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MODULATION METER
MODEL 8701
Operation and Maintenance Manual

BOONTON

BOONTON ELECTRONICS • 25 EASTMANS ROAD • PARSIPPANY, NEW JERSEY 07054-0465

TELEPHONE: (973) 386-9696 • FAX: (973) 386-9191 • E-MAIL: boonton@boonton.com

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IMPORTANT NOTICE

January 30, 2001

OPERATION AND MAINTENANCE MANUAL-ADDENDUM: MODEL 8701

Operation and Instruction manual addenda are issued to adapt the manual to changes and improvements
made after this printing. Please review the following text and retain with your manual for future reference. These changes will be applied in the next printing of the manual.

Thank you for selecting BOONTON ELECTRONICS for your Test and Measurement needs.

Page 5-5 “Table 5-3. Recommended Test Equipment (Continued)”
ADD to Table;

Instrument	Critical Specifications	Usage Performance Evaluation	Maintenance	Model
AM/FM TEST SOURCE			X	11715A

Page 5-60 “RF Board Adjustments, Procedure”, paragraph 5-12.1.2 step f.
CHANGE “9.9 MHz” to “10.02 MHz”.

Page 5-60 “RF Board Adjustments, Procedure”, paragraph 5-12.1.2 step i.
CHANGE “9.9 MHz” to “10.02 MHz”.

Page 5-62 “RF Board Adjustments, Procedure”, paragraph 5-12.1.2 step r.
CHANGE “10.02 MHz” to “9.9 MHz”.

Page 5-63 “Detector Board Adjustments, Equipment Required.”, paragraph 5-12.3.1
ADD “AM/FM Test Source”.

Page 5-63 “Detector Board Adjustments, Procedure.”, paragraph 5-12.3.2 steps a through i.
CHANGE steps a through i to read as follows;

“a. Connect the Output of the Audio Analyzer to the Audio Input of the AM/FM TEST SOURCE.

b. Connect the FM/4 Output of the AM/FM TEST SOURCE to the 8701 RF IN.

c. While monitoring the 8701 Carrier Frequency measurement, tune the Carrier Frequency of the AM/FM TEST SOURCE for 100 $\pm$ 0.1 MHz.

d. Set the Audio Analyzer Source Frequency to 1kHz and the Source Level to 2 Vrms.

e. Set the 8701 to FM and select the 30 kHz high-pass and 220 kHz low-pass filters. Ensure the 8701 De-emphasis filters are disabled (OFF). (command string: “FM H2 L5 D5”)

f. Select the Peak RMS detector on the 8701.

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(command string: “PR”)

g. Adjust the Audio Analyzer Source Level for an 8701 FM indication of approximately 50 kHz deviation. Note the final indication.

h. Set the Audio Analyzer Source Frequency to 100 kHz.

i. Adjust C23 (figure 5-11 on the Detector board) for the same FM indication observed in step g. ”.

Page 5-64 “Oscillator Board Adjustments, Procedure.”, paragraph 5-12.4.2 steps b and c.
DELETE steps b and c.

Page 5-64 “Oscillator Board Adjustments, Procedure.”, paragraph 5-12.4.2 step d.
CHANGE “pin 6 of U11” to “TP1”.

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June 15, 1998

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Thank you for selecting BOONTON ELECTRONICS for your Test and Measurement needs.

Page 5-10 “Audio Filters (PVT), Procedure.”, paragraph 5-4.3.5.3 steps g. and h.
CHANGE “Table 5-4” to “Table 5-5”.

Page 5-12 “FM Modulation Accuracy and Incidental AM (PVT), Description.”, paragraph 5-4.3.7.1
CHANGE “30 Hz to 5kHz” to “30 to 500 Hz”.

Page 5-63 “Detector Board Adjustments, Equipment Required.”, paragraph 5-12.3.1
REMOVE reference to “DC Voltmeter”.

Page 5-63 “Detector Board Adjustments, Procedure.”, paragraph 5-12.3.2 step h.
CHANGE step h. to read;
“Set the audio analyzer to 100 kHz and adjust C23 (Figure 5-11 on the detector board) until the ratio indication on the Model 8701 display is the same as in step f.”.

Page 5-64 “Oscillator Board Adjustments, Procedure.”, paragraph 5-12.4.2 step c.
CHANGE step c. to read;
“Using the keyboard type the command “FR 1.211 MH” in the “Send Message” field and click on “Send”.”

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May 21, 1998

OPERATION AND MAINTENANCE MANUAL-ADDENDUM: MODEL 8701

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Thank you for selecting BOONTON ELECTRONICS for your Test and Measurement needs.

Page 5-6 “Maintenance Section”, Figure 5-1 “Measurement Setup No.1”

CHANGE the block name, which connects, to the power supply from “50MHz Filter”

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TABLE OF CONTENTS

Chapter 1 - General Information

Paragraph	Description	Page
1-1	Introduction	1-1
1-3	Description	
1-4.1	Automatic Tuning and Leveling	1-1
1-4.2	Low Residual Modulation	1-2
1-4.3	VXI Plug and Play	1-2
1-5	Performance Characteristics	1-2
1-7	Outline Dimensions	1-2
1-9	Consumable Materials	1-2

Chapter 2 - Preparation for Use and Installation

2-1	Introduction	2-1
2-3	Unpacking	2-1
2-5	Installing the Modulation Meter	2-2
2-7.	Equipment Required but not Supplied	2-2
2-9	Cable Connections	2-5
2-11	Preliminary Check	2-5
2-13	Preparation for Shipment	2-7

Chapter 3 - Principles of Operation

3-1	Introduction	3-1
3-3	Functional Block Diagram	3-1
3-9	RF Circuits	3-3
3-16	Local Oscillator Circuits	3-6
3-24	FM Circuits	3-9
3-28	AM Circuits	3-11
3-33	Filter Circuits	3-13
3-39	Detector Circuits	3-15
3-49	VXI Processor Circuits	3-19

Chapter 4 - Operating Instructions

4-1	Introduction	4-1
4-3	Operating Controls (Fields), Indicators and Connectors	4-1
4-5	Initial Connections	4-1
4-7	Using the Modulation Meter	4-6
4-8.1	Mode Selection Control	4-6
4-8.2	Data Keyboard	4-8
4-8.3	Measurement Control Fields	4-9
4-8.6	Display Messages	4-9
4-8.7	Special Functions	4-11
4-8.8	Front Panel Connectors	4-11
4-8.9	Rear Panel connectors	4-14
4-8.10	RF Housing Assembly Connections (Test points).	4-14
4-8.11	Measuring and Setting Carrier Frequency	4-15
4-8.12	Measuring and Setting Carrier Level	4-16

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4-8.13 Selecting Modulation Mode 4-18
4-8.13.1 AM Measurement Mode 4-18
4-8.13.2 FM Measurement Mode 4-18
4-8.13.3 PM Measurement Mode 4-21
4-8.14 Measurement and Display Controls - Ratio Measurements 4-21
4-8.15 Peak and RMS Detectors 4-23
4-8.18 Detector Hold 4-24
4-8.19 Filters 4-24
4-8.22 Program Store and Recall 4-26
4-8.23 Triggered Operation 4-27
4-8.24 Talk Operation 4-27
4-8.24.1 Talk Status (TS) Mode 4-28
4-8.24.2 Talk Function (TF) Mode 4-28
4-8.24.3 Talk Value (TV) Mode 4-28
4-8.24.4 Talk Program (TP) Mode 4-31
4-8.24.5 Identify (ID) Mode 4-31
4-8.25 SRQ Operation 4-31
4-8.26 Program Function Mnemonics 4-31
4-8.27 Number Formatting 4-31
4-8.28 Data String Format 4-31
4-8.29 Data String Errors 4-31
4-8.30 Data String Examples 4-32
4-9 Shutdown Procedure 4-32
4-11 Emergency Shutdown Procedure 4-32

Chapter 5 - Maintenance

5-1 Introduction 5-1
5-3 Preventive Maintenance 5-1
5-4.1 Cleaning 5-1
5-4.1.1 Corrosion Control 5-2
5-4.1.2 Touch-up (Paint) 5-2
5-4.2 Visual Inspection 5-2
5-4.3 Performance Verification Test (PVT) 5-3
5-4.3.1 Recommended Test Equipment 5-3
5-4.3.2 Calibration Interval 5-3
5-4.3.3 Initial Calibration 5-7
5-4.3.4 AM Modulation Accuracy and Residuals (PVT) 5-7
5-4.3.4.1 Description 5-7
5-4.3.4.2 Specifications 5-7
5-4.3.4.3 Procedure 5-8
5-4.3.5 Audio Filters (PVT) 5-9
5-4.3.5.1 Description 5-9
5-4.3.5.2 Specifications 5-9
5-4.3.5.3 Procedure 5-9
5-4.3.6 Amplitude Modulation, Distortion (PVT) 5-10
5-4.3.6.1 Description 5-10
5-4.3.6.2 Specifications 5-10
5-4.3.6.3 Procedure 5-12
5-4.3.7 FM Modulation Accuracy and Incidental AM (PVT) 5-12
5-4.3.7.1 Description 5-12
5-4.3.7.2 Specifications 5-12
5-4.3.7.3 Procedure 5-13

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5-4.3.8 Frequency modulation, Distortion (PVT) 5-14
5-4.3.8.1 Description 5-14
5-4.3.8.2 Specifications 5-14
5-4.3.8.3 Procedure 5-16
5-4.3.9 FM Residuals 3 and 15 kHz Filters (PVT) 5-16
5-4.3.9.1 Description 5-16
5-4.3.9.2 Specifications 5-16
5-4.3.9.3 Procedure 5-18
5-4.3.10 Phase Modulation, Accuracy and Flatness (PVT) 5-19
5-4.3.10.1 Description 5-19
5-4.3.10.2 Specifications 5-19
5-4.3.10.3 Procedure 5-19
5-4.3.11 Carrier Level (PVT) 5-20
5-4.3.11.1 Description 5-20
5-4.3.11.2 Specifications 5-20
5-4.3.11.3 Procedure 5-20
5-4.3.12 Frequency Accuracy and Sensitivity (PVT) 5-21
5-4.3.12.1 Description 5-21
5-4.3.12.2 Specifications 5-21
5-4.3.12.3 Procedure 5-22
5-4.3.13 VSWR (PVT) 5-23
5-4.3.13.1 Description 5-23
5-4.3.13.2 Specifications 5-23
5-4.3.13.3 Procedure 5-23
5-4.3.14 Calibrators (PVT) 5-24
5-4.3.14.1 Description 5-24
5-4.3.14.2 Specifications 5-24
5-4.3.14.3 FM Calibration 5-24
5-4.3.14.6 AM Calibration 5-25
5-5 Corrective Maintenance 5-27
5-6.1 Corrective Maintenance 5-27
5-6.2 Troubleshooting 5-27
5-6.2.2 Trouble Localization 5-28
5-6.2.3 Troubleshooting, RF Board 5-28
5-6.2.3.1 Logic Signals 5-33
5-6.2.4 Troubleshooting, Local Oscillator Board 5-35
5-6.2.4.1 Calibrator Circuits 5-37
5-6.2.4.2 Logic Signals 5-38
5-6.2.5 Troubleshooting, FM Board 5-39
5-6.2.5.1 Logic Signals 5-40
5-6.2.6 Troubleshooting, AM Board 5-40
5-6.2.6.1 Logic Signals 5-43
5-6.2.6.2 AGC Attenuator 5-44
5-6.2.7 Troubleshooting Filters 5-44
5-6.2.7.1 Logic Signals 5-47
5-6.2.8 Troubleshooting, Detector Board 5-49
5-6.2.8.1 Logic Signals 5-53
5-7 Disassembly 5-55
5-8.1 Preliminary Procedures 5-55
5-8.2 Front Panel 5-55
5-8.3 Attenuator Assembly 5-55
5-8.4 VXI Processor/Power Supply 5-56
5-8.5 Printed Wiring Board(s) 5-56

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5-9 Reassembly 5-57
5-10.1 Replacement of Printed Wiring Board(s) 5-57
5-10.2 VXI Processor/Power Supply 5-58
5-10.3 Attenuator Assembly 5-58
5-10.4 Modulator Meter Assembly 5-59
5-11 Adjustments 5-60
5-12.1 RF Board Adjustments 5-60
5-12.1.1 Equipment Required 5-60
5--12.1.2 Procedure 5-60
5-12.2 AM Board Adjustments 5-62
5-12.2.1 Equipment Required 5-62
5-12.2.2 Procedure 5-62
5-12.3 Detector Board Adjustments 5-63
5-12.3.1 Equipment Required 5-63
5-12.3.2 Procedure 5-63
5-12.4 Oscillator Board Adjustments 5-63
5-12.4.1 Equipment Required 5-63
5-12.4.2 Procedure 5-64

Chapter 6 - Parts List

6-1 Introduction 6-1

Chapter 7 - Drawings and Schematic Diagrams

7-1 Introduction 7-1

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LIST OF FIGURES

Fig. No.	Description	Page No.
	Modulation Meter, Model 8701	*viii*
1-1	Outline Dimensions	1-3
2-1	Packing and Unpacking Diagram	2-3
2-2	System Inter-Connection Diagram	2-4
2-3	Modulation Meter Soft Front Panel	2-6
3-1	Functional Block Diagram	3-2
3-2	Sampling Gate Operation	3-4
3-3	RF Circuits Block Diagram	3-5
3-4	Local Oscillator Circuits Block Diagram	3-8
3-5	FM Circuits Block Diagram	3-10
3-6	AM Circuits Block Diagram	3-12
3-7	Filter Circuits Block Diagram	3-14
3-8	Detector Circuits Block Diagram	3-18
3-9	VXI Processor Circuits Block Diagram	3-22
3-10	Power Supply Block Diagram	3-23
4-1	Modulation Meter-Control Fields, Connectors and Indicators	4-2
4-2	Modulation Meter Connection Points	4-7
4-3	Frequency Panel Pop-up Menu	4-8
4-4	User Interactive Send/Receive Panel Pop-up Menu	4-13
4-5	Typical Level Response	4-16
4-6	Carrier Level Pop-up Menu	4-17
4-7	AM Modulation Panel Pop-up Window	4-19
4-8	FM Modulation Panel Pop-up Window	4-20
4-9	PM Modulation Panel Pop-up Window	4-22
4-10	Residual FM and 15 kHz Filters	4-25
4-11	Residual AM, 3 and 15 kHz Filters	4-25
4-12	Residual FM, 50 and 220 kHz Filters	4-25
4-13	Residual AM, 50 and 220 kHz Filters	4-25
4-14	Response, 20 kHz Bessel Filter	4-26
4-15	Response, 3 and 15 kHz Filters	4-26
4-16	Response, High-Pass Filters	4-26
4-17	Response 50 and 220 kHz	4-26
4-18	Response, De-emphasis Filters	4-26
5-1	Measurement Setup No. 1	5-6
5-2	Measurement Setup No. 2	5-6
5-3	Measurement Setup No. 3	5-24
5-4	AM Calibration Emax Equals Emin	5-26
5-5	RF Board Waveforms	5-32
5-6	FM Board Waveforms	5-41
5-7	AM Board Waveforms	5-43
5-8	Detector Board Waveforms	5-50
5-9	RF Board Adjustment	5-61
5-10	AM Board Adjustment	5-62
5-11	Detector Board	5-64
5-12	Oscillator Board Adjustment	5-65

