset first, as the next levels may cause the loss of successively more data.

If simply pressing the RESET button does not solve the problem, move to the next level. Press and hold down both the **SHIFT** and **GRPH** keys, while then pressing the **RESET** button. When this level of reset is executed, system initialization takes place, followed by a cold start. This means that after the system is up and running again, you will need to go into **UTILITIES**, select "Time," and reprogram the date and time information.

The last level of reset we will consider is pressing the **7508 Reset Button** located inside the ROM and Reset Button compartment on the bottom of the HX-40. Appendix I entitled **"PC-40 Mechanical"** on page 66 of this manual details removing the HX-40 computer from the PC-40 frame, and accessing the ROM and Reset Button compartment. We refer you to that section if you are not already familiar with disassembling the PC-40. Figure M below shows a closeup of the ROM and Reset Button compartment on the bottom of the HX-40:

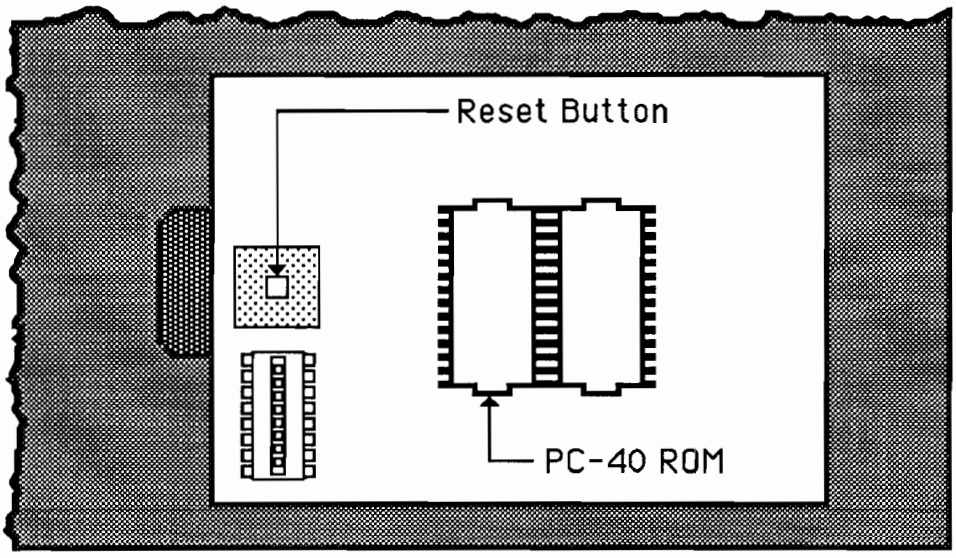


Figure M

Using the **7508 Reset Button** should be a last resort. It works very effectively, but you will have to reprogram date and time information as previously discussed, and this level of reset can also wipe out data in the PC-40's twenty memories, or in buffer memory. Memory destruction does not always happen, but it can happen, so we recommend using the **7508 Reset Button** only when all else has failed.

With the above data, and the rest of the information in the appendices, you should be in a position to solve most problems you might encounter using the PC-40. You should find it rarely necessary to troubleshoot you PC-40, but if you do encounter a problem you cannot solve using all the information in this and the other manuals which came with your PC-40, please do not hesitate to give us a call at the factory. We'll be happy to help.

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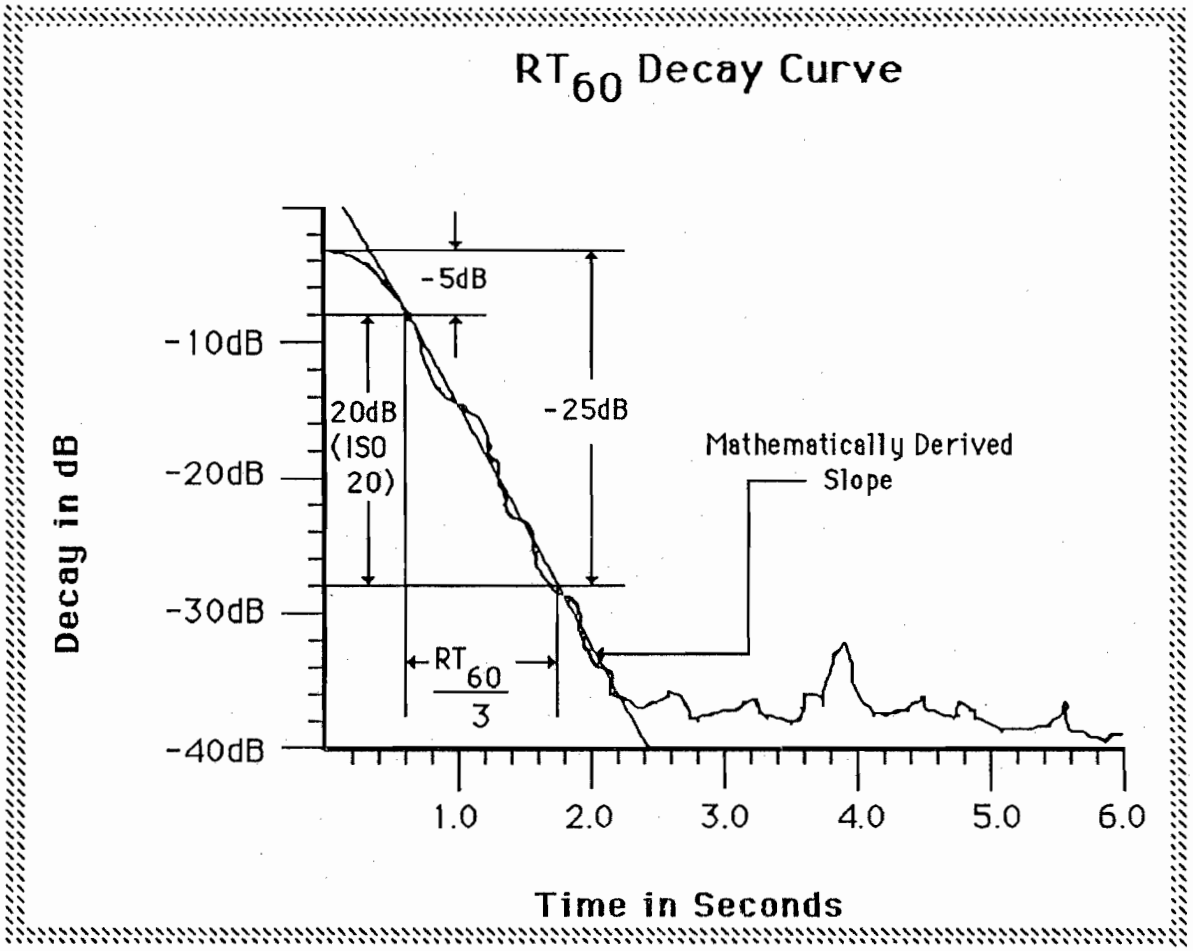
RT_{60} Software Manual for the Ivie PC-40 Audio Spectrum Analyzer



RT_{60} Manual for the Ivie PC-40 Audio Spectrum Analyzer

Table of Contents

RT_{60} Measurements Using the PC-40

Introduction and Theory of RT_{60} Measurements

In theory, reverberation measurements seem easy and straight-forward to make. In actual practice, they are not as easy as they might appear. RT_{60} is defined as the time, in seconds, it takes sound in a reverberant environment to decay 60dB in level. Measurements are usually made in narrow bands (octave or 1/3 octave), rather than broadband (20Hz to 20kHz). ISO standard octave bandwidths are the most common basis of measurement, with ISO standard 1/3 octave bandwidths being often used as well.

To make RT_{60} measurements, the following items are needed: a sound source to excite the environment being measured, a sound level meter to measure the sound decay, and a clock to measure the time over which the decay occurs. If our sound source were sufficiently powerful, and we had good hearing protection, we could excite an environment to a level 65 or 70dB (60dB of decay plus 5 to 10dB of headroom) above the ambient sound level. We could note the overall SPL, then shut off the sound while simultaneously starting a stop watch. We could watch the SPL meter until the sound level decayed 60dB, and then punch our stop watch. The time showing on the stop watch could be defined as RT_{60}.

The accuracy of the measurement would, of course, be affected by our ability to punch the stop watch at just the right times, and by our ability to read the SPL meter, determining exactly when the sound had decayed 60dB. In actual practice, a number of other factors affect both the accuracy and the interpretation of the data gathered. In the first place, it is usually not possible to generate sound levels which are 65 to 70dB above ambient - in many environments, such a level would approach the threshold of pain. This means that decay has to be measured over smaller windows than 60dB, with extrapolated RT_{60} then being calculated, rather than actually measured. Also, the rate of decay can vary over the measurement window, so, if an average of all rates of decay is desired, more calculations are involved. Additionally, methods of exciting the environment, along with other factors, can cause dramatic differences in the rate of decay for the first 5dB, when compared to the rest of the decay window. Consequently, we may want to be selective as to the section of the decay window we use to calculate decay time.

If we create a graphic plot of sound level versus time, we can observe the behavior of the sound as it decays. Of course, the number of amplitude samples we take over our time window will affect the resolution of decay curve we construct. Once we have this decay curve, we can make some decisions about which section of the curve to use to calculate RT_{60}. After a suitable section of curve has been selected, we face the problem of determining what the average rate of decay over that section of curve is. Once we have that, we can finish the RT_{60} calculation.

Perhaps the best way to handle all of these variables and calculations is through the use of a computer. The PC-40 does just that. The diagram below helps to explain how the PC-40 works and why it works the way it does.

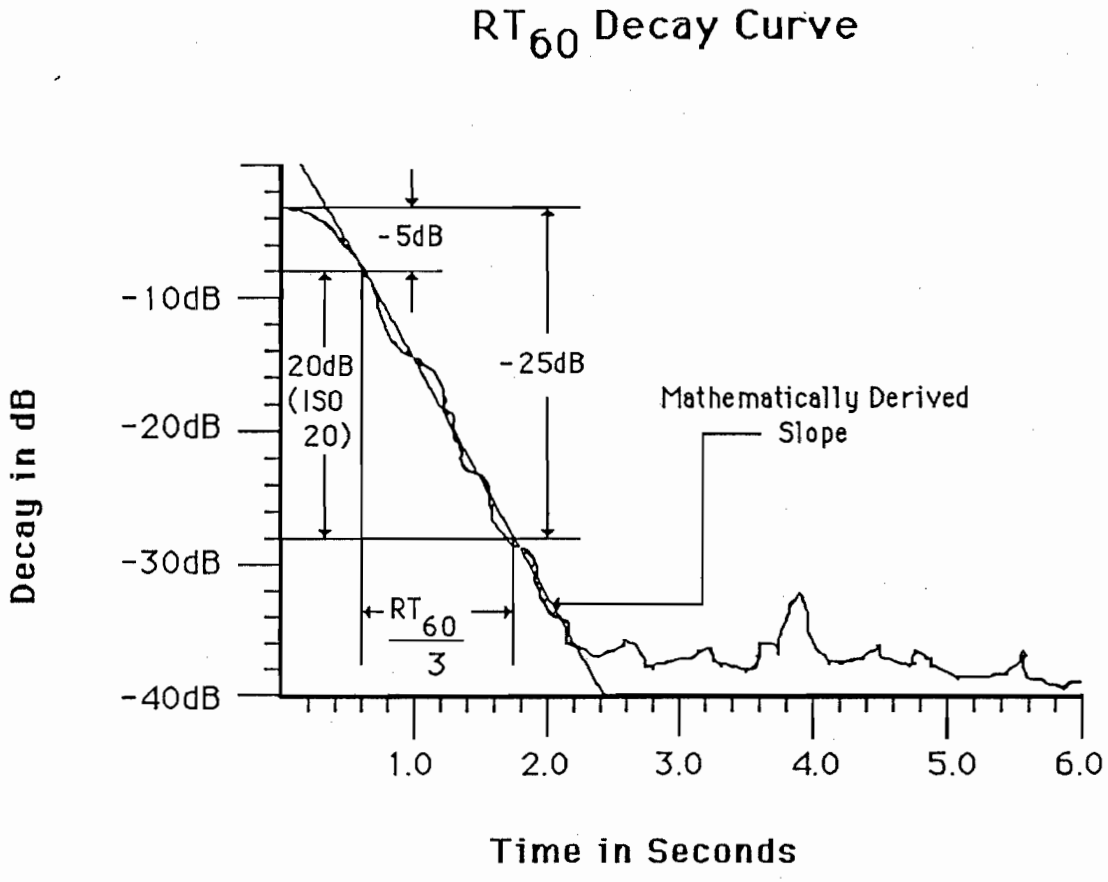


Figure 1

The above plot shows a decay curve and identifies sections of that decay curve. To insure statistical accuracy in measuring and plotting decay, the PC-40 takes samples (of amplitude in dB) at the rate of 100 samples per second, regardless of

the length of the measurement window selected.

Notice that a 20dB section of decay curve has been identified. It begins at -5dB and ends at -25dB. Since 20dB is one third of 60dB, the decay time over this 20dB window would be 1/3 of the total RT_{60}, as the diagram shows. Not using the first 5dB of the decay curve in calculations of RT_{60} is an international practice that has evolved due to the variations often occurring in the first 5dB of decay, as compared to rest of the decay curve. The PC-40 uses the 20dB section of decay curve from -5dB to -25dB for RT_{60} calculations and delineates these calculations as ISO (20). The PC-40 also defines a 30dB decay window from -5dB to -35dB which can be used for calculations if there is sufficient decay available. The PC-40 delineates this as ISO (30). Additionally, the first 10dB of decay is often of major interest. Calculation of RT_{60} based on this section of the decay curve is delineated by the PC-40 as Early Decay. The PC-40 calculates ISO (20), ISO (30), and Early Decay times for each frequency band. A PC-40 tabular printout of RT_{60} includes numbers for all three of these. If there were insufficient decay to calculate ISO (30) or ISO (20), dashes would be printed to indicate insufficient data.

In our example above, a straight line has been fitted over the decay curve which represents the average slope of the decay. It is this line from which the final RT_{60} calculation is made, and therefore, the accuracy with which the line is fitted to the decay curve affects the accuracy of the final calculation. To insure the most accurate "fit" possible, the PC-40 uses linear regression (the "least squares" method) to fit the line to the decay curve.

The last item that needs to be mentioned is the improved statistical accuracy provided when several decay samples are taken and averaged together before RT_{60} calculations are made. Five or more samples are sufficient to provide excellent statistical accuracy. The PC-40 will average up to 99 decay samples, far more than are necessary.

Measuring RT_{60} Using Pink Noise and the PC-40 Audio Relay

Measuring RT_{60} with the PC-40 is really very simple and fast. Let's go through the procedure step by step. In an actual RT_{60} measurement, we would be feeding pink noise into a sound system through the PC-40 Relay. The Relay function is to shut off the sound as the test is begun. For the purposes of this discussion, we are going to "cheat" a little, and feed the pink noise electrically into the PC-40, instead of sending it through a speaker to the microphone. What we will be measuring is

the decay of the PC-40 filters, rather than the decay of a room. The intent here is to conveniently familiarize you with the measurement procedure in the peace and comfort of your own office, before you have to go out and make a measurement.

A measurement setup is shown below which outlines our "office setup," and also the setup for an actual RT_{60} measurement. Only the output from the Audio Relay differs. Our "office setup" is demonstrated by the solid lines which show pink noise coming out of the Audio Relay, then feeding directly into the PC-40. A "real" measurement setup is demonstrated by the broken lines which show pink noise coming out of the Audio Relay, then feeding through a sound system, to be listened to by the PC-40 through its microphone.

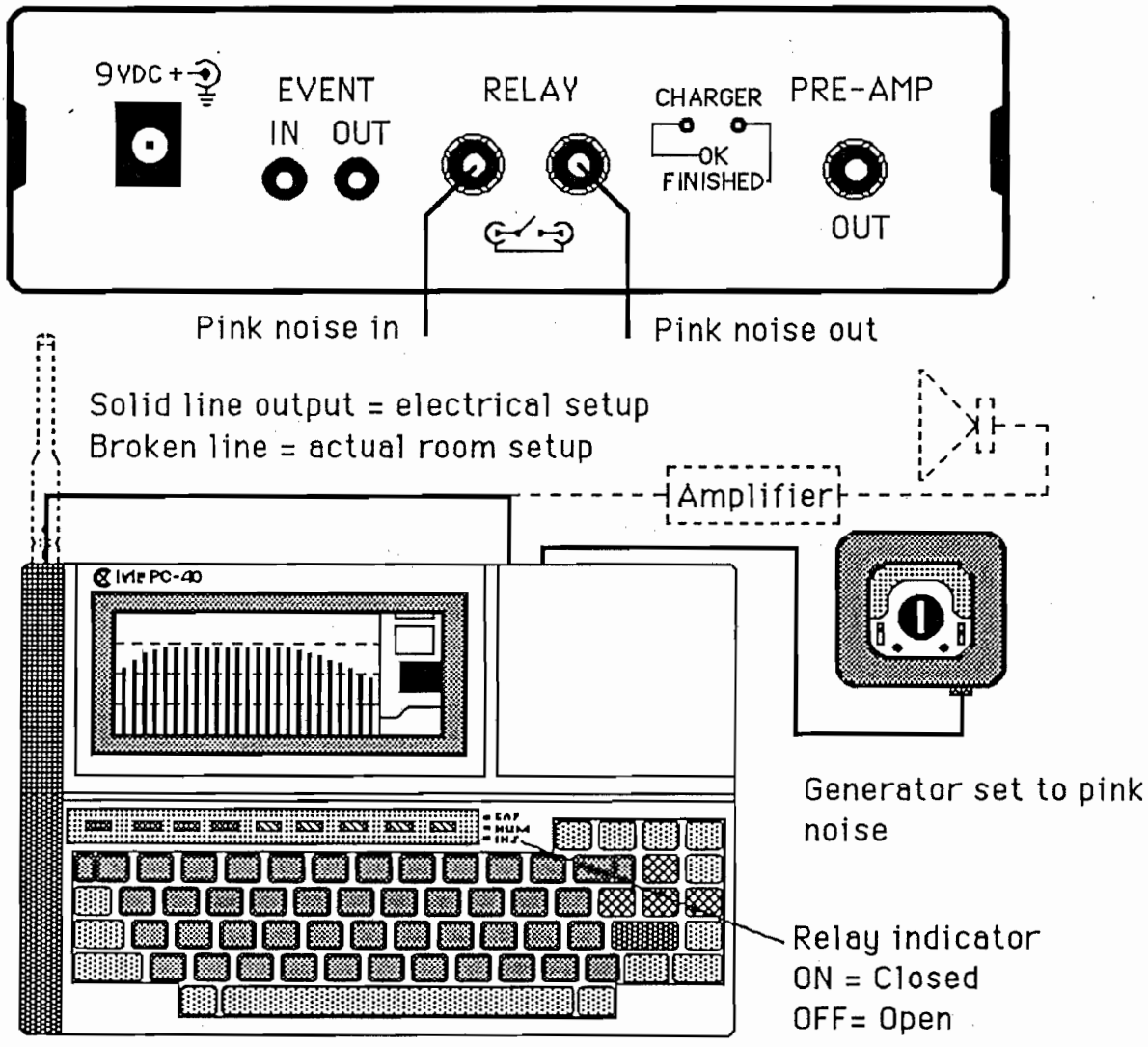


Figure 2

As already mentioned, the setup in Figure 2 shows both the normal setup for measuring room RT_{60} through the PC-40 microphone, and our electrical "office" setup for feeding pink noise directly back into the PC-40. This electrical setup can be accomplished using an Ivie 83AD adaptor (6 pin XLR to phono) plugged directly into the microphone input. If this adaptor is not available, the 1036B RTA Probe supplied with the PC-40 can be used by connecting it to the BNC input of the PC-40, and then clipping the probe to the output of the noise generator. In this instance, you would have to go into the UTILITIES menu of the PC-40, select Mic/Probe, and change the input to dBm, or dBV. If you failed to make this change, (switching the PC-40 from mic input to probe input) the PC-40 would still be looking for signal coming in through the mic input, and all it would see is crosstalk from the probe input.

Once the setup is completed as shown in Figure 2, and pink noise can be seen on the PC-40 screen, RT_{60} measurements can be begun. To make a measurement, the following keystrokes are necessary:

Press **UTILITIES** to select the UTILITIES menu. You will see RT_{60} listed.

Hold down the **Shift** key and press **PF1** to select RT_{60}.

The PC-40 will prompt, asking you to select a sample time base. You may choose from 1.81 seconds to 10.86 seconds. (If instead you get a prompt at this point that says data is already in memory and will be lost if you continue, see page 16 of this manual under "Allocation of Buffer Memory.") Regardless of the sample time you choose, the PC-40 will take samples at the rate of 100 per second, so accuracy of measurement will not be affected by choosing a long sample time for a short RT_{60} measurement. Resolution of the decay plot will be affected, though, because the entire width of the display screen will be equal to the time base you select. If you, for example, select a time base of 10.86 seconds to measure a filter decay that is less than a half a second, the decay plot will be compressed against the left side of the display. If you chose a 1.81 second window instead, the decay plot would be expanded and much easier to follow visually. It is best, therefore, to choose the shortest time base that will allow for your measurement. Of course, if you choose a time base that is shorter than the decay time you are trying to measure, you won't get complete measurement results.

Following through with our measurement setup, select a time base of 1.81 seconds by pressing the number **1**. The PC-40 will prompt again, asking if you wish octave analysis. If you select **Y** (Yes), the PC-40 will measure RT_{60} in octave bandwidths. If you select **N** (No), the PC-40 will measure decay in 1/3 octave

bandwidths.

For our example, hit **N** to select 1/3 octave band measurements. The PC-40 screen should now look like Figure 3 below.

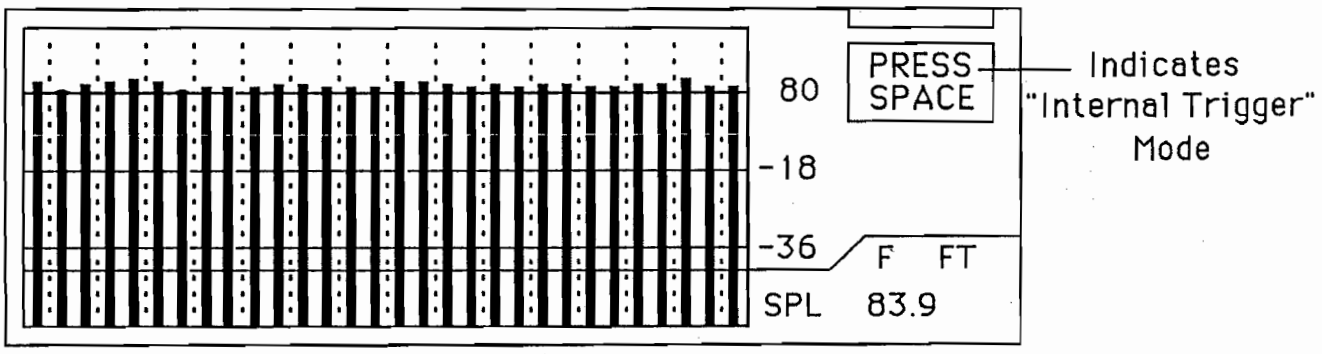


Figure 3

The PC-40 is now ready to make a measurement. If you are not happy with the level of noise showing on the screen, you can adjust the Reference Level, or even adjust the level of noise coming from the noise generator. Once you are happy with the display, press the **Space Bar** to begin a measurement.

The PC-40 Relay will open, turning off the noise (visual indication of the Relay status is provided by the Relay LED indicator - see Figure 2), and the measurement will begin. After a moment, you should get a PC-40 screen that looks something like Figure 4 on page 7. (Your decay curve will likely look different from the one here because the one here has been tailored to make it easier to demonstrate the measurement manipulations possible.)

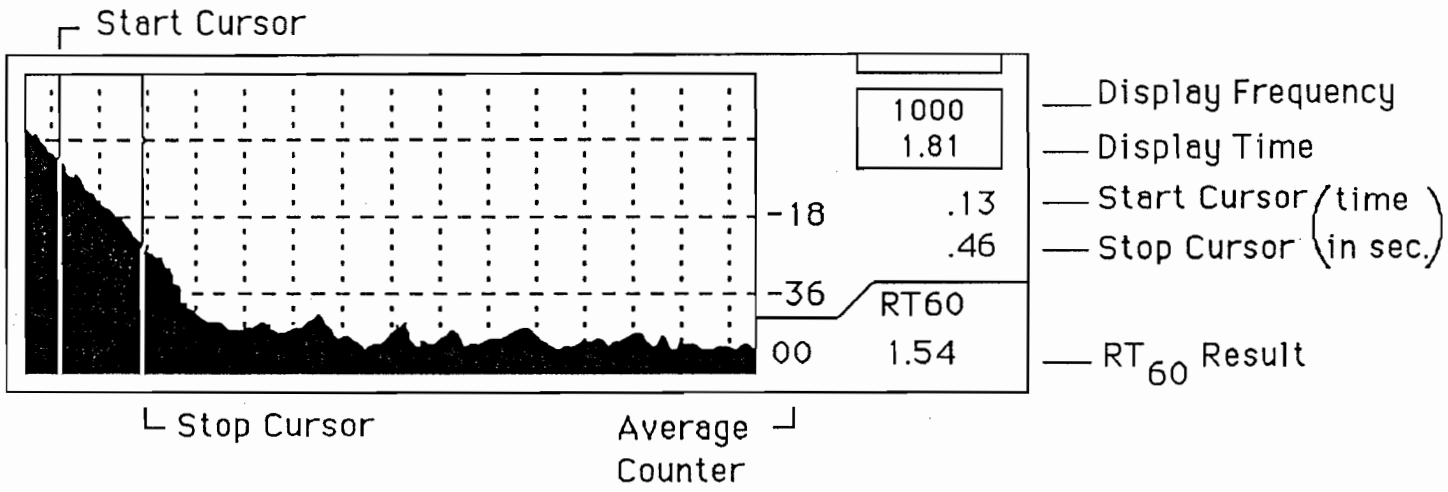
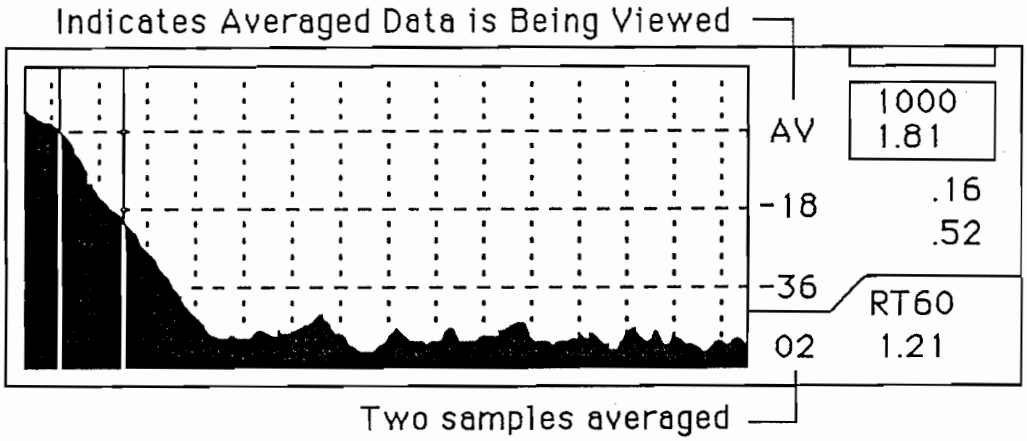


Figure 4

Averaging Several Measurement Samples Together:

If we were going to take several sample measurements to average them together, we would hit the **AVERAGE** button at this point. This would enter all the data from the first measurement into the accumulators and the average counter (See Figure 4 above) would increase by 1. Then, to ready the PC-40 to take another sample, press **STORE**. This would reset the display screen back to its "trigger ready" mode as shown in Figure 3. The pink noise would again come on and we would be ready to take another measurement by pressing the **Space Bar**. Successive measurements could be entered into the averaging accumulators as we continued to follow this same procedure. It is important to note that when averaging samples, the display shown is the display of the last sample taken. In order to view the average of all samples taken, press **V** (for view). This will display the averaged data, and the Average Counter will list the number of samples that have been averaged. In addition, the letters "AV" (for "Average") will appear next to the Message Window to give visual indication that averaged data is being displayed, as shown in Figure 5 on page 8.



Averaging Several Measurement Samples

Figure 5

For our example here, we will not take the time to average several samples. You can easily do that by following the above procedure when making an actual measurement. Instead, let's examine the data shown on the PC-40 screen in Figure 4 on page 7.

Understanding the RT_{60} Display Screen

The PC-40 display shown in Figure 4 on page 7 provides a great deal of information. Firstly, the start and stop cursors are shown selecting a section of decay curve. The Message Window tells us what frequency band we are looking at (in this case, 1000 Hz), and the time window we have selected (in this case, 1.81 seconds).

Below the Message Window, the time location of the start and stop cursors is displayed. Notice that the start and stop cursors, in Figure 4, are at .13 seconds and .46 seconds respectively. Our time references are 0.0 seconds, the left side of our decay display, and 1.81 seconds, the far right side of our display. (You may recall that the time window we selected was 1.81 seconds long. Our display, therefore, shows that exact time window.)

At the bottom, right of the display, the average counter tells us the number of samples we have averaged together to generate our data (In Figure 4, we have not averaged any measurement samples together, so the average counter says 00). Lastly, our RT_{60} calculation is displayed: 1.54 seconds.

We could conclude, then, by looking at Figure 4: after a single sample measurement, the calculated RT_{60}, based on the 20dB of decay from approximately -5dB to -25dB on the decay curve, is 1.54 seconds. This, however, is only the beginning of the information available.

Figure 4 shows the PC-40 "default display." That is, the 1000 Hz bandwidth is shown, the start and stop cursors have selected the ISO (20) measurement (-5dB to -25dB on the decay curve), and the location of the cursors is shown in time. The PC-40 can display the decay curve and calculated RT_{60} for any of the other frequency bands (it measured all the bands simultaneously), it can display ISO (30) automatically (-5dB to -35dB on the decay curve), and it can indicate the location of the cursor wands in dB relative to the Reference Line, as well as in time. Furthermore, you may select any portion of the decay curve you desire, and the PC-40 will calculate RT_{60} over that portion of the curve. Lastly, you may print any decay curve, or get a tabular printout of calculated RT_{60} at every bandwidth. The commands to accomplish all of these are simple.

To change the display from ISO (20) to ISO (30): Hold down the **CTRL** button and hit the "**Up**" arrow key on the PC-40. Your display should then look something like this.

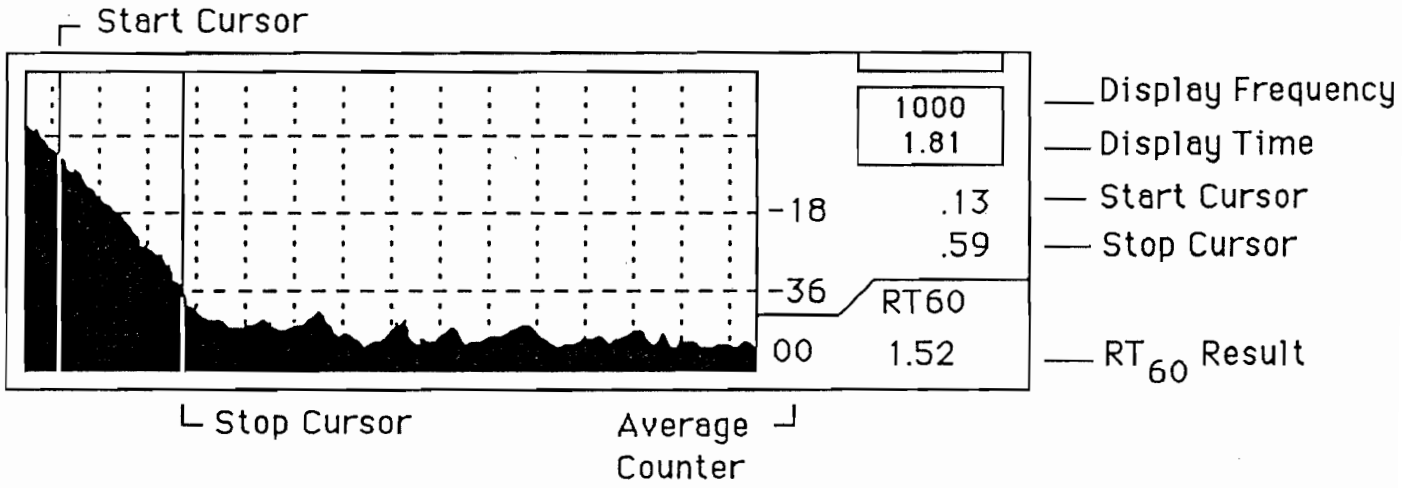


Figure 6

Notice that the start and stop cursors are now located at approximately -5dB and

-35dB, with the stop cursor time and the calculated RT_{60} number having been changed accordingly. To change back to ISO (20), hold down the **CTRL** key and press the "**Down**" arrow key. In this manner, you may toggle back and forth from ISO (20) to ISO (30).