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LIST OF DRAWINGS AND SCHEMATIC DIAGRAMS

Draw. No.	Description	Page No.
7-1	Modulation Meter Assembly (2 sheets)	7-2
7-2	A2, RF Housing Assembly (2 sheets)	7-4
7-3	A3, Protect Attenuator Assembly	7-6
7-4	A2A1, RF PWB Component Location (2 sheets)	7-7
7-5	A2A2, Local Oscillator PWB Component Location	7-9
7-6	A2A3, AM PWB Component Location	7-10
7-7	A2A4, FM PWB Component Location	7-11
7-8	A2A5, Filter PWB Component Location	7-12
7-9	A2A6, Detector PWB Component Location	7-13
7-10	A1, VXI Processor PWB Component Location (2 sheets)	7- 14
7-11	A3, Attenuator PWB Component Location	7-16
7-12	Main Frame Schematic Diagram	7-17
7-13	A2A1, RF PWB, Schematic Diagram (3 sheets)	7-18
7-14	A2A2, Local Oscillator PWB Schematic Diagram (3 sheets)	7-21
7-15	A2A3, AM PWB Schematic Diagram (3 sheets)	7-24
7-16	A2A4, FM PWB Schematic Diagram (3 sheets)	7-27
7-17	A2A5, Filter PWB Schematic Diagram (3 sheets)	7-30
7-18	A2A6, Detector PWB Schematic Diagram (3 sheets)	7-33
7-19	A1, VXI Processor PWB Schematic Diagram (16 sheets)	7-36
7-20	A3, Protect Attenuator PWB Schematic Diagram	7-52

LIST OF TABLES

Table No.	Description	Page No.
1-1	Leading Particulars	1-4
1-2	Consumable Materials	1-9
4-1	Control Fields, Indicators, Connectors	4-3
4-2	Instrument Error Codes	4-10
4-3	Special Functions	4-12
4-4	Hardware Status, Bit Assignments	4-28
4-5	VXI Bus Mnemonics	4-29
5-1	Schedule of Preventive Maintenance Routines	5-1
5-2	Visual Inspection	5-3
5-3	Recommended Test Equipment	5-4
5-4	Amplitude Modulation	5-9
5-5	Audio Filters	5-11
5-6	Amplitude Modulation, Distortion	5-12
5-7	Frequency modulation Accuracy	5-15
5-8	FM Modulation Distortion	5-17
5-9	Frequency Modulation, Residuals	5-18
5-10	Phase Modulation, Accuracy and Flatness	5-20
5-12	Carrier Level Accuracy	5-22
5-13	Carrier Frequency Accuracy and Sensitivity	5-23
5-14	VSWR	5-24
5-15	Hardware Error Displays	5-29

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5-16 RF Housing Assembly Feedthru Wiring 5-30
6-1 Modulation Meter Assembly Parts List Ref. Figure 7-1 6-2
6-2 RF Housing Assembly, Ref. Figure 7-2 6-4
6-3 Protect Attenuator Assembly Parts List, Ref. Figure 7-3 6-6
6-4 RF PWB Parts List, Ref. Figure 7-4 6-7
6-5 Local Oscillator PWB, Parts List, Ref. Figure 7-5 6-11
6-6 AM PWB Parts list, Ref. Figure 7-6 6-15
6-7 FM PWB Parts List, Ref. Figure 7-7 6-19
6-8 Filter PWB Parts List, Ref. Figure 7-8 6-23
6-9 Detector PWB Parts List, Ref. Figure 7-9 6-26
6-10 VXI Processor PWB Parts List, Ref. Figure 7-10 6-29
6-11 Attenuator PWB Parts List, Ref. Figure 7-11 6-32

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Modulation Meter, Model 8701

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Chapter 1

General Information

1-1. Introduction

1-2. This technical manual contains operation and maintenance instructions for the modulation meter, Model 8701 (Figure 1-1) manufactured by Boonton Electronics Corporation, Parsippany, New Jersey. This chapter of the manual contains general information. Chapter 2 provides preparation for use and installation instructions. Chapter 3 contains the principles of operation via a function breakdown of the instrument's circuits. Chapter 4 provides a detailed description of how to use the meter. Chapter 5 contains maintenance instructions for the cleaning, inspection, verification testing, troubleshooting, disassembly and reassembly of the meter. Chapter 6 provides a parts breakdown of the main assembly and its components. Chapter 7 contains the schematic diagrams necessary to maintain the modulation meter.

1-3. Description

1-4. The Model 8701 Modulation Meter is a versatile, precision, state-of-the-art instrument with features and performance characteristics especially suitable for laboratory and industrial applications. It covers a frequency range of 100 kHz to 2.5 GHz. Operation can be completely automatic with internal frequency and level acquisition or the carrier frequency and level can be entered remotely over the bus.

The features in the following paragraphs together with those listed in Table 1-1, make the Model 8701 particularly useful for design, production line and field testing of AM, FM and PM transmitters and signal generators. Due to its flexibility, it is also a good meter for laboratory applications. Some of its more outstanding features are:

1-4.1 Automatic Tuning and Leveling. This instrument can automatically acquire the largest signal present at the input connector and adjust its local oscillator and measurement channel gain to provide a calibrated display of amplitude modulation (AM), frequency modulation (FM) or phase modulation (PM). The operator can select to display carrier level in millivolts or dBm on his computer remotely via the VXI bus.

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1-4.2 Low Residual Modulation. The instrument's low modulation residuals provide excellent measurement accuracy with low noise sources. Direct residual measurements can be accomplished using the Model 8701 with internal true rms detectors. In addition, active peak detectors insure exceptional baseband detection linearity so that residuals may be easily discounted for enhanced measurement accuracy.

1-4.3 VXI Plug and Play. A LAB Windows/CVI 3.1 driver is provided so that the user may operate the instrument without the need to write software to perform the modulation meter functions.

1-5. Performance Charachteristics

1-6. The extensive performance characteristics of the Modulation Meter are listed in Table 1-1, Leading Particulars.

1-7. Outline Dimensions

1-8. The outline dimensions of the Model 8701 are listed in Table 1-1 and illustrated in Figure 1-1.

1-9. Consumable Materials

1-10. Table 1-2 lists the consumable materials required for maintenance. Where applicable similar acceptable materials may be substituted if it does not degrade items.

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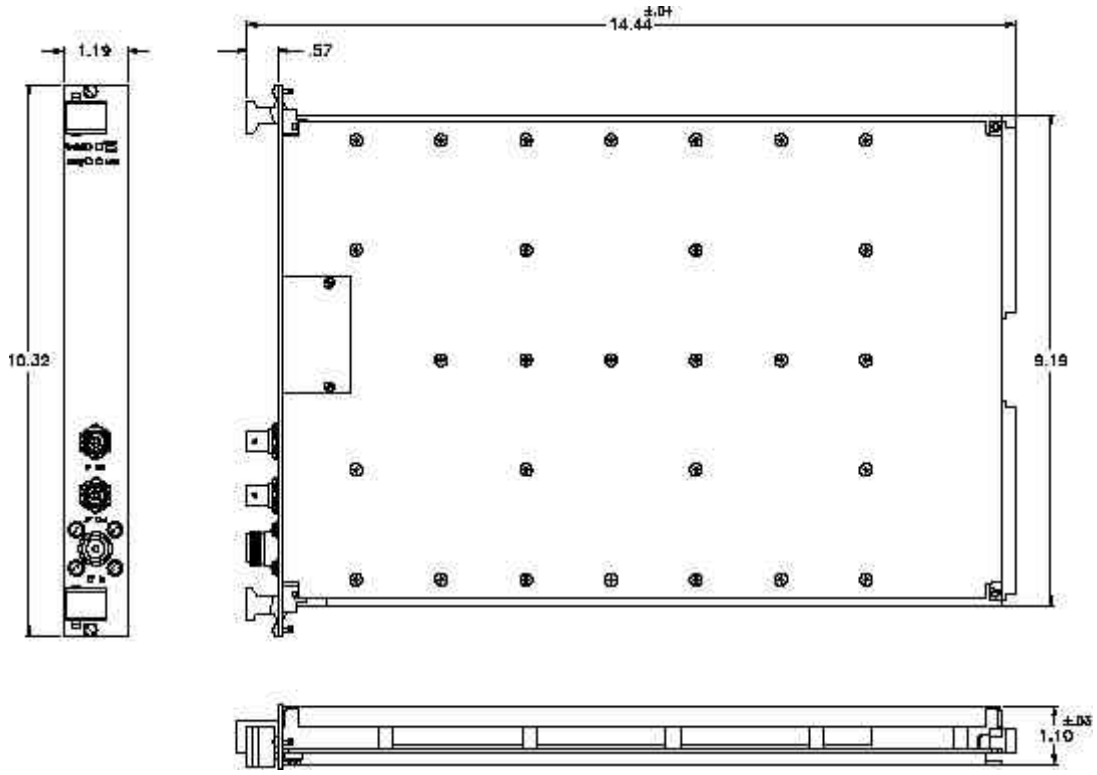


Figure 1-1 Outline Dimensions

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Table 1-1. Leading Particulars

Characteristic	Specification
RF INPUT	
Frequency Range	: 100 kHz to 2.5 GHz
Tuning (8)	:Automatic, typical acquisition time one second, or manual from VXIbus
Sensitivity	: 10 mV, Frequency Range: 100 kHz to 520 MHz : 15 mV, Frequency Range: 520 MHz to 1000 MHz : 28 mV, Frequency Range: 1000 MHz to 1500 MHz : 50 mV, Frequency Range: 1500 MHz to 2500 MHz
Maximum Input (8)	: 1 watt (7 Vrms, +30 dBm)
Maximum Safe Input (8)	: 40 Vdc, 35 Vac (25W for source SWR < 4)
Level Set (8)	: Automatic, typical acquisition time one second for levels up to 7 V, or manual from VXIbus
Input Impedance	: 50 ohms nominal.
VSWR	: < 1.50, Frequency Range: 100 kHz to 2.0 GHz. : < 1.80, Frequency Range: 2.0 GHz to 2.5 GHz.
FREQUENCY MODULATION	
Measurement	: +peak, - peak, peak average, and rms.
Rates	: 20 Hz to 15 kHz, Frequency Range: 0.2 to 0.5 MHz : 20 Hz to 50 kHz, Frequency Range: 0.5 MHz to 10 MHz : 20 Hz to 220 kHz, Frequency range: 10 MHz to 2.5 GHz
Range (6)	: 0 to carrier (kHz)/10 kHz peak, Frequency Range: 0.2 to 0.5 MHz : 0 to 150 kHz peak, Frequency Range: 0.5 to 10 MHz : 0 to 500 kHz peak, Frequency Range: 10 MHz to 2.5 GHz
Resolution (7)	: 1 Hz, 0.000 to 5.000 kHz deviation : 10 Hz, 5.00 to 50.00 kHz deviation : 100 Hz, 50.0 to 500.0 kHz deviation
Accuracy (1) (2)	: 1% of reading, 30 Hz to 5 kHz rates, Frequency Range: 0.2 to 0.5 MHz : 2% of reading, 5 kHz to 7.5 kHz, Frequency Range: 0.2 to 0.5 MHz : 1% of reading, 30 Hz to 15 kHz, Frequency Range: 0.5 to 10 MHz : 2% of reading, 15 kHz to 30 kHz, Frequency Range: 0.5 to 10 MHz

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Table 1-1. Leading Particulars (Continued)

Characteristic	Specification
	: 2% of reading, 10 Hz to 30 Hz, Frequency Range 0.01 to 2.5 GHz : 1% of reading, 30 Hz to 100 kHz, Frequency Range: 0.01 to 2.5 GHz : 2% of reading, 100 kHz to 150 kHz, Frequency Range: 0.01 to 2.5 GHz
Distortion	: < 0.1% for deviations <30 kHz, Frequency Range: 0.2 to 0.5 MHz : < 0.1% for deviations <75 kHz, Frequency Range: 0.5 to 10 MHz : < 0.1% for deviations <100 kHz, Frequency Range 0.01 to 2.5 GHz
Residual FM	: < 60 Hz RMS at 2000 MHz carrier, decreasing linearly with frequency
(3 kHz low-pass)	: < 2 Hz RMS at 100 MHz (floor)
Residual FM	: < 20 Hz RMS at 2000 MHz carrier, decreasing linearly with frequency
(15 kHz low-pass)	: < 4 Hz RMS at 100 MHz (floor)
Incidental FM	: < 20 Hz peak deviation at 50% AM, 30 Hz to 3 kHz measurement bandwidth
AMPLITUDE MODULATION	
Measurement	: +peak, -peak, peak average, and rms.
Rates	: 10 Hz to 15 kHz, Frequency Range: 0.1 to 0.5 MHz : 10 Hz to 50 kHz, Frequency Range: 0.5 to 10 MHz : 10 Hz to 220 kHz, Frequency Range: 10 MHz to 2.5 GHz
Range	: 0 to 99.9%
Resolution	: 0.001% from 0.000 to 5.000% AM : 0.01% from 5.00 to 50.00% AM : 0.1% from 50.1 to 99.9% AM
Accuracy (1) (2)	:2% of reading, 10 Hz to 30 Hz Frequency Range: 100 kHz to 2.5 GHz : 1% of reading, 30 Hz to 5 kHz, Frequency Range: 0.1 to 0.5 MHz : 2% of reading, 5 Hz to 7.5 kHz, Frequency Range 0.1 to 0.5 MHz

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Table 1-1. Leading Particulars (Continued)

Characteristic	Specification
	: 1% of reading, 30 Hz to 15 kHz, Frequency Range: 0.5 to 10 MHz : 2% of reading, 7.5 kHz to 30 kHz, Frequency Range: 0.5 to 10 MHz : 1% of reading, 30 Hz to 100 kHz, Frequency Range: 0.01 to 2.5 GHz : 2% of reading, 100 kHz to 150 kHz, Frequency Range: 0.01 to 2.5 GHz
Distortion	: < 0.3% for depths up to 90%
Residual AM (3)	: 0.02% RMS, 30 Hz to 3 kHz bandwidth : 0.05% RMS, 30 Hz to 15 kHz bandwidth
Incidental AM (3 kHz low-pass)	: < 0.2% AM peak at 5 kHz deviation, Carrier Frequency < 10 MHz : < 0.2% AM peak at 50 kHz deviation, Carrier Frequency > 10 MHz
PHASE MODULATION	
Measurement	: +peak, -peak, peak average, and rms
Rates	: 100 Hz to 15 kHz, Frequency Range: 0.2 to 0.5 MHz : 20 Hz to 50 kHz, Frequency Range: 0.5 to 10 MHz : 20 Hz to 100 kHz, Frequency Range: 10 MHz to 2.5 GHz
Range (4)	: 0 to CARRIER (kHz)/10 RAD peak, Frequency Range: 0.2 to 0.5 MHz : 0 to 150 RAD peak, Frequency Range: 0.5 to 10 MHz : 0 to 500 RAD peak, Frequency Range: 10 MHz to 2.5 GHz
Resolution (5)	: 0.001 RAD, 0.000 to 5.000 RAD deviation : 0.01 RAD, 5.00 to 50.00 RAD deviation : 0.1 RAD, 50.0 to 500.0 RAD deviation
Accuracy (1) (2)	: 3% of reading, 200 Hz to 7.5 kHz, Frequency Range: 0.2 to 0.5 MHz : 3% of reading, 200 Hz to 30 kHz, Frequency Range: 0.5 MHz to 2.5 GHz
Distortion	: < 0.1% for deviations < 30 RAD, Frequency Range: 0.2 to 0.5 MHz : < 0.1% for deviations < 75 RAD, Frequency Range: 0.5 to 10 MHz : < 0.1% for deviations < 100 RAD, Frequency Range: 0.01 to 2.5 GHz

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Table 1-1. Leading Particulars (Continued)

Characteristic	Specification
Residual PM	: < 0.1 RAD RMS at 2 GHz decreasing linearly with frequency : < 0.005 RAD RMS at 100 MHz (floor)
Incidental PM	: <0.02 RAD peak at 50% AM, 30 Hz to 3 kHz bandwidth
CARRIER FREQUENCY	
Range	: 100 kHz to 2.5 GHz
Resolution	: 10 Hz, Frf < 1000 MHz : 100 Hz, Frf > 1000 MHz
Accuracy	: reference accuracy ± 3 digits
CARRIER LEVEL	
Range*	: -47 (-27.0) to +30.0 dBm, Frequency Range: 0.1 to 520 MHz : -37.0 (-17.0) to +30.0 dBm, Frequency Range 520 to 1500 MHz : -33.0 (-13.0) to +30.0 dBm, Frequency Range: 1500 to 2500 MHz *With carrier frequency set. ( ) values in automatic mode
Frequency Range	: 100 kHz to 2500 MHz
Resolution	: 0.01 dB or 0.1 millivolts
Accuracy	: ± 1 dB, Frequency Range: 0.1 to 520 MHz : ± 2.0 dB, Frequency Range: 520 to 1500 MHz : ±3.0 dB, Frequency Range: 1500 to 2500 MHz
AUDIO FILTERS	
High-pass	: < 10 Hz gaussian, less than 10% droop with 5 Hz square wave (8) : 30, 300 and 3000 Hz, 3-pole Butterworth
Low-pass	: 3 and 15 kHz, 3-pole Butterworth : 20 kHz, 3-pole Bessel : 50 and 220 kHz, 7-pole Butterworth
De-emphasis	: 25, 50, 75, and 750 µs
Accuracy	: ± 4% 3 dB corner and time constant
AM CALIBRATOR	
	: internal, 50.00% depth, 0.1% accuracy

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Table 1-1. Leading Particulars (Continued)

Characteristic	Specification
FM CALIBRATOR	: internal, 125.0 kHz deviation, 0.1% accuracy
PM CALIBRATOR	: internal, 136.3 RAD deviation, 1% accuracy
GENERAL	
Power Requirements	+5V, 0.68 A +24V, 0.60 A -24V, 0.43A +12, < 1 mA -12, < 3 mA
Operation Temperature	: 0 to 55° C
Relative Humidity	95% non-condensing
Dimensions	: C-size, single-slot, VXI bus module
Weight	5 lbs.
SUPPLEMENTAL SPECIFICATIONS	
AF OUT (8)	: Uncalibrated, approximately 1 V into 600 ohms at 5000 counts on display. Source impedance 600 ohms
IF OUT (8)	: Approximately 0 dBm into 50 ohms : Frequency 1.21 MHz nominal for carriers from 10 to 2500 MHz 346 kHz for carriers from 2 to 10 MHz, and 100 kHz to 2 MHz for carriers below 2 MHz : Source impedance 50 ohms
Stereo Separation (8)	: > 48 dB, 50 Hz to 15 kHz, < 10 to 220 kHz bandwidth
AVIONICS AM CALIBRATION (optional)	
Accuracy	: ±0.7%, 20 to 40% AM, at 30 Hz to 3 kHz rates, < 10 to 15 kHz filters
Flatness	: ±0.4% for constant AM between 20 and 40%, and 90 and 150 Hz rates
NOTES	

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Table 1-1. Leading Particulars (Continued)

(1)	Peak residuals must be accounted for.
(2)	For rms add ± 1% of reading.
(3)	Level > 100 millivolts, carrier frequency < 520 MHz. Above 520 MHz, residuals increase linearly with frequency.
(4)	Up to 1 kHz modulation rate. Above 1 kHz range decreases linearly with modulation frequency.
(5)	Up to 1 kHz modulation rate. Above 1 kHz resolution is determined by the product of deviation and modulation rate.
(6)	With 750 µs de-emphasis, and pre-display selected, the deviation is limited to 50 kHz peak
(7)	Display resolution is ten times greater with 750 µs de-emphasis, and pre-display selected.
(8)	These specifications are for application purposes and, although typical, are not warranted.

Table 1-2. Consumable Materials

Item	Nomenclature Type	Manufacturer Or Specification	Use
Items 3 and 6 are toxic, see appropriate warnings in Safety Summary			
1	Acid Brush	H-B -463 Type Class 1, size 1	Application of solvents
2	Desiccant	MIL-D-3464	Moisture Absorber
3	Isopropyl Alcohol	TT-I-735, Grade B	Clean metal parts and cable
4	Lint-free cloth	DDDC 301	Clean metal surfaces
5	solder	QQ-S-571 SN60WRMAP2 0.046	Soldering
6	Trichloromethane	MIL-T-81533	Clean metal parts and cables
7	Conductive Sealant Adhesive	3596339-1	Gasket Adhesive
8	Zinc Chromate Primer	MIL-P-8585	Touch-up painting
9	Gray Semigloss Enamel	BEC spec. 83751214A	Touch-up painting
10	Locking Compound	M22473-7-5-N-N	Cover retaining compound
11	Black Marking Ink	MIL-I-43553	Stencil Repairs

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Chapter 2

Preparation for Use and Installation

2-1. Introduction

2-2. This chapter contains installation and preparation for use procedures. Included is information pertinent to unpacking, mounting, power requirements, cable connections and a preliminary check prior to normal usage.

2-3. Unpacking

2-4. The Model 8701 is shipped complete and is ready for use upon receipt. To unpack the instrument from its packing carton proceed as follows:

a. Carefully remove the inner instrument and support from the outer packing carton. (See figure 2-1)

CAUTION

The Modulation Meter is shipped packaged in an antistatic bag to prevent electrostatic damage. Before removing the instrument from the antistatic bag, touch the back to a metal part of the computer or VXI chassis.

b. Carefully remove the instrument from its antistatic plastic bag.

c. Carefully inspect the instrument for any damages. If the instrument shows signs of damage or is incomplete, notify Boonton Electronics and the carrier.

d. Save the packing material, antistatic bag, and carton for use in reshipment of the instrument or for carrier inspection in case of shipping damage.

NOTE

The Modulation Meter is not supplied with any connecting cables.

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2-5. Installing the Modulation Meter

2-6. The Modulation Meter is designed for mounting in a C-size VXI Mainframe (i.e.., a Hewlet Packard HP E1401A). To install the instrument proceed as follows:

a. Prior to installation inspect the instrument to make sure that the top and bottom covers and attaching hardware are securely fastened.

b. Carefully place the top and bottom edges of the protruding motherboard in the VXI retainer rails.

c. Slowly push the meter into the case assembly until the board connector is securely seated in the VXI bus backplane.

d. Use the top and bottom front panel screws to secure the meter to the VXI panel retainer blocks.

e. If it becomes necessary to remove the instrument, release the two front panel mounting screws.

f. Use the extractor handles to release the instrument from the VXI bus backplane. Carefully pull the Model 8701 forward until it is clear of the bus rails.

2-7. Equipment Required but not Supplied

2-8. In order for the Modulation Meter to function properly the configuration it is installed in, MUST meet certain equipment requirements. The following equipment or equivalent must be installed (Figure 2-2) prior to performing the Preliminary Check in paragraph 2-11.

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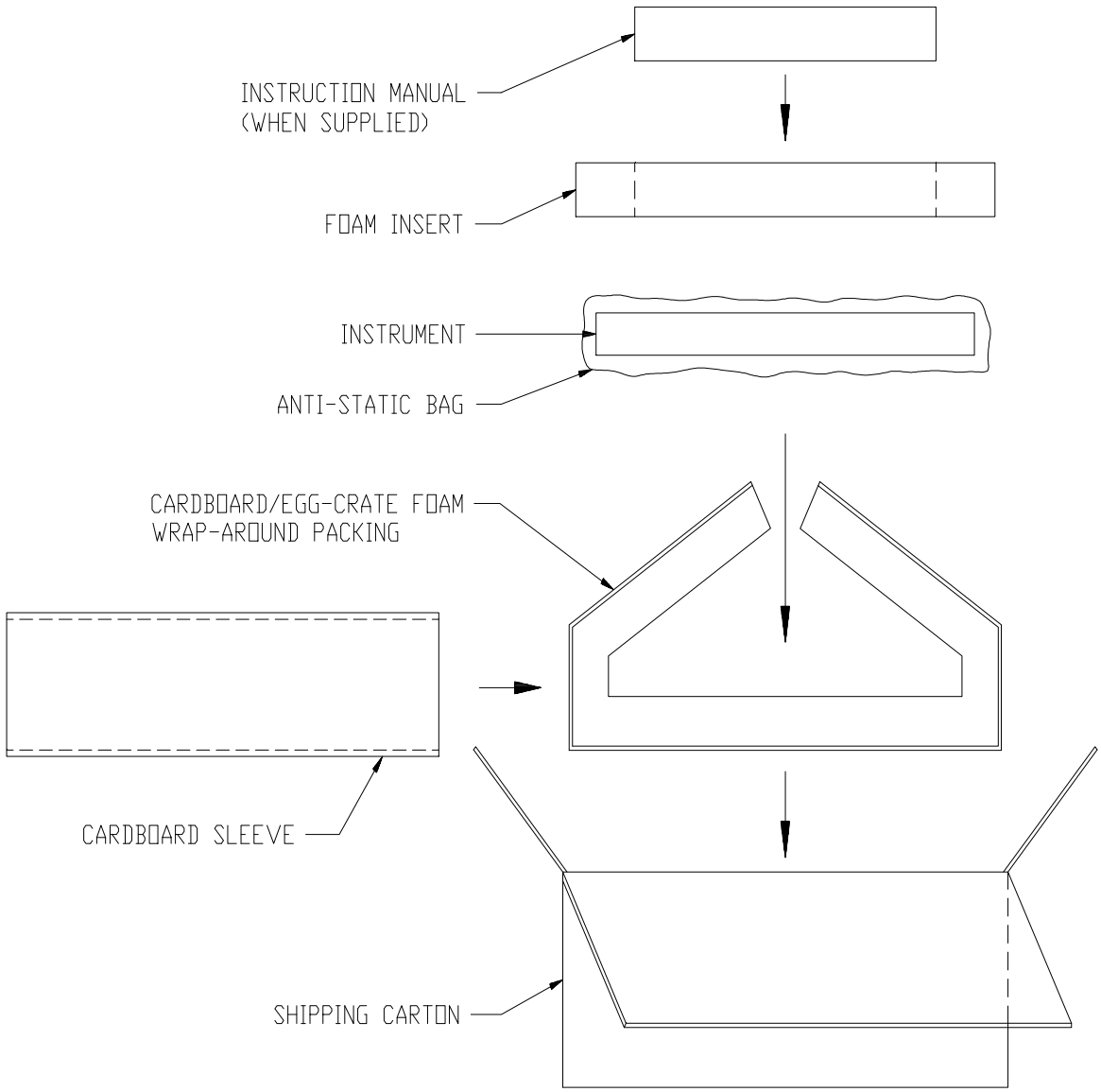