To have the start and stop cursors indicate in dB relative to the Reference Line: Hit the letter **D** (for dB) on the keyboard. Your display should now look something like this.

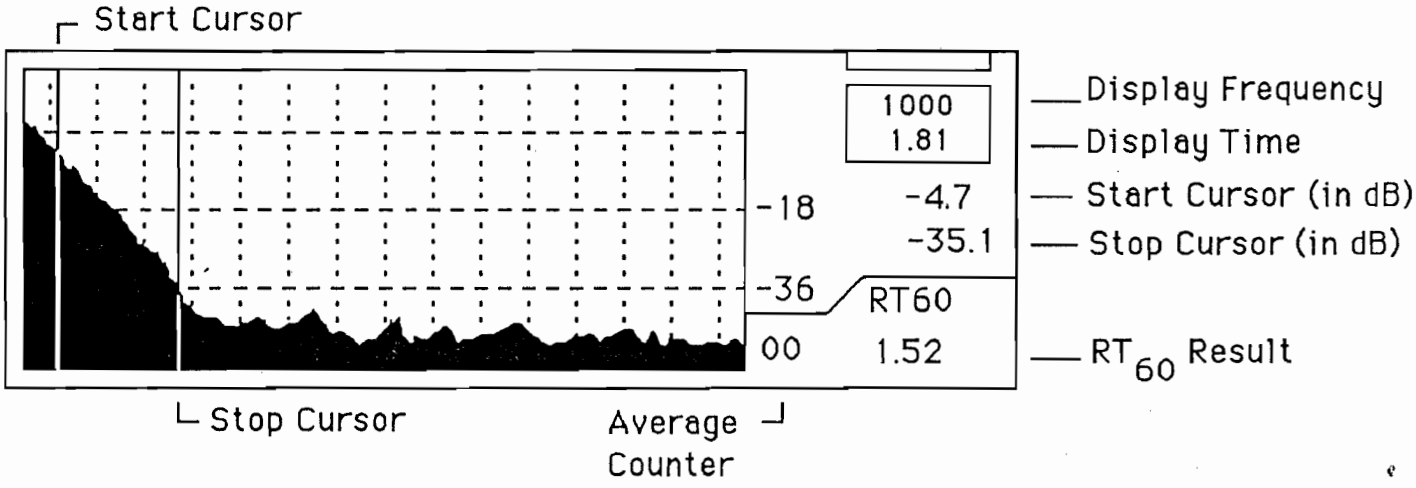


Figure 7

Notice that we are measuring ISO (30), and our start and stop cursors are approximately 30dB apart. ISO (30) measurements specify -5dB to -35dB on the decay curve and the PC-40 will choose values as close to these as possible to locate the start and stop cursors. Notice, however, that the dB locations of the start and stop cursor printed below the Message Window are dB relative to the Reference Line, not relative to the beginning of the decay curve. In our example above, the start cursor is 4.7dB below the Reference Line, which is about 5dB down on the decay curve. (In our example, the decay curve begins almost exactly at the Reference Line.)

To change the display indication of the start and stop cursors from dB back to time: Hit the letter **T** (for time). Hitting the letters **D** and **T**, then, will allow toggling between dB and time when displaying cursor locations.

To display the decay curve from a different frequency band: Hit the "**Up**" arrow key to go up in frequency, and the "**Down**" arrow key to go down in frequency. You will

notice as you do this that the new frequency you have selected appears in the Message Window. The decay curve for that frequency is also displayed automatically, and the calculated RT_{60} is shown as well. The decay curves and RT_{60} information for each frequency band are in the PC-40 memory, and you may step through each band to view any frequency you wish. Let's continue with our example. Press the "**Down**" arrow key and select the 500 Hz bandwidth. After you have done this, you should get a display similar to Figure 8 below.

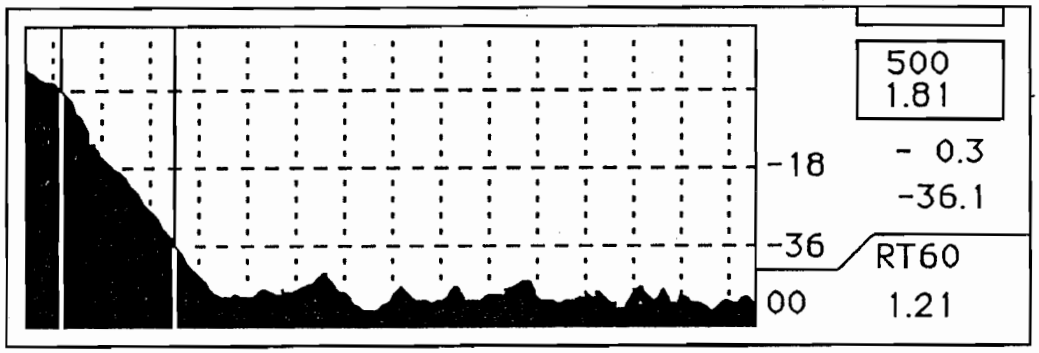


Figure 8

Notice that the start and stop cursors are still in ISO (30) on the new decay curve, and their locations are shown in dB. This is how we left them before we changed frequency bands.

To change the location of the start and stop cursors: The arrow keys are used. To move the start cursor left or right, press the "**Left**" or "**Right**" arrow key. To move the stop cursor left or right, hold down the **Shift** key while pressing the "**Left**" or "**Right**" arrow key. To move both cursors simultaneously, hold down the **CTRL** key while pressing the "**Left**" or "**Right**" arrow key. Once you have selected the section of decay curve you wish with the start and stop cursors, press the "Recalculate" button (**PF5**) to calculate RT_{60} based upon the section on curve you have selected. (You will notice that as soon as you begin to move either the start or stop cursor, the calculated RT_{60} number will disappear from the display. It will not reappear until you have placed the cursors where you want them and then pressed the "Recalculate" button.)

To print out any decay curve: Follow the same procedure as in printing other

screens of information - hold down the **CTRL** button while pressing **PF5**. This will give you a "screen dump" printout, just as in other functions of the PC-40. Of course, you must display the decay curve you want to print out before you can print it.

To print a tabular RT report of all bands measured: Hold down the **CTRL** key and press **P** for "print." The PC-40 will visually step through all the decay curves and print out a tabular report that looks something like the one printed out below. This one is a printout for octave bandwidth measurements, but 1/3 octave measurements would print out in a similar fashion, with all thirty 1/3 octave channels printing out instead of just ten octave channels.

NOV. 18, '88 03:45:09 PM

RT-60 REPORT AFTER 01 SAMPLES

FREQ.	EARLY	ISO (20)	ISO (30)
31.5	1.79	1.55	----
63	1.63	1.51	1.59
125	1.40	1.36	----
250	1.02	0.99	1.00
500	0.98	0.96	0.94
1000	0.85	0.84	0.81
2000	0.76	0.73	0.74
4000	0.69	0.68	0.68
8000	0.65	0.64	0.62
16000	0.61	0.62	0.60

Figure 9

Notice that three RT_{60} numbers are printed for each band: Early Decay, which is calculated from the first 10dB of decay, ISO (20), which is calculated from the -5dB to -25dB section of the decay curve, and ISO (30), which is calculated from the -5dB to -35dB section of the decay curve. If there is not sufficient decay to do an ISO (20) or ISO (30) calculation, dashes ---- will be displayed or printed out.

Once you have completed your measurements, you will want to exit the RT_{60} program and perhaps annotate the file that has been created. To exit the program,

press **UTILITIES**. This will create a condition on the display screen that should be familiar to you - the screen will appear to do a carriage return and a cursor will appear at the bottom of the display to allow you to annotate the RT_{60} file, if you wish. When annotation has been completed, hit Return, and the UTILITIES menu will appear. Pressing **UTILITIES** again will return the system to a real-time function.

Note: Annotating any one decay curve (1000 Hz, for example) will automatically annotate the rest of the decay curves. You need not annotate each curve separately. Annotation will also appear on tabular printouts.

Measuring RT_{60} Using a Blank Pistol or Other External Sound Sources

It may not always be possible to use an existing sound system to make an RT_{60} measurement, so an alternative method is sometimes necessary. A blank pistol is often used, but in smaller rooms, a popped balloon or something similar may be adequate. If this method is used, it is important that the measurement device be turned on at the proper time to begin making the measurement. The PC-40 accomplishes this by "external triggering."

External triggering occurs when measurement is begun by some external means, as opposed to beginning by some means internal to the analyzer (such as pressing the **Space Bar**). The PC-40 uses sound, at a given frequency and amplitude, to trigger the beginning of the measurement process. Both the frequency band used, and the amplitude required to effect triggering are selectable.

No equipment setup is necessary for this method of measuring RT_{60} other than the PC-40 itself. Set it up exactly the same way as described previously in making room measurements using pink noise. Select RT_{60} from the Utilities Menu, select a time window for sample taking, and choose either octave or 1/3 octave bandwidths for measurement purposes. This should bring you to the display shown in Figure 10 on the next page, which is similar to the display you saw in Figure 3, page 6, except that now you will be looking at ambient room noise instead of pink noise.

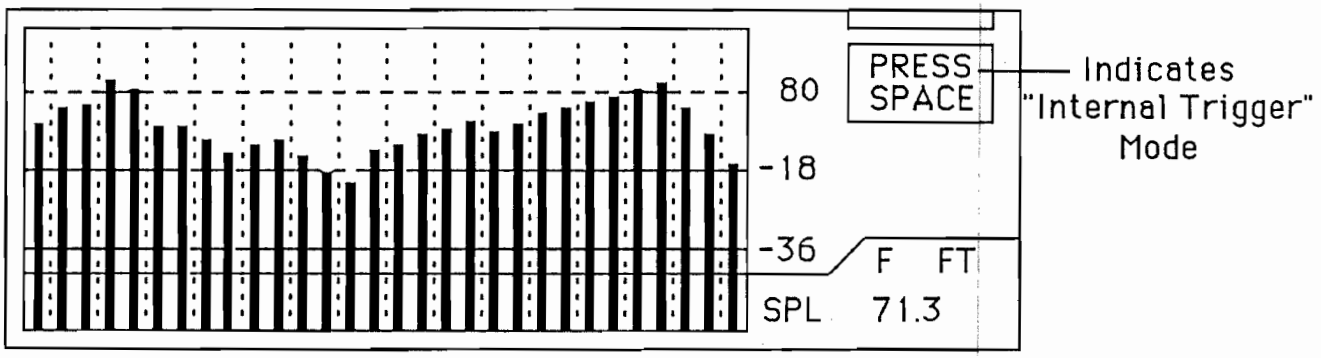


Figure 10

The Message Window says "Press Space" indicating that the PC-40 is in the "Internal Trigger" mode and is waiting for you to press the **Space Bar** to begin a measurement. We must change the PC-40 to "External Triggering." To do this, hit the letter **T** (for trigger) on the keyboard. (Hitting **T** again will toggle the PC-40 back to the "Internal Trigger" mode. Successive presses of the letter **T** will toggle the PC-40 back and forth between "Internal Triggering" and "External Triggering.") The Message Window will change and you will see the "default" frequency band (1000 Hz) and the "default" amplitude (0.0dB, which is equal to the Reference Level) displayed, as shown below.

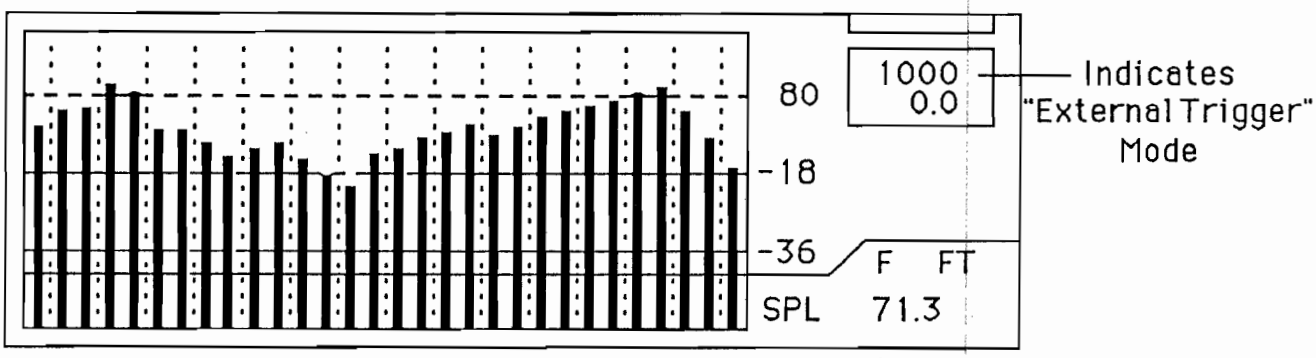


Figure 11

The trigger frequency band and the trigger amplitude may be changed by using the arrow keys. To change the frequency band, use the **"Up"** and **"Down"** arrow keys. To change the trigger amplitude, use the **"Left"** and **"Right"** arrow keys. Once you have selected the desired trigger frequency and amplitude, you are ready for the next step.

The Reference Level must now be properly set. Ambient noise should be far down on the display, or even below the display screen. The blank pistol or balloon generated noise should bring the display up near the Reference Level, high enough to trip the "trigger," but not so high that it drives the display above the PC-40 screen. You may have to experiment by firing the pistol or popping the balloon a time or two to see where the noise registers on the PC-40 display in order to get the Reference Level properly set. Your experimentation may also cause you to want to change the trigger amplitude or the trigger frequency.

After you are happy with your settings - you know that the noise will bring the display up near the Reference Line, and will definitely trip the trigger at the frequency and amplitude you have chosen, you can "arm" the system so that it will make a measurement when the trigger is tripped. Up until this time, you have been able to adjust and experiment without making measurements because the system has not been armed.

To arm the system, press the **Space Bar**. Once this is done, the system will be armed and a visual indication will be provided by inverse video appearing in the Message Window. An armed system display with the proper Reference Level setting will look something like this.

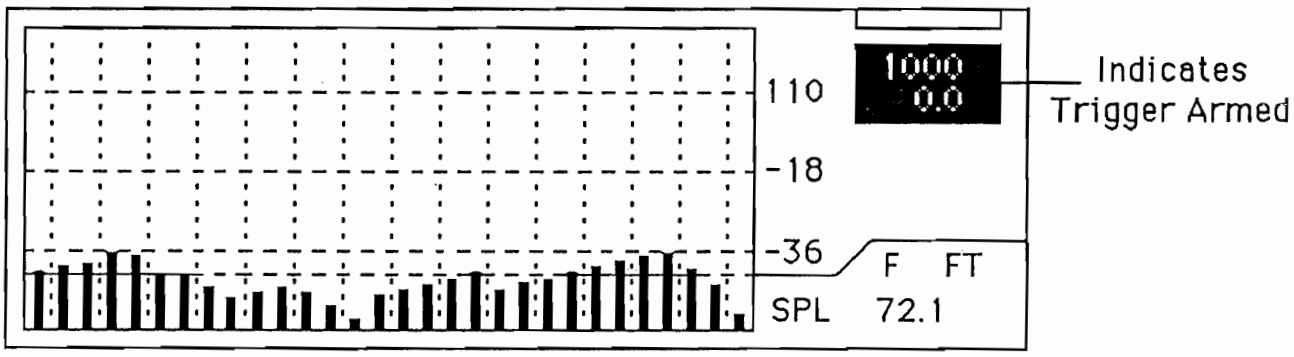


Figure 12

Firing the pistol or popping the balloon will now trip the trigger and a measurement will be made.

The procedures for averaging multiple measurements, manipulating displays, and printing out data is exactly the same as has been previously described for making measurements using pink noise.

Allocation of Buffer Memory and Clearing Files

The RT_{60} program uses the same buffer memory as the Record Function. If you have been using the Record Function and then go to RT_{60}, the PC-40 will prompt, telling you that if you proceed with RT_{60} measurements, data already in the record buffer memory will be lost. The converse is also true, if you have been making an RT_{60} measurement and then enter the Record Function, the same prompt will appear. Just be aware that both functions share some of the same memory, and if you wish not to lose data as you change functions, save that data to another location (RAM disk, external disk drive, etc.).

If you have been making RT_{60} measurements and have quit the program, the data remains in nonvolatile buffer memory. If you enter the RT_{60} program at some later time, the program will return to the same spot where it was terminated. The last display showing at the time of termination will be the display that is recalled. If you wish to continue that same measurement (take some more samples, for example) you may do so - it will be as though you had never quit the program.

However, if you wish to begin a completely new measurement, the data will need to be cleared. To clear all data from the RT_{60} program, hold down the **CTRL** button while pressing **R** (for "Reset"). This will clear the buffer memory and ready the PC-40 to begin a new battery of measurements. If you take a "bad" reading, or want to clear the data from the program for any other reason, this same procedure may be followed. (Please note, however, that all RT_{60} data will be lost, including data that has been averaged.)

Changing the Display Time Base for Data Already Taken

Earlier in this manual we discussed the wisdom of choosing a sample window that would provide maximum visual display of the decay curve. For example, we wouldn't want to choose a very long sample time for a short decay because the decay curve would be compressed against the left side of the display, giving poor visual information.

There is a simple way, however, to change the time base (and, therefore, the resolution) of the display window for data that has already been taken, should we need or want to do so. In other words, if we make the mistake (Heaven Forbid!) of choosing too long a sample time, and get a compressed display, we can expand it

by shortening the display window. To do this, hold down the **Shift** key and press the "**Up**" or "**Down**" arrow keys. This will step the display through the time windows from 1.81 seconds minimum to 10.86 seconds maximum.

Obviously, this cannot create data that is not there. Time windows may only be shortened, they cannot be increased above the time window wherein the measurement was actually taken. (Remember, the sample rate is 100 samples per second, regardless of the time period chosen. 181 samples, for example, are taken over the 1.81 second window, and increasing the time base of the display will not cause the PC-40 to display more than 181 samples.)

Shortening the time base, on the other hand, can be quite useful for visually examining the behavior of the decay curve. Some care should be exercised in noting the position of the start and stop cursors on the display. It is possible, on a long decay time, to keep shortening the time base on the display, which expands the decay curve and moves the cursors to the right, until the cursors have been moved off the screen.

The "Help" Function

As with all other functions of the PC-40, the Help screens contain useful information in making measurements. If you don't have this manual with you, and have forgotten a "command" or "keystroke," don't forget to try the Help screen where a summary of all the keystorke commands is shown. It will probably save you a call to the factory.

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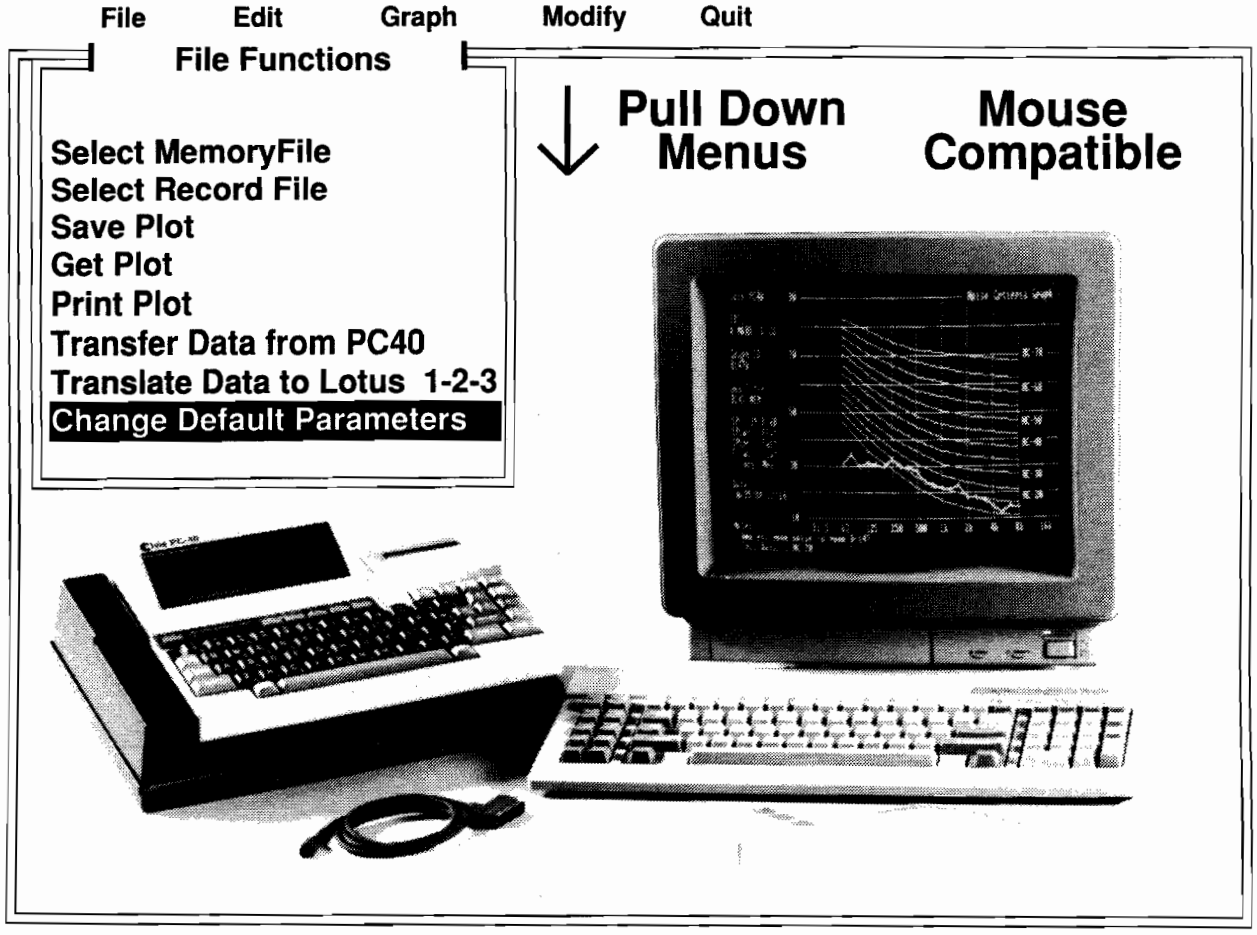
Owner's and Operators Manual for the PC-40 to PC file transfer program



PC40 TO PC Manual Table of Contents

INTRODUCTION

The PC40 to PC file transfer program enhances the utility of the PC40. The portability of the PC40 allows data to be easily gathered and verified in the field. Then, with the help of the *PC40 to PC* file transfer program this data may be brought back into the laboratory for analysis and formal documentation.

Data gathered in the field must be stored as a CPM file, either on the PC40 Ram disk, or on the microcassette or floppy disk drives. Individual memories or blocks of 20 memories may be stored as a file. Data stored in the "RECORD" buffer may also be stored as a file. Refer to the, "Utilities Functions in Depth", section of the PC40 manual for detailed information on saving files.

These files may then be transferred from the PC40 to an IBM® PC or compatible clone. Once transferred, the program allows the files to be viewed in graph and/or tabular form. The graphs may be appended with notes and other pertinent information for purposes of documentation. Noise Criteria and Preferred Noise Criteria overlays may be used with the graphs. Filter weightings of "A" or "C" may be either applied to, or removed from, the octave or 1/3 octave data.

Any graph that has been created with comments or other data may be stored as a graph file for future reference and recall. All graphs may be printed using a standard dot-matrix "Epson Compatible" printer or an "HP laserjet or Thinkjet " compatible printer.

SYSTEM REQUIREMENTS

PC40 with PC-PC program in ROM (Drive C:)
PC40 serial transfer cable. Ivie part #725.

IBM PC® or compatible with:
- CGA color graphics capability with Monochrome or Color monitor
- Serial port (may require a female/female gender adapter for #725 cable)
- Printer port
- Floppy disk drive
- Optional Mouse

Epson Compatible dot matrix printer or HP compatible laser printer
PC40 to PC program on floppy disk. Version 2.4

MANUAL CONVENTIONS

Throughout this manual we will be using the expression **<cr>** (which stands for carriage return). Whenever you see **<cr>** it means you should press a certain key on your computer. Depending upon the labeling of your computer press either the "RETURN", "ENTER" or "Carriage Return" key when you see **<cr>**.

Bold type is used to indicate that you are to enter, via the keyboard the bold printed items, into the computer. You will see text appearing in bold type along with instructions to type the commands into the computer.

SOFTWARE INSTALLATION

As always it is good practice to make a backup copy of all program disks. So take a minute now to make a copy of the *PC40 to PC* program disk. It is not copy protected.

You may run the program directly from the floppy disk or you may install it on your hard drive. There are two files that are required for operation of the program. First, there is the file "PC40.EXE", which is the actual program file. The second file is "PC40.PRM" which contains user supplied preferences or parameters for the program file. These two files must always be in the same directory.

You will notice that there are other files on the disk. These are sample data files of individual memories, memory blocks and record buffer files. You may use these files to become acquainted with the graphing portion of the program. There are batch files that you will use to select the desired print driver for your printer.

FLOPPY DISK OPERATION

Running the program directly from the floppy disk requires no installation. Insert the floppy into the default drive and type **PC40 <cr>.** Remember that **<cr>** means to press the ENTER or RETURN key.

You will see a screen that is blank except for a menu bar at the top of the screen. Please refer to the program operation section of this manual for further details on program operation. To exit the program and return to the DOS prompt, press and hold the ALT key, while pressing the "Q" (for quit) key. Then press the **<cr>** key to return to the DOS prompt.

HARD DISK INSTALLATION/OPERATION

You will need to make a directory for the PC40 program. While in the ROOT directory of your hard drive, type: **MDIR \PC40 <cr>**. Next type **CD PC40 <cr>** to change to the PC40 directory that you have just created. Now place the backup copy of the *PC40 to PC* program disk into the A: drive and type the following command: COPY **A:*.* <cr>** This will copy all of the files on the floppy into PC40 directory on the hard drive.

You may desire to create a sub-directory in which to store the data files transferred from the PC40. This will allow you to keep your PC40 directory uncluttered. You could create a sub-directory for each "job" if desired. Let's say that we wish to create a general sub-directory called "DATA" in which we will store our files. Type: **MDIR \PC40\DATA <cr>**. We will show you how to access this directory from within the file transfer program (see the Change Default Settings menu under the "File" heading).

HARDWARE SETUP

We will assume that your PC has been functioning properly as a computer with CGA graphics and with an Epson Compatible dot matrix printer or HP compatible laser printer.

We need to connect the PC40 to the PC. This is accomplished by using the serial connecting cable for the PC40 (Ivie part #725). The small round end of the cable is connected to the RS-232 connector on the PC40. The flat rectangular end of the cable goes the RS-232 serial or COM port on the PC. Please note that you may need to purchase, from a local source, a DB-25 gender changer (female to female) to allow the cable to match the serial connector on the computer.

Some PCs have only one serial connector while some have more then one. Also a serial connector may already be in use by a mouse. The *PC40 to PC* program will only recognize serial communication ports one and two. So we must use port one or port two for the serial connection between the two computers. The program will automatically look to serial port number one (COM 1) for the file transfer data. You can use port number two (COM 2) if that is more convenient, but when you start the program you will need to tell it to look at port number two. This is accomplished by typing the following when starting the program: **PCEPSON COM2 <cr>** (COM2 stands for Serial Communication Port #2). If you have an available serial port (one or two) connect the #725 cable to it at this time.

What about the computer that has only one serial communications port and that port is currently being used by a mouse? Well, you will need to share the port. If your computer has only one serial port we will assume that this is port number one.

When you wish to make a file transfer, disconnect the mouse and restart the computer by pressing the following three keys at the same time: Control (Ctrl), Alternate (Alt) and Delete (Del). Now the computer will not see the mouse connected to the port as it restarts and will treat it as an available port.

When using serial port one, start the program with the command: **PCEPSON <cr>** . If desired, you may quit the program after all the data has been transferred from the PC40 to the PC, then reconnect the mouse to the serial port and restart the computer as described above. You can then start the program and have full use of the mouse. The PC40 does not need to remain connected to the PC once data has been transferred. The PC40 may then be returned to the field for other measurements.

USING THE PROGRAM WITH OR WITHOUT A MOUSE

The *PC40 to PC* program will support a mouse but does not require a mouse for operation. This program uses a pull-down menu system that lends itself to either mouse or keyboard operation. The keyboard is always active even when a mouse is in use.

Mouse operation

Across the top of the screen are seven menu headers. To gain access to the commands under the headers you must "pull down" on the header to expose the commands below. To "pull down" with a mouse, place the mouse cursor on the desired menu header and click the left mouse button. This will expose all the menu items below that header. To select a particular item, place the mouse cursor over the desired item and then click the left mouse button.

As other windows are opened and menu items are selected, you will need to use the same method of point and click. Some windows have a "close window" marker that if pointed to and clicked upon will close that window without taking any action and return you to the main menu. The "close window" marker is diamond shaped symbol located in the top left-hand corner of the window.

When a graph is displayed on the screen and you wish to return to the main menu, press the left key of the mouse.

There is a special note about using the mouse in the "Graph Comments Input Screen" (found under the FILE menu Add Comments selection). The mouse may be used to place the cursor in any of the fields that you wish to edit. Locate the cursor and then click the left mouse button. Of special note is that when you are finished editing and you wish to leave the screen, you must move the mouse outside and below the "Graph Comments Input Screen" and press the left mouse button.

Keyboard operation

Across the top of the screen are seven menu headers. To gain access to the commands under the headers you must "pull-down" on the header to expose the commands below. To "pull-down" a menu with the keyboard, press and hold the "Alt" key while pressing the first letter of the desired menu item.

For example: To pull down the "File" menu, press and hold the "Alt" key while pressing the "F" key. By the way, you need not worry about capitalization of the letter. The "f" key could be used instead of the "F" key.

Now that the "File" menu has been "pulled-down" you can see all of the commands under this menu header. You will note that the first menu item is highlighted. If you pressed the **<cr>** (Enter or Return) key, that item would be selected. To select other items in the menu use the up and down arrow cursor keys to highlight the menu item of choice. After highlighting your selection press the **<cr>** key to select it.

Once a menu has been "pulled down", there is a shortcut that can be used to select a menu item. You may press the key that corresponds to the first letter of the desired menu item. For Example: To directly select "Get Plot" press the "G" key. Again, capitalization does not matter. If there is more than one menu item with the same first letter, then the first item will be selected with the first press of the key, and the second item will be selected with the second press of the same key and so on. This alphabetical selection shortcut only works in the pull-down menus. It does not work in other windows such as "File Select."

The "Esc" key allows you to return to the main menu from other screens. For Example: When a graph is displayed on the screen, the menu bar at the top of the screen disappears. This allows maximum display area for the graph. To display the menu above the graph, just press "Esc." Remember, "Esc" returns you to the menu. You can also click on left mouse button to display the menu.

PROGRAM OPERATION

STARTING THE PROGRAM

The PC-PC program can support several different types of printers. Ivie has supplied batch files that will automatically install the desired printer driver and start the program if you start the program by using one of the supplied batch files.

Should you start the PC-PC program by typing PC40 you will not be able to print any of the data. You must start the program with a batch file if you intend to print.

Batch files are supplied for the following printers. Epson compatible dot matrix, HP Thinkjet, IBM compatible dot matrix, HP laser printers and user defined printers.

If you have an Epson compatible printer connected to your PC then start the PC-PC program by typing: **PCEPSON <cr>**.

If you have an IBM compatible printer connected to your PC then start the PC-PC program by typing: **PCIBM <cr>**.

If you have an HP compatible laser printer connected to your PC then start the PC-PC program by typing: **PCLASER <cr>**.

If you have an HP Thinkjet compatible printer connected to your PC then start the PC-PC program by typing: **PCHPINK <cr>**.

If your particular dot matrix printer is not listed above then start the PC-PC program by typing: **PCUSER <cr>**. This will start a program that will display a variety of dot matrix printers and prompt you for input about the mixer.

Remember that the program normally uses the first serial port (COM1) to communicate with the PC40. If you are using the second serial port (COM2) then start the program by typing in the name of the desired batch file followed by: COM2.

For example: If you have and Epson compatible dot matrix printer connected to your computer and the PC40 is connected to COM2 then type the following:
PCEPSON COM2 <cr> .

Instructions for operation of the program will be given using examples. The examples will make use of the sample files included on the program disk. An efficient way to become familiar with the program is to follow along on your computer with the example.

SELECTING A MEMORY FILE (under the File menu)
The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled-down you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

If you chose "Select Memory File," you will be shown only files that contain data from the PC40 memories. Files that have the extension of ".MBK" (memory block) contain data from a block of twenty memories. If a ".MBK" file is selected another menu will be shown that will allow you to choose which one of the twenty stored memories you wish to display. Files that have a ".MEM" extension contain only a single memory.

Remember that at the time you saved a file to a disk in the PC40 you were given the choice of storing memories as a complete block of twenty or as an individual (single) memory.

Lets pull-down the "File" menu and select "Select Memory File" by pressing **<cr>**. Next the "File Select" window will appear with two files: DEMO.MBK and DEMO.MEM. Select DEMO.MBK. We will now see a listing of twelve memories on the screen. The remaining memories can be viewed by using the down arrow key to scroll them onto the screen. We can now choose any of the twenty memories by highlighting the desired memory and either clicking on it with the left mouse button or pressing the **<cr>** key.

You will notice that the "NOTE" you appended to the memory at the time of measurement is displayed in the file select window. This is to assist you in choosing which memory to display.

Let's select the memory titled "Singing in the lab isn't pretty." The program will now display the curve on the screen along with other pertinent data. Remember that we can return to the menu by pressing the "Esc" key or the left button on the mouse.

Selecting a single memory file (".MEM") follows the same process as above with exception that you will not be shown a second screen from which to choose one of twenty memories.

The above example continues with the next section of this manual. In preparation, return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

Now that we have retrieved a file, we can perform some operations on the graph of that file.

EDIT (Main menu item)

The "EDIT" menu allows you to edit the graphic and tabular data.

ADD COMMENTS (Under the EDIT Menu)

The "Add Comments" heading under the "Edit" menu allows you access to the written data located to the left and bottom of the graph screen.

If you wish to add, delete, or modify the documentation of a graph, select the "Add Comments" function from the "Edit" menu. Let's try an example. Select the "Singing in the lab isn't pretty" memory from the "DEMO.MBK" file. After it is up on the screen, return to the menu (press "Esc or click left mouse button) and select "Add Comments" from the "Edit" menu.

You are now looking at all the data, notes, file name and comments that appear on the screen with the graph. You can now modify this documentation. The first two lines at the top of the screen allow you to enter your own company name so that it will appear on the graph. The two lines for the company name will accept up to fourteen characters. Editing is done with the cursor and backspace keys. All editing is done in the overwrite mode. Keyboard entries will overwrite the existing data.

It is important to note that all original data contained in the ".MEM", ".MBK" or ".REC" files will remain unchanged as all editing is performed only on the screen display.

You will note that the default company name is "IVIE TECHNOLOGIES." This name will always appear on every graph screen unless you change the default setting. This can be done under the "File" menu with the "Change Default Parameters" function. Detailed information on how to do this is in the "Change Default Parameters" section of this manual.

With the "Graph Comments Input Screen" displayed, overwrite "IVIE TECHNOLOGIES" with your own company name. To view the changes, press the "Esc" key or move the mouse outside of the "Graph Comments" window and press the left mouse button. You should now be looking at the graph with your company name.

Now return to the "Graph Comments Input Screen" by returning to the menu and selecting "Add Comments" under the "Edit" menu. As you edit any field, the computer will only allow you to enter a limited number of characters per field. Any field that appears on the "Graph Comments Input Screen" may be edited. There are three lines of notes that may be entered below the word "Notes." Each of these three lines may have up to seventy-five characters.

Go ahead and experiment by editing some notes on the screen and then viewing the results on the graph screen. Remember that by pressing the "Esc" key or the left mouse button you will return to the graph screen.

The above example continues with the next section of the manual. In preparation return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

SHOW TABULAR (Under the EDIT Menu)
Another function under the "Edit" menu is "Show Tabular." This function allows the data of the currently displayed graph to be shown in tabular form. When the function "Print Tabular" is exercised this data will be sent to the printer as formated on the "Show Tabular" screen.

If you are following along with the above example, select the "Show Tabular" function at this time so that you may view the tabular data. When ready, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

PRINT TABULAR (Under the EDIT Menu)
The tabular data that can be viewed by the "Show Tabular" menu item, may be sent to the printer using the "Print Tabular" function. Before selecting this function make certain that the printer is connected to the computer and is "on line" ready to print.

The tabular data that will be printed is from the currently displayed graph. Modifications to the curve, such as "A" or "C" weighting, will be reflected in the tabular data printout.

If you are following along with the above example, select the "Print Tabular" function at this time so that you may print the tabular data. Make certain that a printer is connected to the computer and is ready to print. When finished printing, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

The above example continues with the next section of this manual. In preparation, return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

Edit Curve (Under the EDIT Menu)
The "Edit Curve" menu selection allows you to alter or edit the individual data points on any displayed curve. If two curves are displayed you will be prompted for which curve you wish to edit. You then select either curve one or curve two, or if desired you may exit this operation by selecting the "Cancel" box.

A pop-up window will appear on screen displaying the numerical data for the selected curve. The data points will be labeled with the frequency. An asterisk beside a frequency label reminds you that the frequency is an octave band center.

To edit, just type in the new data being sure to type in the decimal point as well. Use the TAB key to move to the next data field or just click on the new field with the mouse. The SHIFT TAB will allow you move back through the previous data fields.

There is a "Filter Offset" box that allows a value to be added to, or subtracted from, all filters at the same time. This is very handy if you are trying to lay one curve over top of another curve. For example: you could shift the entire curve up by 10 dB by entering the value of 10.0 into the filter offset box. If you desired to shift the curve down by 10 dB you need to enter a minus sign before entering the value of 10.0.

At any time you can elect to accept the data and exit or to exit the window without making any changes to the curve.

Please note that any changes made to the displayed curve do not change the original data stored on the disk. If you wish to keep any changes made in the displayed data you will need to store the modified curve using the "SAVE PLOT" function found under the "FILE" main menu.

Create 1/3 Curve (Under the EDIT Menu)
This function allows you to create a custom 1/3 octave curve by allowing you to enter in your own data points for the curve.

A pop-up window will appear on screen prompting you to enter the numerical data for your curve. The data points will be labeled with the frequency. An asterisk beside a frequency label reminds you that the frequency is an octave band center.

Type in the new data being sure to type in the decimal point as well. Use the TAB key to move to the next data field or just click on the new field with the mouse. The SHIFT TAB will allow you move back through the previous data fields.

There is a "Filter Offset" box that allows a value to be added to, or subtracted from, all filters at the same time. This is very handy if you are trying to lay one curve over top of another curve. For example: you could shift the entire curve up by 10 dB by entering the value of 10.0 into the filter offset box. If you desired to shift the curve down by 10 dB you need to enter a minus sign before entering the value of 10.0.

At any time you can elect to accept the data and exit or to exit the window without making any changes to the curve. *If you wish to keep any changes made in the displayed data you will need to store the modified curve using the "SAVE PLOT" function found under the "FILE" main menu.*

Create Oct Curve (Under the EDIT Menu)
This function allows you to create a custom octave curve by allowing you to enter in your own data points for the curve.

A pop-up window will appear on screen prompting you to enter the numerical data for your curve. The data points will be labeled with the frequency. An asterisk beside a frequency label reminds you that the frequency is also an octave band center.

Type in the new data being sure to type in the decimal point as well. Use the TAB key to move to the next data field or just click on the new field with the mouse. The SHIFT TAB will allow you move back through the previous data fields.

There is a "Filter Offset" box that allows a value to be added to, or subtracted from, all filters at the same time. This is very handy if you are trying to lay one curve over top of another curve. For example: you could shift the entire curve up by 10 dB by entering the value of 10.0 into the filter offset box. If you desired to shift the curve down by 10 dB you need to enter a minus sign before entering the value of 10.0.

At any time you can elect to accept the data and exit or to exit the window without making any changes to the curve. *If you wish to keep any changes made in the displayed data you will need to store the modified curve using the "SAVE PLOT" function found under the "FILE" main menu.*

MODIFY (Main menu item)

There are several modifications that may be made to any displayed curve. A curve may be modified to reflect "A" ,"C", or "Flat" weighting. Also a second curve may be added to the graph if desired. Modify also allows the difference between two curves to be displayed.

It should be noted that modifications to the curve do NOT affect the sound pressure level data. The SPL data is not derived from the the octave or 1/3 octave data but comes from its own detector at the time of measurement. Weighting of the SPL measurement can not be changed after the measurement has been taken.

A-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "A" weighting by selecting this function. If the curve is either "Flat" or "C" weighted it will be changed to "A" weighting. The graph will then be re-drawn to refect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

C-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "C" weighting by selecting this function. If the curve is either "Flat" or "A" weighted it will be changed to "C" weighting. The graph will then be re-drawn to refect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

UN-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "Flat" weighting by selecting this function. If the curve is either "A" or "C" weighted it will be changed to "Flat" weighting. The graph will then be re-drawn to reflect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

If you are following along with the above example, select one of the modify functions at this time so that you may view the effect on the curve. When you are ready, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

Add Second Curve (Under the Modify menu)

A second curve may be plotted along with the first curve for purposes of comparison. When you use this function you will be brought back to the main menu so that you may access the "File" menu. When you pull down the "File" menu you will notice that only the "Select Memory File" and "Select Record File" functions are active. You would then go through the same selection process as you did for the first curve.

Because the first curve selected sets the display range of the graph, some thought should be given in advance as to which curve will be plotted first.

As with the first curve that was plotted, the second curve will be plotted with a data marker at all data points. However, a different style of data marker will be used to help differentiate between the two curves.

If you are following along with the above example, select the "Add Second Curve" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

Delete Second Curve (Under the Modify menu)
This function will cause the currently displayed graph with two curves to be redrawn without displaying the second curve. This will delete the second curve and restore the graph to just one curve.

If you are following along with the above example, select the "Delete Second Curve" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

Curve minus Curve (Under the Modify menu)
This function allows you to compare the difference between two curves that have been displayed on the screen. You must display two curves on screen before you can use "Curve minus Curve."

Upon selecting "Curve minus Curve" a pop-up window will appear on the screen. You will then given the choice of subtracting curve number one from curve number two or vice versa. Your selection will then be displayed on the graph. You can exit the "Curve minus Curve" window without performing any operation by selecting the "Cancel" box.

If you wish to once again view both curves after using "Curve minus Curve", go to the "GRAPH" menu and select "Normal."

GRAPH (main menu item)

The curve may be displayed in one of five different graph formats.

Normal (Under the Graph menu)
Normal is normal. This is the standard amplitude versus frequency graph displayed as a line graph. This is the default graph display. The graph will automatically set the display range according to the data being displayed. Also the graph will be set for octave or 1/3 octave display to match the data in the file.

Each data point is emphasized on the screen. A connecting line is drawn between adjacent data points. At times there may be a data point that does not have an immediate adjacent data point due to the constrictions of dynamic range (a filter may be below the invalid data line). When this happens, a connecting line is not drawn to or from that point. To do so would infer (visually) that data which does not exist; exists. To return to the menu from the graph press either the "Esc" key or the left mouse button.

NC (Under the Graph menu)
Noise Criteria provides a means whereby ambient noise levels in rooms may be quantified. A reading of the noise in the room is made in octave bands. The NC overlay is then used determine the NC rating for the room.

When this graph function is selected, an overlay appears on the screen over the normal graph. Also the NC rating for the curve is calculated and displayed on the screen. The overlay is an integral part of the plot, and will appear along with the curve when the "Print" or "Save Plot" functions are used. To return to the menu from the NC graph function press either the "Esc" key or the left mouse button.

If you are following along with the above example, select the the "NC" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

PNC (Under the Graph menu)
Preferred Noise Criteria provides a means whereby ambient noise levels in rooms may be quantified. PNC and NC are related to one another in that PNC is a second generation NC curve. You will notice that different weightings are applied to the noise spectrum by the two curves. The PNC curves were developed after the NC curves.

A reading of the noise in the room is made in octave bands. The PNC overlay is then used to determine the PNC rating for the room.

When this graph function is selected an overlay appears on the screen over the normal graph, and the PNC rating for the curve is calculated and displayed on the screen. The overlay is an integral part of the plot, and will appear along with the curve when the "Print" or "Save Plot" functions are used.

To return to the menu from the PNC graph function press either the "Esc" key or the left mouse button.

If you are following along with the above example, select the the "PNC" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

NR (Under the Graph menu)
NR is a means whereby ambient noise levels in rooms may be quantified. You will notice that NR is very similar to NC and PNC. NR is the standard utilized in Great Britain.

A reading of the noise in the room is made in octave bands. The NR overlay is then used to determine the NR rating for the room.

When this graph function is selected an overlay appears on the screen over the normal graph, and the NR rating for the curve is calculated and displayed on the screen. The overlay is an integral part of the plot, and will appear along with the curve when the "Print" or "Save Plot" functions are used. To return to the menu from the NR graph function press either the "Esc" key or the left mouse button.

If you are following along with the above example, select the the "NR" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

NIC (Under the Graph menu)
NIC requires that two graphs be displayed before you select NIC. These graphs would be the "send" and "receive" measurements made on opposing sides of a wall or partition. The NIC calculation will be made and displayed on the screen along with the overlay.

Detailed NIC data may be viewed by selecting the Show Tabular menu found under the Edit pull-down menu. The the tabular data may be printed by selecting the Print Tabular menu.

Label (Main menu item)

With the PC to PC program you can place labels anywhere on the graphics screen. This provides great flexibility in documenting your data. Once the label is "typed in" you can position it with either the mouse or by using the cursor keys. The resolution of the placement is confined to column and row spacing of text characters.

Add Label (Under the Label menu)
Upon selecting "Add Label" a pop-up window will appear on screen and will prompt you to input your text for the label. You can enter a single line of up to sixty characters. After entering the label text, press **<cr>.**

Now position the the label as desired. Once the label is in position either click the left mouse button or press **<cr>** to anchor the label at that location.

You can exit the pop-up text input window, without generating a label, by either clicking on the diamond symbol in top left hand corner of the window or by pressing the Esc key.

Should you need to reposition the label after it has been set in place, you will need to delete it and then re-enter the label again.

Delete Label (Under the Label menu)
You can delete any label by selecting selecting Delete Label. A pop-up window will appear on the screen with a listing of all the labels currently on the screen. Select which label you wish to delete by clicking on it with the mouse or by using the cursor keys. If you are using a mouse the label will be deleted at the time you select it. When using the cursor keys to highlight a label, you will need to press the **<cr>** key to delete it.

You can exit the pop-up text delete label window, without deleting a label, by either clicking on the diamond symbol in top left hand corner of the window or by pressing the Esc key.

At this point we would like to conclude our example/demonstration of the PC40 program.

File (main menu item)

The "File" menu contains those functions that allow us to retrieve and save various files. We can select files for viewing that we have transferred from the PC40. We can also select files that we have created and saved as completed graphs.

The "File" menu also contains the utilities for the program. These utility functions include: Printing, File transfer, and setting program default parameters.

Select Memory File (under the File menu)

The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled down, you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

If you choose "Select Memory File" you will then be shown only files that contain data from the PC40 memories. Files that have the extension of ".MBK" contain data from a block twenty memories. If a ".MBK" file is selected you will then be shown another menu that will allow you to choose which one of the twenty stored memories you wish to display. Files that have a ".MEM" extension contain only a single memory.

Remember that at the time you saved a file to a disk in the PC40 you were given the choice of storing memories as a complete block of twenty, or as an individual (single) memories.

Lets pull down the "File" menu and select "Select Memory File". Next the "File Select" window will appear with two files: DEMO.MBK and DEMO.MEM. Select DEMO.MBK. We will now see a listing of fourteen memories on the screen. The other six of the twenty memories can be viewed by using the down arrow key to scroll them onto the screen. We can now choose any of the twenty memories by highlighting the desired memory and either clicking on it with the left mouse button or pressing **<cr>** key.

Lets select the memory titled "Singing in the Lab isn't pretty". The program will now display the curve on the screen along with other pertinent data. Remember that we can return to the menu by pressing the "Esc" key or the left button on the mouse.

Selecting a single memory file (".MEM") follows the same process as above with exception that you will not be shown a second screen from which to choose one of twenty memories.

Select Record File (under the File menu)

The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled down you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

The "Select Record File" function provides access to any PC40 Record Buffer files that have been transferred to the PC. All Record Buffer files are saved with a file extension of ".REC." When you choose "Select Record File" you will be presented with a new window titled "Select File," with all record files shown in the window.

Should you need to exit this window without selecting a file you can do this by either pressing the "Esc" key or by placing the mouse over the diamond symbol located at the top left-hand corner of the window and pressing the left mouse button.

To select a file, highlight the desired file by using the mouse or the cursor keys. Once the desired file is highlighted, select it by pressing the **<cr>** key or the left mouse button.

Once a file is selected another screen will appear displaying the name of the file selected along with the number of frames in the file. You will also be prompted for the frame number that you wish to view. After you enter the frame number press the **<cr>** key. The frame will be displayed in the normal graph manner. The graph may then be modified or edited as desired.

SAVE PLOT (under the File menu)
The "Save Plot" function allows you to save to the disk, the currently displayed plot or graph. After you have recalled a memory or record file and modified or edited the graph you can save all of your changes to a new file. This new file will have a ".GRF" (for graph) extension on its file name and is a completely different file from the memory or record file. The original memory or record data file remains totally unchanged.

When you select the "Save Plot" function another screen will appear, prompting you to enter a name for the new Plot file. The name of the currently displayed memory or record file will be shown where you are to enter the file name. You need not enter a new file name if you do not desire to do so. You may elect to use the same file name for the Plot as is used for the data file. To do this just press **<cr>** (the Enter or Return key) and the Plot file name will be the same as the data file name, but with a ".GRF" extension in place of the ".MBK", ".MEM" or ".REC" extension.

A new or different name may be assigned to the file by typing in the desired file name. A file name may have a maximum of eight characters. The program will not allow you to type the file extension. The file will automatically assign the ".GRF" extension to the file name.

If you assign a file name that is already in use, the program will prompt you with another screen informing you that a file already exists using that file name. You will then be prompted to either overwrite the existing file, rename the file you wish to write, or abort the entire procedure.

The "Save Plot" function is not available for use until after a graph has been displayed on the screen. This, of course makes sense in that you cannot save a plot to disk if a plot does not exist.

If you were to examine the "File" menu when first entering the program, you would notice that the "Save Plot" and "Print Plot" functions would be displayed in a different screen attribute than the other headings. This denotes that they are not available at this time. After a plot has been displayed, the screen attributes of these two functions will change to have the same screen attributes as the other functions.

GET PLOT (under the File Menu)
The "Get Plot" function allows you to retrieve and display files that have been saved using the "Save Plot" function. When you choose "Get Plot" you will be presented with a new window titled "Select File" which will display a listing of all files with a ".GRF" extension.

Should you need to exit this window without selecting a file you can do this by either pressing the "Esc" key or by placing the mouse over the diamond located in the top left-hand corner of the window and pressing the left mouse button.

To select a file, highlight the desired file by using the mouse or the cursor keys. Once highlighted, select it by pressing the **<cr>** key or the left mouse button.

Print Plot (under the File menu)

The "Print Plot" function sends the currently displayed graph to the printer for printing.

Please note that a printer driver MUST be installed before any printing can occur. The appropriate driver will be installed automatically when you start the program from one of the supplied batch files.

For more information on installing the printer driver please refer to the " **STARTING THE PROGRAM"** section of this manual.

TRANSFER DATA FROM PC40 (under the File menu)

Please note: You must save the memories in the PC40 to a CPM computer file before they can be transferred to the PC. This is done by using the SAVE function in the Utilities section of the PC40. Typically you would save a block of 20 memories to the "A" drive, which is the RAM disk.

There are two programs that must be run at the same time in order to effect a file transfer. One is on the PC40 and other is on your personal computer. The two computers must be connected as described in the hardware set up section of this manual.

Start the program on the PC40 first. Turn the PC40 ON and while in the normal analyzer mode press the red QUIT button. You will now see a listing of programs on the C: or ROM drive. Use the cursor (arrow) keys to highlight the program "PC-PC BAS." Now press the red RETURN key. The program will run and provide you with the message on screen "Waiting for link." The PC40 is now ready to send files to the PC.

Now start the program in the PC by typing name of the desired batch file. The name of the batch file should describe the type of printer that you have connected to you PC.

The screen on the PC will now display the following:

"Opening COM1 for Link with PC40" (note : it may say COM2 in lieu of COM1)
"Attempting Link with PC40"

Once the link is established the screen will be updated to display:

"Opening COM1 for Link with PC40"
"Attempting Link with PC40 - Link Established"
"Enter PC40 File Specification for Directory A:*.M??"

You are now being prompted to enter a file specification. The program wants to know from what source and what types of files you wish to display. The source of the file is determined by the drive, and the type of file is determined by the extension of the file. Remember that files may be stored on any of the drives listed below.

Specification	Drive type
A:	RAM disk
D:	Floppy disk drive
E:	Floppy disk drive
F:	Floppy disk drive
G:	Floppy disk drive
H:	Microcassette drive

You will notice that there is a default file specification loaded into the prompt. If you pressed the **<cr>** key, at the prompt, the program would act upon this specification A:*.M??." Lets take a moment and examine the default file specification.

The "A:" specifies that we want to read the directory of files on the RAM disk (on the PC40) which is disk drive "A:". The "*.M??" specifies what type of files we want to view in the file directory. Remember we have three different types of files as listed below.

File Extension	Type of File
".MBK"	Memory Block of 20 memories
".MEM"	Single memory
".REC"	Record Buffer file

The "*.M??" makes use of what is called wildcard characters in the file specification process. The "*" means give me any file name with the following extension. The extension ".M??" means give me all file names with extensions that have the letter "M" as their first letter. The "??" hold the place for the other two letters in the extension and are also wildcards. So the file specification "A:*.M?? will request the directory of ALL files (regardless of their file name) on the "A:" drive that have a ".MBK" or ".MEM" extension.

You may use the default file specification by pressing the **<cr>** key or you may enter your own specification by typing over the default spec. A spec of "*.*" will allow you to view all available files. A spec of "*.REC" will show you only the record buffer files.

This shows you a directory of file names that meet your specification and does not actually transfer any files. These files will be displayed in the "File Directory" window on the PC.

Once in the PC40 File Directory window you can select which file you would like to transfer to the PC. You select the file by highlighting it with either the mouse or cursor keys and pressing the **<cr>** key or left mouse button. You will notice a file called "ALL Files" in the window. This allows you to transfer all the files in the directory with one command.

Once an individual file or "ALL Files" has been requested, the screens of the PC40 and PC will display the progress of the transfer process. After a file is transferred, the PC will again show you the PC40 file directory window so that you may select another file to transfer. If you are finished transferring files, then press either the "Esc" key or click the mouse on the close window symbol to return to the main menu.

To return the PC40 to the analyzer mode, press the red **QUIT** button to quit the transfer program. You should now see a screen with a listing of programs in the various drives. The program "C:PC40Vxx COM"(xx varies with release #) should be highlighted. This is the program that runs the computer as an analyzer. With the "C:PC40Vxx COM" program highlighted, press the **<cr>** (Return) key start the analyzer.

What happens when you press the red **QUIT** button and you do not return to the screen that was described above. Instead you see something like "DT Error in 30" followed by the prompt "Ok." If at anytime you see a screen that you are not familiar with, and it has the word "Ok", you are in the BASIC programming section of the computer. The PC40 portion of the file transfer program is written in BASIC.

The way to exit BASIC is to type in the word **System** and press **<cr>**. This will return you to the screen displaying "C:PC40Vxx COM". Now press the **<cr>** key once more to start the analyzer.

The PC40 may be disconnected from the PC at this time. The PC40 is no longer needed by the PC.

Change Default Parameters (under the File menu)

There are two default parameters that can be set by the user. These parameters are stored in a file called "PC40.PRM" This file must always be in the same directory as the "PC40.EXE" program.

When this function is selected you will see the following information displayed in the window:

Current Path Spec to IBM Data Directory=
Enter New Path for IBM Data Directory- (a flashing cursor will appear here)

Notice that the space after "Current Path Spec to IBM Data Directory=" is blank. This indicates that it is currently set to the same directory as the "PC40.EXE" program. Any time the program looks for a file or goes to store a file it will look at the directory that contains the "PC40.EXE" program. We will call this the default directory.

The sample files that came with the software are stored in the default directory. If you change the default directory and you wish to access these files you should copy them over to the new directory.

Now, what about the flashing cursor at the end of the prompt:

Enter New Path for IBM Data Directory- (a flashing cursor will appear here)

If you press the <cr> key without entering a new path, then nothing will be changed. The default directory will remain unchanged. Lets say that you wish to store and retrieve your data files from a sub-directory, under the "PC40" directory. You wish to do this so as not to clutter your PC40 directory. We will assume that you have already created a sub-directory called "Data" using the DOS command **MDIR\PC40\DATA <cr>.** Then, at the prompt, type the following:

Enter New Path for IBM Data Directory-**\PC40\DATA <cr>**

Now every time the program does anything that requires a file, it will only act upon files found in the \PC40\DATA directory. It will not know about any other files located in any other directories. You could create a separate sub-directory for each job that you perform.

Keep in mind that in order to use a different sub-directory two things must take place. First you must create a sub-directory in DOS for the data. And second, you must tell the PC-PC program about the new directory using the "Change Default Parameters" function.

Once you have taken care of the Directory prompt, you will see the next prompt:

Current Company Name 1=Ivie
Enter New Company Name 1 - Ivie (with a flashing cursor over the "I")

Unless you want Ivie's name to appear on all of your graphs, type in the name of your company. The "Name 1" line will accept up to fourteen characters. There is also a "Name 2" line that will also accept fourteen characters, so don't worry if your company name will not fit on "Name 1" line.

After entering the name of your company, press the **<cr>** key. You will now see the prompt:

Current Company Name 2= Technologies
Enter New Company Name 2 - Technologies
(with a flashing cursor over the "T")

If a second line is needed for your company name, enter it at this time. If you wish to have this line appear blank on the screen then enter a series of spaces to overwrite the existing name. Now press the **<cr>** key.

At this point the program will save the default parameters that you have entered in the "PC40.PRM" file. The program will then refer to this file any time file or company name information is required.

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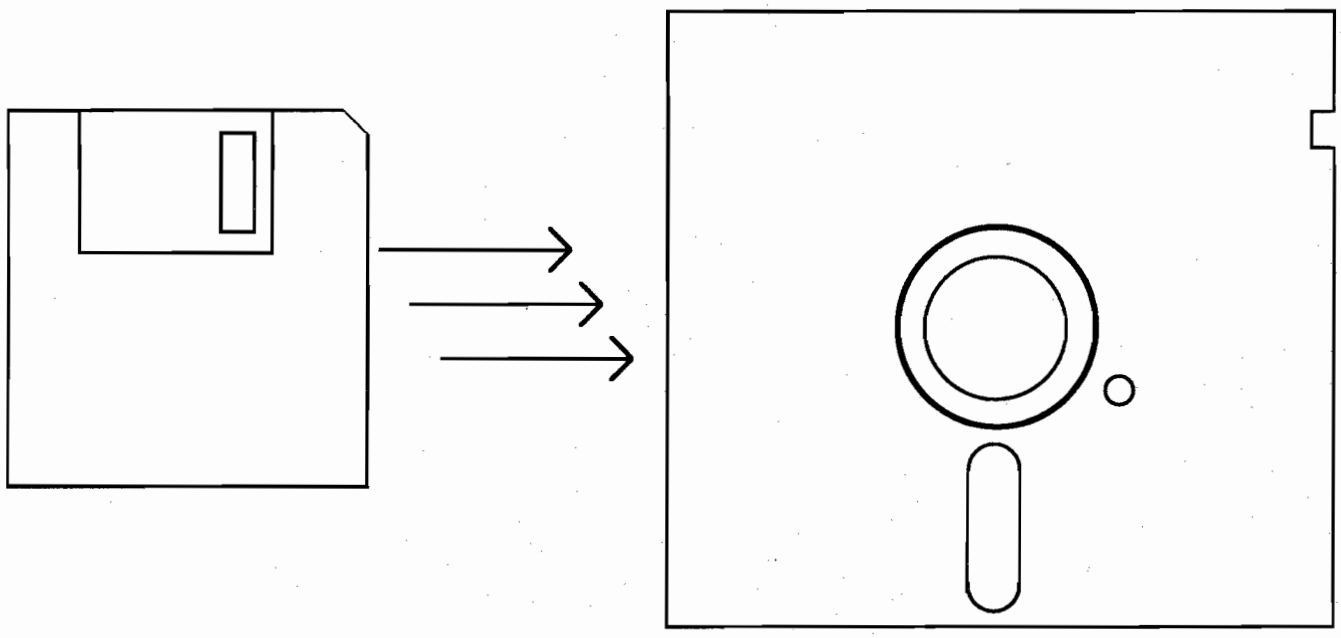
Owner's and Operators Manual for the

PC-40 to PC file transfer program



PC40 TO PC Manual Table of Contents

INTRODUCTION

The PC40 to PC file transfer program enhances the utility of the PC40. The portability of the PC40 allows data to be easily gathered and verified in the field. Then, with the help of the *PC40 to PC* file transfer program this data may be brought back into the laboratory for analysis and formal documentation.

Data gathered in the field must be stored as a file, either in the PC40 Ram disk, or on the microcassette or floppy disk drives. Individual memories or blocks of 20 memories may be stored as a file. Data stored in the "RECORD" buffer may also be stored as a file. Refer to the, "Utilites Functions in Depth", section of the PC40 manual for detailed information on saving files.

These files may then be transferred from the PC40 to an IBM® PC or compatible clone. Once transferred, the program allows the files to be viewed in graph and/or tabular form. The graphs may be appended with notes and other pertinent information for purposes of documentation. Noise Criteria and Preferred Noise Criteria overlays may be used with the graphs. Filter weightings of "A" or "C" may be either applied to, or removed from, the octave or 1/3 octave data.

Any graph that has been created with comments or other data may be stored as a graph file for future reference and recall. All graphs may be printed using a standard dot-matrix "Epson Compatible" printer .

SYSTEM REQUIREMENTS

PC40 with PC-PC program in ROM (Drive C:)
PC40 serial transfer cable. Ivie part #725.

IBM PC® or compatible with:
- CGA color graphics capability with Monochrome or Color monitor
- Serial port (may require a female/female gender adapter for #725 cable)
- Printer port
- Floppy disk drive
- Optional Mouse

"Epson Compatible printer"
PC40 to PC program on floppy disk.

MANUAL CONVENTIONS

Throughout this manual we will be using the expression **<cr>** (which stands for carriage return). Whenever you see **<cr>** it means you should press a certain key on your computer. Depending upon the labeling of your computer press either the "RETURN" or "ENTER" key when you see **<cr>**.

Bold type is used to indicate that you are to enter, via the keyboard the bold printed items, into the computer. You will see text appearing in bold type along with instructions to type the commands into the computer.

SOFTWARE INSTALLATION

As always it is good practice to make a backup copy of all progam disks. So take a minute right now to make a copy of the *PC40 to PC* program disk. It is not copy protected.

You may run the program directly from the floppy disk or you may install it on your hard drive. There are two files that are required for operation of the program. First, there is the file "PC40.EXE", which is the actual progam file. The second file is "PC40.PRM" which contains user supplied preferences or parameters for the program file. These two files must always be in the same directory.

You will notice that there are other files on the disk. These are sample data files of individual memories, memory blocks and record buffer files. You may use these files to become acquainted with the graphing portion of the program. These files are not necessary to the operation of the program and may be erased if desired.

FLOPPY DISK OPERATION

Running the program directly from the floppy disk requires no installation. Insert the floppy into the default drive and type **PC40 <cr>.** Remember that **<cr>** means to press the ENTER or RETURN key.

You will see a screen that is blank except for a menu bar at the top of the screen. Please refer to the program operation section of this manual for futher details on program operation. To exit the program and return to the DOS prompt, press and hold the ALT key, while pressing the "Q" (for quit) key. Then press the **<cr>** key to return to the DOS prompt.

HARD DISK INSTALLATION/OPERATION

You will need to make a directory for the PC40 program. While in the ROOT directory of your hard drive, type: **MDIR \PC40 <cr>**. Next type **CD PC40 <cr>** to change to the PC40 directory that you have just created. Now place the backup copy of the *PC40 to PC* progam disk into the A: drive and type the following command: COPY **A:*.* <cr>** This will copy all of the files on the floppy into PC40 directory on the hard drive.