Figure 2-1. Packing and Unpacking Diagram

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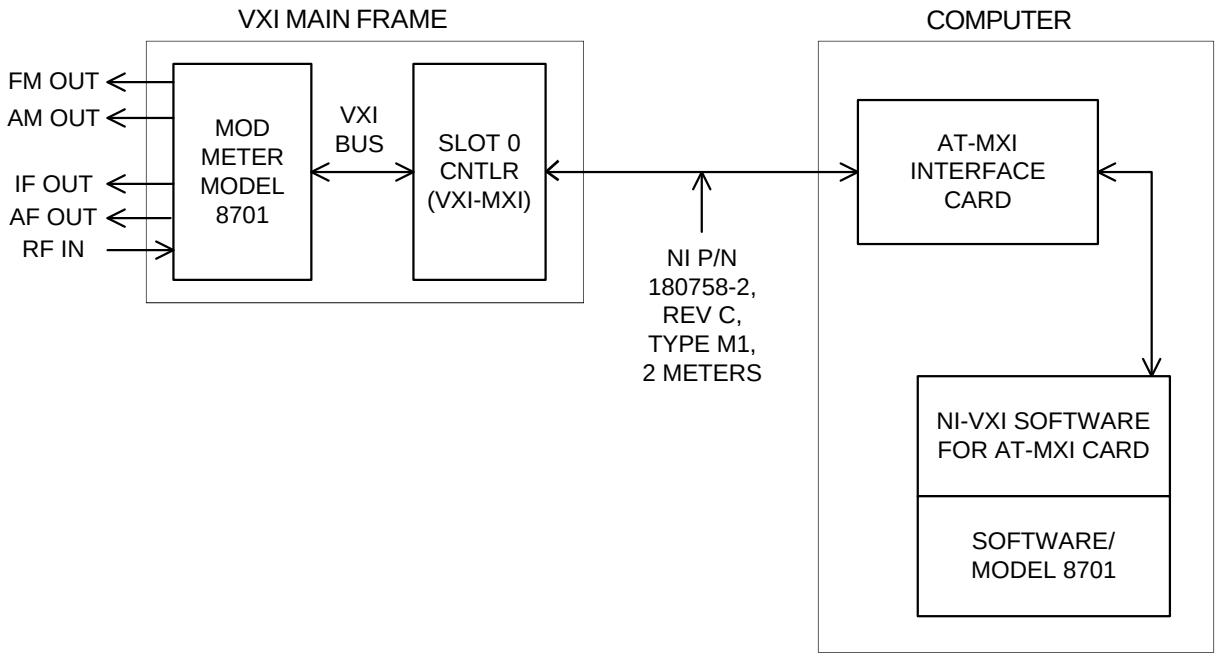


Figure 2-2. System Inter-Connection Diagram

a. C-size VXI Mainframe (HP E14014A or equivalent).

b. VXIbus Interface Kit (National Instruments VXI-AT 4000 series or equivalent).

c. Computer (486 with 16 Meg memory minimum configuration).

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2-9. Cable Connections

2-10. The cable connections required depend upon the application of the instrument. Cable connections that may be required are as follows:

a. RF IN. RF input, front panel Type N connector, 50 ohms nominal impedance. (See Figures 4-1 and 4-2).

b. AF OUT. Audio output, front panel, Type BNC connector 600 ohm impedance, 1 volt rms at 5000 counts on modulation monitor display.

c. IF OUT. IF output, front panel Type BNC connector, 50 ohms nominal source impedance, 0 dBm level.

d. FM (Audio) OUT. FM output on PWB board E10 or TP12, 600 ohms source impedance, approximately 2 volts per ± 100 kHz deviation.

e. AM OUT. AM output on PWB board E8 or TP3, 600 ohms source impedance, approximately 0.2 volt per ± 10% AM.

2-11. Preliminary Check

After all the physical equipment is connected and installed, the following preliminary operational check of the system is performed. In addition, at this time the software driver for the Modulation Meter is installed.

Proceed as follows:

a. Power up the VXI Mainframe and the controlling computer.

b. Allow a 15 minute warm-up period for the equipment to stabilize.

c. Bring up the Windows (3.1) Menu.

d. Insert disk with Modulation Meter drivers into disk drive.

e. Follow the instructions included with the installation disk for installing the instrument graphical user interface drivers.

2-12. After the driver software is installed, a Modulation Meter Icon should appear in the Windows Main Menu.

a. Double-click on the new Icon to display the instrument soft front panel. (See Figure 2-3)

b. Click on "Self Test" field. The field should change from "Run Selftest" to "Running" and the adjacent indicator should come on.

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c. Allow the instrument to complete the self test and the field to return to the "Run Self Test " indication. (Light will go out at the conclusion of the self test run.

d. If Self Test fails, an error message will be displayed in the "Error Message" field.

e. Click on STOP field in display and note that monitor screens return to Windows Main Menu.

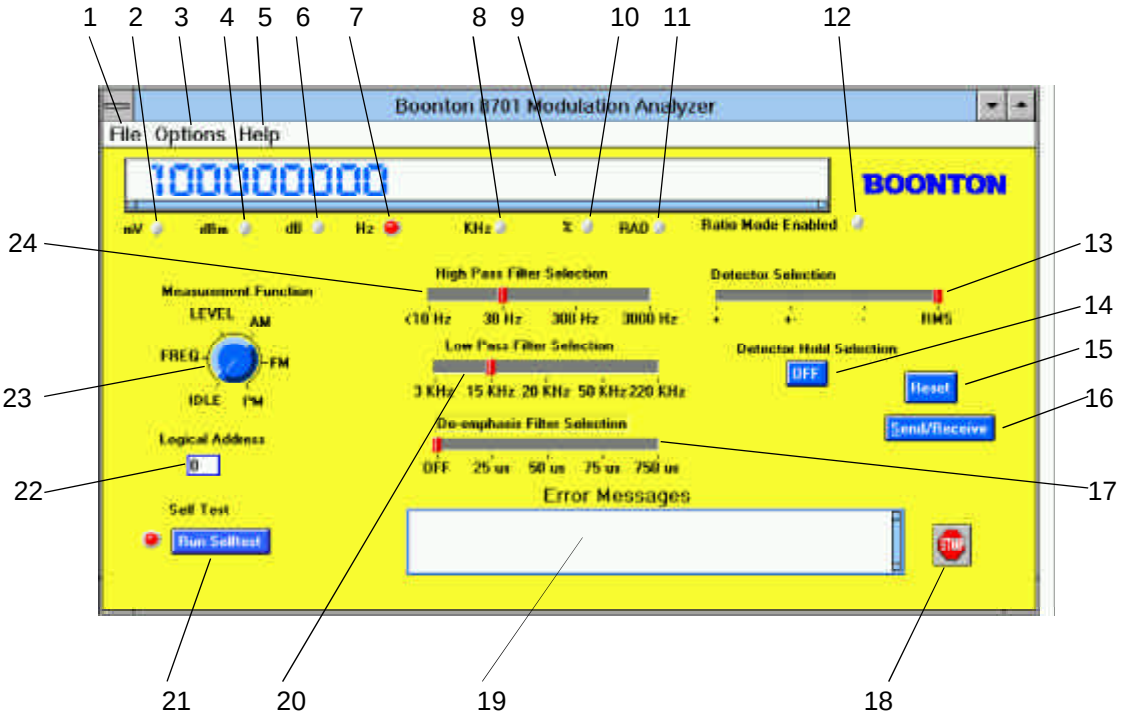


Figure 2-3. Modulation Meter Soft Front Panel

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2-13. Preparation For Shipment

a. Remove all cabling from Modulation Meter and remove it from VXI Mainframe.

b. Inspect the instrument to make sure all hardware is secure.

c. Insert the instrument into the antistatic plastic bag.

d. Carefully insert the entire assembly into the packing carton. Seal the carton securely with tape. (Figure 2-1.)

e. Install several "Fragile Instrument" stickers on the packing carton.

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Chapter 3

Principles of Operation

3-1. Introduction

3-2. The Model 8701 is a versatile, solid-state, microprocessor controlled, modulation meter that covers the carrier frequency range of 100 kHz to 2.5 GHz. Recovered modulation is displayed on a linked PC soft front panel. This provides a maximum resolution of 1 Hz deviation, or 0.001% AM. Operating modes, input frequency, input level, and reference levels can be keyed in through the soft front panel. A VXI interface enables remote programming of the instrument. Selected modes and values are also displayed on the soft front panel. Input commands are processed by the internal microprocessor, and control signals developed to set up the internal circuits in accordance with the commands. The use of a microprocessor also enables storage of up to 99 complete sets of instrument setup data. Commonly used setups can be stored in non-volatile memory via the VXI interface; thereafter, the instrument front panel settings can be restored by typing in the program number assigned to the desired setup and selecting the RE or ST mnemonic on the bus.

3-3. Functional Block Diagram

3-4. Control of instrument operation is exercised by a microprocessor that executes a fixed program in read-only-memory (ROM). Timing of microprocessor operations is controlled by an 8 MHz clock derived from the VXI backplane, "SYSCLK" signal. A random-access-memory (RAM) provides storage capability for microprocessor data. The microprocessor communicates with the internal circuits through a data bus, and address bus and an I^2C bus. Command information is entered into the microprocessor through the soft front panel or a VXI interface. Special functions are provided for option selection and test purposes. Input data selection is displayed by means of the soft front panel. The microprocessor stores and processes input data, and generates data and address information to cause execution of commanded functions.

3-5. The carrier signal is first frequency translated to an intermediate frequency for processing. The intermediate frequency chosen is dependent on carrier frequency. Carriers above 10 MHz are converted to 1.211 MHz, carriers from 2 MHz to 10 MHz are converted to 346 kHz, and carriers below 2 MHz are not converted at all. Frequency translation is accomplished by means of a zero-order hold sampler. The sampler is fully bootstrapped to accept signals as high as 2 Volts rms, without overload. A sampling impulse, generated from a tunable local oscillator, converts the RF signal to the appropriate IF signal. After filtering and buffering, the IF signal is processed by the AM and FM circuits. Additionally, the IF signal is processed by the tuning circuits to provide signals to the microprocessor to properly tune the local oscillator.

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3-6. The frequency modulation information is recovered by first amplitude limiting the IF signal to remove any AM information, and pulse-counting the resulting signal to determine instantaneous frequency. A direct coupled output of the discriminator is connected to the AUDIO OUT test point (TP12) on the FM PWB. The amplitude modulation information is recovered by first setting the gain of the measurement channel to a convenient level for accurate measurement. The resulting signal is amplitude detected by a linear-active detector circuit. A direct coupled output of the detector is connected to the AM OUT test point (TP3) on the AM printed wiring board (PWB).

3-7. The phase modulation information is recovered in the audio filter section by integrating the recovered FM signal. The recovered audio signal from the AM or FM detectors is further processed by amplification and selectable filtering before being converted to dc for measurement. Audio detection consists of precision peak detectors and a true rms detector. The dc information from the audio detectors is digitized by a 13-bit A/D converter for digital processing and display.

3-8. Internal calibration circuits are operated by the control program as required to establish calibration of the internal AM, FM, PM, and rms detectors. The VXI signals "CLK101" and "CLK10-" establish the reference frequency for operation of the frequency counter. An internal 10 MHz crystal can be optionally selected via a jumper to avoid the use of the VXI backplane 10 MHz clock. The power supply circuits convert the incoming ±24 VDC into regulated dc operating voltages to power the instrument circuitry.

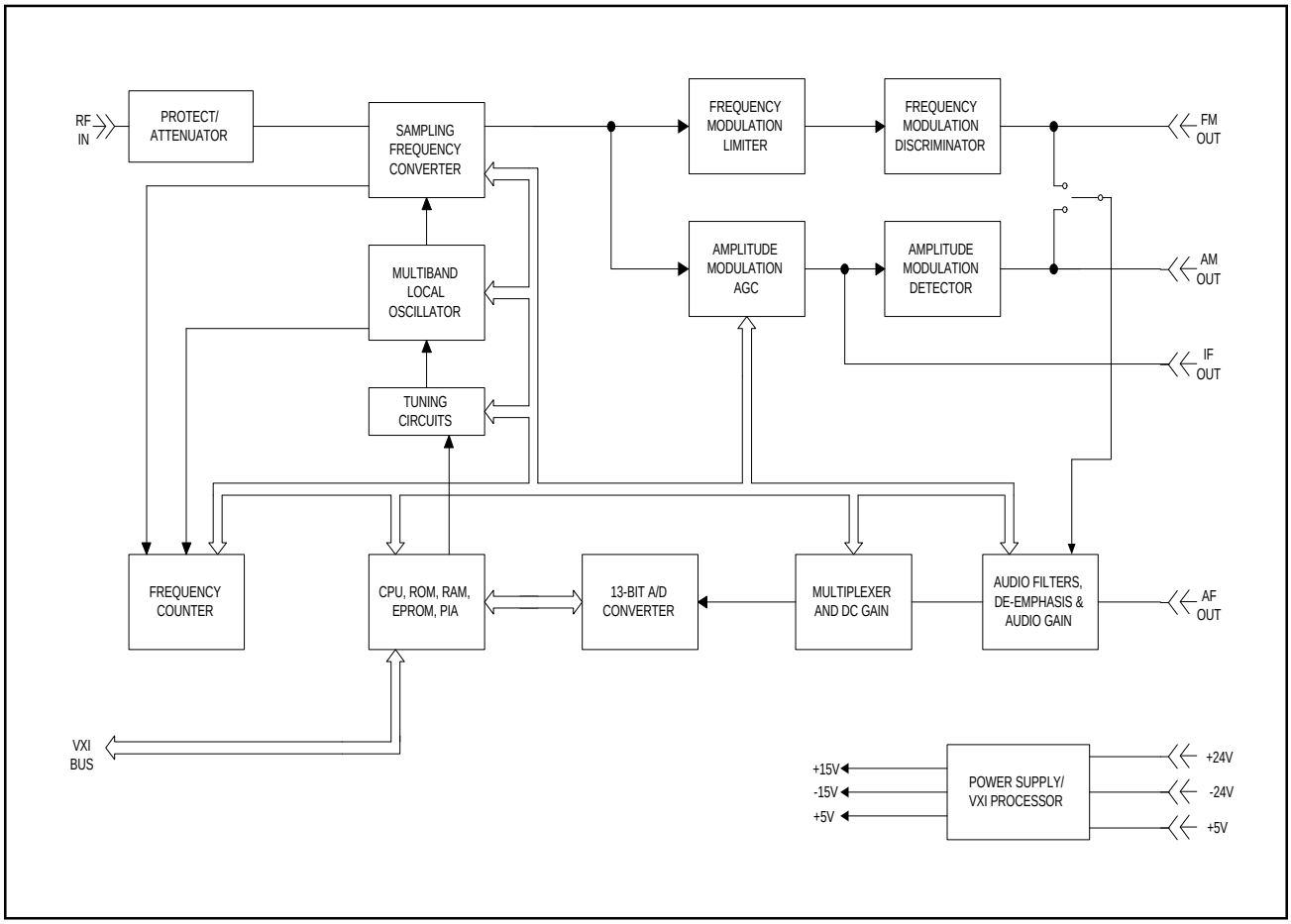


Figure 3-1. Functional Block Diagram

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3-9. RF Circuits

3-10. The RF circuits convert the carrier input signal into a suitable IF signal for AM, FM, and PM measurements. (See Figures 3-2, 3-3 and 7-4.) The carrier to be measured is applied to the front panel RF IN connector. The signal passes through overload protection module A3, and is attenuated by AT1, a 3 dB pad, before it appears at sampling gate CR1 and CR2. The attenuator provides some isolation and protection for the sampling circuit. The protection module includes a switchable 20 dB pad which is activated for input levels above +20 dBm. Simultaneously, a local oscillator signal is stepped-up by transformer T1 and associated components. The signal is passed directly, or divided by 5 in U9 to a pulse forming circuit U1. Switching is accomplished by U8 and band control line B2. The instrument control program operates the band switch to select the proper operating band based on the RF frequency.