You may desire to create a sub-directory in which to store the data files transferred from the PC40. This will allow you to keep your PC40 directory uncluttered. You could create a sub-directory for each "job" if desired. Let's say that we wish to create a general sub-directory called "DATA" in which we will store our files. Type: **MDIR \PC40\DATA <cr>**. We will show you how to access this directory from within the file transfer program (see the Change Default Settings menu under the "File" heading).

HARDWARE SETUP

We will assume that your PC has been functioning properly as a computer with CGA graphics and with an "Epson Compatible " printer.

We need to connect the PC40 to the PC. This is accomplished by using the serial connecting cable for the PC40 (Ivie part #725). The small round end of the cable is connected to the RS-232 connector on the PC40. The flat rectangular end of the cable goes the RS-232 serial port on the PC. Please note that you may need to purchase, from a local source, a DB-25 gender changer (female to female) to allow the cable to match the serial connector on the computer.

Some PCs have only one serial connector while some have more then one. Also a serial connector may already be in use by a mouse. The *PC40 to PC* program will only recognize serial communication ports one and two. So we must use port one or port two for the serial connection between the two computers. The program will automatically look to serial port number one for the file transfer data. You can use port

number two if that is more convenient but when you start the program you will need to tell it to look at port number two. This is accomplished by typing the following when starting the program: **PC40 COM2 <cr>** (COM2 stands for Serial Communication Port #2). If you have an available serial port (one or two) connect the #725 cable to it at this time.

What about the computer that has only one serial communications port and that port is currently being used by a mouse? Well, you will need to share the port. If your computer has only one serial port we will assume that this is port number one.

When you wish to make a file transfer, disconnect the mouse and restart the computer by pressing the following three keys at the same time: Control (Ctrl), Alternate (Alt) and Delete (Del). Now the computer will not see the mouse connected to the port as it restarts and will treat it as an available port.

When using serial port one, start the program with the command: **PC40 <cr>** . If desired, you may quit the program after all the data has been transferred from the PC40 to the PC, then reconnect the mouse to the serial port and restart the computer as described above. You can then start the program and have full use of the mouse. The PC40 does not need to remain connected to the PC once data has been transferred. The PC40 may then be returned to the field for other measurements.

USING THE PROGRAM WITH OR WITHOUT A MOUSE

The *PC40 to PC* program will support a mouse but does not require a mouse for operation. This progam uses a pull-down menu system that lends itself to either mouse or keyboard operation. The keyboard is always active even when a mouse is in use.

Mouse operation

Across the top of the screen are six menu headers. To gain access to the commands under the headers you must "pull down" on the header to expose the commands below. To "pull down" with a mouse, place the mouse cursor on the desired menu header and click the left mouse button. This will expose all the menu items below that header. To select a particular item, place the mouse cursor over the desired item and then click the left mouse button.

As other windows are opened and menu items are selected, you will need to use the same method of point and click. Some windows have a "close window" marker that if pointed to and clicked upon will close that window without taking any action and return you to the main menu. The "close window" marker is diamond shaped symbol located in the top left-hand corner of the window.

When a graph is displayed on the screen and you wish to return to the main menu, press the left key of the mouse.

There is a special note about using the mouse in the "Graph Comments Input Screen." The mouse may be used to place the cursor in any of the fields that you wish to edit. Locate the cursor and then click the left mouse button. Of special note is that when you are finished editing and you wish to leave the screen, you must move the mouse outside and below the "Graph Comments Input Screen" and press the left mouse button.

Keyboard operation

Across the top of the screen are six menu headers. To gain access to the commands under the headers you must "pull-down" on the header to expose the commands below. To "pull-down" a menu with the keyboard, press and hold the "Alt" key while pressing the first letter of the desired menu item.

For example: To pull down the "File" menu, press and hold the "Alt" key while pressing the "F" key. By the way, you need not worry about capitalization of the letter. The "f" key could be used instead of the "F" key.

Now that the "File" menu has been "pulled-down" you can see all of the commands under this menu header. You will note that the first menu item is highlighted. If you pressed the **<cr>** (Enter or Return) key, that item would be selected. To select other items in the menu use the up and down arrow cursor keys to highlight the menu item of choice. After highlighting your selection press the **<cr>** key to select it.

There is a shortcut that can be used to select a menu item. You may press the key that corresponds to the first letter of the desired menu item. For Example: To directly select "Get Plot" press the "G" key. Again, capitalization does not matter. If there is more than one menu item with the same first letter, then the first item will be selected with the first press of the key, and the second item will be selected with the second press of the same key and so on. This alphabetical selection shortcut only works in the pull-down menus. It does not work in other windows such as "File Select."

The "Esc" key allows you to return to the main menu from other screens. For Example: When a graph is displayed on the screen, the menu bar at the top of the screen disappears. This allows maximum display area for the graph. To leave the graph and return to the menu just press "Esc." Remember "Esc" returns you to the menu.

PROGRAM OPERATION

STARTING THE PROGRAM

Start the program on the PC by placing the program disk in the floppy drive or if you are using a hard drive going into the PC40 directory of the hard drive and typing the following:

If Serial Port One is connected to the PC40 type: **PC40 <cr>**

If Serial Port Two is connected to the PC40 type: **PC40 COM2 <cr>**

Instructions for operation of the program will be given using examples. The examples will make use of the sample files included on the progam disk. An efficient way to become familar with the progam is to follow along on your computer with the example.

SELECTING A MEMORY FILE (under the File menu)

The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled-down you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

If you chose "Select Memory File," you will be shown only files that contain data from the PC40 memories. Files that have the extension of ".MBK" contain data from a block of twenty memories. If a ".MBK" file is selected another menu will be shown that will allow you to choose which one of the twenty stored memories you wish to display. Files that have a ".MEM" extension contain only a single memory.

Remember that at the time you saved a file to a disk in the PC40 you were given the choice of storing memories as a complete block of twenty or as an individual (single) memory.

Lets pull-down the "File" menu and select "Select Memory File." Next the "File Select" window will appear with two files: DEMO.MBK and DEMO.MEM. Select DEMO.MBK. We will now see a listing of fourteen memories on the screen. The other six of the twenty memories can be viewed by using the down arrow key to scroll them onto the screen. We can now choose any of the twenty memories by highlighting the desired memory and either clicking on it with the left mouse button or pressing the **<cr>** key.

You will notice that the "NOTE" you appended to the memory at the time of measurement is displayed in the file select window. This is to assist you in choosing which memory to display.

Let's select the memory titled "Singing in the lab isn't pretty." The program will now display the curve on the screen along with other pertinent data. Remember that we can return to the menu by pressing the "Esc" key or the left button on the mouse.

Selecting a single memory file (".MEM") follows the same process as above with exception that you will not be shown a second screen from which to choose one of twenty memories.

The above example continues with the next section of this manual. In preparation, return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

Now that we have retrieved a file, we can perform some operations on the graph of that file.

ADD COMMENTS (Under the EDIT Menu)
The "Add Comments" heading under the "Edit" menu allows you access to the written data located to the left and bottom of the graph screen.

If you wish to add, delete, or modify the documentation of a graph, select the "Add Comments" function from the "Edit" menu. Let's try an example. Select the "Singing in the ab isn't pretty" memory from the "DEMO.MBK" file. After it is up on the screen, return to the menu (press "Esc or click left mouse button) and select "Add Comments" from the "Edit" menu.

You are now looking at all the data, notes, file name and comments that appear on the screen with the graph. You can now modify this documentation. The first two lines at the top of the screen allow you to enter your own company name so that it will appear on the graph. The two lines for the company name will accept up to fourteen characters. Editing is done with the cursor and backspace keys. All editing is done in the overwrite mode. Keyboard entries will overwrite the existing data.

It is important to note that all orginal data contained in the ".MEM", ".MBK" or ".REC" files will remain unchanged as all editing is performed only on the screen display.

You will note that the default company name is "IVIE A MARK IV CO." This name will always appear on every graph screen unless you change the default setting. This can

be done under the "File" menu with the "Change Default Parameters" function. Detailed information on how to do this is in the "Change Default Parameters" section of this manual.

Go ahead and overwrite "IVIE A MARK IV CO " with your own company name. To view the changes, press the "Esc" key or move the mouse outside of the "Graph Comments" window and press the left mouse button. You should now be looking at the graph with your company name.

Now return to the "Graph Comments Input Screen" by returning to the menu and selecting "Add Comments" under the "Edit" menu. As you edit any field ,the computer will allow you to enter only the maximum number of characters per field. Any field that appears on the "Graph Comments Input Screen" may be edited. There are three lines of notes that may be entered below the word "Notes." Each of these three lines can have up to seventy-five characters.

Go ahead and experiment by editing some notes on the screen and then viewing the results on the graph screen. Remember that by pressing the "Esc" key or the left mouse button you will go to the graph screen.

The above example continues with the next section of the manual. In preparation return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

SHOW TABULAR (Under the EDIT Menu)
Another function under the "Edit" menu is "Show Tabular." This function allows the data of the currently displayed graph to be shown in tabular form. When the function "Print Tabular" is exercised this data will be sent to the printer as formated on the "Show Tabular" screen.

If you are following along with the above example, select the "Show Tabular" function at this time so that you may view the tabular data. When ready, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

PRINT TABULAR (Under the EDIT Menu)
The tabular data that can be viewed by the "Show Tabular" menu item, may be sent to the printer using the "Print Tabular" function. Before selecting this function make certain that the printer is connected to the computer and is "on line" ready to print.

The tabular data that will be printed is from the currently displayed graph. Modifications to the curve, such as "A" or "C" weighting, will be refelected in the tabular data printout.

If you are following along with the above example, select the "Print Tabular" function at this time so that you may print the tabular data. Make certain that a printer is connected to the computer and is ready to print. When finished printing, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

The above example continues with the next section of this manual. In preparation, return to the menu by pressing either the "Esc" key or clicking the left button of the mouse.

MODIFY CURVE (Main menu item)

There are several modifications that may be made to any displayed curve. A curve may be modified to reflect "A" ,"C", or "Flat" weighting. Also a second curve may be added to the graph if desired.

It should be noted that modifications to the curve do NOT affect the sound pressure level data. The SPL data is not derived from the the octave or 1/3 octave data but comes from its own detectors at the time of measurement. Weighting of the SPL measurement can not be changed after the measurement has been taken.

A-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "A" weighting by selecting this function. If the curve is either "Flat" or "C" weighted it will be changed to "A" weighting. The graph will then be re-drawn to refect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

C-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "C" weighting by selecting this function. If the curve is either "Flat" or "A" weighted it will be changed to "C" weighting. The graph will then be re-drawn to refect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

UN-Weight (Under the Modify menu)

You can change the "Weighting" of the currently displayed curve to "Flat" weighting by selecting this function. If the curve is either "A" or "C" weighted it will be changed to "Flat" weighting. The graph will then be re-drawn to reflect the change in weighting. The change in weighting will also be reflected in the tabular data of the curve should it be displayed or printed.

If you are following along with the above example, select one of the modify functions at this time so that you may view the effect on the curve. When you are ready, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

Add Second Curve (Under the Modify menu)
A second curve may be plotted along with the first curve for purposes of comparison. When you use this function you will be brought back to the main menu so that you may access the "File" menu. When you pull down the "File" menu you will notice that only the "Select Memory File" and "Select Record File" functions are active. You would then go through the same selection process as you did for the first curve.

Because the first curve selected sets the display range of the graph, some thought should be given in advance as to which curve will be plotted first.

As with the first curve that was plotted, the second curve will be plotted with a data marker at all data points. However, a different style of data marker will be used to help differentiate between the two curves.

If you are following along with the above example, select the "Add Second Curve" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

Delete Second Curve (Under the Modify menu)
This function will cause the currently displayed graph with two curves to be redrawn without displaying the second curve. This will delete the second curve and restore the graph to just one curve.

If you are following along with the above example, select the "Delete Second Curve" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

GRAPH (main menu item)
The curve may be displayed on one of three different graph formats.

Normal (Under the Graph menu)
Normal is normal. This is the standard amplitude versus frequency graph displayed as a line graph. This is the default graph display. The graph will automatically set the display range according to the data being displayed. Also the graph will be set for octave or 1/3 octave display to match the data in the file.

Each data point is emphasized on the screen. A connecting line is drawn between adjacent data points. At times there may be a data point that does not have an immediate adjacent data point due to the constrictions of dynamic range (a filter may be below the invalid data line). When this happens, a connecting line is not drawn to or from that point. To do so would infer (to the mind) that data which does not exist; exists.

To return to the menu from the graph function press either the "Esc" key or the left mouse button.

NC (Under the Graph menu)
Noise Criteria provides a means whereby ambient noise levels in rooms may be quantified. A reading of the noise in the room is made in octave bands. The NC overlay is then used determine the NC rating for the room.

When this graph function is selected, an overlay appears on the screen over the normal graph. Also the NC rating for the curve is calculated and displayed on the screen. The overlay is an integral part of the plot, and will appear along with the curve when the "Print" or "Save Plot" functions are used.

To return to the menu from the NC graph function press either the "Esc" key or the left mouse button.

If you are following along with the above example, select the the "NC" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

PNC (Under the Graph menu)
Prefered Noise Criteria provides a means whereby ambient noise levels in rooms may be quantified. PNC and NC are related to one another in that PNC is a second generation NC curve. You will notice that different weightings are applied to the noise spectrum by the two curves. The PNC curves were developed after the NC curves.

A reading of the noise in the room is made in octave bands. The PNC overlay is then used to determine the PNC rating for the room.

When this graph function is selected an overlay appears on the screen over the normal graph, and the PNC rating for the curve is calculated and displayed on the screen. The overlay is an integral part of the plot, and will appear along with the curve when the "Print" or "Save Plot" functions are used.

To return to the menu from the PNC graph function press either the "Esc" key or the left mouse button.

If you are following along with the above example, select the the "PNC" function at this time so that you may view the effect upon the curve. When you are finished, return to the main menu by either pressing the "Esc" key or the left button on the mouse.

At this point we would like to conclude our example/demonstration of the PC40 program.

File (main menu item)

The "File" menu contains those functions that allow us to retrieve and save various files. We can select files for viewing that we have transferred from the PC40. We can also select files that we have created and saved as completed graphs.

The "File" menu also contains the utilities for the program. These utility functions include: Printing, File transfer, and setting program default parameters.

Select Memory File (under the File menu)

The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled down, you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

If you choose "Select Memory File" you will then be shown only files that contain data from the PC40 memories. Files that have the extension of ".MBK" contain data from a block twenty memories. If a ".MBK" file is selected you will then be shown another menu that will allow you to choose which one of the twenty stored memories you wish to display. Files that have a ".MEM" extension contain only a single memory.

Remember that at the time you saved a file to a disk in the PC40 you were given the choice of storing memories as a complete block of twenty, or as an individual (single) memories.

Lets pull down the "File" menu and select "Select Memory File". Next the "File Select" window will appear with two files: DEMO.MBK and DEMO.MEM. Select DEMO.MBK. We will now see a listing of fourteen memories on the screen. The other six of the twenty memories can be viewed by using the down arrow key to scroll them onto the screen. We can now choose any of the twenty memories by highlighting the desired memory and either clicking on it with the left mouse button or pressing **<cr>** key.

Lets select the memory titled "Singing in the Lab isn't pretty". The program will now

display the curve on the screen along with other pertinent data. Remember that we can return to the menu by pressing the "Esc" key or the left button on the mouse.

Selecting a single memory file (".MEM") follows the same process as above with exception that you will not be shown a second screen from which to choose one of twenty memories.

Select Record File (under the File menu)
The selection of a file to display begins with the "File" pull-down menu selection. After the "File" menu has been pulled down you will see two menu items related to selecting a file. They are "Select Memory File" and "Select Record File."

The "Select Record File" function provides access to any PC40 Record Buffer files that have been transferred to the PC. All Record Buffer files are saved with a file extention of ".REC." When you choose "Select Record File" you will be presented with a new window titled "Select File," with all record files shown in the window.

Should you need to exit this window without selecting a file you can do this by either pressing the "Esc" key or by placing the mouse over the diamond symbol located at the top left-hand corner of the window and pressing the left mouse button.

To select a file, highlight the desired file by using the mouse or the cursor keys. Once the desired file is highlighted, select it by pressing the **<cr>** key or the left mouse button.

Once a file is selected another screen will appear displaying the name of the file selected along with the number of frames in the file. You will also be prompted for the frame number that you wish to view. After you enter the frame number press the **<cr>** key. The frame will be displayed in the normal graph manner. The graph may then be modified or edited as desired.

SAVE PLOT (under the File menu)
The "Save Plot" function allows you to save to the disk, the currently displayed plot or graph. After you have recalled a memory or record file and modified or edited the graph you can save all of your changes to a new file. This new file will have a ".GRF" (for graph) extension on its file name and is a completly different file from the memory or record file. The original memory or record data file remains totally unchanged.

When you select the "Save Plot" function another screen will appear, prompting you to enter a name for the new Plot file. The name of the currently displayed memory or record file will be shown where you are to enter the file name. You need not enter a

new file name if you do not desire to do so. You may elect to use the same file name for the Plot as is used for the data file. To do this just press **<cr>** (the Enter or Return key) and the Plot filename will be the same as the data filename, but with a ".GRF" extension in place of the ".MBK", ".MEM" or ".REC" extension.

A new or different name may be assigned to the file by typing in the desired file name. A file name may have a maximum of eight characters. The program will not allow you to type the file extension. The file will automatically assign the ".GRF" extension to the filename.

If you assign a file name that is already in use, the program will prompt you with another screen informing you that a file already exists using that filename. You will then be prompted to either overwrite the existing file, rename the file you wish to write, or abort the entire procedure.

The "Save Plot" function is not available for use until after a graph has been displayed on the screen. This, of course makes sense in that you cannot save a plot to disk if a plot does not exist.

If you were to examine the "File" menu when first entering the program, you would notice that the "Save Plot" and "Print Plot" functions would be displayed in a different screen attribute than the other headings. This denotes that they are not available at this time. After a plot has been displayed, the screen attributes of these two functions will change to have the same screen attributes as the other functions.

GET PLOT (under the File Menu)

The "Get Plot" function allows you to retrieve and display files that have been saved using the "Save Plot" function. When you choose "Get Plot" you will be presented with a new window titled "Select File" which will display a listing of all files with a ".GRF" extension.

Should you need to exit this window without selecting a file you can do this by either pressing the "Esc" key or by placing the mouse over the diamond located in the top left-hand corner of the window and pressing the left mouse button.

To select a file, highlight the desired file by using the mouse or the cursor keys. Once highlighted, select it by pressing the **<cr>** key or the left mouse button.

Print Plot (under the File menu)

NOTE: The DOS command "GRAPHICS" must be used (Installed) before proper graphics printing can occur.

The "Print Plot" function sends the currently displayed graph to the printer for printing. The printer must be compatible with Epson printer commands. Even an Epson MX-series computer will work with the program.

The plot or graph of the curve will be printed as it appears on the screen. The screen will be printed length-ways on the paper so that the aspect ratio of the paper and the screen more closely match.

In order for the computer to send the proper commands to the printer the DOS command "GRAPHICS" must be installed in the computer. The print-out of the graph screen contains two types of information. There is the graphics portion which is the graph and curve. Then there is the text portion which is all of the comments and documentation at the left and bottom of the graph.

If you use the "Print Plot" function and only the text portion of the screen is printed, then you have not invoked the DOS command "GRAPHICS" on your computer. This is easily accomplished by quitting the program and returning to the DOS prompt and typing: **GRAPHICS <cr>**. Then restart the program and try the "Print Plot" function.

TRANSFER DATA FROM PC40 (under the File menu)
There are two programs that must be run at the same time in order to effect a file transfer. One is on the PC40 and other is on the PC. The two computers must be connected as described in the hardware set up section of this manual.

Lets start the program on the PC40 first. Turn the PC40 ON and while in the normal analyzer mode press the red QUIT button. You will now see a listing of programs on the C: or ROM drive. Use the cursor (arrow) keys to highlight the program "PC-PC BAS." Now press the red RETURN key. The program will run and provide you with the message on screen "Waiting for link." The PC40 is now ready to send files to the PC.

Now start the program in the PC by typing **PC40 (or PC40 COM2)**. After the menu appears at the top of the screen pull-down the "File" menu and select "Transfer Data from PC40" and press **<cr>**.

The screen on the PC will now display the following:

"Opening COM1 for Link with PC40" (note that it may say COM2 in lieu of COM1)
"Attempting Link with PC40"

Once the link is established the screen will be updated to display:

"Opening COM1 for Link with PC40"
"Attempting Link with PC40 - Link Established"
"Enter PC40 File Specification for Directory A:*.M??"

You are now being prompted to enter a file specification. The program wants to know from what source and what types of files you wish to display. The source of the file is determined by the drive, and the type of file is determined by the extension of the file. Remember that files may be stored on any of the drives listed below.

Specification	Drive type
A:	RAM disk
D:	Floppy disk drive
E:	Floppy disk drive
F:	Floppy disk drive
G:	Floppy disk drive
H:	Microcassette drive

You will notice that there is a default file specification loaded into the prompt. If you pressed the **<cr>** key, at the prompt, the program would act upon this specification A:*.M??." Lets take a moment and examine the default file specification.

The "A:" specifies that we want to read the directory of files on the RAM disk which is disk drive "A:". The "*.M??" specifies what type of files we want to view in the file directory. Remember we have three different types of files as listed below.

File Extension	Type of File
".MBK"	Memory Block of 20 memories
".MEM"	Single memory
".REC"	Record Buffer file

The "*.M??" makes use of what is called wildcard characters in the file specification process. The "*" means give me any filename with the following extension. The

extension ".M??" means give me all filenames with extensions that have the letter "M" as their first letter. The "??" hold the place for the other two letters in the extenstion and are also wildcards. So the file specification "A:*.M?? will request the directory of ALL files (regardless of their filename) on the "A:" drive that have a ".MBK" or ".MEM" extension.

You may use the default file specification by pressing the **<cr>** key or you may enter your own specification by typing over the default spec. A spec of "*.*" will allow you to view all available files. A spec of "*.REC" will show you only the record buffer files.

This shows you a directory of filenames that meet your specification and does not actually transfer any files. These files will be displayed in the "File Directory" window on the PC.

Once in the PC40 File Directory window you can select which file you would like to transfer to the PC. You select the file by highlighting it with either the mouse or cursor keys and pressing the **<cr>** key or left mouse button. You will notice a file called "ALL Files" in the window. This allows you to transfer all the files in the directory with one command.

Once an individual file or "ALL Files" has been iniated, the screens of the PC40 and PC will display the progress of the transfer process. After a file is transferred, the PC will again show you the PC40 file directory window so that you may select another file to transfer. If you are finished transferring files, then press either the "Esc" key or click the mouse on the close window symbol to return to the main menu.

To return the PC40 to the analyzer mode, press the red **QUIT** button to quit the transfer program. You should now see a screen with a listing of programs in the various drives. The program "C:PC40Vxx COM"(xx varies with release #) should be highlighted. This is the program that runs the computer as an analyzer. With the "C:PC40Vxx COM" program highlighted, press the **<cr>** (Return) key start the analyzer.

What happens when you press the red **QUIT** button and you do not return to the screen that was described above. Instead you see something like "DT Error in 30" followed by the prompt "Ok." If at anytime you see a screen that you are not familar with, and it has the word "Ok", you are in the BASIC programming section of the computer. The PC40 portion of the file transfer program is written in BASIC.

The way to exit BASIC is to type in the word **System** and press **<cr>**. This will return you to the screen displaying "C:PC40Vxx COM". Now press the **<cr>** key once more to start the analyzer.

The PC40 may be disconnected from the PC one at this time. The PC40 is no longer needed by the PC.

Change Default Parameters (under the File menu)
There are two default parameters that can be set by the user. These parameters are stored in a file called "PC40.PRM" This file must always be in the same directory as the "PC40.EXE" program.

When this function is selected you will see the following information displayed in the window:

Current Path Spec to IBM Data Directory=
Enter New Path for IBM Data Directory- (a flashing cursor will appear here)

Notice that the space after "Current Path Spec to IBM Data Directory=" is blank. This indicates that it is currently set to the same directory as the "PC40.EXE" program. Any time the program looks for a file or goes to store a file it will look at the directory that contains the "PC40.EXE" program. We will call this the default directory.

The sample files that came with the software are stored in the default directory. If you change the default directory and you wish to access these files you should copy them over to the new directory.

Now, what about the flashing cursor at the end of the prompt:

Enter New Path for IBM Data Directory- (a flashing cursor will appear here)

If you press the <cr> key without entering a new path, then nothing will be changed. The default directory will remain unchanged. Lets say that you wish to store and retrieve your data files from a sub-directory, under the "PC40" directory. You wish to do this so as not to clutter your PC40 directory. We will assume that you have already created a sub-directory called "Data" using the DOS command **MDIR\PC40\DATA <cr>.** Then, at the prompt, type the following:

Enter New Path for IBM Data Directory-**\PC40\DATA <cr>**

Now every time the program does anything that requires a file, it will only act upon files found in the \PC40\DATA directory. It will not know about any other files located in any other directories. You could create a separate sub-directory for each job that you perform.

Keep in mind that in order to use a different sub-directory two things must take place. First you must create a sub-directory in DOS for the data. And second, you must tell the PC transfer program about the new directory using the "Change Default Parameters" function.

Once you have taken care of the Directory prompt, you will see the next prompt:

Current Company Name 1=Ivie
Enter New Company Name 1 - Ivie (with a flashing cursor over the "I")

Unless you want Ivie's name to appear on all of your graphs, type in the name of your company. The "Name 1" line will accept up to fourteen chatacters. There is also a "Name 2" line that will also accept fourteen characters, so don't worry if your company name will not fit on "Name 1" line.

After entering the name of your company, press the **<cr>** key. You will now see the prompt:

Current Company Name 2= a MARK IV CO.
Enter New Company Name 2 - a MARK IV CO.
(with a flashing cursor over the "a")

If a second line is needed for your company name, enter it at this time. If you wish to have this line appear blank on the screen then enter a series of spaces to overwrite the existing name. Now press the **<cr>** key.

At this point the program will save the default parameters that you have entered in the "PC40.PRM" file. The program will then refer to this file any time file or company name information is required.

Geting Started with Your PC40 Disk Drive(s)

READ THE MANUAL (when all else fails)

The manual titled "User's Manual for the PF-10 Portable Floppy Disk Drive for Epson Geneva" contains the nitty-gritty blow-by-blow description on preparing the disk drive for use. If you have read the manual and followed its instructions, the floppy drive should be set as Drive "D" or Drive "F" and it should be connected to the PC40 via the #726 cable. Also the batteries have been installed and are charging at this time.

If you have not read the above manual you will need to do so before proceeding.

If are going to use two drives with the PC40 then I hope you paid particular attention to page 14 of the drive manual on using two disk drives. It describes how one drive must be designated as "D" and the other drive designated as "F". It tells you how to remove the battery pack to gain access to the DIP switches so that their drive designation can be set. If you are only using one drive than there is no need to change its designation as they come factory set to Drive "D".

WHATS NEXT?

If you have not already done so, please turn on the PC40 and PF-10. Place the PC40 in the analyzer mode with the normal display on screen. The following instructions will take you from this screen out to the drive and back into the analyzer screen.

1. On the PC40 press the red button labled "QUIT". This will take you out of the analyzer mode into the MENU screen of the computer. You will see displayed in this screen the applications programs for the computer. You should see the analyzer programs C:PC40YXX.COM (the letters XX will be numbers on your screen) andB:BASIC.COM

   The C: in front of the PC40XX.COM program indicates that the program is stored in the "C" drive which is the internal ROM Capsule 2. This is the program that runs the analyzer. The B: indicates that Basic is stored in the "B" drive which is the internal ROM Capsule 1.

2. On the PC40 press the UTILITIES/ESC button. This will take you out of the MENU screen and into the CCP screen. This screen is displayed when the system is operating in the CP/M mode. In this mode you can execute CP/M commands or application programs.

   You will see the CP/M "prompt" at this time. The "prompt" is the letter of the current drive followed by ">" greater than symbol. More than likely the prompt will be "A>" indicating that the current drive is "A" which is the internal RAMDISK of the computer.

3. Insert the disk labeled "PC40 Utilities" into the PF-10 that has been designated as the "D" drive. Then type "D:" (do not include the quotation marks) into the computer and press red RETURN key. The prompt on the screen should now be "D>". This shows that the computer now recognizes the "D" drive as the current drive.

4. Now type "DIR" (without the quotes) and press the red RETURN key. DIR stands for directory and reads the directory or listing of all files on the disk and prints them onto the screen of the computer. If there are too many files to fit on the screen; then as files are printed to the bottom of the screen other files will be scrolled off the top of the screen.

   Not to worry, the files that scrolled off of the screen may be reviewed by pressing the UPARROW key while holding down the SHIFT key. You can scroll down the screen by using the DOWNARROW key while pressing the SHIFT key.

   You now have listed on the screen all of the files that are on the utilites disk. There are several files on this disk but we are only concerned about the "COPYDISK" file at this time.

FORMAT THE DISK BEFORE BACKUP

It is always prudent to make a copy of your software and then store the original disk in a safe place. If anything happens to the copy then you have the orginal from which to make another copy. The process of copying your PC40 utilities disk will allow to learn the pocedures for formatting a disk and copying a disk. We first need to format a disk before we can copy data onto that disk.

1. At the "D>" prompt type "COPYDISK" (no quotes) and press the RETURN key. This will load the COPYDISK program from the utilities disk (on drive D) into the computer. You will then be prompted with the question "How many drives connected". Press the "1" key and then the RETURN key if you are using one drive. If you are using two floppy drives then press the "2" key and then the RETURN key. Remove the utilities floppy disk from the drive at this time.

2. You should now see a menu with the prompt "Select COPYDISK operation". Before we can use a new disk we must prepare it for use with a process called formatting.

   So, press the "1" key and then the RETURN key to select the formatting operation from the menu. You now need to press the "D" key and then the RETURN key to select drive "D".

3. In response to the instruction on the screen, insert a new floppy disk into drive "D". With the floppy to be formatted in the drive, press the RETURN key to start the formatting process.

4. Once the disk is formatted the screen will show the prompt "Repeat with new diskette(s) (Y/N) ?" Now would be a good time to format some additional disks for the PC40. You will need one disk to copy the utilities program onto and at least one more for data file storage from the analyzer. So press the "Y" key to format another disk. You will repeat the above formatting process on a new disk.

5. When you are finished formatting press the "N" key followed by the RETURN key. You will then be asked if you wish to "exit or Continue COPYDISK (X/C)?". Press the "C" key to continue with the copydisk program in order to make a backup copy of your utilities disk.

6. You are instructed to "Insert Source diskette.", this is the disk you wish to have copied. So insert your PC40 Utilities Disk into the drive. NOTE! That in order to prevent any accidental

writing on, or erasing of, your PC40 utility disk, please make certain that disk is "write protected." Instructions for write protecting your disk can be found on page one of the DISK UTILITES SOFTWARE manual for the PF-10.

7. Start the copying process by pressing the RETURN key.

8. At the screen prompt, remove your PC40 utilities disk and replace it with a disk that you have formatted for this purpose. Now press the RETURN key. Data that was copied from the first disk and stored in the computer's RAM is now being written onto the new disk.

   You will need to swap the original (source) disk and the disk being copied to(destination disk) in and out of the drive until all the data is transfered to the new disk. You will be prompted by the computer for each swap.

   If you have wondered whether or not to purchase a second disk drive, the diskcopy experience might help you with that decision.

9. When the copy pocedure finishes, press the QUIT key to exit from the copydisk program and return to the MENU screen. You should see the two application programs C:PC40VXX.COM (the letters XX will be numbers on your screen) andB:BASIC.COM .

   The C:PC40VXX.COM program should be highlighted. To return to the analyzer press the RETURN key. You should now be back into the analyzer.

   You now have a backup copy of your PC40 utilities disk and one or more formatted disks read for data storage.

USING YOUR PC40 DISK DRIVE FOR DATA STORAGE

The PC40 can generate three different types of data files. Each of these different files can be stored to a "DRIVE". The PC40 can store the data to one of three different drives. There is the floppy disk drive that we have been reading aboutin the above sections, there is the RAM disk drive which is interal to the PC40 and there is the Tape Cartridge drive.

We will concern ourselves with only the floppy disk drive in this section of the manual. The floppy disk drive has the capacity to store up to 320K bytes of data in a maximum of 64 different files per floppy disk. It is portable and battery operated so it can be easily used on the jobsite.

TYPES OF FILES

The twenty memories in the PC40 can be stored to disk either as a single individual memories or as a block of 20 individual memories. When stored as a block, all 20 memories are stored to the disk under one filename. When they are recalled into the PC40 they will replace the twenty memories currently residing in the PC40.