3-11. The pulse signal from U1 is further shaped and amplified by Q1 and Q2 to drive step-recovery diode CR3, through transformer T3. Initially CR3 is forward biased from the +5 volt supply through R22. The pulse signal from Q1 and Q2 drives CR3 into reverse conduction; however, CR3 does not "open" until all of its stored charge is depleted. At that instant the diode recovers and produces a large narrow pulse, which is couple to the sampling bridge by T2, a balun transformer. The output of T2 is nearly equal opposite polarity pulses. If the two pulses were exactly equal, they would exactly cancel at the input and output of the bridge. Since such equality is never the case, however, R14 is required to balance the bridge on the various operating bands. R77 is adjusted when the local oscillator signal is between 2 and 4 MHz for optimum sampler efficiency. R12 is adjusted when the local oscillator signal is between 10 and 20 MHz.

3-12. The operation of the sampling gate is shown in simplified form in Figure 3-3. Each time the sampling gate is closed, by a short-duration pulse, the input capacitance of the sampler amplifier plus any stray capacitance is charged to a voltage that is less than the instantaneous RF input voltage. Before the next sample is taken, positive feedback from the sampler amplifier causes additional charge to be placed on this capacitance. Charge is added until the voltage at the output of the sampling amplifier is exactly equal to the RF input when the sample was taken. This output is held constant until the next sample is taken. Successive samples are taken until the RF waveform is reconstructed at 1.211 MHz or 346 kHz, depending on the RF frequency. Additional feedback from the sampler amplifier maintains symmetrical reverse bias on the sampling gate. When the carrier frequency is between 100 kHz and 2 MHz, the 1.211 MHz IF is selected and the local oscillator is set to about 18 MHz. Under these conditions, the input signal passes through the sampling bridge without conversion. The IF circuits then process the signal directly.

3-13. The sampler amplifier is composed of transistors Q3 and Q6-Q7 and associated components The gain is fixed at less than one by a direct feedback connection. The stage has a low output impedance required to properly bootstrap the sampling bridge. The output of the sampling amplifier is connected to a switched 10 times attenuator consisting of R37 and R38. Analog switches U2 and U3 are operated by the control program, via data decoder U25, to select the signal, the signal divided by 10, or the calibrator signal. The calibrator is connected to the IF circuits when the calibration program is operating, otherwise the attenuator outputs are selected. If the carrier level is greater than about 100 millivolts, the signal is attenuated 10 times. An amplifier consisting of transistors Q14, Q15, Q17, Q18 and associated components is required to amplify and buffer the IF signal. This stage has a gain of about 3.3, as determined by R61 and R62. When the 1.211 MHz IF is selected, FET Q22 is operated to select

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the output of this stage. If the 346 kHz IF is being used, the signal is filtered by a 750 kHz low-pass filter consisting L12, L13, C57, C58, and C59. Amplifier U10 has a gain of two which compensates for the insertion loss of the filter. The output of U10 then becomes the IF signal.

3-14. This signal is connected to the AM and FM boards for further processing, and to analog switch U6. U6 is operated by the control program, via data decoder U25, to select one of two low-pass filters. The filters, consisting of L2-5, L10-11, C38-43 and C51-52, are designed to reject the local oscillator signal and maintain a bandwidth of at least one-half of the sampling rate. At any sampling frequency the carrier signal will be converted to a frequency between dc and on-half the sampling rate. Therefore, to insure proper signal discrimination, the filters must have a bandwidth of at least one-half of the sampling rate. The filter bandwidths are 7 and 10 MHz. MECL line receiver U4 and associated components comprise a limiter circuit. The limiter removes AM modulation and produces a square wave output signal to drive U13, a TTL counter, and U12 a buffer amplifier used to provide a sample of the IF signal for the frequency counter circuits.

3-15. The counter output signal is used to measure the IF signal frequency for tuning and RF frequency calculation. Counter circuit U13 is programmed to divide by 2 or by 7 as determined by the state of control line B2. If B2 is a TTL high, the 10 to 20 MHz local oscillator is active and U13 is set to divide by 7. This converts the 1.211 MHz IF to 173 kHz. If B2 is a TTL low, the 2 to 4 MHz local oscillator is active and U15 is set to divide by 2. This converts the 346 kHz IF to 173 kHz. The 173 kHz signal is connected to the local oscillator circuits for further processing.

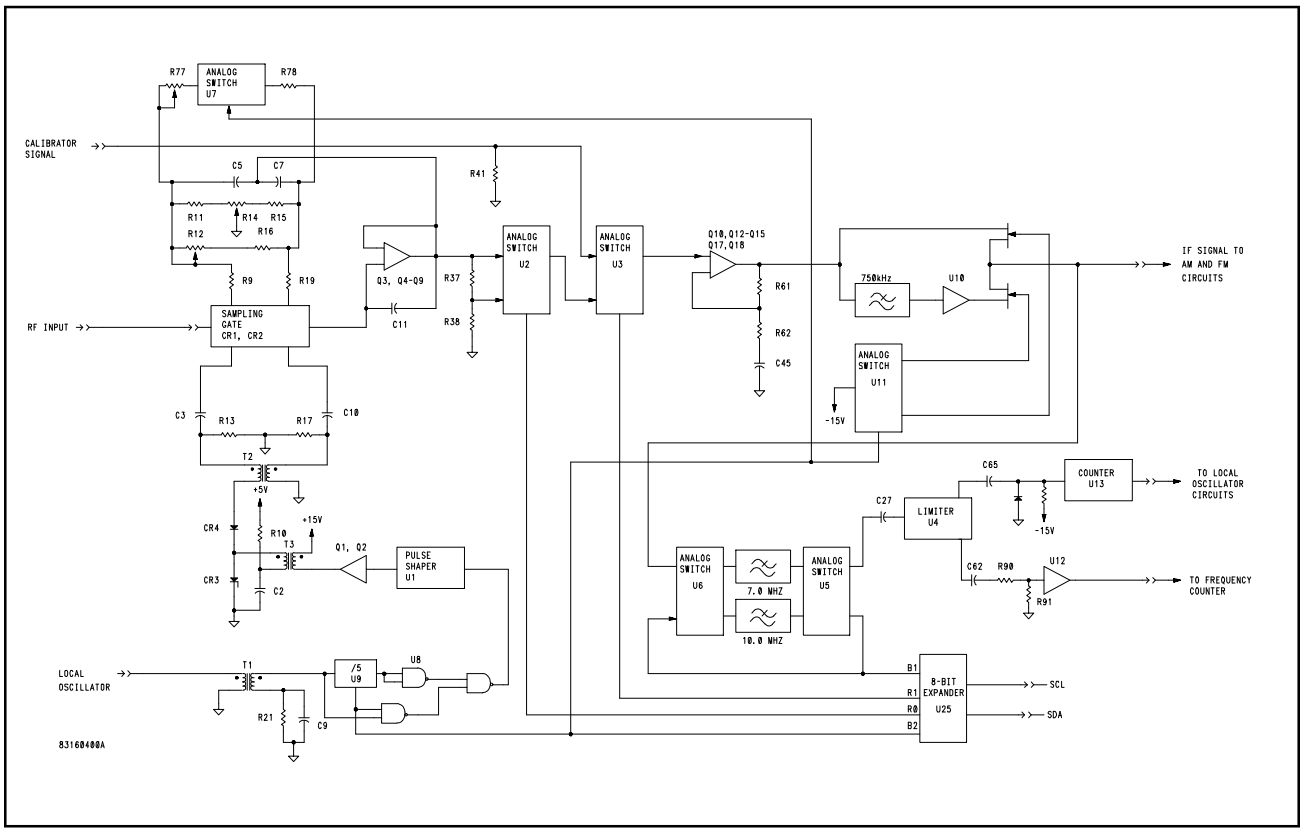


Figure 3-2. Sampling Gate Operation

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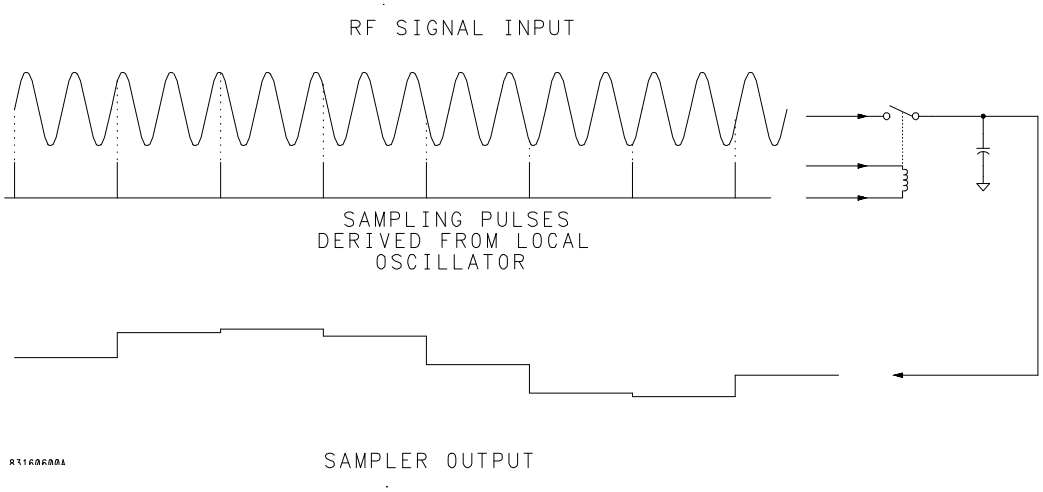


Figure 3-3. RF Circuits Block Diagram

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3-16. Local Oscillator Circuits

3-17. The local oscillator circuits provide the signals to operate the pulse generator circuits on the RF board. See Figure 3-4 and 7-5. A variable frequency oscillator is tuned from 80 to 100 MHz to provide the input to a variable modulus counter. The oscillator is designed and constructed to produce minimum residual FM. The output signal is divided by 5, 6, 7, and 8 to produce four overlapping frequency bands of:

10 to 12.5
11.4 to 14.3
13.3 to 16.6
16 to 20 MHz

3-18. The oscillator consists of FET Q1 and associated components. FET Q1 provides the gain required to sustain oscillations, while transformer T1 and capacitors C5, and C1 along with varactor diodes CR3 and CR4 form the tuned circuit. Feedback is taken from the secondary winding of T1 and connected to the source of Q1 through dc blocking capacitor C6. Diode CR2 provides output voltage amplitude control by rectifying the feedback voltage and reverse biasing Q1, thus limiting stage operating current. Capacitor C2 bypasses the gate of Q1 at the frequency of oscillation. Resistor R2 is required to establish initial gate bias and inductor L2 provides a dc return for the source. The output of the oscillator is connected through high-pass filter, C9 and R10, to isolation amplifier Q3 and associated components. The signal is further buffered by impedance converter Q6, to drive the input of a variable modulus counter circuit consisting of U12, U14A, and U15. The inverting output of U12B is level translated by Q9 and associated components. This signal is then routed to frequency counter circuit on the VXI Processor Board for frequency calculations.

3-19. Band switching is accomplished by the control program via data lines B0-B3. The program (P) inputs of U15 are changed to cause U15 to divide by 5, 6, 7, or 8. The output of U14A is ac coupled to the pulse generator circuits on the RF Board. The 173 kHz IF signal from the RF board is connected to retriggerable one-shot U13. The period of U13 is determined by R61 and C48 to be 2.9 µS, the semi-period of the 173 kHz signal. The duty cycle of the waveform on pin 6 of U13 is then 50% and the average value of the waveform is about 1.5 volts. Amplifier U11 shifts the dc level of the signal to make the average value about 0 volts dc. Resistor R37 adjusts the circuit for exactly 0 volts dc at 173 kHz.

3-20. The output of U11 is connected through resistors R59, R31, and analog switch U9 to integrator U6a. The output of U6a is connected through a level shifting circuit composed of RZ13 and U22. The output of U22 is the voltage used to tune the oscillator. Oscillator tuning is accomplished by varying the voltage at the junction of C10 and L3 from -5 to -25 volts. Additional connections to the integrator permit the control program to tune the oscillator using a digital-to-analog converter (DAC) located on the VXI Processor Board.

3-21. Analog switch U9 is dual switch array. The second section is used to operate a bypass circuit consisting of U20. This circuit operates to speed up acquisition by bypassing R8, a 4-7 megohm resistor, during search. Frequency acquisition in the automatic tuning mode proceeds as follows. The input carrier frequency is applied to the sampling bridge for frequency conversion. The resulting IF frequency is somewhere

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between dc and one-half of the local oscillator frequency. The input signal to U13, the retriggerable one-shot, will produce an output waveform whose duty cycle and thus average, value will be proportional to frequency. The control program configures U9 so as to connect the integrator to R31, providing a closed loop for frequency acquisition. The integrator will ramp until the input frequency to U13 is 173 kHz.