This enables you to store and recall your most frequently used reference and offset curves

with little effort. At the conclusion of your job you can transfer the data from the memories to a data file on the disk drive.

There is also the ability to store single individual PC40 memories to the disk drive. When a single memory is recalled from the disk to the PC40 you are required to assign it a particular memory in the PC40.

The data stored in the record buffer can also be written to a file on the floppy disk. RT60 decay files, which are a special form of record buffer files may also be written to the floppy disk.

When a file is named by you and stored to a disk, the computer automaticaly appends an extension to the filename designating the type of file. For example, if the file is a block of twenty memories and you give it the name of "LCHURCH" the computer will add the extension of ".MBK "(for **M**emory **B**loc**K**). When you view the file in the directory the name will appear as "LCHURCH.MBK". If you store a single memory, the extenstion of ".MEM" (**MEM**ory) will be appended to the filename. In the case of an Record buffer or RT60 file, the extension of ".REC" (**REC**ord buffer) will be appended to the filename.

HOW TO STORE A FILE TO THE FLOPPY DISK

First of all, the PC40 and the PF-10 disk drive need to be connected together as was done for the formatting and copying of disks as described above. You will also need a formatted disk on which to store the data.

If you do not have a formatted disk or do not know how to connect the computer and disk drive together, then go to the section of the manual titled "Getting Started with Your PC40 Disk Drive(s)."

STORE A BLOCK OF 20 MEMORIES TO THE FLOPPY DISK.

For our first data store operation lets the 20 memories to the disk. It does not matter how many memories in the computer you have used to store data. The block store will store blank memories as well as memories with data. It will even store 20 blank memories if that is what you have.

1. While in the analyzer mode press the UTILITIES key. You should now be looking at the utilites menu screen.

2. Now press the PF1 function key to get into the SAVE utility. You will now see the menu for the SAVE utility.

3. Press the letter "M" on the keyboard to select the "MEMORY BLOCK (all 20)"

4. In response to the question "Which DRIVE?" you will need to press the letter "D" or the letter "F" on the keyboard depending upon which drive you wish to send the data. If you have only one drive and you have not changed the factory preset of the DRIVE designation, then type the

letter "D". If you are using two drives than you may need to press either "D" or "F".

5. Make certain that the PF-10 disk drive is turned on. Otherwise you will get an error message when you try to save to the disk.

   The screen is prompting you to enter a name for the file. This is the name that will show on the disk directory when go to recall the file. The filename can be up to eight characters in length. The computer will not allow to enter more than eight characters for the filename and the first character of the filename must be letter, it cannot be a numeral.

   Enter a filename at this time and press the RETURN key to save the file to the disk. The file will be written to the disk at this time.

6. At the completion of the file writing process, the SAVE utility screen will appear. At this point you can elect to save other files to disk by repeating the above steps or to exit to the analyzer mode. You can exit back to the UTILITY screen by pressing the UTILITY key. To get back to the analyzer screen press the UTILITY key one more time.

RECALL A BLOCK OF MEMORIES FROM THE FLOPPY DISK TO THE PC40

Before you can recall a block of memories from the floppy disk it is assumed that you have read and followed the above instructions on storing a block of memories to the disk. The process of recalling memories from the disk drive to the PC40 is very similar the process used orginally to store them to the disk.

First of all, the PC40 and the PF-10 disk drive need to be connected together as was done for the formatting and copying of disks as described above. You will also need a disk on which data has been stored.

1. While in the analyzer mode press the UTILITIES key. You should now be looking at the utilites menu screen.

2. Now press the PF2 function key to get into the SAVE utility. You will now see the menu for the LOAD utility.

3. In response to the question "Which DRIVE?" you will need to press the letter "D" or the letter "F" on the keyboard depending upon which drive you have placed the disk with the data. If you have only one drive and you have not changed the factory preset of the DRIVE designation, then type the letter "D". If you are using two drives than you may need press either "D" or "F".

3. Press the letter "M" on the keyboard to select the "MEMORY BLOCK (all 20)".

4. The screen will show you a directory of all memory block (.MBK) files on the disk. Notice that one of the files is highlighted in inverse video. This indicates the file that will be loaded into the computer when you press the RETURN key. Use the the ARROW keys to select the file that you wish to load and then press the RETURN key.

5. The screen will show the words "LOADING FILE" and "DATA in MEMORY will be OVERWRITTEN! Do you wish to continue? (y/n). This notice is telling you that whatever you have in the 20 computer memories is about to be replaced (or overwritten) by the files on the floppy disk. This provides a chance for you to abort the process for any reason. Normally you will press the "y" key to continue the loading proceess. If you press the "n" key than the process will be aborted and the memories in the computer will remain as before the loading process was started.

   After you press the either the "y" or "n" key the computer will return to the UTILITIES menu.

SINGLE MEMORY AND RECORD BUFFER STORE OR RECALL

The process of storing and recalling either a single memory or record buffer is very similar to working with the twenty memory block. We will not go into detail on the process for these two procedures but would reccommend that you refer to the above sections on storing and recalling the twenty memory block.

INFORMATION ON PC40 UTILITIES SOFTWARE DISK

A variety of software is supplied on the "PC40 UTILITIES" disk that is included with the PF-10 disk drive. Some of the programs are standard utilities for use with a CP/M computer. Some are specific application programs for the computer portion of the PC40. Other programs are written specifially for the PC40.

Some of these programs are useful only to someone with a background in programming and/or CP/M computers. We recognize the technical expertise of some of our customers so we have included these programs on the disk. Cetec Ivie does not maintain the resources to provide training and support for these types of programs, they are supplied soley as a resource for the user.

Some of these programs such as HXEDIT (a word processing type program) are public domain and are supplied as convienence to our customers. We neither endorse, reccommend or provide support for these programs. They stand on their own merits - besides, the price is right. There is however, documentation provided on the disk for the HXEDIT program.

Many of the programs are supported with documentation either in the Epson HX-40 OPERATING MANUAL or the PF-10 USERS MANUAL. Cetec Ivie will endeavor to the assist the user , as time and resources allow, with these programs.

There are several programs written in BASIC as examples of how to extract data from PC40 files or to support certain PC40 accessories. These programs are not complete applications programs but provide an example or program "kernel" that the user can build upon and incoporate into his own programs. It is assumed that the user is familiar with the BASIC programing language and is capable of writing his own programs. Cetec Ivie is willing to provide limited support to such users in helping them to understand the data format and its conversion process for use in such programs.

STANDARD PROGRAMS

The following programs are supplied with documentation in the HX-40 OPERATION MANUAL:

- STAT
- TERM
- PIP
- FLINK
- CONFIG

In the manual they are refered to as being on the "Utilities ROM". Because of space constraints, Cetec Ivie has elected to supply these programs on the PC40 UTILITIES DISK.

The following programs are supplied with documentation in the PF-10 USERS MANUAL.

- COPYDISK
- XSUB Please note that in the PF-10 USERS MANUAL this program is refered to as DEXSUB.

TEXT EDITOR

HXEDIT is a public domain text editor type program. It has undergone several generations of adaptation from the PXEDIT program. This program is supplied soley as a resource for our users. There are two documentation files to help you with HXEDIT. They are HXEDIT.DOC and PXEDIT.DOC .

To view the document files you must first be in CP/M operating system with the drive connected and the PC40 UTILITIES disk in drive. You must also have the CP/M prompt on the disk drive. This would be drive "D" or drive "F". Type in the filename HXEDIT and press return. This will

If you have connected the PC40 to a printer you can print the documentation by pressing the ESC key followed by the "P" key. This is the HXEDIT command to print the document. You will be prompted for some set up codes. When this occurs just hit the RETURN key at each prompt. The document will then be sent to the printer. When you wish to leave the HXEDIT program press the ESC key followed by the "Q" key(Q for Quit).

All files that carry the ".DOC" extension can be printed out using the HXEDIT program. You can also print out any file with the ".DOC" extension by pressing and holding the CTRL key while pressing the "P" key. This will send anything that appears on the screen to the printer. Then use the CP/M command TYPE to display the desired file on the screen. Information on this command can be found on page 2-79 of the HX-40 OPERATING MANUAL.

BASIC APPLICATION PROGRAMS FOR THE PC40

There are three BASIC application programs on the PC40 UTILITIES disk. They are RECORD.BAS, MEMORY.BAS and DMMTEST.BAS . You should note that all BASIC programs have the extension of ".BAS" appended to them at the time they are stored to the disk.

RECORD.BAS and MEMORY.BAS were both written by Cetec Ivie as an example of how to retrieve data files into basic so that they can manipulated via user defined programs.

For more information print out the RECORD.DOC file which contains documentation on the RECORD.BAS program. The information is this document can also be applied to the MEMORY.BAS program.

The DMMTEST.BAS program is documented in the users manual that comes with the DMM module for the PC40. The DMM (**D**igital **M**ulti**M**eter) is an accessory plug in module for the PC40.

PROGRAMMERS' FILES

All other files on the disk are supplied as resource and as a convience for the users who have the ability to utilize them. Cetec Ivie cannot and will not provide support assistance for these programs as they go beyond the scope of the application of the PC40.

Quick Reference

1) Range - [Pf1] or [Pf2]

2) Scale - [Pf3]

3) STORE - [Pf4] MESSAGE WINDOW → [STORE 0-9, C]

[0] - [9] ~~or~~ TO STORE TO MEMORY #

or

[M] TO SWITCH TO ALTERNATE MEMORY BANK

or

[Pf4] ~~Quit~~ Cancel WITHOUT STORING

← After Memory selected -

[ANY key] To Enter ^NO character note (OPTIONAL)

Then

[RETURN] TO ~~SA~~ complete Store process and return to Real time Analysis

4) Clear - [Pf4] MESSAGE Window [STORE 0-9, C]

[C] MESSAGE WINDOW [CLEAR 0-9]

[0] - [9] clear selected memory

or

[M] - switch memory Bank

[C] or [Pf4] cancel clear function

5) ~~Retrieve~~ Recall - [Pf5] - MESSAGE WINDOW [RECALL 0-9, C]

[0] - [9] to DISPLAY MEMORY

[M] to SHIFT MEMORY BANK

[Pf5] - Cancel Recall

[Pf6] ~~to Store to another Memory~~

6) Recall Composit - [Pf5] followed by [C]

MESSAGE WINDOW [RCOMP + - < □]

[0] - [9] to select Memory

[←] - [→] to select Current Legend character

message window [RCOMP + < □ or >]

[M] selects Memory Bank

[C] or [Pf5] Cancel Recall Composit

[CTRL] + [0] - [9] Select Memory without redrawing screen with "_" Legend character

1) Wieghting - SPL - [SHIFT] + [Pf1]

2) Responce - SPL - [SHIFT] + [Pf2]

3) Decay - Filter - [SHIFT] + [Pf3]

4) Octave - Filter - [SHIFT] + [Pf4] until desired screen appears

5) 3rd Octave - Filter - ~~[SHIFT] + [Pf4]~~ same as Octave

6) Wieghting - Filters - Same as Octave until "↵" appears next to SPL Wieght indicator
Weighting follows SPL.

7) Relative SPL - [SHIFT] + [Pf5]

SPL AT TIME OF Key Press is stored and Relative Result is displayed in message window

Sign → [REL XXX.X]

8) Peak Hold - [SHIFT] + [Pf2] until Peak Responce is set

[SPACE]

Toggles Hold on/OFF
"A" INVERSE VIDIO Bottom Right Corner indicates Hold on

9) Average - [AVERAGE]

MESSAGE WINDOW [AVG R, S, M]

[R] - Resets Accumulation Buffer to ∅

[S] - set to single Sample mode

[ ] - set to Multiple sample mode

once Average on Message window

sample ~~Frame Number~~ → AVG XXXX

15A) Single Average Mode

SPACE - Freeze a sample from realtime MESSAGE WINDOW

AVG RETRN

Return - average frozen sample in

ANY Key - ANY OTHER key Cancel current sample

15B) Multiple Sample Mode

SPACE - Take samples until space Bar pressed again.

15C) Average View

V - will ~~###~~ display current average result at any time.

16) Save (DISK)

UTILITIES then Pf1

then R - Saves record Buffer

or

M - Saves memory Block

or

0 - 9 - Saves single memory

or + SHIFT

then

2) [A] - [K] drive select

then [ALPHA Keys] enter unique file name for save

[UTILITIES] Cancels Save operation

1) Load - [utilities] ~~then~~

[Pf2] ~~then~~

[A] - [ALPHA Keys] [K] select drive

~~[illegible] - Load file Index~~

[R] - Load record Buffer

or

[M] - Memory Block

or

[Ø] - [9] or + Shift Single Memory

[↑]

[←] [→] use cursor keys to move

[↓] inverted area over desired file

[Return] accepts file

[UTILITIES] ~~Quits~~ Cancels Load operation

18) Offset

[0] toggles ON/OFF

19) Offset Set-up

[utilities]

[Pf3]

[↑] or [↓] Set level .1 dB steps

[←] or [→] Select frequency

[UTILITIES]

MESSAGE WINDOW

FREQUENCY → x x x x x HZ
LEVEL → ± x x . x dB
sign

EXIT WITHOUT ~~Store~~ accepting Changes

[RETURN] EXIT and change offset Buffer to match screen.

20) Record ON/OFF

[UTILITIES]

[Pf4]

MESSAGE WINDOW [REC xx] SAMPLE Rate
~~NO. OF SAMPLES~~ → XXXX
NEXT FREE FRAME

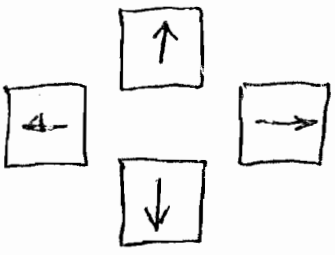
While active (as shown by MESSAGE WINDOW)

[SPACE] - Start/STOP SAMPLING

21) Rate

UTILITIES

PF4 + SHIFT



use cursor keys to change rate

Return — EXIT Rate set up

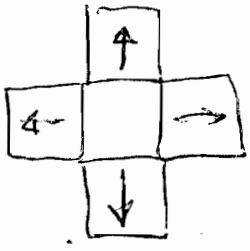
22) PlayBack ON/OFF

UTILITIES

PF5 — MESSAGE WINDOW — PBACK xxxx

FRAME # →

While active (as shown by window)



use cursor keys to advance or retard 1 Frame ~~numbers by~~

+ SHIFT advance or retard ~~Frames by~~ 10 Frames

23) Input Select

[UTILITIES]

[Pf5] + [SHIFT]

[Pf1] - [Pf4] select input type and scaling

[Return] when done

24) Printer Select

[UTILITIES] &

[Pf3] + [SHIFT]

[Pf1] - [Pf5]

[Return] when done

25) Time Set-up

[UTILITIES]

[Pf2] + [Shift]

[←] [→] Select time parameter

Select time value

Return when done

MEMORY max 472 screens + 512/per additional Chip

each Chip (32K) = 512 screens

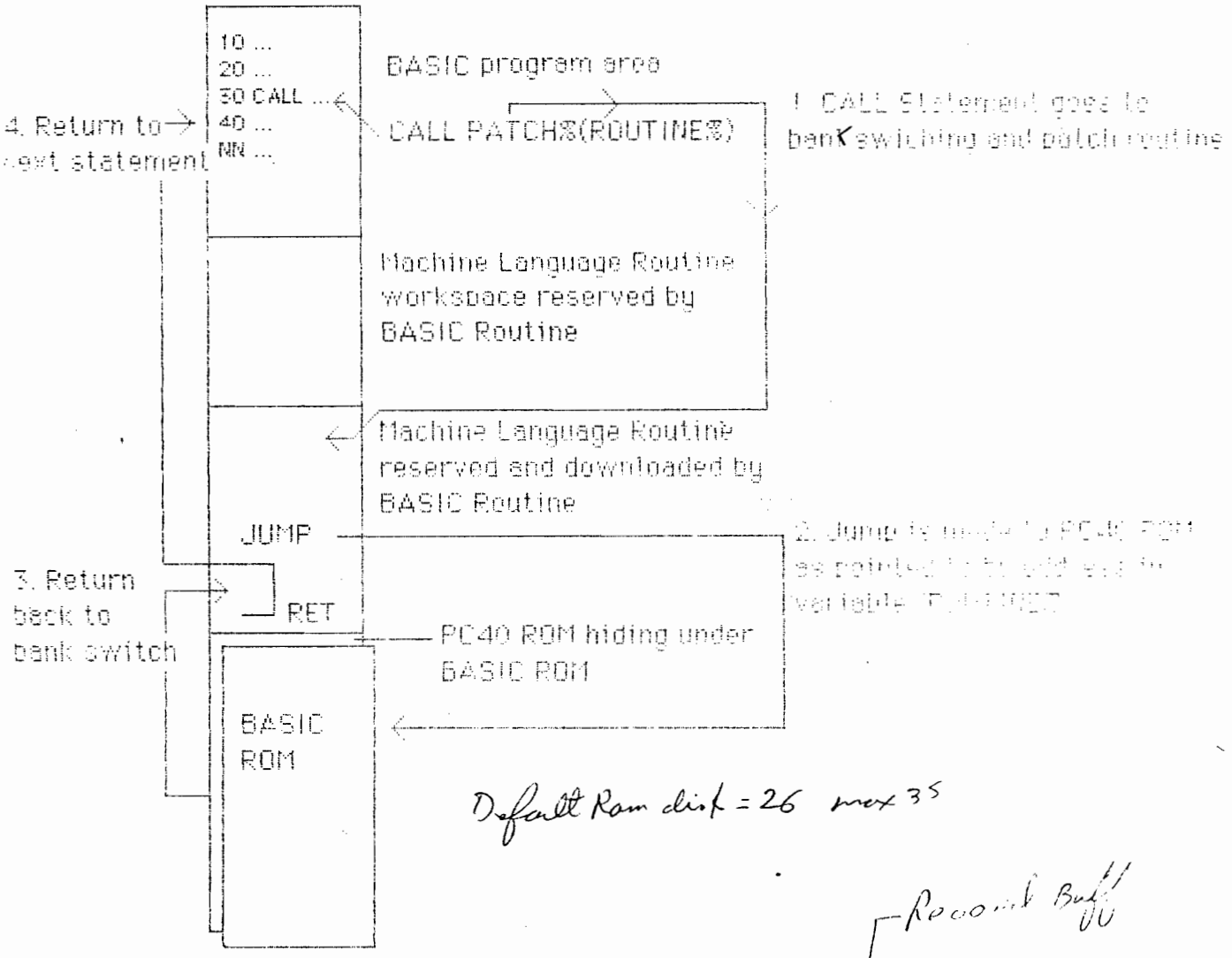
Can add up to 14(32K) chips

POKE 3, &HE9 = directs printer to parallel

69 = Cart

89 = 410

A9 = RS232



Default Ram disk = 26 max 35

Record Buff

472 max

Each Chip 512

1.81 Sec - std Ram # of screens x 2

3.62 Sec -

FIG. 1

Turns ON Audio Relay — OUT PORT 2B, INP(PORT 2B) or 64

off out port 2B, INP(PORT 2B) and 191

Event control ON " " " or 16

OF and 239

Event sense INP (PORT 2C) and 4

0 = low 1 = high

ANRT60 File Needs

Time base X 12,800

1.81 requi 24K

3.62 47K

7.24 93K

10.86 140K

Stores last Sample and Accumulator

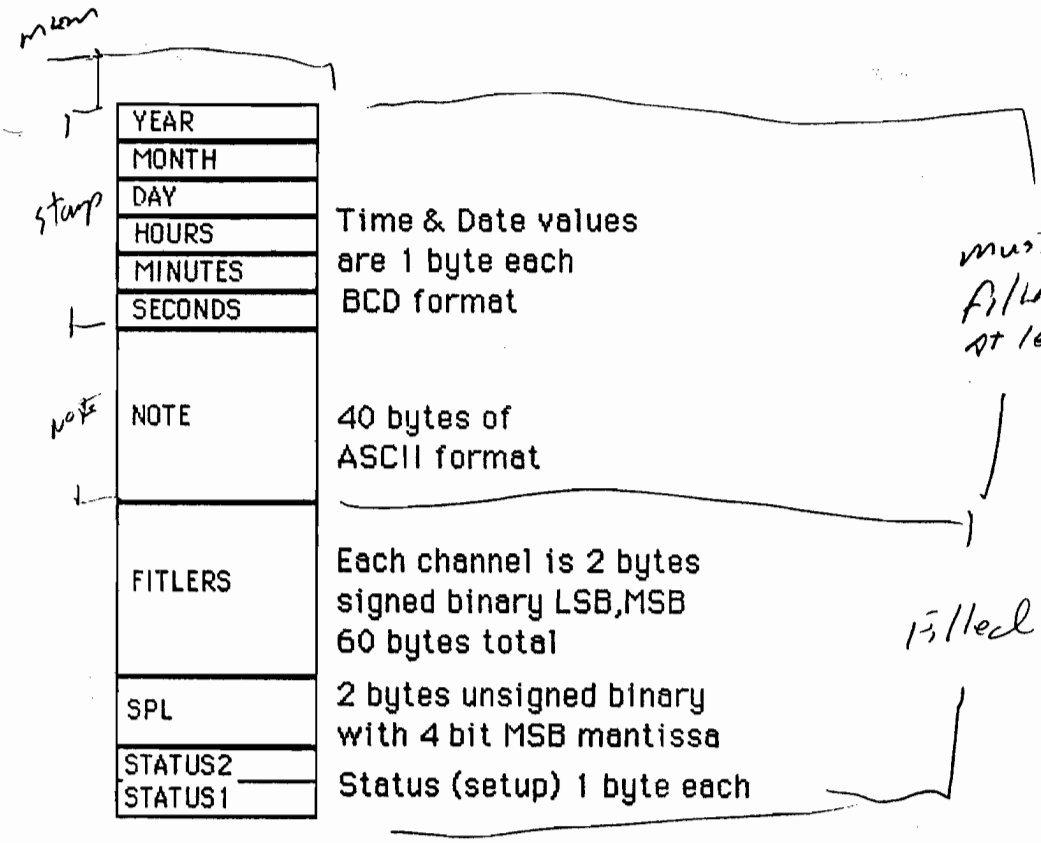
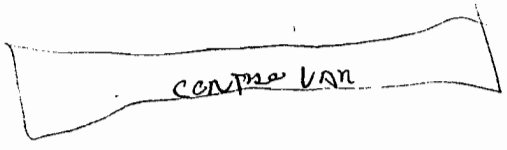
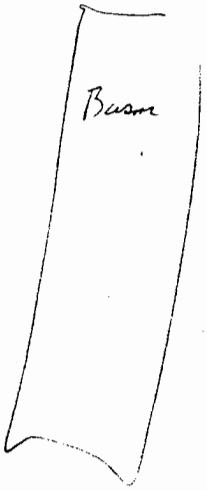


FIG. 2





PF Keys 1-5

Run

NOTE SAVE ALL DATA IN PC40 BEFORE RUNNING your BASIC Program.

How to have Basic return to partitions ?

Basic and the PC40

The BASIC programming language that comes with the PC40 is very close to the that found on an IBM PC or compatable. This manual assumes that the reader has a working knowledge of that kind of BASIC. If this is not the case, it is suggested that the reader first become familiar with programming in BASIC through one of the many tutorials that are commercialy available. This manual will not be teaching how to program in BASIC, rather it will attempt to describe how to utilize the machine language subroutines found in the PC40 program from BASIC. This will bring out performance characteristics that BASIC could not achieve on its own. This is however a two edged sword. Many of the machine language routines have no error checking and there are rules that need to be strictly followed. Lack of dilligence in these areas can cause program crashes that could result in complete loss of data. To this end, the manufacturer, the dealers, and the representives of the PC40 claim no responsibility or liability for the programs run in BASIC by the user. Therefore the user should check and recheck all programs created and or entered into the PC40 before running them. The two major RULES to follow to prevent CRASHING are these: 1. ALWAYS use INTEGER VARIABLES in the CALL statements, and 2. ALWAYS be sure to check for CORRECT SPELLING of the VARIABLES used in the CALL statements. Failure to do either of these will result in CALLING to a memory location where no programs exist or into the middle of a program. Since the Z80 processor or its operating system has no error trapping to prevent this very strange things can and will happen and in these cases nothing in memory is sacred. As a final note before getting started, the patches from BASIC to the PC40 program routines have not been created and supplied to facilitate programming by the manufacturer. Instead, they have been supplied so that the users of the PC40 can create and customize their OWN programs. The manufacturer and its representatives will be happy to answer questions where possible and give examples of "HOW TO", but will not tailor programs for each and every user.

Getting Started

The subroutines used in the PC40 program have been made accessable to BASIC by using the CALL statement. In every case CALLs will be made to a machine language routine that has been down loaded beforehand to a protected area of memory. This routine will bank switch memory over to the ROM that contains the PC40 program, and will JUMP to the routine needed. After the routine has completed its task, control is handed back to the machine language routine first called where the BASIC ROM is bank switched back in and control is handed back to BASIC where the next logical instruction is executed.

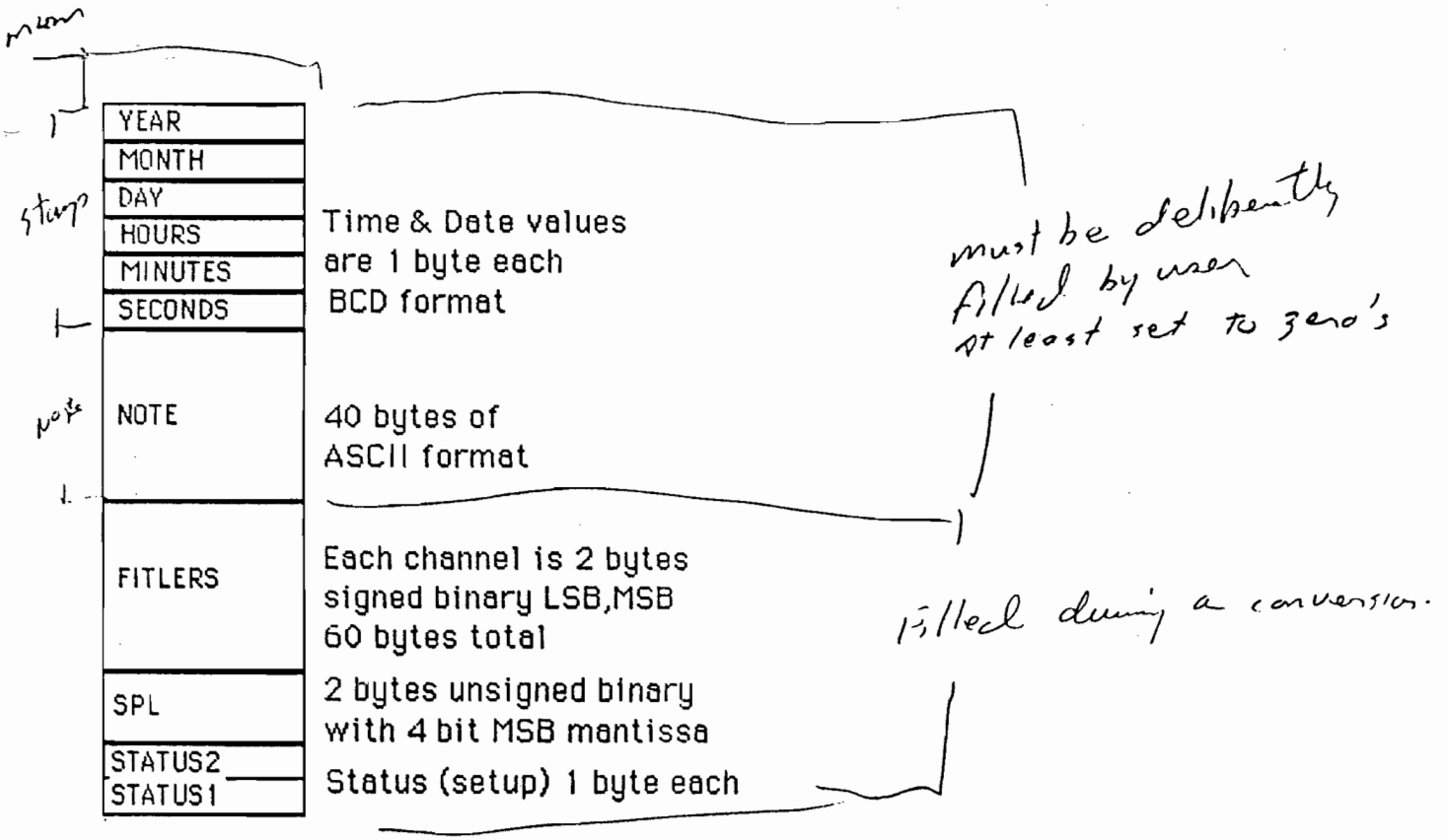
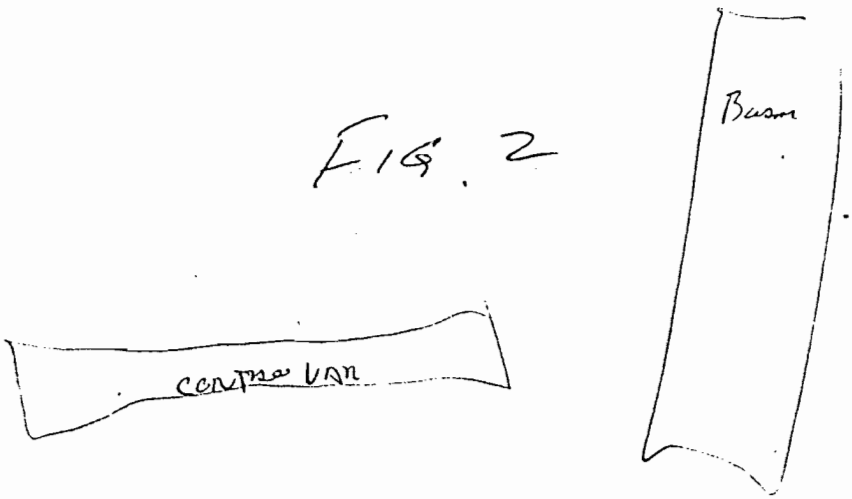


FIG. 2



PP Keys 1-5

RUN

The first statement that should always be run when BASIC is first started is;

10 CLEAR ,&H5E30

The statement number can be any number as long as it is the lowest or the first thing basic does. Don't forget the comma just before the ampersand symbol or the statement will not work. Now come the first caution; When using the patch routines, NEVER initialize internal RAM disk allocation larger than 26K. (Default value) RAM disk space also under lies the BASIC and the PC40 ROM. If it is intialized to larger than 26K, it will conflict with the area normaly loaded by the machine language patch routine and will be overwritten. This causes no problem for the machine language routine but data residing in RAM disk can get clobbered. The way to avoid this is to check the sign on message in BASIC. If it shows less than 20313 bytes of free space then there may be a problem with RAM disk being too large. If this is the case, the computer will have to be reinitialized or the "CONFIG" utility run to reduce the RAM disk size to 26K. The second statement that needs to be run is;

20 BLOAD"C:PC40BSUB.CIM"

This will cause the object file named "PC40BSUB.CIM" on drive "C:" to be loaded starting at the address CLEARed by the first statement. It will not only load the machine language routine, but will also load the default values for the analyzer and clear the memory locations used by the PC40 subroutines. These two statements once run will never need to be run again as long as BASIC is in operation. If BASIC is exited to go back to the SYSTEM prompt, then all is lost including the BASIC programs and these statements will need to be executed again when BASIC is reentered. Any programs that were SAVEd to RAM disk will still be intact.

Handled by STARTUP.BAS ??

MEMORY AND VARIABLES

The PC40 subroutines use part of the memory protected by the CLEAR statement as areas to keep variables. Variables that control the analyzer when some routines are run to variables that receive data from other routines. Control variables are used by POKEing a value in the appropriate location and then calling the routine that exercises control using that variable. The rest of the variables are used for storing or passing data to BASIC programs usually by the PEEK statement. Listed below are the variables used by the PC40 routines, their location, and the amount of memory the variable addresses. Below each variable is an explanation of how the variable is used. In many instances there are specific values that

can cause serious problems.

Poke &H5E35,6
Poke Refer%,6

REFERENCE : Location &H5E35 - 1 byte
(REFER%) Controls the gain of the analyzer and is set in relation to the dB level of the REFERENCE LINE /10. To set the REFERENCE LINE to 60 dB, poke this location with 60/10 = 6, then CALL the port setup routine. When using the Microphone as input valid references can be 3 to 14. When using the probe, valid references can be from 5 to 18. Default = 60

NEED TO CUT DEFAULT SETTINGS OF REFER, DECAY, ETC

DECAY : Location &H5E36 - 1 byte POKE DECAY%, 1
DECAY% Controls the response of the filter detectors. There are three speeds; 1=slow, 2=medium, and 3=fast. Default is Fast

SCALE : Location &H5E37 - 1 byte POKE SCALE%,3
SCALE% Sets the resolution of the display screen. It can take on values of 1,2, or 3 and corresponds to the dB/step. Default 3dB/STEP

RESPONSE : Location &H5E38 - 1 byte
RESPON% Controls the response of the SPL detector. Valid values are 1=fast, 2=slow, 3=peak, or 4=impulse. Default = FAST

WEIGHT : Location &H5E39 - 1 byte
WEIGHT% Controls the SPL weighting and can also control the filter weighting if the filters have been set to follow the SPL weighting. Valid values are 0=FLAT, 1=C WT., 2=A WT. Default = Flat
see Display% below

DISPLAY : Location &H5E3A - 1 byte
DISPLAY% This controls two separate items. First, it sets the filters to OCTAVE or 1/3 OCATVE response. Second, it causes the filters to follow the SPL weighting or sets the filters to flat response. 0=OCTAVE and FLAT, 1=1/3 OCTAVE and FLAT, 2=OCTAVE and follows SPL weighting, 3=1/3 OCTAVE and follows SPL weighting. Display = Default = 1/3 octave

MIC/PROBE: Location &H5E3B - 1 byte
MICPRB% There are two possible inputs to the analyzer. When this location is 0, the input is taken from the 2P microphone input. Values of 1, 2, or 3 will cause the analyzer to take input from the BNC Probe connection. When set to 1, the SPL print routine will scale the SPL value to dBM. When set to 2, the SPL will be scaled to dBV. When set to 3, the value returned by the CONVERT routine will be scaled to AC volts. Default = SPL

—INSERT RECDRAT% explanation

MEMORY : Location &H5E44 - 110 bytes Format is Figure 2
This is the place where PC40 memories are brought back, realtime converted data is stored, and where records from the record buffer are returned. Hence, this area sees alot of changes and care must be taken in CALLing routines so that important data residing there is stored somewhere else before the CALL. The Memory area is divided up

amp — Flag Register

Real time samples write to this area as Getmem or Get Record.

into smaller areas depending on the routine CALLed and the type of data.

These areas are as follows:

STAMP : Location &H5E44 - 6 bytes
Here is the actual Time and Date Stamp created for a MEMORY when the STORE button was pressed. It is kept in packed BCD format. If this is a problem, be aware that these values are decoded by the memory fetch routine and stored in another location which will be shown later.

NOTE : Location &H5E4A - 40 bytes
Here is the 40 character note for a memory that has been returned by the memory fetch routine. It is kept in ascii format and can be PEEKed into a string variable as will be seen later.

PIXELS : Location &H5E54 - 30 bytes
This is field is of little use to the user directly. It is brought to light here to show that it is sharing the same space as NOTE. It is used to store the number of pixels that are OFF in the bargraph on the screen. The values can either be calculated by a routine or brought straight in as is the case for a realtime sample.

FILTERS : Location &H5E72 - 60 bytes
Here is the values for each of the 30 filter channels. They are kept in signed, binary format and are relative to the reference at the time they were stored. They are also stored in LSB, MSB format which means that the Least Significant Byte if first and the Most Significant Byte is second. This means that there are 2 bytes/value and the values start with 25 Hz and end with 20 KHz. If this is a problem, there is an easy way to return these values directly to an array predefined in the BASIC program.

SPL : Location &H5EAE - 2 bytes
The SPL data is also kept in binary format just as the filters are with two exceptions. First, the value is unsigned and has a 4 bit MSB mantissa. SAY WHAT? Don't worry too much this is also decoded automatically by the SPL print routine. Plus there are easy to follow BASIC statements that will be shown later to handle the decoding.

STATUS : Location &H5EB0 - 2 bytes
Compressed into these 2 bytes is all of the analyzer parameters such as reference, decay, response, weighting, ect. Don't worry, there again is a simple way to decode this information.

THE ROUTINES

Here is where the fun begins. Consequently, this is also where the danger begins so as a word of caution, BE SURE TO CHECK ALL STATEMENTS BEFORE RUNNING THEM! To simplify the programming process another help has been added besides the subroutine patch to the PC40 ROM. The program is called "STARTUP.BAS" and also resides in the PC40 ROM which is known to the computer as disk drive "C:". This program performs most of the variable assignments for the machine language addresses and the locations of the variables in the PC40 workspace area. Before looking at this routine however lets get into BASIC.

Turn the analyzer on and Quit the PC40 application (program). Now should be seen the CP/M prompt or MENU. If the MENU is in effect, place the cursor over "B:BASIC.COM" and press return. If the system is in the PROMPT mode, then type in

B:BASIC.COM<CR> The "<CR>" means to press 'RETURN'.

The analyzer should now show the USER LOGIN MENU for BASIC. Pressing the 'SPACE' bar should login to USER AREA 1 with the ever-so-popular "OK" prompt showing up in the left most column just under the BASIC sign on message. If you have failed to get this far then stop everything and refer to the OPERATING SYSTEM MANUAL and the BASIC MANUAL that came with the PC40.

Once safely in BASIC, type in the following;

LOAD "C:STARTUP.BAS"<CR>

The response on the next line down should be "OK" with a flashing cursor below the "OK". If the next line down says, "NE ERROR" and then displays the "OK" prompt, check the spelling of the line with LOAD on it. If neccessary, move the cursor with the cursor arrows up to the mistake and type over it with the correct spelling. If it is correct now, press 'RETURN'. If all has gone well, the "OK" prompt will write over where the "NE" used to be and the response on th next two lines down will read,

"OK ERROR"
"OK"

Now type,

LIST<CR>

The program that was listed to the screen is devised to make all of the

normal variable assignments and declarations for the user. This program can be altered and SAVEd or used to CHAIN to a user written program. More about that later! Now, lets use this program as a starting point and add a little to it.

Read the last line of the program. It should read,

"630 CHAIN "PC40BAS",,ALL"

Delete the line by typing,

DELETE 630<CR>

Now type,

630 CLS:CALL PATCH%(DRAWSCRN%)<CR> – Draws
640 FOR I%=0 TO 1000:NEXT I%<CR> -

syntax

Remember sintax (spelling) is very important; CHECK YOUR WORK! When the program is correct type,

RUN

What happens next is that you will think that the analyzer has gone back to the PC40 program and in a way it has. Only after a second or two the PC40 screen will shift up one line and the "OK" prompt will be back indicating that the BASIC program has finished it's task. Always include a clear screen command before executing this routine or weird things can happen such as the upper half of the screen on the bottom.

SCREEN DRAW ROUTINE

The routine uses the control variables to graphically construct a sckeletal screen upon which other information can be overlayed such as the filter channel data. Before that , however, lets take a minute to see what affect the control variables have on the screen. Insert a new line of instruction by typing,

625 POKE REFER%,3<CR>
RUN<CR>

Clear ↓ Load CP40 ↓ ... ↓ Poke in ...

By changing the values for the REFERence it should be changing the number that is printed by the REFERENCE LINE on the screen. Remember, only enter those values that are valid.

Now try changing "REFER%" to the variable "DECAY%" and try the valid

Now try changing "REFER%" to the variable "DECAY%" and try the valid values. The decay indicator box on the righthand side of the screen should

be moving to the appropriate positions.

Now use the variables "SCALE%", "RESPON%", "WEIGHT%", "DISPLAY%", and "MICPRB%" and observe the result. Note, when changing "MICPRB%", the result will be to change "SPL" in the bottom righthand corner to "DBM", "DBV", to "ACV".

ANALYZER CONTROL

All of the control parameters for the analyzer are handled by one routine, but this routine has two entry points. The first entry point is used to initialize the I/O port adapters and then set the control lines going to the analyzer. The second entry point is used for setting the control lines without initializing. The reason for the two entry points is that once the I/O ports have been initialized, it is not necessary to do again unless the analyzer has been turned off. Also, during initialization of the I/O ports the control lines all go to a high state which will cause a momentary glitch in the audio circuitry of the analyzer. Before using this routine it is necessary to be sure that the control variables contain the desired values. When the machine object file "C:PC40BSUB.CIM" is loaded in the variables are set to a default value. The default settings are listed below.

Reference = 60
Scale = 3 dB/step
SPL Responce = Fast
SPL Weighting = Flat
Filter Bandwidth = 1/3 Octave
Filter Weighting = Flat
Filter Decay = Fast
Input = Microphone (SPL)

The syntax for this command is,

CALL PATCH%(PORTR%)
or
CALL PATCH%(PORT%)

The latter statement will set the control lines without intializing the I/O ports.

STATUS SETUP & RETURN

Before it was stated that the analyzer setup was also encoded down into two bytes called "STATUS". This is done so when data is stored, it does not take up as much space. There are two routines that encode and decode

status bytes. The other goes the opposite direction and rewrites the

control variables based on the status bytes. These routines are used when recalling data from memory or putting data into memory. In the first case , after fetching a memory from the PC40, the status to variable routine would be used to set the control variables to the state they were in when the memory was stored. Afterward a screen would be generated and the data displayed just as it was saved. To use these routines they should look like this,

CALL PATCH%(STATVARI%) Converts STATUS bytes to Control Variables
or
CALL PATCH%(VARISTAT%) Converts Control Variables to STATUS bytes

DISPLAYING DATA

There are four routines that display data. They are Filter display, SPL display, Battery display, and Screen Redraw. We have already seen how screen redraw works. The other three routines are called in the same manner as the Screen Redraw routine. However, there are no default values for the other routines because they depend on data that has been created by some means as recalling a memory or taking a realtime sample. Do not use these routines unless valid data exists. Failure to follow this rule will possible cause a program crash. The syntax for these routines is,

CALL PATCH%(FLTDSP%) Filter bargraph drawing routine
and
CALL PATCH%(SPLDSP%) SPL prints in bottom righthand corner
and
CALL PATCH%(BATDSP%) Draws bargraph indicator in top right corner

TAKING A SAMPLE

The routine for taking a sample assumes that the analyzer has been turned on. Of course if this is not the case, the data returned will be garbage although it will not cause the computer to crash. Before running this routine then it is necessary to have CALLed the analyzer setup routine. After having done so you can take a realtime sample by doing,

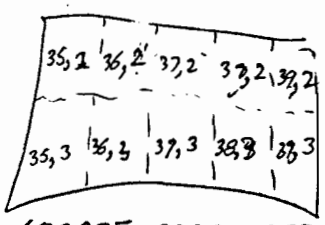
- what is analyzer setup routine PORTR??

CALL PATCH%(CONVERT%)

This will return the ~~relative~~ relative to level of all 30 filters, the SPL, and the level of the Battery. This routine will use the same area as the memory fetch and the record fetch routines so it assumed that any important data residing there has been transfered elsewhrere. This routine is unique in that you dont need to calculate the height of all the filter bars after the routine is done. It does all that as part of the process. Using the routines we know about this far, lets make a realtime analyzer program. Type in

routine is done. It does all that as part of the process. Using the routines we know about this far, lets make a realtime analyzer program. Type in the following at the end of the "C:STARTUP.BAS" program. — remember delete line 630 first


```
630 CALL PATCH%(PORTR%)
640 CLS:CALL PATCH%(DRAWSCRN%)
650 CALL PATCH%(VARISTAT%)
660 CALL PATCH%(CONVERT%)
670 CALL PATCH%(FLTDSP%)
680 CALL PATCH%(SPLDSP%)
690 CALL PATCH%(BATDSP%)
700 GOTO 660
```



LOCATE COORDINATES FOR Annunciator window ON PC40 Screen

Before typing 'RUN<CR>' check your typing.
The result should be the PC40 action that you are used to seeing. The only exception is that it will not, at this point, respond to any of the keys except for the 'QUIT' key which will "BREAK" the program execution. Below is an explanation of the program.

Line **10-620**, sets up the variables for PEEKing, POKEing, and CALLing
Line **630**, sets the analyzer on and sets the control lines
Line **640**, clears the screen and draws the basic sceen graphics (remember this is important)
Line **650**, sets the status bytes = the variables (not necessary here but a good practice
Line **660**, gets realtime data from the analyzer
Line **670**, displays the filter levels
Line **680**, displays the decoded version of the SPL
Line **690**, displays the battery level
Line **700**, loops the program back for more (indefinitly)
To stop Hit the Quit button

FETCHING A MEMORY

Returning a memory STOREd by the PC40 is just a little different than what we have seen so far. Beyond CALLing the routine to fetch the memory we also need to tell the routine what memory number to get. This is done by passing a second parameter in the CALL statement. "Passing a parameter"; What is that? Well, so far, the CALL statements that have been used are CALLing to an address in the variable "PATCH%". Then the routine at that address CALLed takes the value in the variable inside the parenthesies as a "passed parameter" and jumps to the address that is equivalent to the value "passed". We add the second parameter like this,

```
CALL PATCH%(GETMEM%,NUM%)
```

The first variable in the parentesies is the address of the GETMEMory routine while the second variable is the number of the memory we want to get back. The two variable must be integer and they must be separated by a comma. The valid range for memories is 1 - 20. 1 - 10 would correspond

inverted memories 1 - 9,0. Let see how this works by typing in these

statements at the end of "C:STARTUP.BAS". Note: Before doing this program you might want to make sure there are some memories stored in the PC40 or there won't be anything to recall.

```
630 CLS:INPUT"SELECT A MEMORY NUMBER (1-20)";NUM%
640 IF NUM%<1 OR NUM%>20 THEN 630
650 CALL PATCH%(PORTR%)
660 OUT 37,INP(37) OR 128
670 CALL PATCH%(GETMEM%,NUM%)
680 IF PEEK(STATUS1%) THEN 690 ELSE 630
690 CALL PATCH%(STATVARI%)
700 CLS:CALL PATCH%(DRAWSCRN%)
710 POKE REFBUFF%,PEEK(REFER%)
720 CALL PATCH%(REFLOCAL%)
730 CALL PATCH%(PIXCAL%)
740 CALL PATCH%(FLTDSP%)
750 CALL PATCH%(SPLDSP%)
760 K$=INKEY$:IF K$="" THEN 760
770 GOTO 630
```

Check your work before typing 'RUN<CR>'
You must have noticed that there were a number of CALLs and procedures that have not been discussed yet. Well let's see what is hapening here.

Line **630**, Prompting for memory number to get.
Line **640**, Test input against limits to be sure the number is ok.
Line **650**, Configure the ports. Even though the analyzer is not being used this needs to be done so that the routine can address the RAM in the PC40.
Line **660**, Turn the anlyzer power OFF. Not absolutely necessary but helpful.
Line **670**, Get the memory to display.
Line **680**, Test STATUS byte #1 to see if the data is there. If data was actually stored here then this location would not be zero. If this memory is not active then there is nothing to display.
Line **690**, Set up the control variables so the screen draw routine will reflect the set up when the memory was stored
Line **700**, Draw generic PC40 screen.
Line **710**, Set the original reference equal to the new reference. This is done so that when the filter bar heights are calculated, they are figured on the basis that they are being displayed with the original reference. To see the data at a different reference, after executing Line 710 then reset the variable REFER% to the desired reference/10. This must be done before CALLing the routine REFLOCAL% on line 720.
Line **720**, This routine sets the lower limit of the screen so the next routine can calaulte how high to make the bars on the filter bargraph. The result is not returned to BASIC, but is stored in work space for later

Line 720, This routine sets the lower limit of the screen so the next routine can calaulte how high to make the bars on the filter bargraph. The result is not returned to BASIC, but is stored in work space for later reference.

Line **730**, Calculate how high to make each bar on the filter bargraph. This must be done because unlike realtime, the pixel data for the height of the bars is not readily available. Since it not stored it must be recalculated. This feature allows the user to recalculate the filter bars for different references and scales.
Line **740**, The rest is the same as before except that the battery is not displayed. This is simply due to the data not being kept. Who cares what the battery was doing then, what matters is what it is doing right now which is now then so again, Who cares?
Line **760**, Simply a mechanism to hold the program up until your ready to look at the next memory. Again the program can be quit by pressing the 'QUIT' key.

NOTES AND TIME

The memories are all stored with a time and date stamp as well as a 40 character note. These are available, but the note needs to be read out of work space memory before the pixel calculation takes place as that routine shares space with the note area. To read out the note use the PEEK command in a loop sch as this,

```
10 NOTE$=""
20 FOR I%=6 TO 45                                  / I%
30 NOTE$=NOTE$+CHR$(PEEK(MEMORY%+I%)
40 NEXT I%                          ↑ LETTER "I" NOT the number 1
```

Line **10**, clear any previous note.
Line **20**, the note goes from position 6 to position 45 in the memory area.
Line **30**, concatonate all of the characters. read and add to note string each individual character
Line **40**, do all of the 40 characters.(spaces and all)
At this point the note$ can be ~~stored somewhere else or printed, or what~~ ever else you do with strings. The note $ is safley stored in the NP

/ By Pixcal

The time and date are not over written and can be directly read at memory locations 0-5 relative to the value kept in MEMORY%. The time is kept in BCD format, most significant to least. First is the Year, then Month, Day, Hour, Minutes, Seconds. If BCD is scary to you then use the decoded values placed in work space for you at the location kept in the variables YEAR%, MONTH%, DY%, HOUR%, MINUTE%, SECOND%. The reason the variable DY% is spelled DAY% is that DAY is a reserved word to BASIC. To get a value out of memory simply PEEK it. (ie. PEEK(YEAR%))

GETTING A RECORD

Fetching information back from the record buffer is the same as fetching a

record checking exists. The two things to keep in mind while using this routine is know beforehand the limits of the record buffer (Available RAM) and know how many records have been put there. The range can take on values from 0 to 8155. The statement to get the record would look like this,

From Basic Keep track of # of Screens Recorded

```
CALL PATCH%(GETREC%,NUM%)
```

All of the same calculation procedures have to be done before you can display the results.

RECORDING RECORDS – Basic does not protect some space of P.C 40 Rel. Buffer and it will be overwritten with out any notice to anyone

This routine will go out and record what ever number of records it is told. Using the rate specified by the control variables as well as the set up, the routine will not return to BASIC until the limit specified has been reached. Rate by the way, is a control variable that has not been priviously covered. Pointed to by the variable RECDRATE%, valid values that can be POKEd there are 1 to 100. Any values outsdie this range will have unpredictable results. the default is 30, which meand that the analyzer will take samples at a rate of 30 spectral stores per second. One spectral store includes all 30 filters, the SPL, and the two status bytes. Use of this routine might look like this,

```
630 CLS:INPUT"ENTER NUMBER OF SAMPLES";NUM%
640 IF NUM$>400 THEN 630
650 INPUT"ENTER RATE TO SAMPLE";~~RATE%~~ RT%
660 IF RT%<1 OR RT%>100 THEN ~~630~~ 650
670 POKE RECDRATE%,~~RATE%~~ RT%
680 CALL PATCH%(PORTR%)
685 CALL PATCH%(VARISTAT%)
690 INPUT"PRESS ANY KEY WHEN READY";DUMMY$
695 CALL PATCH%(RECD%,NUM%)
700 OUT 37, INP(37) OR 128 – Turns analyzer ~~ON~~ off
705 POKE REFBUFF%,PEEK(REFER%)
710 CALL PATCH%(DRAWSCRN%)
715 CALL PATCH%(REFLOCAL%)
720 FOR I%=0 TO NUM%
730 CALL PATCH%(GETREC%,I%)
740 CALL PATCH%~~(PIXCAL%)~~(PIXCALC%)
750 CALL PATCH%(FLTDSP%)
760 CALL PATCH%(SPLDSP%)
770 NEXT I%
```

To turn on OUT 37, INP(37) and 127

```
630 A$=INPUT$(1)
640 CALL PATCH%(RECD%,NUM%)
650 OUT 37, INP(37) OR 128
660 POKE REFBUFF%,PEEK(REFER%)
670 CALL PATCH%(DRAWSCRN%)
680 CALL PATCH%(REFLOCAL%)
690 FOR I% =0 TO NUM%
700 CALL PATCH%(GETREC%, I%)
710 CALL PATCH%(PIXCALC%)
720 CALL PATCH%(FLTDSP%)
730 CALL PATCH%(SPLDSP%)
740 NEXT I%
750 GOTO 750
```

Much of this program should be readily understood when compared with those given already. Therefore, only those statements that differ will be dicussed.

much of this program should be readily understood when compared with those given already. Therefore, only those statements that differ will be dicussed.
Line 705, the difference here is order in the program. It should be noted

that the original reference need only be set once if the data is not going to be changing in reference. Likewise the lower screen limit only needs to be calculated once if the data is not going to be rescaled.
Line 740, calculation can be done without any more reference or screen low limit calculations because the data is being displayed without any rereferencing or rescaling.

What should happen during the execution of the program is the user will be prompted for the number of sample to record and the rate at which to record the samples. Then the program will wait for the user to press a key. After the key press, the program will then record the number of samples requested and then when done will display what has been recorded.

PUTTING RECORDS AND MEMORIES BACK

The routines that do the reverse of getting are available but there is a word of caution; BE SURE THE RECORD OR MEMORY AREA CONTAINS THE ARRANGEMENT OF DATA THAT IS CONSISTANT WITH RECORDS OR MEMORIES. So there is no confusion, below is a memory map of the area.
(INSERT FIG 2 HERE)

The sintax for these statements should read,
CALL PATCH%(PUTMEM%,NUM%)
and
CALL PATCH%(PUTREC%,NUM%)

SPL - TO CODE OR NOT TO CODE

The question has been raised. It has been said previously that the SPL value returned to the work space is 2 byte, unsigned binary with a 4 bit MSB mantissa. So the number will be of value to the user in BASIC other than using the print routine, we will take some time to explain the concept. First of all, the term 2 byte, unsigned binary means that the number is kept in a manner that is conveinent for the computer. With 2 bytes the number can take on values from 0 to 65535 if there is no sign. Since the SPL is recorded to 1/10 of a dB and the computer does not like decimal points, the values are multiplied by 10. So the number range we are dealing with is 0 to 2000. This correlates to 0.0 to 200.0 dB SPL. In hexidecimal format that would be 0 to 07D0h. Notice that the leading 0 in 07D0h; since this position is never really used to store the value it can be used to store other information such as where to put a decimal point if one where used. This could only be done if that leading position where

stripped off before the number was actually used. In the case of SPL values this is not really necessary because the decimal point is always in

the same place.(ie. 10.0, 200.0, 9.5) However, recording values in Volts AC is another story. So we adopted a method of storing decimal place information in the unused upper 4 bits of the 2 byte number and limit Volts AC to 999. (03E7h) The number contained in the upper nibble (4 bits) is the position to place the decimal point as starting from the left. For example, if we ANDed F000h with ths SPL value that was recorded in dB, we would get 4000h. If we then ANDed the SPL value with 0FFFh and got back 0755, the decimal place would be 0755.5. The first position is in front of the 0, the second place infront of the 7 and so on. This was done to facilitate the machine language print routine and not to be mathimaticly handy. It is also easier to store and takes up less room than other matissa techniques. It can be calculated in BASIC by using the following statements.

```
10 SPL%=PEEK(RLTMSPL%)+PEEK(RLTMSPL%+1)*256
20 D%=(SPL% AND &HF000)/&H1000
30 SPL%=SPL% AND &HFFF
40 SPL=SPL%*10^(D%-5)
```

Line 10, get the value returned to memory.
Line 20, strip off the 4 bit mantissa and bring it down to the one's place.
Line 30, strip off the SPL from the mantissa.
Line 40, mathimatically set the decimal place into a single precision variable.

This over kill if not dealing with Volts AC. When just dealing with dB, use,

~~10 SPL=(PEEK(RLTMSPL%)+PEEK(RLTMSPL%+1)*256)/10~~

SPL = ((PEEK(RLTMSL%) + PEEK(RLTMSPL%+1) AND &HFFF) * 256)/10

SPL - ANOTHER WAY STILL

CHLOAD Transfer from Transient → CH Array
CHSAVE Transfer from CH Array → Transient

If it is desired to return the numerical data without drawing the fancy bargraph or screen, there is another way. There is a routine pointed to by the variable called **CHLOAD%**. In the listing of "C:STARTUP.BAS", there is at line 610, a statment which is dimentioning an array called CH%(). The routine searches for this array in the variable table of BASIC. When and if found it procedes to load the array with the 30 filter values, the SPL, and the STATUS bytes. The result is the array variables will contain the decoded values times 10. The array positions start with the lowest filter (25 Hz) in CH%(0) and go to the highest filter (20KHz) in CH%(29), with the stripped SPL value in CH%(30), Status2 in CH%(31), Status1 in CH%(32). The filter values loaded into the array are also converted to absolute. This means that if a value less than zero is returned and the analyzer is set up for dB SPL, then the number should be thought of as zero. This routine is

note that if a value less than zero is returned and the analyzer is set up for dB SPL, then the number should be thought of as zero. This routine is CALLed when ever the data pointed to by RLTMFILD%,RLTMSPL%,STATUS2%,

and STATUS1% needs to be transfered to the array variable CH%().. As an example, go back to the GET MEMory program. After the memory has been retreived by line 670, execute the statements,

```
680 CALL PATCH%(CHLOAD%)
690 FOR I%=0 TO 30
700 PRINT CH%(I%)/10
710 NEXT I%
```

This routine will print the values for the data numerically. The screen will scroll upward as the printing goes beyond 8 lines, but the numbers can be seen after the program stops by using SHIFT and the up-arrow. Since the numbers are kept as times ten, they need to be divided by ten before printing.

DUMPING THE SCREEN TO A PRINTER

LPRINT CHR$(2) sets double/high mod
LPRINT CHR$(3) sets normal mode

Screen dumps can be accomplished in two ways, sideways or normal. Both are bit map transfers of the screen to the printer and assume that the user is operating an EPSON MX or compatable. The normal screen dump is unusual here because it does not use the same CALLing mechanism. Since this routine is found in the SYSTEM ROM, it is CALLed directly by issuing the statement CALL SCRNDMP%, where the variable SCRNDMP% is equal to &HEB36.

The other routine is used by the PC40 to dump to the cartridge printer. It is more readable and can be done in two sizes. It also causes the screen dump to come out sideways on the paper. This routine will work with any printer as long as it maintains EPSON compatability. The size of the screen dump is controlled by a memory location at &H5ECE. The value of this location is very important and should be &H80 for the small format and &HC0 for the large format. Any other values will have unpredictable if not disasterous results. The default value is 'Small'. Also there is a second variable passed with the CALL that selects or deselects the frequency labling. If the second variable is zero, the frequency labling will not appear. If the second variable is a one then it will. As an example, try the GET MEMory program again, only this time insert the line,

```
755 NUM%=0:CALL PATCH%(SDEDMP%,NUM%)
or
755 ADR%=&HEB36:CALL ADR%
```

- sideways - Lg or Small depending up VARIBLE
- normal screen dump same size always

BATTERY DISPLAY

The battery indicator normally seen while in realtime analysis can be

recreated by CALLing the routine located by **BAIDSP%**. This routine assumes that a realtime sample has been taken and that the data located

in memory used by the routine is correct. If this is not so it will be crash time again. In otherwords, don't CALL this routine unless you have run the sample routine at least once.

STARTUP.BAS ROUTINE

This BASIC program is supplied in the PC40 ROM to aid the user in learning how to interface with the PC40 application and to conserve on memory when running programs. It is specifically devised to assign values to memory pointers and then get out of the way by chaining to the program that will be doing the actual work. It is not necessary for this program to be used before every program. The user is free to take statements out of this program or customize it in any way that the user desires. In fact this may be very advantageous once the program is developed to conserve on even more memory. If there is something that is of no use, don't use it! This is easily accomplished by LOADing the program into BASIC, EDITing it then SAVEing it away under a different file name. It is also advantageous to condense the names of the variables to two letters as this will also save program memory space. Also, there is nothing scred about the variable names, they can be what ever you choose. (Just be sure to be consistant)

OUT 39,137 : OUT 52,0

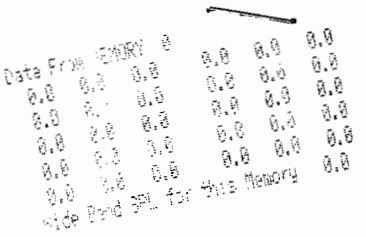
BASIC - SPEED & EFFICIENCY

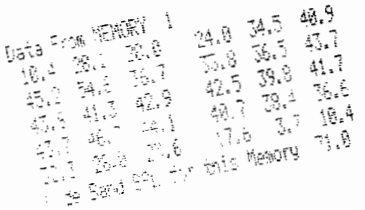
Sorry for the contradition in terms, BASIC has never been known for either. However, there are a couple of things to remember so as to make it as painless as possible. First, always use INTEGER variables where possible, especially in loop counters. A 25% savings in time can be realized by using integer variables as the counters in FOR-NEXT loops. Second, always locate statements that are pointed to by GOTOs, GOSUBs, NEXTs, etc. as near to the beginning of the program as possible.