3-22. The control program monitors the dc voltage at the output of the integrator and at the output of U11 to determine if a valid IF has been established. If the integrator output is greater than ±10 volts, the integrator is reset by connecting the junction of resistors R22 and R27 to the input of U6a, with the DACIN input set to 0 volts. The band is changed and the integrator is released. This process continues until a valid IF is found. When a valid IF signal is found, the control program changes the DACIN dc level. This causes a current to flow through R29 which also causes the IF frequency to change. The control program then measures the resulting integrator output voltage change and calculates the harmonic number. Analog switch U9 is configured to connect the junction of resistors R22 and R27 to the input of U6a, and the DACIN voltage is adjusted so that the integrator output voltage remains unchanged. The frequency acquisition loop is opened. The final tuning is optimized by the microprocessor.

3-23. Amplifier U1 and transistor Q2 regulate the -15 volt supply down to -14 volts to reduce power supply noise and ripple which improves the stability of the oscillator circuits. The theory of operation of the calibrator circuits, which are located on this assembly, is discussed in detail in Chapter 5, paragraph 5-4.3.14, Calibrators (PVT).

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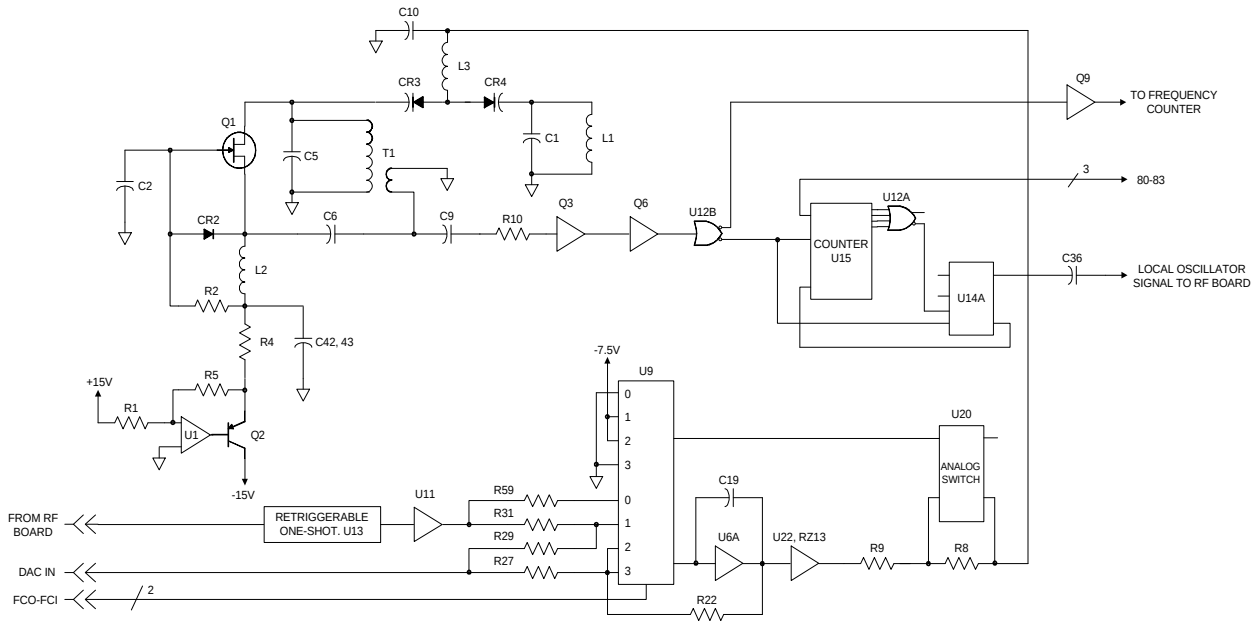


Figure 3-4. Local Oscillator Circuits Block Diagram

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3-24. FM Circuits

3-25. The frequency modulation circuits recover the audio signal from the frequency modulated carrier. See Figures 3-5 and 7-6. The intermediate frequency signal from the RF circuits is connected through a 3 MHz, flat-phase, low-pass filter consisting of inductors L3 and L4 and capacitors C1 and C4-C7 to a 4-stage limiter. The limiter is composed of integrated amplifier arrays Q3 and Q8 and associated components. The stages are designed with small signal feedback to minimize phase shift changes with level, thus minimizing incidental FM when the carrier contains large amounts of AM. The output of the limiter is connected to a pulse forming network consisting of Q13, R77, and R78, C48 and C49 and L8. This circuit creates a differentiated signal which drives U1b, a TTL flip-flop, which is wired as an inverter to drive the FM detector.

3-26. The FM detector is a precision monostable multivibrator which operates as follows. Each positive transition of the signal at pin 11 of U1a (corresponding exactly to each cycle of the IF frequency) causes the signal at pin 8 of U1a to go low. Enhancement mode FET Q1 is turned off, and the constant current source consisting of Q2, R2, R4, R11, R13, and CR1 charges C10 toward the positive supply rail. When the voltage reaches the value established at the base of Q5 by R30 and R28, transistor Q4 conducts and Q5 is turned off. This causes Q6 and Q7 to turn on which resets U1a. FET Q1 is turned on and capacitor C10 is discharged, completing the cycle. The result of this operation is a constant width pulse at a rate equal to the IF frequency. As the IF frequency varies, the duty cycle and thus the average value of the waveform changes.

3-27. Enhancement mode FET Q10 operates in parallel with Q1 to toggle current switch Q11 and Q12. The collector current of Q12 is a rectangular pulse with a duty cycle determined by the instantaneous IF frequency and an amplitude determined by a precision current generator consisting of AR2, Q9 and associated components. The 220 kHz low-pass filter consisting of capacitors C36, C39, C41, and C42 and inductors L6, L9, and L10 removes the IF frequency components from the signal leaving only the modulation information. A phase equalizer consisting of C27, C28, C33, L5, L12, and R51 linearizes the filter phase response. Transistors Q15 an Q16 and amplifier AR3 level shift and amplify the signal to drive the audio circuits. Two local power supplies are required by the FM circuits. One is generated by Q14, R63, R70, R71 and C35. This circuit isolates the -15 volt instrument supply. The other is a +5 volt supply generated by R14, R15, C12, and AR1. This supply powers the TTL circuits on the FM board.

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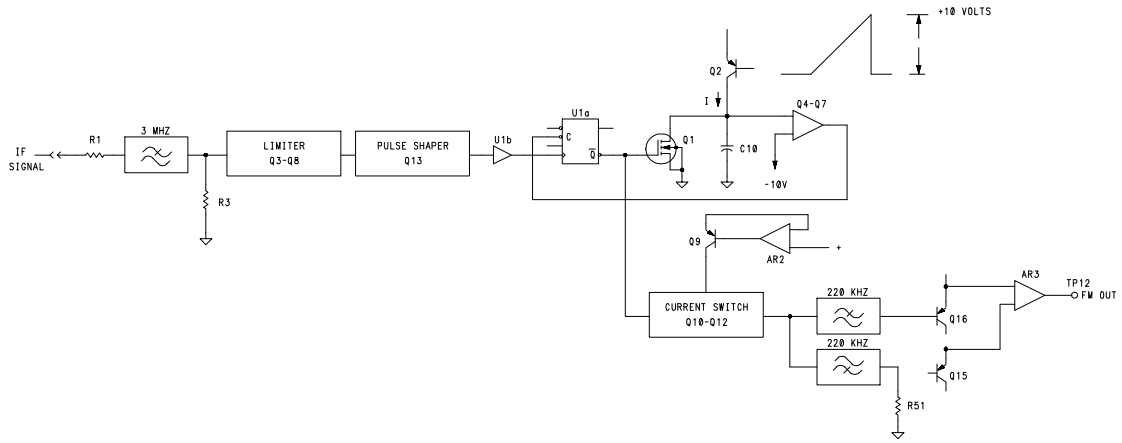


Figure 3-5. FM Circuits Block Diagram

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3-28. AM Circuits

3-29. The amplitude modulation circuits recover the audio signal from the amplitude modulated carrier. Additionally, these circuits provide a dc signal which is proportional to the carrier level at the RF IN connector (See Figures 3-6 and 7-7.) The intermediate frequency signal from the RF circuits is connected through a 3 MHz, flat-amplitude, low-pass filter consisting of inductors L5 and L6, and capacitors C1, C7, and C10 to an input amplifier composed of Q3-Q6 and associated components. The gain from the input of the filter to the output of the amplifier is about 1.5, as determined by resistors R1, R7, and R19. This stage is carefully compensated by R88, C62, R18, and C19 to provide very flat response from less than 100 kHz to greater than 2 MHz. A flat frequency response is required to maintain low incidental AM when the carrier contains large amounts of FM.

3-30. The programmable attenuator maintains the output of the AM detector within reasonable limits while the carrier level changes about 40 dB. The attenuator consists of two light dependent resistors (LDRs), two control loops, an 8-bit DAC and two isolating transistors.

3-31. Each of the two control loops operate as follows. A current flows through the variable resistance element of DS1 producing a voltage drop. This drop is monitored at one input to loop amplifier AR1a, while the other input is a reference voltage of about -0.5 volts. The output of AR1a is then the amplified difference between the reference and the drop across DS1. This error voltage is coupled to the LED portion of DS1 through buffer Q7 in such a way as to reduce this difference to nearly zero. The result is that by adjusting the current through the LDR, the resistance can be set precisely. The variable current is supplied by U2, an 8-bit DAC and isolating transistors Q8 and Q9. The current outputs of the DAC are differential, and proportional to the magnitude of the 8-bit digital data. When the most significant bit, B1 of U2 is high and all others are low, the two currents are nearly equal. The magnitude of this current is set by resistor R5. Any other combination of bits will increase one current while decreasing the other. The two attenuator arms track the DAC current and thus produce an attenuation which is proportional to the digital data. The control program adjusts the digital data to adjust the dc output of the AM detector.

3-32. An amplifier consisting of transistors Q10 and Q13-Q16 increases the level of the attenuator output about 18 times as determined by resistors R42 and R40. The input impedance of the stage is high to avoid loading the attenuator, and the output impedance is high to maximize the loop gain of the following stage, the AM detector. The AM detector is a linear-active design, that is, the diode rectifiers are linearized by including them in the feedback path of a high gain amplifier. The amplifier consists of transistors Q19-Q21 and associated components. The stage is optimized for high gain and high output impedance to drive the nonlinear feedback elements. The half-wave rectified voltages at the junctions of CR6a and CR6b and R68 and R71 are buffered by Q22a and Q22b and amplified by differential amplifier AR2. A 220 kHz, seven pole, low-pass filter consisting of inductors L10-L12 and capacitors C50-C54, and C56 removes IF frequency components from the signal, leaving only the modulation and dc components. Amplifier AR3 provides an additional gain of two. Resistors R85-R87 provide a means to compensate for various offsets between the detector and the output of AR3. An amplifier consisting of transistors Q12, Q17, and Q18 provides a sample of the leveled AM signal to the front panel IF OUT connector.

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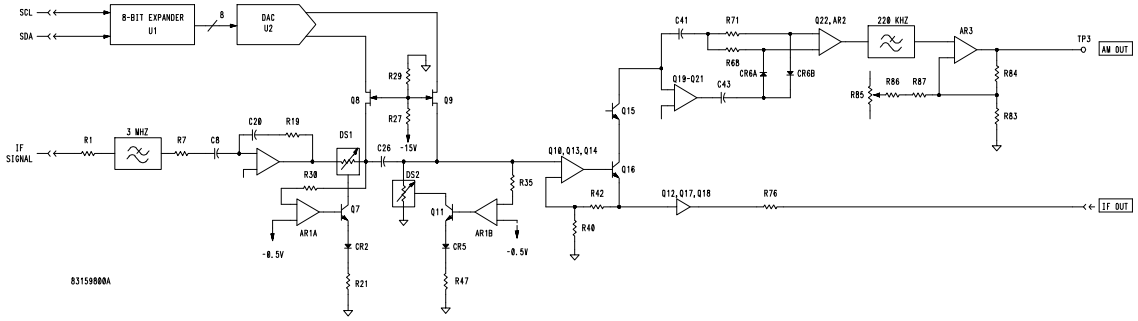


Figure 3-6. AM Circuits Block Diagram

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3-33. Filter Circuits

3-34. The recovered modulation from the AM or FM circuits is further processed by the filter circuits. See Figures 3-7, and 7-8. Relay K1 is operated to select the output of the FM board for either FM or PM modulation, or the output of the AM board for AM modulation. Relays K2 and K3 select either an attenuator, or a 50 kHz, seven pole, low-pass filter as determined by the control program and the low-pass filter selection. The 50 kHz filter is in the measurement path for all low-pass filter selections except the 220 kHz filters which are located on the AM and FM boards.

3-35. Capacitors C15 and C16 remove any dc information from the signal before it is connected to a programmable attenuator consisting of R10, R11 and U3a. When the modulation signal is greater than 52.00 kHz, RAD, or %, the attenuator is selected. The dual diodes in CR4 protect the following stages from severe overload during range switching. Buffer amplifier AR1 has a gain of ten as determined by resistors R9 and R17. This stage is inserted in the signal path when the modulation is less than 5.200 kHz, RAD, or %, otherwise it is bypassed. Unity gain buffer AR12 drives the high-pass filter array. The filters are 3-pole Butterworth designs except for the < 10 Hz filter which is dc coupled at this point. Resistors R19 and R26 set the insertion loss of the < 10 Hz position to equal that of the other active filters. The other filters are designed to cut off at 30, 300, and 3000 Hz. The control program operates analog multiplexer U4 based on the high-pass filter selection.

3-36. Amplifier AR2 and associated components comprise the 30 Hz filter. Similarly AR3, AR4 and associated components comprise the 300 Hz filter, and 3000 Hz filter respectively. Amplifier AR5 increases the signal approximately 4.6 times, as determined by resistors R30 and R31 and drives a low-pass filter array. The 3 and 15 kHz filters are 3-pole Butterworth designs, and the 20 kHz filter is a 3-pole Bessel design. Additionally, a through position is provided for the 50 and 220 kHz filters, and a gaussian filter consisting of R34, R38, R40, C36, C38, and C41 is provided for calibration. Analog multiplexer U5 is operated by the control program based on the low-pass filter setting or the carrier frequency to select the appropriate filter.

3-37. Unity gain buffer AR8 drives the de-emphasis and phase modulation filters. The de-emphasis networks are single pole gaussian filters with cut frequencies of 212 Hz, 2.122 kHz, 3.183 kHz, and 6.366 kHz corresponding to the time constants of 750, 75, 50, and 25 microseconds respectively. Amplifiers AR9a and b and associated components comprise the phase modulation filter. This filter is designed to have an insertion gain of unity at 1 kHz modulation frequency, and a response that approximates an ideal integrator over most of the audio frequency range. Analog multiplexer U7 is operated by the control program to select the appropriate de-emphasis network as determined by the de-emphasis filter setting. Additionally, the control program bypasses these networks in the AM measurement mode, and selects the phase modulation filter in the PM mode.

3-38. Unity gain amplifier A10 buffers the signal which is connected to the detector circuit board through analog switch U8. U8 is operated by the control program to select pre-display or post-display de-emphasis as determined by SPCL functions 7 or 8, or the de-emphasis mode as set via the VXI bus controller. Amplifier AR11 increases the signal by about 2.4 times as determined by resistors R53 and R54 to generate the front panel AF OUT signal. Resistor R55 determines the output impedance of 600 ohms and diodes CR7 and CR8 provide reverse power protection for AR11. Digital control signals for the filter board are latched from the instrument control bus by 8-bit Expanders U2 and U6.

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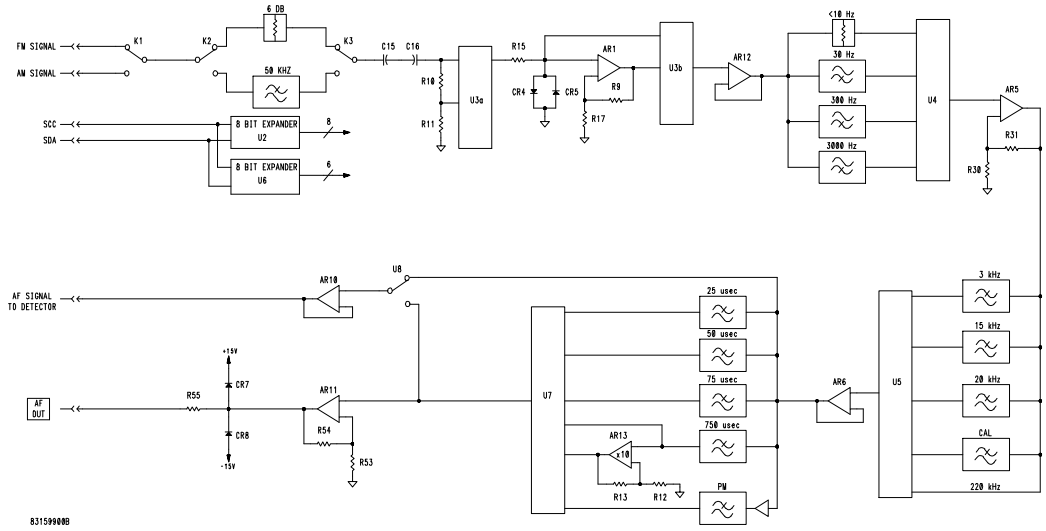


Figure 3-7. Filter Circuits Block Diagram

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3-39. Detector Circuits

3-40. The recovered modulation signals from the filter board are converted to dc signals by the detector circuits. The detectors include plus and minus peak detectors, an rms detector, and an average detector. (See Figures 3-8 and 7-9.) This recovered modulation signal is AC coupled to analog switch U1 through coupling network C36 and R5. Analog switch U1 is operated by the control program to connect the peak detector circuits to the audio signal or a ground reference established by R11 and C6. The output of U1 is connected to the input of U13d through an equalizer network consisting of R12 and R13 and C37 and 38. This network compensates for a slight decrease in peak detector efficiency at about 250 kHz. U13d and U13c are voltage followers cascaded to drive the positive peak detector. The output of U13d also drives a precision inverter circuit consisting or U13a and R55a-R55d which in turn drives the negative peak detector through voltage follower U13b. This seemingly unnecessary symmetry is required because the full-scale resolution of the peak displays is 0.02%. The positive and negative peak detectors are identical circuits driven by audio signals that are 180 degrees out of phase.

3-41. Amplifier U15 and U19b and associated components are arranged as a positive peak detector. During the positive excursion of the audio signal, the output of U15 is driven positive; capacitor C20 then charges through CR3. Amplifier U19b buffers the voltage across C20 and adds a small offset. When the output of U19b reaches a value equal to the positive peak of the waveform plus a small increment, the output of U15 goes negative and thus terminates the charging of C20. The output of U19b is then equal to the positive peak of the audio signal. The small offset created by R24 and R25 is required to insure that there is a net positive charge on C20 when the signal on pin 3 of U15 is zero. Diode CR1 improves frequency response by limiting the voltage excursion at pin 6 of U15 at about -0.7 volts in the negative direction.

3-42. The peak detector consisting of U16 and U19a and associated components operates in an identical manner, except that the audio signal at pin 3 of U16 is inverted, so that the positive output voltage at pin 1 of U19a represents the negative peak of the audio waveform. Analog switch U6, R20 and R22 are connected across capacitors C20 and C21 to reset the peak detectors during the various phases of the peak measurement cycle.

3-43. The measurement cycle proceeds as follows: The control program asserts the peak detector reset signal discharging capacitors C20 and C21. Analog switch U1 is set to connect the ground reference network R11 and C6 to the input of U13d. After a short wait for transients to settle, the reset signal is removed and both peak detector outputs are measured. The measurements represent the zero input signal condition of the detectors. The reset signal is again asserted, and analog switch U1 is set to connect the audio input signal. The reset signal is again removed and both peak detectors are again measured. The measurement represents the output of the detectors including the input signal and offsets. The offsets are removed by the control program and the corrected measurement displayed on the front panel digital display. The measurement cycle is repeated by the control program as required. The peak average display is generated by adding the plus and minus peaks and dividing the result by two.

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3-44. The outputs of the peak detectors and a dc signal from the AM detector are routed through an analog multiplexer, U7, to amplifier U22b. The circuit gain is three, as determined by R43 and R37, which brings the full-scale output of the peak detectors and the nominal output of the AM detector to about three volts. This signal is connected through analog multiplexer, U9, to second amplifier U22a and associated components. This stage is designed to have a gain of about 2.04 and a dc offset of about 100 millivolts. Gain is required to increase the full-scale signal to about 6 volts for later analog-to-digital conversion; the offset is required to insure that inputs near zero volts still produce a positive dc output. The output of U22a is routed to the VXI Processor Board to a 16-bit A/D converter.

3-45. Several other signals are connected to multiplexer U9. A signal representing the output of the frequency acquisition integrator is attenuated and level shifted by resistors R33, R34, and R35. When the output of the integrator is +10 volts, the voltage at the pin 5 of U9 will be about 3.7 volts and when the output of the integrator is -10 volts, pin 5 will be about 0.58 volts. A second voltage from the frequency acquisition discriminator is attenuated and level shifted by R38, R40, and R41. For discriminator voltages between +3 and -3 volts, the voltage at pin 4 of U9 will vary between 3.2 and 0.8 volts respectively. Pin 7 of U9 is grounded to provide a zero volt reference for the analog to digital converter. Three other inputs to U9 will be covered separately below.

3-46. A second audio signal is AC coupled by coupling network C4, C5, R18 and R19 to analog switch U5. This signal represents an amplified version of the signal at the peak detectors. Resistors R18 and R19 divide the input signal by ten, so that the signal at pin 3 of U14 is either the input signal, or the signal divided by ten, as determined by the setting of U5. The stage gain of U14 is set at 11.5 as determined by resistors R6 and R7. Capacitor C7 provides high frequency compensation. Similarly, the output of U14 is connected to an attenuator consisting of R8 and R9, analog switch U5, and a second amplifier U18. Diodes CR7-CR10 and resistors R57-R59 speed overload recovery of U14 and U18. Integrated circuit U18 is also configured for a gain of 11.5 and is AC coupled to an attenuator consisting of R1-R4 and analog switch U4. This attenuator is programmable for an attenuation of zero, six, fourteen, or twenty dB. Amplifier U20 is configured for a gain of 11.5 and is AC coupled to rms detector U8.

3-47. The complete amplifier/attenuator chain is programmable for a gain change of 0 to 60 dB (1000 times) in steps of 6 or 8 dB. Gain is established as required by the control program to maintain the output of the rms detector between about 1 and 3 volts dc, corresponding to rms inputs of 1 to 3 volts respectively. Capacitor C26 determines the low frequency characteristics of the rms detector and is selected to maintain modest errors down to about 10 Hz. The output at pin 6 of U8 is connected to multiplexer U9 as one of the possible inputs to the analog to digital converter. An average detector consisting of U21 and associated components monitors the signal level at the input to the high-pass filter array. This detector is used to determine if an overload condition exists in the filter circuits, since the filters may attenuate an overrange signal before it is detected by the peak or rms detectors. This detector is also used for autoranging in the PM measurement mode.

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3-48. The voltage at pin 2 of U21 is nearly zero due to the amplifier's high open loop gain. The voltage at the junction of C35 and R39 produces a current which also flows through R44, CR6, and CR5. If the current is sinusoidal, the current flows through R44 and CR5 on one half-cycle of the waveform, and through CR6 on the other half-cycle. The voltage at the junction of CR5 and R44 is thus half-wave rectified, and a dc voltage equal to the voltage peak divided by PI (3.14159) is produced. This voltage is connected to pin 10 of multiplexer U9 through filter R45 and C33. The filter removes the AC components from the rectified signal. 8-bit Expanders U3 and U10 are used to store the control data from the instrument bus. Power supply decoupling is provided by L1, L2, L3, C1, C2, and C3. Additional supplies (+5 and -5 volts) are generated on board by U23a and b, and resistors R27, R29, R31, and R32. Capacitors C10 and C13 provide filtering to reduce power supply noise.

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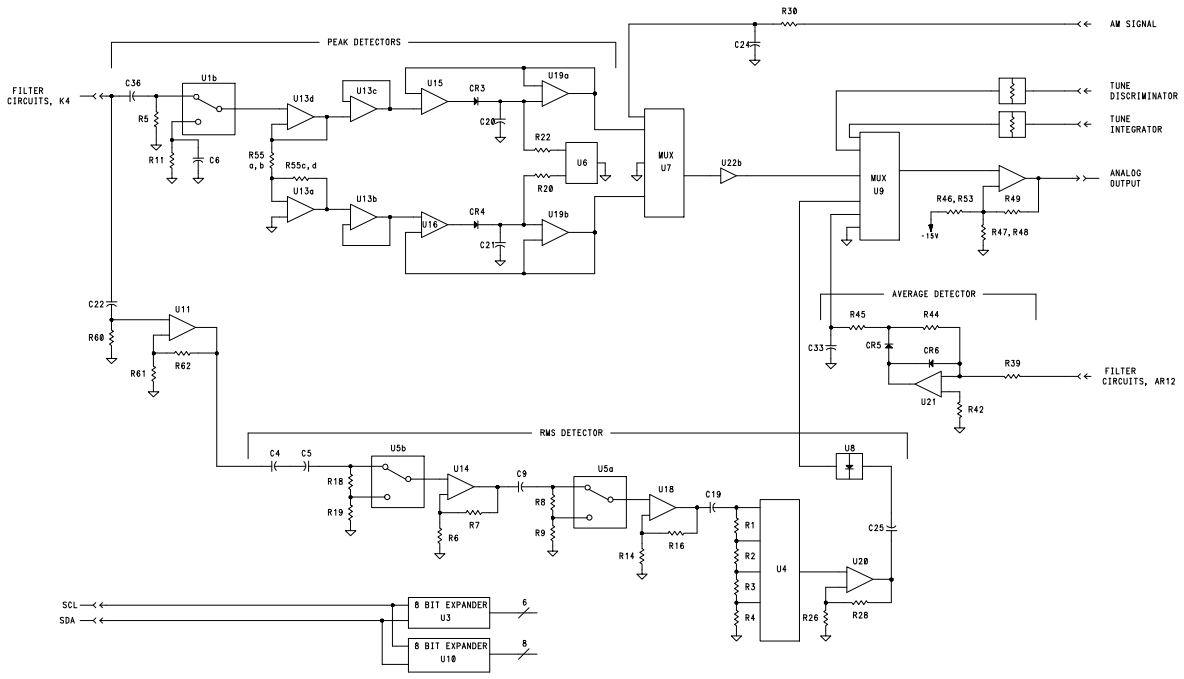


Figure 3-8. Detector Circuits Block Diagram

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3-49. VXI Processor Circuits

3-50. The VXI Processor circuits provide the microprocessor control of all functions of the instruments. Additionally, the VXI Message-Based Interface chip is located on the board as are the tuning DAC, the A/D converter, a Field Programmable Gate Array (FPGA), complex logic device (CPLD) and a Universe Asynchronous Receiver/ Transmitter (UART).

3-51. The 68000 microprocessor executes a control program stored in the 1M Flash memory U16. Program variables and instrument configuration is stored in random-access-memory (RAM) U2 and U7. Instrument control is accomplished by an I^2C bus where the FPGA U10 generates the required interface signals. VXIbus communications is controlled by U12 a Message-Based Interface Ship. Analog-to-digital conversion is accomplished by one-half of DAC U19 in conjunction with reference AR4, comparator U23 and precision resistor array RZ1. The other half of U19 is used to tune the local oscillator circuits.

3-52. Local communications on the VXI Processor Board are via the high-speed CPU data bus D00 through D15 and address bus A01 through A19. Address lines A20 through A23 are not utilized. Memory space is partitioned by CPLD U11 as follows:

Address	**Function**
0 0000 - 1 FFFF	Flash EPROM, U16
2 0000 - 2 FFFF	RAM, U2 and U7
4 0000 - 4 0FFF	FPGA, U10
4 1000 - 4 1FFF	A/D conversion, U19a
4 2000 - 4 2FFF	D/A conversion, U19b
4 3000 - 4 3FFF	FPGA Download Register, U10
6 000 - 8 0FFF	VXIbus ASIC, U12
8 1000 - 8 1FFF	LED Lamp register, CR3-4
A 0000 - B FFFF	UART, U20

3-53. At power-on, the VXI backplane signal SYSRESET is asserted typical by a Slot 0 Controller. This causes the VXIbus ASIC U12 to enter the HARD RESET state activating the SFTRST output. This signal is further decoded in the CPLD U11 and reset signals are sent to the FPGA U10, UART U20, DAC U19 and microprocessor U21. Additionally, the microprocessor HALT signal is decoded when SYSRESET is asserted. This causes the microprocessor to enter a total system reset state until SYSRESET is de-asserted at which time the control program starts executing.