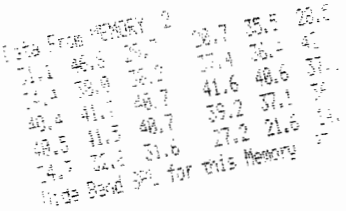
40 RAM Track (BACK DOOR)
OUT 39,137 : OUT 52,0

Raise Strobe pins before CTR pins

```
10 REM DEMO Recall Stored Memories and Place in Array
20 REM NOTICE - This Software is a DEMO ONLY
30 REM  - Designed to Demonstrate Programming
40 REM  - Techniques for the PC40.
50 REM  - 8/30/90 DRM
60 REM
70 REM Get and Define PC40 Constants and Calls
80 CLS:PRINT "Loading PC40 Definitions..."
90 CHAIN MERGE "C:STARTUP.BAS",60000!
100 REM ---> NOTE ** User Program MUST start at LINE 100 ** NOTE <---
110 DIM A%(19,30)
120 REM setup i/o ports to allow access to instrument memory
130 CALL PATCH%(PORTR%)
140 REM set analyzer to low power mode
150 OUT 37,INP(37) OR 128
160 CLS:PRINT "Loading Data"
170 FOR MEM%=0 TO 19
180 REM recall the memory data
190 REM
200 REM Note: GETMEM memories are numbered 1-20
210 GMEM%=MEM%+1
220 CALL PATCH%(GETMEM%,GMEM%)
230 REM transfer data from workspace to Basic CH%() array
240 CALL PATCH%(CHLOAD%)
250 REM test to verify memory contained valid data
260 IF PEEK(STATUS1%) THEN 300
270 REM if data invalid, force it to zero
280 FOR FREQ%=0 TO 30:CH%(FREQ%)=0:NEXT FREQ%
290 REM load target array with this memory data (includes wideband spl)
300 FOR FREQ%=0 TO 30:A%(MEM%,FREQ%)= CH%(FREQ%):NEXT FREQ%
310 A%(MEM%,30)=A%(MEM%,30)AND &HFFF
320 NEXT MEM%
330 REM here with all memories transferred to Basic Array A%()
340 REM
350 REM
360 REM now dump the data to verify its there
370 PRINT "Printing Array"
380 FOR MEM%=0 TO 19
390 LPRINT "Data From MEMORY ";MEM%
400 FOR FREQ%=0 TO 29 STEP 6
410 REM print data 2 octaves per line
420 LPRINT USING "###.# ";A%(MEM%,FREQ%)/10;
430 LPRINT USING "###.# ";A%(MEM%,FREQ%+1)/10;
440 LPRINT USING "###.#   ";A%(MEM%,FREQ%+2)/10;
450 LPRINT USING "###.# ";A%(MEM%,FREQ%+3)/10;
460 LPRINT USING "###.# ";A%(MEM%,FREQ%+4)/10;
470 LPRINT USING "###.#";A%(MEM%,FREQ%+5)/10
480 NEXT FREQ%
490 LPRINT " Wide Band SPL for this Memory ";
500 LPRINT USING "###.#";A%(MEM%,30)/10
510 LPRINT
520 LPRINT
530 NEXT MEM%
540 SYSTEM
```







MEMORY max 472 screens + 512/per additional Chip

each Chip (32K) = 512 screens

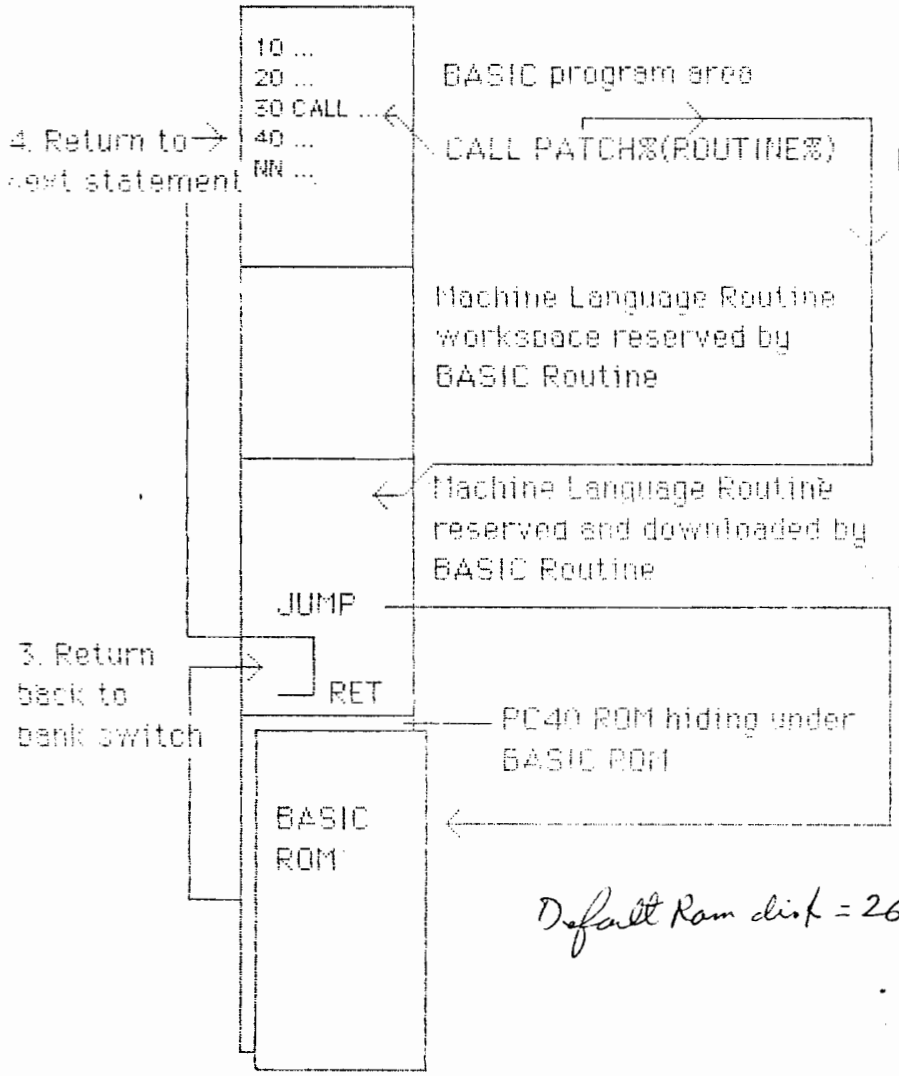
Can added up to 14(32K) chips

POKE 3, &HE9 = directs print to parallel

69 = Cart

89 = 410

A9 = RS232



Default Ram disk = 26 max 35

Record Buff

472 max

Each Chip 512

1.81 Sec - std Ram # of screens x 2

3.62 Sec -

FIG. 1

Turns ON Audio Relay — OUT PORT 2B, INP(PORT 2B) or 64

off out port 2B, INP(PORT 2B) and 191

Event control ON " " " or 16

OF and 239

Event sense ~~report~~ INP (PORT 2C) and 4

0 = low 1 = high

ANRT60 File Needs

Time base X 12,800

1.81 requi 24K

3.62 47K

7.24 93K

10.86 140K

4 times last Sample and Accumulator

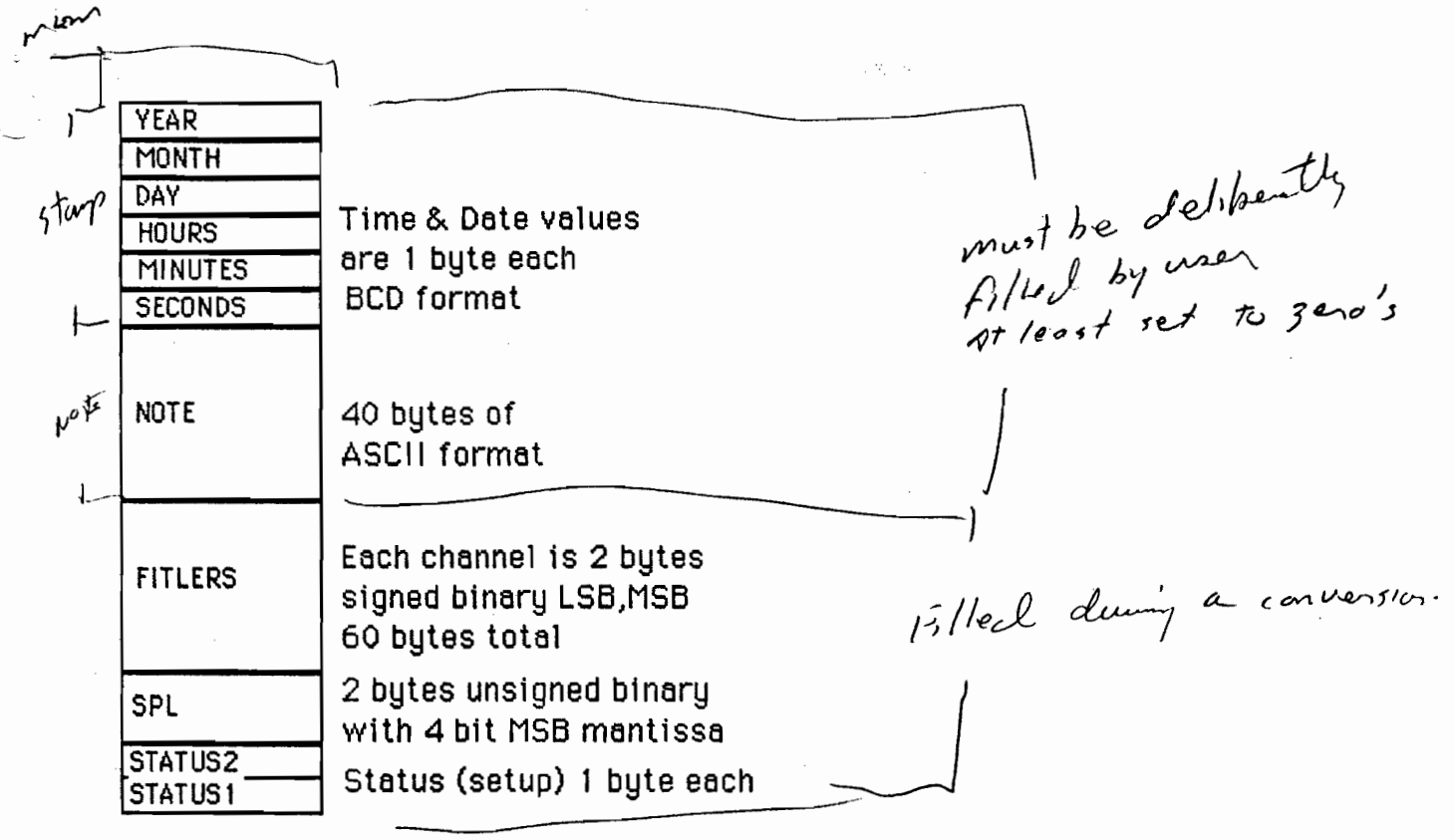
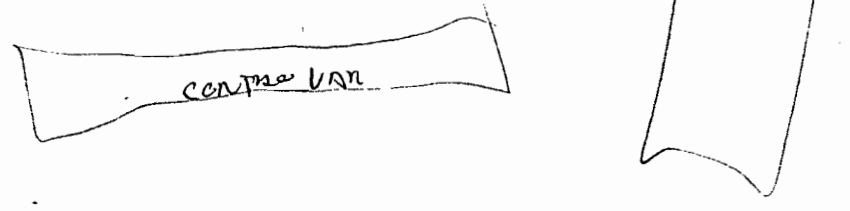


FIG. 2



PF Keys 1-5

RUN

NOTE SAVE ALL DATA IN PC40 BEFORE RUNNING YOUR BASIC Program.

How to have Basic to return to partitions ?

Basic and the PC40

The BASIC programming language that comes with the PC40 is very close to the that found on an IBM PC or compatable. This manual assumes that the reader has a working knowledge of that kind of BASIC. If this is not the case, it is suggested that the reader first become familiar with programming in BASIC through one of the many tutorials that are commercialy available. This manual will not be teaching how to program in BASIC, rather it will attempt to describe how to utilize the machine language subroutines found in the PC40 program from BASIC. This will bring out performance characteristics that BASIC could not achieve on its own. This is however a two edged sword. Many of the machine language routines have no error checking and there are rules that need to be strictly followed. Lack of dilligence in these areas can cause program crashes that could result in complete loss of data. To this end, the manufacturer, the dealers, and the representives of the PC40 claim no responsibility or liability for the programs run in BASIC by the user. Therefore the user should check and recheck all programs created and or entered into the PC40 before running them. The two major RULES to follow to prevent CRASHING are these: 1. ALWAYS use INTEGER VARIABLES in the CALL statements, and 2. ALWAYS be sure to check for CORRECT SPELLING of the VARIABLES used in the CALL statements. Failure to do either of these will result in CALLING to a memory location where no programs exist or into the middle of a program. Since the Z80 processor or its operating system has no error trapping to prevent this very strange things can and will happen and in these cases nothing in memory is sacred. As a final note before getting started, the patches from BASIC to the PC40 program routines have not been created and supplied to facilitate programming by the manufacturer. Instead, they have been supplied so that the users of the PC40 can create and customize their OWN programs. The manufacturer and its representatives will be happy to answer questions where possible and give examples of "HOW TO", but will not tailor programs for each and every user.

Getting Started

The subroutines used in the PC40 program have been made accessable to BASIC by using the CALL statement. In every case CALLs will be made to a machine language routine that has been down loaded beforehand to a protected area of memory. This routine will bank switch memory over to the ROM that contains the PC40 program, and will JUMP to the routine needed. After the routine has completed its task, control is handed back to the machine language routine first called where the BASIC ROM is bank switched back in and control is handed back to BASIC where the next logical instruction is executed.

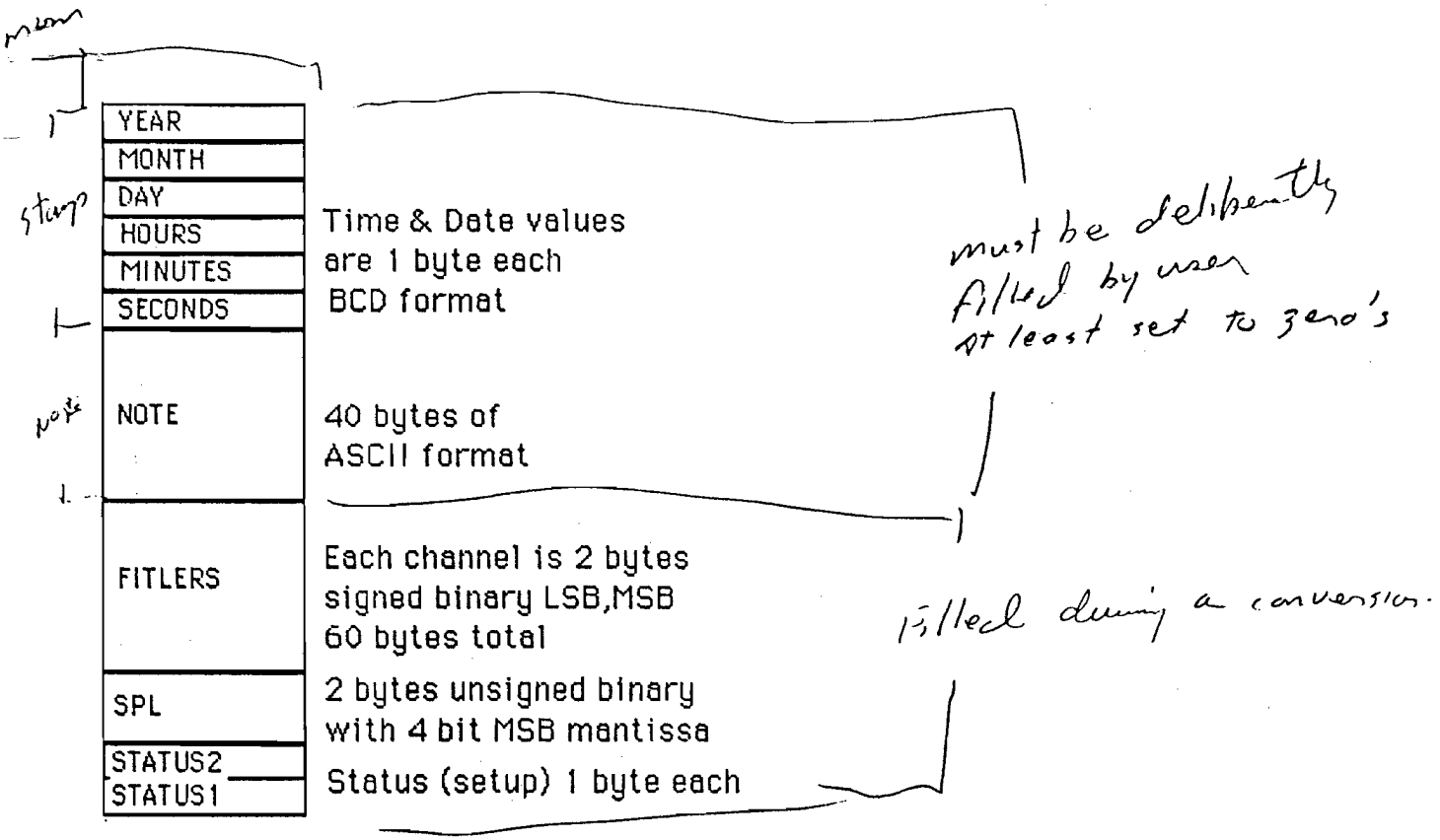
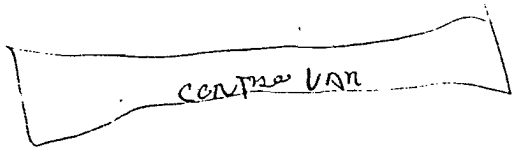
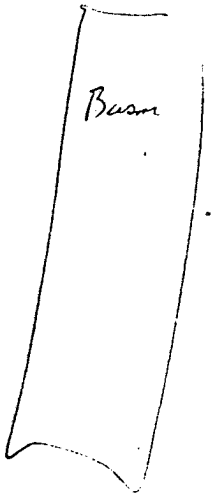


FIG. 2





PP Keys 1-5

Run

The first statement that should always be run when BASIC is first started is;

10 CLEAR ,&H5E30

The statement number can be any number as long as it is the lowest or the first thing basic does. Don't forget the comma just before the ampersand symbol or the statement will not work. Now come the first caution; When using the patch routines, NEVER initialize internal RAM disk allocation larger than 26K. (Default value) RAM disk space also under lies the BASIC and the PC40 ROM. If it is intialized to larger than 26K, it will conflict with the area normaly loaded by the machine language patch routine and will be overwritten. This causes no problem for the machine language routine but data residing in RAM disk can get clobbered. The way to avoid this is to check the sign on message in BASIC. If it shows less than 20313 bytes of free space then there may be a problem with RAM disk being too large. If this is the case, the computer will have to be reinitialized or the "CONFIG" utility run to reduce the RAM disk size to 26K. The second statement that needs to be run is;

20 BLOAD"C:PC40BSUB.CIM"

This will cause the object file named "PC40BSUB.CIM" on drive "C:" to be loaded starting at the address CLEARed by the first statement. It will not only load the machine language routine, but will also load the default values for the analyzer and clear the memory locations used by the PC40 subroutines. These two statements once run will never need to be run again as long as BASIC is in operation. If BASIC is exited to go back to the SYSTEM prompt, then all is lost including the BASIC programs and these statements will need to be executed again when BASIC is reentered. Any programs that were SAVEd to RAM disk will still be intact.

Newsletter by STARTUP.BAS ??

MEMORY AND VARIABLES

The PC40 subroutines use part of the memory protected by the CLEAR statement as areas to keep variables. Variables that control the analyzer when some routines are run to variables that receive data from other routines. Control variables are used by POKEing a value in the appropriate location and then calling the routine that exercises control using that variable. The rest of the variables are used for storing or passing data to BASIC programs usually by the PEEK statement. Listed below are the variables used by the PC40 routines, their location, and the amount of memory the variable addresses. Below each variable is an explanation of how the variable is used. In many instances there are specific values that

can cause serious problems.

Poke &H5E35,6
Poke Refer%,6

REFERENCE : Location &H5E35 - 1 byte
(REFER%) Controls the gain of the analyzer and is set in relation to the dB level of the REFERENCE LINE /10. To set the REFERENCE LINE to 60 dB, poke this location with 60/10 = 6, then CALL the port setup routine. When using the Microphone as input valid references can be 3 to 14. When using the probe, valid references can be from 5 to 18. Default =60

NEED TO CUT DEFAULT SETTINGS OF REFER, DECAY, ETC

DECAY : Location &H5E36 - 1 byte POKE DECAY%, 1
DECAY% Controls the response of the filter detectors. There are three speeds; 1=slow, 2=medium, and 3=fast. Default is Fast

SCALE : Location &H5E37 - 1 byte POKE SCALE%,3
SCALE% Sets the resolution of the display screen. It can take on values of 1,2, or 3 and corresponds to the dB/step. Default 3dB/STEP

RESPONSE : Location &H5E38 - 1 byte
RESPON% Controls the response of the SPL detector. Valid values are 1=fast, 2=slow, 3=peak, or 4=impulse. Default = FAST

WEIGHT : Location &H5E39 - 1 byte
WEIGHT% Controls the SPL weighting and can also control the filter weighting if the filters have been set to follow the SPL weighting. Valid values are 0=FLAT, 1=C WT., 2=A WT. Default = Flat
see Display% below

DISPLAY : Location &H5E3A - 1 byte
DISPLAY% This controls two separate items. First, it sets the filters to OCTAVE or 1/3 OCATVE response. Second, it causes the filters to follow the SPL weighting or sets the filters to flat response. 0=OCTAVE and FLAT, 1=1/3 OCTAVE and FLAT, 2=OCTAVE and follows SPL weighting, 3=1/3 OCTAVE and follows SPL weighting. Display = Default = 1/3 octave

MIC/PROBE: Location &H5E3B - 1 byte
MICPRB% There are two possible inputs to the analyzer. When this location is 0, the input is taken from the 2P microphone input. Values of 1, 2, or 3 will cause the analyzer to take input from the BNC Probe connection. When set to 1, the SPL print routine will scale the SPL value to dBM. When set to 2, the SPL will be scaled to dBV. When set to 3, the value returned by the CONVERT routine will be scaled to AC volts. Default = SPL

—INSERT RECDAT% explanation

MEMORY : Location &H5E44 - 110 bytes Format is Figure 2
This is the place where PC40 memories are brought back, realtime converted data is stored, and where records from the record buffer are returned. Hence, this area sees alot of changes and care must be taken in CALLing routines so that important data residing there is stored somewhere else before the CALL. The Memory area is divided up

temp — Hex Register

Real time samples write to this area as Getmem or Get Record.

into smaller areas depending on the routine CALLed and the type of data.

These areas are as follows:

STAMP : Location &H5E44 - 6 bytes
Here is the actual Time and Date Stamp created for a MEMORY when the STORE button was pressed. It is kept in packed BCD format. If this is a problem, be aware that these values are decoded by the memory fetch routine and stored in another location which will be shown later.

NOTE : Location &H5E4A - 40 bytes
Here is the 40 character note for a memory that has been returned by the memory fetch routine. It is kept in ascii format and can be PEEKed into a string variable as will be seen later.

PIXELS : Location &H5E54 - 30 bytes
This is field is of little use to the user directly. It is brought to light here to show that it is sharing the same space as NOTE. It is used to store the number of pixels that are OFF in the bargraph on the screen. The values can either be calculated by a routine or brought straight in as is the case for a realtime sample.

FILTERS : Location &H5E72 - 60 bytes
Here is the values for each of the 30 filter channels. They are kept in signed, binary format and are relative to the reference at the time they were stored. They are also stored in LSB, MSB format which means that the Least Significant Byte if first and the Most Significant Byte is second. This means that there are 2 bytes/value and the values start with 25 Hz and end with 20 KHz. If this is a problem, there is an easy way to return these values directly to an array predefined in the BASIC program.

SPL : Location &H5EAE - 2 bytes
The SPL data is also kept in binary format just as the filters are with two exceptions. First, the value is unsigned and has a 4 bit MSB mantissa. SAY WHAT? Don't worry too much this is also decoded automatically by the SPL print routine. Plus there are easy to follow BASIC statements that will be shown later to handle the decoding.

STATUS : Location &H5EB0 - 2 bytes
Compressed into these 2 bytes is all of the analyzer parameters such as reference, decay, response, weighting, ect. Don't worry, there again is a simple way to decode this information.

THE ROUTINES

Here is where the fun begins. Consequently, this is also where the danger begins so as a word of caution, BE SURE TO CHECK ALL STATEMENTS BEFORE RUNNING THEM! To simplify the programming process another help has been added besides the subroutine patch to the PC40 ROM. The program is called "STARTUP.BAS" and also resides in the PC40 ROM which is known to the computer as disk drive "C:". This program performs most of the variable assignments for the machine language addresses and the locations of the variables in the PC40 workspace area. Before looking at this routine however lets get into BASIC.

Turn the analyzer on and Quit the PC40 application (program). Now should be seen the CP/M prompt or MENU. If the MENU is in effect, place the cursor over "B:BASIC.COM" and press return. If the system is in the PROMPT mode, then type in

B:BASIC.COM<CR> The "<CR>" means to press 'RETURN'.

The analyzer should now show the USER LOGIN MENU for BASIC. Pressing the 'SPACE' bar should login to USER AREA 1 with the ever-so-popular "OK" prompt showing up in the left most column just under the BASIC sign on message. If you have failed to get this far then stop everything and refer to the OPERATING SYSTEM MANUAL and the BASIC MANUAL that came with the PC40.

Once safely in BASIC, type in the following;

LOAD "C:STARTUP.BAS"<CR>

The response on the next line down should be "OK" with a flashing cursor below the "OK". If the next line down says, "NE ERROR" and then displays the "OK" prompt, check the spelling of the line with LOAD on it. If neccessary, move the cursor with the cursor arrows up to the mistake and type over it with the correct spelling. If it is correct now, press 'RETURN'. If all has gone well, the "OK" prompt will write over where the "NE" used to be and the response on th next two lines down will read,

"OK ERROR"
"OK"

Now type,

LIST<CR>

The program that was listed to the screen is devised to make all of the

normal variable assignments and declarations for the user. This program can be altered and SAVEd or used to CHAIN to a user written program. More about that later! Now, lets use this program as a starting point and add a little to it.

Read the last line of the program. It should read,

"630 CHAIN "PC40BAS",,ALL"

Delete the line by typing,

DELETE 630<CR>

Now type,

630 CLS:CALL PATCH%(DRAWSCRN%)<CR> – Draws
640 FOR I%=0 TO 1000:NEXT I%<CR> -

syntax Remember sintax (spelling) is very important; CHECK YOUR WORK! When the program is correct type,

RUN

What happens next is that you will think that the analyzer has gone back to the PC40 program and in a way it has. Only after a second or two the PC40 screen will shift up one line and the "OK" prompt will be back indicating that the BASIC program has finished it's task. Always include a clear screen command before executing this routine or weird things can happen such as the upper half of the screen on the bottom.

SCREEN DRAW ROUTINE

The routine uses the control variables to graphically construct a sckeletal screen upon which other information can be overlayed such as the filter channel data. Before that , however, lets take a minute to see what affect the control variables have on the screen. Insert a new line of instruction by typing,

625 POKE REFER%,3<CR>
RUN<CR>

clear → load PC40 SW → Set Equates → Poke in ... Patch

By changing the values for the REFERence it should be changing the number that is printed by the REFERENCE LINE on the screen. Remember, only enter those values that are valid.

Now try changing "REFER%" to the variable "DECAY%" and try the valid

Now try changing "REFER%" to the variable "DECAY%" and try the valid values. The decay indicator box on the righthand side of the screen should

be moving to the appropriate positions.

Now use the variables "SCALE%", "RESPON%", "WEIGHT%", "DISPLAY%", and "MICPRB%" and observe the result. Note, when changing "MICPRB%", the result will be to change "SPL" in the bottom righthand corner to "DBM", "DBV", to "ACV".

ANALYZER CONTROL

All of the control parameters for the analyzer are handled by one routine, but this routine has two entry points. The first entry point is used to initialize the I/O port adapters and then set the control lines going to the analyzer. The second entry point is used for setting the control lines without initializing. The reason for the two entry points is that once the I/O ports have been initialized, it is not necessary to do again unless the analyzer has been turned off. Also, during initialization of the I/O ports the control lines all go to a high state which will cause a momentary glitch in the audio circuitry of the analyzer. Before using this routine it is necessary to be sure that the control variables contain the desired values. When the machine object file "C:PC40BSUB.CIM" is loaded in the variables are set to a default value. The default settings are listed below.

Reference = 60
Scale = 3 dB/step
SPL Responce = Fast
SPL Weighting = Flat
Filter Bandwidth = 1/3 Octave
Filter Weighting = Flat
Filter Decay = Fast
Input = Microphone (SPL)

The syntax for this command is,

CALL PATCH%(PORTR%)
or
CALL PATCH%(PORT%)

The latter statement will set the control lines without intializing the I/O ports.

STATUS SETUP & RETURN

Before it was stated that the analyzer setup was also encoded down into two bytes called "STATUS". This is done so when data is stored, it does not take up as much space. There are two routines that encode and decode

status bytes. The other goes the opposite direction and rewrites the control variables based on the status bytes. These routines are used when recalling data from memory or putting data into memory. In the first case , after fetching a memory from the PC40, the status to variable routine would be used to set the control variables to the state they were in when the memory was stored. Afterward a screen would be generated and the data displayed just as it was saved. To use these routines they should look like this,

CALL PATCH%(STATVARI%) Converts STATUS bytes to Control Variables
or
CALL PATCH%(VARISTAT%) Converts Control Variables to STATUS bytes

DISPLAYING DATA

There are four routines that display data. They are Filter display, SPL display, Battery display, and Screen Redraw. We have already seen how screen redraw works. The other three routines are called in the same manner as the Screen Redraw routine. However, there are no default values for the other routines because they depend on data that has been created by some means as recalling a memory or taking a realtime sample. Do not use these routines unless valid data exists. Failure to follow this rule will possible cause a program crash. The syntax for these routines is,

CALL PATCH%(FLTDSP%) Filter bargraph drawing routine
and
CALL PATCH%(SPLDSP%) SPL prints in bottom righthand corner
and
CALL PATCH%(BATDSP%) Draws bargraph indicator in top right corner

TAKING A SAMPLE

The routine for taking a sample assumes that the analyzer has been turned on. Of course if this is not the case, the data returned will be garbage although it will not cause the computer to crash. Before running this routine then it is necessary to have CALLed the analyzer setup routine. After having done so you can take a realtime sample by doing,

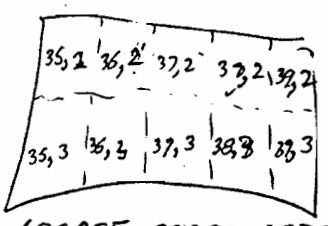
CALL PATCH%(CONVERT%)

This will return the ~~relative~~ level of all 30 filters, the SPL, and the level of the Battery. This routine will use the same area as the memory fetch and the record fetch routines so it assumed that any important data residing there has been transfered elsewhrere. This routine is unique in that you dont need to calculate the height of all the filter bars after the routine is done. It does all that as part of the process. Using the routines we know about this far, lets make a realtime analyzer program. Type in

routine is done. It does all that as part of the process. Using the routines we know about this far, lets make a realtime analyzer program. Type in the following at the end of the "C:STARTUP.BAS" program. — remember delete line 630 first

PAGE 11.

```
630 CALL PATCH%(PORTR%)
640 CLS:CALL PATCH%(DRAWSCRN%)
650 CALL PATCH%(VARISTAT%)
660 CALL PATCH%(CONVERT%)
670 CALL PATCH%(FLTDSP%)
680 CALL PATCH%(SPLDSP%)
690 CALL PATCH%(BATDSP%)
700 GOTO 660
```



LOCATE COORDINATES FOR Annunciator window ON PC40 Screen

Before typing 'RUN<CR>' check your typing.
The result should be the PC40 action that you are used to seeing. The only exception is that it will not, at this point, respond to any of the keys except for the 'QUIT' key which will "BREAK" the program execution. Below is an explanation of the program.

Line **10-620**, sets up the variables for PEEKing, POKEing, and CALLing
Line **630**, sets the analyzer on and sets the control lines
Line **640**, clears the screen and draws the basic sceen graphics (remember, important)
Line **650**, sets the status bytes = the variables (not necessary here but a good practice
Line **660**, gets realtime data from the analyzer
Line **670**, displays the filter levels
Line **680**, displays the decoded version of the SPL
Line **690**, displays the battery level
Line **700**, loops the program back for more (indefinitly)
To Stop Hit the Quit button

FETCHING A MEMORY

Returning a memory STOREd by the PC40 is just a little different than what we have seen so far. Beyond CALLing the routine to fetch the memory we also need to tell the routine what memory number to get. This is done by passing a second parameter in the CALL statement. "Passing a parameter"; What is that? Well, so far, the CALL statements that have been used are CALLing to an address in the variable "PATCH%". Then the routine at that address CALLed takes the value in the variable inside the parenthesies as a "passed parameter" and jumps to the address that is equivalent to the value "passed". We add the second parameter like this,

```
CALL PATCH%(GETMEM%,NUM%)
```

The first variable in the parentesies is the address of the GETMEMory routine while the second variable is the number of the memory we want to get back. The two variable must be integer and they must be separated by a comma. The valid range for memories is 1 - 20. 1 - 10 would correspond

inverted memories 1 - 9,0. Let see how this works by typing in these

statements at the end of "C:STARTUP.BAS". Note: Before doing this program you might want to make sure there are some memories stored in the PC40 or there won't be anything to recall.

```
630 CLS:INPUT"SELECT A MEMORY NUMBER (1-20)";NUM%
640 IF NUM%<1 OR NUM%>20 THEN 630
650 CALL PATCH%(PORTR%)
660 OUT 37,INP(37) OR 128
670 CALL PATCH%(GETMEM%,NUM%)
680 IF PEEK(STATUS1%) THEN 690 ELSE 630
690 CALL PATCH%(STATVARI%)
700 CLS:CALL PATCH%(DRAWSCRN%)
710 POKE REFBUFF%,PEEK(REFER%)
720 CALL PATCH%(REFLOCAL%)
730 CALL PATCH%(PIXCAL%)
740 CALL PATCH%(FLTDSP%)
750 CALL PATCH%(SPLDSP%)
760 K$=INKEY$:IF K$="" THEN 760
770 GOTO 630
```

Check your work before typing 'RUN<CR>'
You must have noticed that there were a number of CALLs and procedures that have not been discussed yet. Well let's see what is hapening here.

Line **630**, Prompting for memory number to get.
Line **640**, Test input against limits to be sure the number is ok.
Line **650**, Configure the ports. Even though the analyzer is not being used this needs to be done so that the routine can address the RAM in the PC40.
Line **660**, Turn the anlyzer power OFF. Not absolutely necessary but helpful.
Line **670**, Get the memory to display.
Line **680**, Test STATUS byte #1 to see if the data is there. If data was actually stored here then this location would not be zero. If this memory is not active then there is nothing to display.
Line **690**, Set up the control variables so the screen draw routine will reflect the set up when the memory was stored
Line **700**, Draw generic PC40 screen.
Line **710**, Set the original reference equal to the new reference. This is done so that when the filter bar heights are calculated, they are figured on the basis that they are being displayed with the original reference. To see the data at a different reference, after executing Line 710 then reset the variable REFER% to the desired reference/10. This must be done before CALLing the routine REFLOCAL% on line 720.
Line **720**, This routine sets the lower limit of the screen so the next routine can calcuite how high to make the bars on the filter bargraph. The result is not returned to BASIC, but is stored in work space for later

Line 720, This routine sets the lower limit of the screen so the next routine can calaulte how high to make the bars on the filter bargraph. The result is not returned to BASIC, but is stored in work space for later reference.

Line **730**, Calculate how high to make each bar on the filter bargraph. This must be done because unlike realtime, the pixel data for the height of the bars is not readily available. Since it not stored it must be recalculated. This feature allows the user to recalculate the filter bars for different references and scales.
Line **740**, The rest is the same as before except that the battery is not displayed. This is simply due to the data not being kept. Who cares what the battery was doing then, what matters is what it is doing right now which is now then so again, Who cares?
Line **760**, Simply a mechanism to hold the program up until your ready to look at the next memory. Again the program can be quit by pressing the 'QUIT' key.

NOTES AND TIME

The memories are all stored with a time and date stamp as well as a 40 character note. These are available, but the note needs to be read out of work space memory before the pixel calculation takes place as that routine shares space with the note area. To read out the note use the PEEK command in a loop sch as this,

```
10 NOTE$=""
20 FOR I%=6 TO 45
30 NOTE$=NOTE$+CHR$(PEEK(MEMORY%+I%))
40 NEXT I%
```

I%
↑ LETTER "I" NOT the number 1

Line **10**, clear any previous note.
Line **20**, the note goes from position 6 to position 45 in the memory area.
Line **30**, concatonate all of the characters. read and add to note string each individual character
Line **40**, do all of the 40 characters.(spaces and all)
At this point the note$ can be ~~stored somewhere else or printed, or what~~ ever else you do with strings. The note $ is safley stored in the N$

By Pixcal

The time and date are not over written and can be directly read at memory locations 0-5 relative to the value kept in MEMORY%. The time is kept in BCD format, most significant to least. First is the Year, then Month, Day, Hour, Minutes, Seconds. If BCD is scary to you then use the decoded values placed in work space for you at the location kept in the variables YEAR%, MONTH%, DY%, HOUR%, MINUTE%, SECOND%. The reason the variable DY% is spelled DAY% is that DAY is a reserved word to BASIC. To get a value out of memory simply PEEK it. (ie. PEEK(YEAR%))

GETTING A RECORD

Fetching information back from the record buffer is the same as fetching a

record checking exists. The two things to keep in mind while using this routine is know beforehand the limits of the record buffer (Available RAM) and know how many records have been put there. The range can take on values from 0 to 8155. The statement to get the record would look like this,

From Basic Keep track of # of Screens Recorded

```
CALL PATCH%(GETREC%,NUM%)
```

All of the same calculation procedures have to be done before you can display the results.

RECORDING RECORDS – Basic autopauses some space of P.C 40 Rec. Buffer and it will be overwritten with out any notice to anyone

This routine will go out and record what ever number of records it is told. Using the rate specified by the control variables as well as the set up, the routine will not return to BASIC until the limit specified has been reached. Rate by the way, is a control variable that has not been priviously covered. Pointed to by the variable RECDRATE%, valid values that can be POKEd there are 1 to 100. Any values outsdie this range will have unpredictable results. the default is 30, which meand that the analyzer will take samples at a rate of 30 spectral stores per second. One spectral store includes all 30 filters, the SPL, and the two status bytes. Use of this routine might look like this,

```
630 CLS:INPUT"ENTER NUMBER OF SAMPLES";NUM%
640 IF NUM$>400 THEN 630
650 INPUT"ENTER RATE TO SAMPLE";RATE%   RT%
660 IF RT%<1 OR RT%>100 THEN 630   650
670 POKE RECDRATE%,RATE%   RT%
680 CALL PATCH%(PORTR%)
685 CALL PATCH%(VARISTAT%)
690 INPUT"PRESS ANY KEY WHEN READY";DUMMY$
695 CALL PATCH%(RECD%,NUM%)
700 OUT 37, INP(37) OR 128   – Turns analyzer off
705 POKE REFBUFF%,PEEK(REFER%)
710 CALL PATCH%(DRAWSCRN%)
715 CALL PATCH%(REFLOCAL%)
720 FOR I%=0 TO NUM%
730 CALL PATCH%(GETREC%,I%)
740 CALL PATCH%(PIXCAL%)   (PIXCALC%)
750 CALL PATCH%(FLTDSP%)
760 CALL PATCH%(SPLDSP%)
770 NEXT I%
```

To turn on
OUT 37, INP(37) and 127

```
630 A$=INPUT$(1)
640 CALL PATCH%(RECD%,NUM%)
650 OUT 37, INP(37) OR 128
660 POKE REFBUFF%,PEEK(REFER%)
670 CALL PATCH%(DRAWSCRN%)
680 CALL PATCH%(REFLOCAL%)
690 FOR I% =0 TO NUM%
700 CALL PATCH%(GETREC%, I%)
710 CALL PATCH%(PIXCALC%)
720 CALL PATCH%(FLTDSP%)
730 CALL PATCH%(SPLDSP%)
740 NEXT I%
750 GOTO 750
```

Much of this program should be readily understood when compared with those given already. Therefore, only those statements that differ will be dicussed.

much of this program should be readily understood when compared with those given already. Therefore, only those statements that differ will be dicussed.
Line 705, the difference here is order in the program. It should be noted

that the original reference need only be set once if the data is not going to be changing in reference. Likewise the lower screen limit only needs to be calculated once if the data is not going to be rescaled.
Line 740, calculation can be done without any more reference or screen low limit calculations because the data is being displayed without any rereferencing or rescaling.

What should happen during the execution of the program is the user will be prompted for the number of sample to record and the rate at which to record the samples. Then the program will wait for the user to press a key. After the key press, the program will then record the number of samples requested and then when done will display what has been recorded.

PUTTING RECORDS AND MEMORIES BACK

The routines that do the reverse of getting are available but there is a word of caution; BE SURE THE RECORD OR MEMORY AREA CONTAINS THE ARRANGEMENT OF DATA THAT IS CONSISTANT WITH RECORDS OR MEMORIES. So there is no confusion, below is a memory map of the area.
(INSERT FIG 2 HERE)

The sintax for these statements should read,
CALL PATCH%(PUTMEM%,NUM%) — must write date, time, and note before calling — to check look for non zero
and
CALL PATCH%(PUTREC%,NUM%) — Knew limits # of ~~reds~~ record spaces available

SPL - TO CODE OR NOT TO CODE

The question has been raised. It has been said previously that the SPL value returned to the work space is 2 byte, unsigned binary with a 4 bit MSB mantissa. So the number will be of value to the user in BASIC other than using the print routine, we will take some time to explain the concept. First of all, the term 2 byte, unsigned binary means that the number is kept in a manner that is conveinent for the computer. With 2 bytes the number can take on values from 0 to 65535 if there is no sign. Since the SPL is recorded to 1/10 of a dB and the computer does not like decimal points, the values are multiplied by 10. So the number range we are dealing with is 0 to 2000. This correlates to 0.0 to 200.0 dB SPL. In hexidecimal format that would be 0 to 07D0h. Notice that the leading 0 in 07D0h; since this position is never really used to store the value it can be used to store other information such as where to put a decimal point if one where used. This could only be done if that leading position where

stripped off before the number was actually used. In the case of SPL values this is not really necessary because the decimal point is always in

the same place.(ie. 10.0, 200.0, 9.5) However, recording values in Volts AC is another story. So we adopted a method of storing decimal place information in the unused upper 4 bits of the 2 byte number and limit Volts AC to 999. (03E7h) The number contained in the upper nibble (4 bits) is the position to place the decimal point as starting from the left. For example, if we ANDed F000h with ths SPL value that was recorded in dB, we would get 4000h. If we then ANDed the SPL value with 0FFFh and got back 0755, the decimal place would be 0755.5. The first position is in front of the 0, the second place infront of the 7 and so on. This was done to facilitate the machine language print routine and not to be mathimaticly handy. It is also easier to store and takes up less room than other matissa techniques. It can be calculated in BASIC by using the following statements.

```
10 SPL%=PEEK(RLTMSPL%)+PEEK(RLTMSPL%+1)*256
20 D%=(SPL% AND &HF000)/&H1000
30 SPL%=SPL% AND &HFFF
40 SPL=SPL%*10^(D%-5)
```

Line 10, get the value returned to memory.
Line 20, strip off the 4 bit mantissa and bring it down to the one's place.
Line 30, strip off the SPL from the mantissa.
Line 40, mathimatically set the decimal place into a single precision variable.

This over kill if not dealing with Volts AC. When just dealing with dB, use,

~~10 SPL=(PEEK(RLTMSPL%)+PEEK(RLTMSPL%+1)*256)/10~~

SPL = ((PEEK(RLTMSL%) + PEEK(RLTMSPL%+1) AND &HFFF) *256)/10

[SPL = SPL + Peek Attn *10 for Attenuator]

SPL - ANOTHER WAY STILL

CHLOAD Transfer from Transient → CH Array
CNSAVE Transfer from CH Array → Transient

If it is desired to return the numerical data without drawing the fancy bargraph or screen, there is another way. There is a routine pointed to by the variable called **CHLOAD%**. In the listing of "C:STARTUP.BAS", there is at line 610, a statment which is dimentioning an array called CH%(). The routine searches for this array in the variable table of BASIC. When and if found it procedes to load the array with the 30 filter values, the SPL, and the STATUS bytes. The result is the array variables will contain the decoded values times 10. The array positions start with the lowest filter (25 Hz) in CH%(0) and go to the highest filter (20KHz) in CH%(29), with the stripped SPL value in CH%(30), Status2 in CH%(31), Status1 in CH%(32). The filter values loaded into the array are also converted to absolute. This means that if a value less than zero is returned and the analyzer is set up for dB SPL, then the number should be thought of as zero. This routine is

means that if a value less than zero is returned and the analyzer is set up for dB SPL, then the number should be thought of as zero. This routine is CALLed when ever the data pointed to by RLTMFILD%,RLTMSPL%,STATUS2%,

and STATUS1% needs to be transfered to the array variable CH%().. As an example, go back to the GET MEMory program. After the memory has been retreived by line 670, execute the statements,

```
680 CALL PATCH%(CHLOAD%)
690 FOR I%=0 TO 30
700 PRINT CH%(I%)/10
710 NEXT I%
```

This routine will print the values for the data numerically. The screen will scroll upward as the printing goes beyond 8 lines, but the numbers can be seen after the program stops by using SHIFT and the up-arrow. Since the numbers are kept as times ten, they need to be divided by ten before printing.

DUMPING THE SCREEN TO A PRINTER

LPRINT CHR$(2) sets double/high mod
LPRINT CHR$(3) sets normal mode

Screen dumps can be accomplished in two ways, sideways or normal. Both are bit map transfers of the screen to the printer and assume that the user is operating an EPSON MX or compatable. The normal screen dump is unusual here because it does not use the same CALLing mechanism. Since this routine is found in the SYSTEM ROM, it is CALLed directly by issuing the statement CALL SCRNDMP%, where the variable SCRNDMP% is equal to &HEB36.

The other routine is used by the PC40 to dump to the cartridge printer. It is more readable and can be done in two sizes. It also causes the screen dump to come out sideways on the paper. This routine will work with any printer as long as it maintains EPSON compatability. The size of the screen dump is controlled by a memory location at &H5ECE. The value of this location is very important and should be &H80 for the small format and &HC0 for the large format. Any other values will have unpredictable if not disasterous results. The default value is 'Small'. Also there is a second variable passed with the CALL that selects or deselects the frequency labling. If the second variable is zero, the frequency labling will not appear. If the second variable is a one then it will. As an example, try the GET MEMory program again, only this time insert the line,

```
755 NUM%=0:CALL PATCH%(SDEDMP%,NUM%)
or
755 ADR%=&HEB36:CALL ADR%
```

- sideways - Lg or Small depending up VARIBLE
- normal screen dump same size always

BATTERY DISPLAY

The battery indicator normally seen while in realtime analysis can be

recreated by CALLing the routine located by **BAIDSP%**. This routine assumes that a realtime sample has been taken and that the data located

in memory used by the routine is correct. If this is not so it will be crash time again. In otherwords, don't CALL this routine unless you have run the sample routine at least once.

STARTUP.BAS ROUTINE

This BASIC program is supplied in the PC40 ROM to aid the user in learning how to interface with the PC40 application and to conserve on memory when running programs. It is specifically devised to assign values to memory pointers and then get out of the way by chaining to the program that will be doing the actual work. It is not necessary for this program to be used before every program. The user is free to take statements out of this program or customize it in any way that the user desires. In fact this may be very advantageous once the program is developed to conserve on even more memory. If there is something that is of no use, don't use it! This is easily accomplished by LOADing the program into BASIC, EDITing it then SAVEing it away under a different file name. It is also advantageous to condense the names of the variables to two letters as this will also save program memory space. Also, there is nothing scred about the variable names, they can be what ever you choose. (Just be sure to be consistant)

OUT 39,137 : OUT 52,0

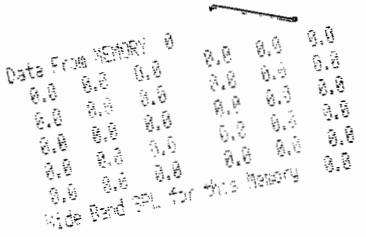
BASIC - SPEED & EFFICIENCY

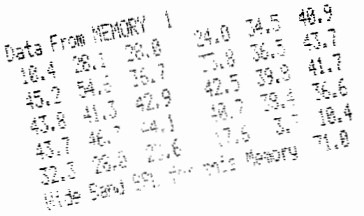
Sorry for the contradition in terms, BASIC has never been known for either. However, there are a couple of things to remember so as to make it as painless as possible. First, always use INTEGER variables where possible, especially in loop counters. A 25% savings in time can be realized by using integer variables as the counters in FOR-NEXT loops. Second, always locate statements that are pointed to by GOTOs, GOSUBs, NEXTs, etc. as near to the beginning of the program as possible.

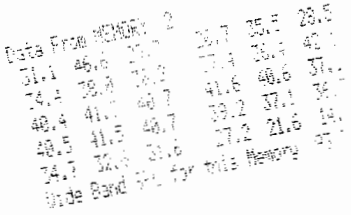
40 RAM Track (BACK DOOR)
OUT 39,137 : OUT 52,0

Printer Select PINS before CTR PIN-S

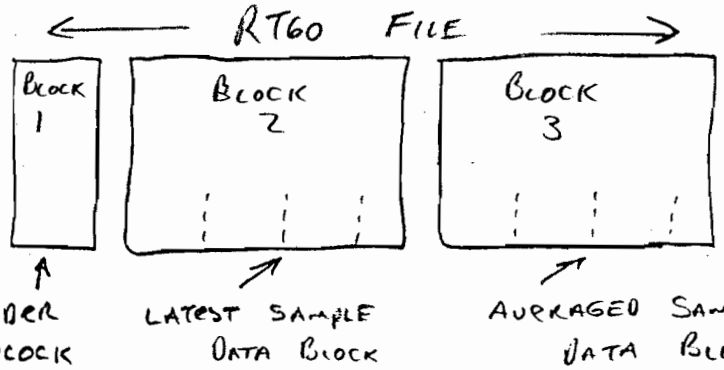
```
10 REM DEMO Recall Stored Memories and Place in Array
20 REM NOTICE - This Software is a DEMO ONLY
30 REM  - Designed to Demonstrate Programming
40 REM  - Techniques for the PC40.
50 REM  - 8/30/90 DRM
60 REM
70 REM Get and Define PC40 Constants and Calls
80 CLS:PRINT "Loading PC40 Definitions..."
90 CHAIN MERGE "C:STARTUP.BAS",60000!
100 REM ---> NOTE ** User Program MUST start at LINE 100 ** NOTE <---
110 DIM A%(19,30)
120 REM setup i/o ports to allow access to instrument memory
130 CALL PATCH%(PORTR%)
140 REM set analyzer to low power mode
150 OUT 37,INP(37) OR 128
160 CLS:PRINT "Loading Data"
170 FOR MEM%=0 TO 19
180 REM recall the memory data
190 REM
200 REM Note: GETMEM memories are numbered 1-20
210 GMEM%=MEM%+1
220 CALL PATCH%(GETMEM%,GMEM%)
230 REM transfer data from workspace to Basic CH%() array
240 CALL PATCH%(CHLOAD%)
250 REM test to verify memory contained valid data
260 IF PEEK(STATUS1%) THEN 300
270 REM if data invalid, force it to zero
280 FOR FREQ%=0 TO 30:CH%(FREQ%)=0:NEXT FREQ%
290 REM load target array with this memory data (includes wideband spl)
300 FOR FREQ%=0 TO 30:A%(MEM%,FREQ%)= CH%(FREQ%):NEXT FREQ%
310 A%(MEM%,30)=A%(MEM%,30)AND &HFFF
320 NEXT MEM%
330 REM here with all memories transferred to Basic Array A%()
340 REM
350 REM
360 REM now dump the data to verify its there
370 PRINT "Printing Array"
380 FOR MEM%=0 TO 19
390 LPRINT "Data From MEMORY ";MEM%
400 FOR FREQ%=0 TO 29 STEP 6
410 REM print data 2 octaves per line
420 LPRINT USING "###.# ";A%(MEM%,FREQ%)/10;
430 LPRINT USING "###.# ";A%(MEM%,FREQ%+1)/10;
440 LPRINT USING "###.#   ";A%(MEM%,FREQ%+2)/10;
450 LPRINT USING "###.# ";A%(MEM%,FREQ%+3)/10;
460 LPRINT USING "###.# ";A%(MEM%,FREQ%+4)/10;
470 LPRINT USING "###.#";A%(MEM%,FREQ%+5)/10
480 NEXT FREQ%
490 LPRINT " Wide Band SPL for this Memory ";
500 LPRINT USING "###.#";A%(MEM%,30)/10
510 LPRINT
520 LPRINT
530 NEXT MEM%
540 SYSTEM
```







6/19/90



RT60 RECORD FILES CONTAIN THREE BLOCKS OF INFORMATION EACH BLOCK CONTAINS ONE OR MORE 64 BYTE RECORDS.

THE FIRST BLOCK IS THE HEADER BLOCK AND CONSISTS OF ONE 64 BYTE RECORD. THIS HEADER BLOCK CONTAINS GENERAL FILE INFORMATION AND DESCRIBES THE TWO DATA BLOCKS.

Header Block Layout

bytes 1,2 - lsb,msb of Number of Records in each Data Block
byte 3 - (RECDRATE) - Record Rate in use at time of measurement (100 Samples per Sec)
byte 4 - (RT60CNT) - Number of RT60 Tests Averaged togeather in the Average Data Block.
byte 5 - (FNCTSTAT) - Byte containing Bit Flags for various Internal Functions.
byte 6,7 - lsb,msb of RT60 Measurement Period. 181 => 1.81 Seconds etc
bytes 8-13 - 6 bytes of Date/Time Stamp when measurment was taken. Date/Time bytes contain Year,Month,Day,Hours,Min,Sec. Packed 1 byte each in BCD format.
bytes 14-53 - 40 Bytes of ASCII Note Info Entered with Measurment

THE SECOND BLOCK IS THE DATA BLOCK FOR THE LAST RT60 DATA SET TAKEN. IF ~~YOUR~~ THE RT60 SAMPLE TIME IS 1.81 SECONDS AND THE RECORD RATE IS 100 SAMPLES PER SECOND THEN ~~THIS~~ THIS DATA BLOCK WILL CONSIST OF 181 RECORDS. EACH 64 Byte Record ~~RECORD~~ CONTAINS THE INSTANTANEOUS ~~VALUES~~ LEVELS FOR EACH FILTER AT THE TIME OF THE SAMPLE.

Data RECORD Layout

bytes 1,2 - lsb,msb of Signed Binary Relative Level for 25 Hz Filter
bytes 3,4 - lsb,msb of Signed Binary Relative Level for 31.5 Hz Filter
bytes 5,6 - lsb,msb of Signed Binary Relative Level for 40 Hz Filter
.
.
.
bytes 57,58 - lsb,msb of Signed Binary Relative Level for 16K Hz Filter
bytes 59,60 - lsb,msb of Signed Binary Relative Level for 20K Hz Filter
bytes 61,62 - lsb,msb of Unsigned Binary SPL with 4 bit MSB mantissa
byte 63 - (STATUS2) - Bit Fields Defining Instrument Setup such as Weighting, Response, Decay, and Octave or 1/3 Octave.
byte 64 - (STATUS1) - Bit Fields further Defining Instrument Setup such as Reference Level, mic/probe selection, 20/40 dB input atten setting.

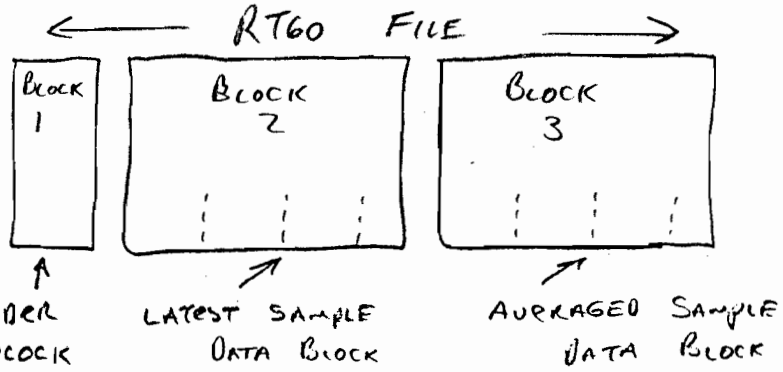
THE THIRD BLOCK IS THE DATA BLOCK FOR AVERAGED RT60 MEASUREMENTS. IF SEVERAL RT60 TESTS ARE AVERAGED TOGETHER, THEN THE TIME AVERAGED DATA IS STORED IN THIS BLOCK. THIS BLOCKS DATA FORMAT IS IDENTICAL TO BLOCK TWO'S FORMAT.

~~SAMPLE DATA BLOCK DECODER~~

SAMPLE DATA RECORD DECODE PROGRAM

```
DEFINT A-Z

'Open the Data File and Define the 64 byte Data Record Format.
OPEN path$ + File$ FOR RANDOM AS #9 LEN = 64
FIELD #9, 60 AS FilterData$, 2 AS Spl$, 1 AS stat2$, 1 AS stat1$

'Position to the desired Data record and Read it.
GET #9, Rec%

'Decode and Calculate the Reference Level
ref! = (ASC(stat1$) AND &HF) * 10

'Decode the SPL reading for this Data Sample
WD.Spl = (CVI(Spl$) - &H4000) / 10

'Now Decode and Calculate the Absolute Level for each Filter
FOR i% = 1 TO 30
   wft! = (CVI(MID$(FilterData$, i% * 2 - 1, 2)) / 10)
   'if filter level is not under range then convert to abs else flag
   '  under range error.
   IF wft! > -41 THEN wft! = wft! + ref! ELSE wft! = 0
   Wf!(i%) = wft!
NEXT i%

'Decode and Convert the Status Bytes
stat2% = ASC(stat2$)
SELECT CASE stat2% AND &H3
   CASE 0
      WD.Splwt = "Flat"
   CASE 1
      WD.Splwt = "C-wt"
   CASE 2
      WD.Splwt = "A-wt"
END SELECT

WD.Fltwt = "Flat"
IF stat2% AND &H80 THEN WD.Fltwt = WD.Splwt

SELECT CASE stat2% AND &HC
   CASE &H0
      WD.splrsp = "Fast"
   CASE &H4
      WD.splrsp = "Slow"
   CASE &H8
      WD.splrsp = "Peak"
   CASE &HC
      WD.splrsp = "Impl"
END SELECT

SELECT CASE stat2% AND &H30
   CASE &H10
      WD.Fltdcy = "Slow"
   CASE &H20
      WD.Fltdcy = "Med "
   CASE &H30
      WD.Fltdcy = "Fast"
END SELECT

IF stat2% AND &H40 THEN WD.Oct = false ELSE WD.Oct = true
```

6/19/90



RT60 RECORD FILES CONTAIN THREE BLOCKS OF INFORMATION EACH BLOCK CONTAINS ONE OR MORE 64 BYTE RECORDS.

THE FIRST BLOCK IS THE HEADER BLOCK AND CONSISTS OF ONE 64 BYTE RECORD. THIS HEADER BLOCK CONTAINS GENERAL FILE INFORMATION AND DESCRIBES THE TWO DATA BLOCKS.

Header Block Layout

bytes 1,2 - lsb,msb of Number of Records in each Data Block
byte 3 - (RECDRATE) - Record Rate in use at time of measurement (100 Samples per Sec)
byte 4 - (RT60CNT) - Number of RT60 Tests Averaged togeather in the Average Data Block.
byte 5 - (FNCTSTAT) - Byte containing Bit Flags for various Internal Functions.
byte 6,7 - lsb,msb of RT60 Measurement Period. 181 => 1.81 Seconds etc
bytes 8-13 - 6 bytes of Date/Time Stamp when measurment was taken. Date/Time bytes contain Year,Month,Day,Hours,Min,Sec. Packed 1 byte each in BCD format.
bytes 14-53 - 40 Bytes of ASCII Note Info Entered with Measurment

THE SECOND BLOCK IS THE DATA BLOCK FOR THE LAST RT60 DATA SET TAKEN. IF ~~YOUR~~ THE RT60 SAMPLE TIME IS 1.81 SECONDS AND THE RECORD RATE IS 100 SAMPLES PER SECOND THEN ~~THIS~~ THIS DATA BLOCK WILL CONSIST OF 181 RECORDS. EACH ~~64 RECORD~~ 64 BYTE RECORD ~~IN THE~~ CONTAINS THE INSTANTANEOUS ~~TIMES~~ LEVELS FOR EACH FILTER AT THE TIME OF THE SAMPLE.

Data RECORD Layout

bytes 1,2 - lsb,msb of Signed Binary Relative Level for 25 Hz Filter
bytes 3,4 - lsb,msb of Signed Binary Relative Level for 31.5 Hz Filter
bytes 5,6 - lsb,msb of Signed Binary Relative Level for 40 Hz Filter
.
.
.
bytes 57,58 - lsb,msb of Signed Binary Relative Level for 16K Hz Filter
bytes 59,60 - lsb,msb of Signed Binary Relative Level for 20K Hz Filter
bytes 61,62 - lsb,msb of Unsigned Binary SPL with 4 bit MSB mantissa
byte 63 - (STATUS2) - Bit Fields Defining Instrument Setup such as Weighting, Response, Decay, and Octave or 1/3 Octave.
byte 64 - (STATUS1) - Bit Fields further Defining Instrument Setup such as Reference Level, mic/probe selection, 20/40 dB input atten setting.

4/19/90

THE THIRD BLOCK IS THE DATA BLOCK FOR AVERAGED RT60 MEASUREMENTS. IF SEVERAL RT60 TESTS ARE AVERAGED TOGETHER, THEN THE TIME AVERAGED DATA IS STORED IN THIS BLOCK. THIS BLOCKS DATA FORMAT IS IDENTICAL TO BLOCK TWO'S FORMAT.

~~SAMPLE DATA BLOCK DECODER~~

SAMPLE DATA RECORD DECODE PROGRAM

```
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   wft! = (CVI(MID$(FilterData$, i% * 2 - 1, 2)) / 10)
   'if filter level is not under range then convert to abs else flag
   '  under range error.
   IF wft! > -41 THEN wft! = wft! + ref! ELSE wft! = 0
   Wf!(i%) = wft!
NEXT i%

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END SELECT

WD.Fltwt = "Flat"
IF stat2% AND &H80 THEN WD.Fltwt = WD.Splwt

SELECT CASE stat2% AND &HC
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      WD.splrsp = "Fast"
   CASE &H4
      WD.splrsp = "Slow"
   CASE &H8
      WD.splrsp = "Peak"
   CASE &HC
      WD.splrsp = "Impl"
END SELECT

SELECT CASE stat2% AND &H30
   CASE &H10
      WD.Fltdcy = "Slow"
   CASE &H20
      WD.Fltdcy = "Med "
   CASE &H30
      WD.Fltdcy = "Fast"
END SELECT

IF stat2% AND &H40 THEN WD.Oct = false ELSE WD.Oct = true
```

PC40 POWER SUPPLY

Connect variable DC power supply to PC40. Check 5 volt regulator. Measure 5V ± .4V between source of Q37 (middle leg) and source of Q41 (farthest right leg). This is the output of the regulator circuit. Vary power supply voltage from 8V to 15V. Regulator output should be 4.8 to 5.3V. If voltage is over 5.5 volts unplug power supply immediately or the DC to DC converter will be damaged. Set power supply to 9Vdc. From ground to pin 7 on IC27 measure +8Vdc ± .5V. From ground to pin 4 on IC27 measure -8Vdc ±.5V. From ground measure 8Vdc ±1V to + battery pin which is the closest pin to the DC to DC converter. Measure 6Vdc at drain of ±.5V Q41 (middle leg). Adjust 7 volt reference. From pin 1 to U28 to ground measure 7Vdc. If not 7Vdc adjust R170 to get as close to 7Vdc as possible. ± .001. Adjust 12 volt reference. From pin 7 of U28 to ground measure 12Vdc. If not 12Vdc adjust R169 to get as close as possible to 12Vdc ± .001.

Test CB1 with 9 Vdc input to charger
CB1 should be 6.6 Vdc.

PC40 Weight Calibration

Filter select

Reference the PC40 to 90. The SPL needs to be in A weight. Input 1kHz sine wave through 6 pin connector of PC40 using either the 82AD or 83AD. Adjust the amplitude of the input until there is ~~1Vrms~~ 2.5 at ~~SPL TP1 or pin 14 of U6~~ RCA Jack output. Voltage at the output of the sinewave generator should be approximately 2.8Vrms. Change SPL to C weight and adjust R74 until there is ~~1Vrms~~ 2.5 at ~~TP1~~ RCA Jack. Change SPL to flat and adjust R76 until there is ~~1Vrms~~ 2.5 at ~~TP1~~ RCA Jack.

After these adjustments have been made change the frequency of the generator and see that the data on the following table is confirmed. All measurements are from ~~TP1~~ RCA Jack to ground.

	100Hz	1kHz	10kHz
A weight	.270 .300 .108 - .120	2.475 2.525 .990 - 1.010	1.875 1.987 .750 - .795
C weight	2.347 2.485 .939 - .994	2.475 2.525 .990 - 1.010	1.462 1.60 .585 - .640
Flat	2.475 2.562 .990 - 1.025	2.475 2.75 .990 - 1.10	2.525 2.625 1.010 - 1.050

Check the SPL output on J4. It should be the same as the input voltage to the 6 pin connector ± .05. Check the filter input voltage. It should be 1.03Vrms ± .05.

PC40 Logger Calibration

(Requires digital board to be separated from analog board)

Reference PC40 to 90. Input 1kHz sinewave through 6 pin connector of PC40 using either the 82AD or 83AD. Adjust amplitude of input until there is 1Vrms at SPL test point 1.

Connect scope probe to test point 2 log out or the emitter of Q9. Set the scope volts/division to 50mv and the time/division axis to .5V. The scope should look like this:

Adjust R34 until peaks overlap each other. Attenuate signal 15dB and adjust R14 until peaks overlap. Attenuate signal 15dB more and adjust R16 until peaks overlap. Attenuate signal 15dB more and adjust R19 until peaks overlap. Attenuate signal 15dB more and adjust R38 until peaks overlap. Repeat procedure until the peaks overlap each time the signal is attenuated 15dB.

NOTE: R40 and R42 should be centered.

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PC40 SPL Calibration

(Requires digital board to separated from analog board)

Reference the PC40 to 120. Input 1kHz sinewave through 6 pin connector of PC40 using either the 82AD or 83AD. Amplitude of the sinewave needs to be 1Vrms. DC voltage on TP3 (pin 14 of U11) should be 9 volts. If not adjust R11 until there is 9 volts. Adjust R140 until there is 2Vdc on TP4 (pin 8 of U11). Adjust R205 until 120.0 is in SPL window.

Set reference to 80. Adjust R125 until there is 5.40Vdc $\pm$ .001 on pin 1 of U11.

Set reference to 120. Adjust R102 until there is 4.60Vdc $\pm$.001 on pin 1 of U11.

Set reference to 80 and adjust R113 until 120.0 is in the SPL window. Set reference to 120 and adjust R111 until 120.0 is in the SPL window. Toggle between 80 and 120 adjusting the appropriate pot until 120.0 is in the SPL window when referenced at 80 and 120.

Set reference to 90 and adjust R100 until 120.0 is in the SPL window. Set reference to 100 and adjust R101 until 120.0 is in the SPL window.

Change reference from 80 to 90 to 100 to 110 to 120 to 130 to 140. SPL window should read 120.0 $\pm$ .3dB.

Real Time Display Calibration

Setup:

reference PC40 to 120

1 dB per division

input 1Vrms at 1kHz

Adjust R137 until 1kHz filter is even with the reference line. Attenuate signal 10dB and change dB per division to 2dB. Adjust R143 until filter is even with -10dB division. Attenuate signal 36dB and change dB per division to 3dB. Adjust R133 and/or R144 until filter is even with -36 dB line. Repeat procedure until attenuating the signal 10, 20, and 36dB produces the correct reading on the display. This may take several times as the adjustments interact.