3-54. The code begins with the initialization of the VXIbus ASIC U12 in conformance with VXIbus System Specifications Rev. 1.4. All front panel LEDs are shut off, interrupts are disabled, and then the ASIC asserts SYSFAIL, lighting the front panel SYSFAIL LED. The VXI controller then de-asserts SYSRESET and the unit performs a self test. This self test initializes the instruments capability to execute VXI bus communications. If after 4.9 seconds the SYSFAIL LED remains lighted, then the instrument has failed the self test. However, when the instrument successfully completes its self test, SYSFAIL is de-asserted and the SYSFAIL LED is turned off. The unit remains in an idle state waiting for a Begin-normal-Operation command. This command launches the 8701 Modulation meter into full operation by initializing the reset of the devices then executing the measurement loop.

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3-55. Complex Programmable Logic Device U11 provides the common controls for all of the peripheral devices such as read, write, chip-select and reset. Additionally, control signals are decoded for programming the FPGA at instrument initialization. All interrupts pass through the CPLD and are decoded before passing on the information to the microprocessor. All clocks generated in the CPLD are derived from the VXI backplane 16 MHz clock. The clocks are: 8 MHz for the microprocessor and VXI ASIC, 4 MHz and BaudCLK for the UART and a programming clock for the FPGA. The front panel LED control lines are also decoded by U11.

3-56. VXI Message-Based-interface Chip U12 provides the 8701 with all of the configuration registers and message-based device registers required by the VXIbus specification, as well as control circuitry and VXIbus arbitration. Bi-directional buffers U3 and U4 used on the data lines and buffer U18 for the interrupt request lines are required for driving the high-current backplane signals of the VXIbus. Switch S1 provides for the selection of the logical address of the 8701 as seen by the VXI controller. Valid VXI device addresses are 1-254.

3-57. The primary functions of the Field Programmable Gate Array U10 are I2C signal generation and decoding and frequency counting of the LO and IF signals. The I2C function converts an 8-bit parallel data byte to a serial data byte and vice-versa while providing the required I2C timing along with Start, Stop and ACK bits. Two 32-bit frequency counters provide the data required for frequency acquisition. Carrier frequency measurements are made by counting the local oscillator for N gate cycles, where N is the harmonic number used to generate the intermediate frequency. Simultaneously, the intermediate frequency is measured and the difference is calculated as the carrier frequency. The expression relating the three frequencies is:

Frf = N * Flo - Fif

P10, comparator U15 and associated components convert the IF signal to TTL for further processing in the FPGA. P11, T1 and associated components boast the LO signal (80 - 100 MHz) to levels acceptable to drive the inputs. The timebase for the frequency counters are derived from the VXI backplane signals CLK10P and CLK10N and are level shifted by U5 and associated components. Alternatively Y1 via J1, P3 can be used as the timebase clock allowing the frequency counters to operate without the need of the backplane 10 MHz.

3-58. Analog-to-Digital conversion is accomplished by the control program, one-half of DAC U19, comparator U23, and precision resistor RZ1. The analog signal to be measured is connected to pins 1 and 4 of RZ1 which parallels two of the precision resistors and connects them to pin 2 of U23. Also connected to pin 2 is one precision resistor of RZ1 which is connected to the -10.0 volt reference generated by AR4. A second resistor of RZ1 is connected to the Vout_A output of DAC U19. The control program successively sets data bits and tests the output of U23 (CMPI) via FPGA U10. The progression is from most significant to least significant bit. If the comparator changes states, the bit is reset, otherwise it is left set. This successive approximation continues until 13 bits are tested. Control of the local oscillator is accomplished with one-half of DAC U19. The 16-bit digital word representing the desired output (-10 to +10 volts) is simply written to U19 and the output taken from the Vout_Bterminal.

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3-59. Non-volatile data is stored in E2PROM U1. Calibration factors for all internal calibrations along with frequency tuning tables resid within the E2PROM. Data is stored and retrieved via I^2C protocol.

3-60. Universal Asynchronous Receiver/Transmitter (UART) U20 and U14 provide an RS232 interface used primarily by factory authorized personal for troubleshooting purposes. However, this interface may be used to monitor the instrument's activities. Mounting holes for a 3 pin header (0.100 inch spacing) are provided on the board. The pinout is as follows: E2-receive, E3-ground, E4-transmit. The communication parameters for the UART are fixed and are as follows: Baud-38.4k, Parity-none, Duplex-full, Data bits-8, Stop bits-1. If a terminal set to the parameters outlined above is connected to the RS232 port, the user can monitor the status of the instrument configuration and the active measurement in progress. The status is updated and sent over the interface at the completion of parsing and executing incoming VXIbus commands. Then the active measurement is updated and displayed at the completion of each measurement cycle. This provides a good means on how the unit is working if for some reason unexpected results were being encountered using the VXIbus.

3-61. Analog switches U28 and U29 were added to isolate the cross-coupling of signals between the I^2C bus and the local oscillator. The switches are normally closed when the instrument is in the Unlocked state allowing I^2C signals to control the 8-bit expander located on the Local Oscillator board. Once the instrument successfully locks onto an incoming signal, the LOCK LED is turned on. This control signal also controls the analog switches. When active, the switches open removing the digital noise from the local oscillator assembly yielding a quieter LO signal.

3-62. The power supplies required for the 8701 are ±5, ±12 and ±15 VDC. The ±5 and ±12 volt supplies provided by the VXI backplane are used directly with local bypassing at all critical areas. The ±15 volt supplies are generated by regulators connected to the ±24 volt lines on the VXI backplane. Voltage regulators U26 and U27 are enclosed in feedback loops to improve regulation and increase the operating voltages from 5 to 15 volts. Capacitors C27-28, C32, C34, and C100-101 reduce input ripple voltage and D1-4 provide reverse voltage protection. Reference U24 is the primary reference for the power supply circuits. Precision resistors RZ4a, RZ4b and RZ4c configure AR2a for a gain of +1.5. This converts the +10.00 volt reference into +15.00 volts. RZ4d and RZ4e configure AR2b for a gain of -1 which inverts the +15.00 volt supply into -15.00 volts. Zener diodes CR5 and CR6 are required to insure proper start-up of the supply and are normally reversed biased when the supply is operating properly. C30 and C31 provide local bypassing to maintain loop stability as the supply loading changes. The +10.00 volt reference is also inverted via AR4 to furnish the needed reference (-10.00 volts) for DAC U19.

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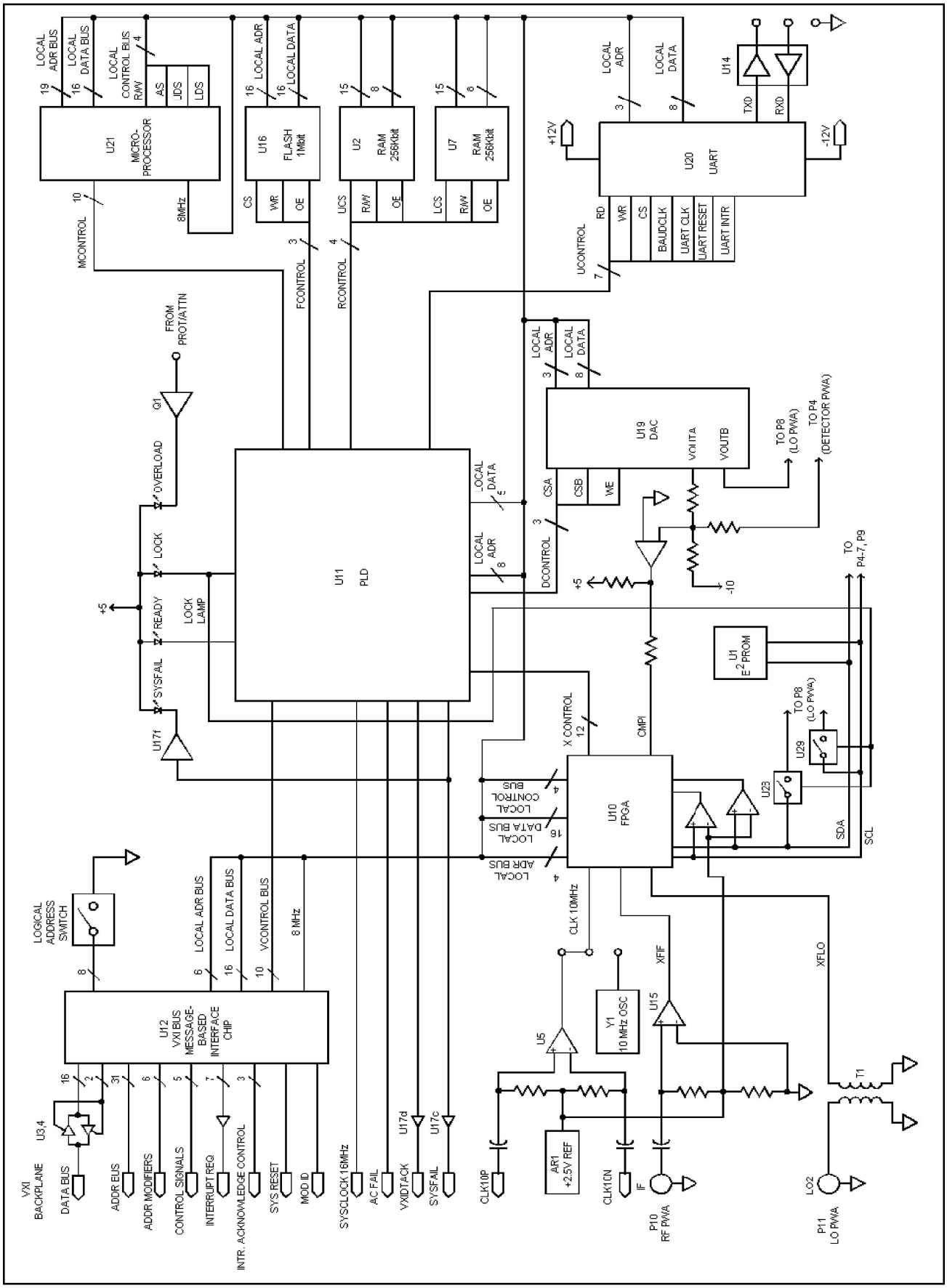


Figure 3-9. VXI Processor Circuits Block Diagram

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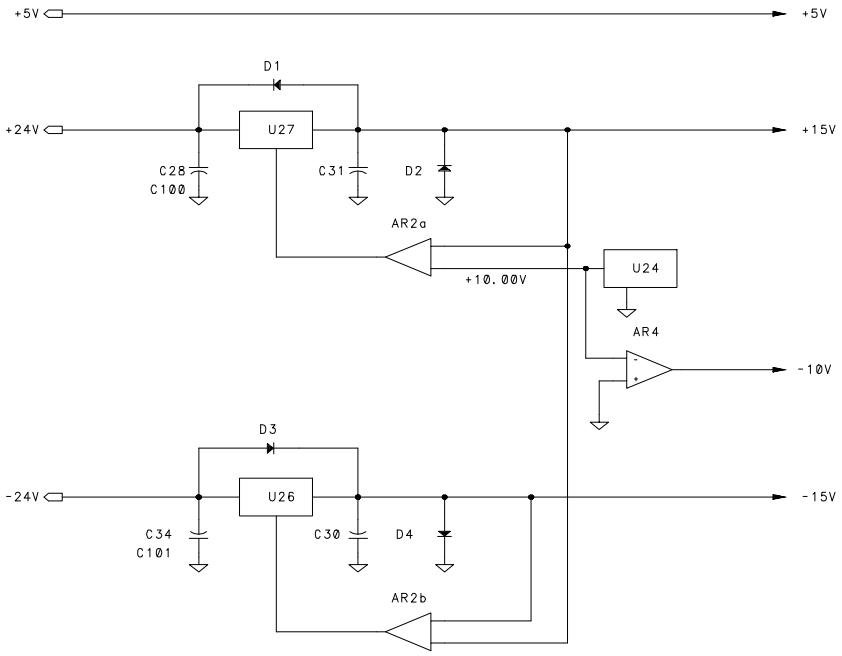


Figure 3-10. Power Supply Block Diagram

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Chapter 4

Operating Instructions

4-1. Introduction

4-2. This chapter contains complete operating instructions for the Model 8701 Modulation Meter. Included are description of the Soft Front Panel controls and indicators and the hardware connections. The executable soft front panel program interactively controls the instrument. Subsequent paragraphs provide detailed procedures for performing the measurements that the instrument is used for. Prior to using the instrument, the user should carefully read the first four chapters of this manual. In the procedures, typical measurement situations are used to help the user develop a sense of the capabilities of the instrument.

4-3. Operating Controls (Fields), Indicators and Connectors

4-4. The Modulation Meter does not have any solid (hardware) controls rather it utilizes a soft front panel which is displayed on a PC monitor. All switch selection and corresponding indicator action is accomplished via "mouse" control. The soft control and indicator, and hardware connectors are shown in Figure 4-1 and listed in Table 4-1. The table provides the location (via index No.) and function of each operating component of the instrument. However, two connection test points (TP) are located on individual printed wiring boards in the shield assembly. During the various operating procedures, other pop-up screens will display soft controls. The function of these controls (field) will be explained in detail during the procedure.

4-5. Initial Connections

4-6. Connections to the Modulation Meter are primarily made from the front panel connectors (Figure 4-2). There are two BNC connectors (IF and AF OUT) and a single N Type connector (RF IN). However, two additional outputs are available at the AM and FM printed wiring board. (Refer to paragraph 2-9.) To access these connections proceed as follows:

a. Remove the 29 screws securing the top cover to the shield assembly.

CAUTION

This equipment contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautionary procedures as described in TO 00-25-234 when touching, removing, or inserting parts or assemblies. When handling static sensitive devices, wear a skin contact wrist strap.

b. At this point a cable connection can be made to the AM-OUT test point (TP3) on the AM PWB.

NOTE

Any connection made, even though temporary, should be soldered in place to prevent accidental shorting or premature disconnection.

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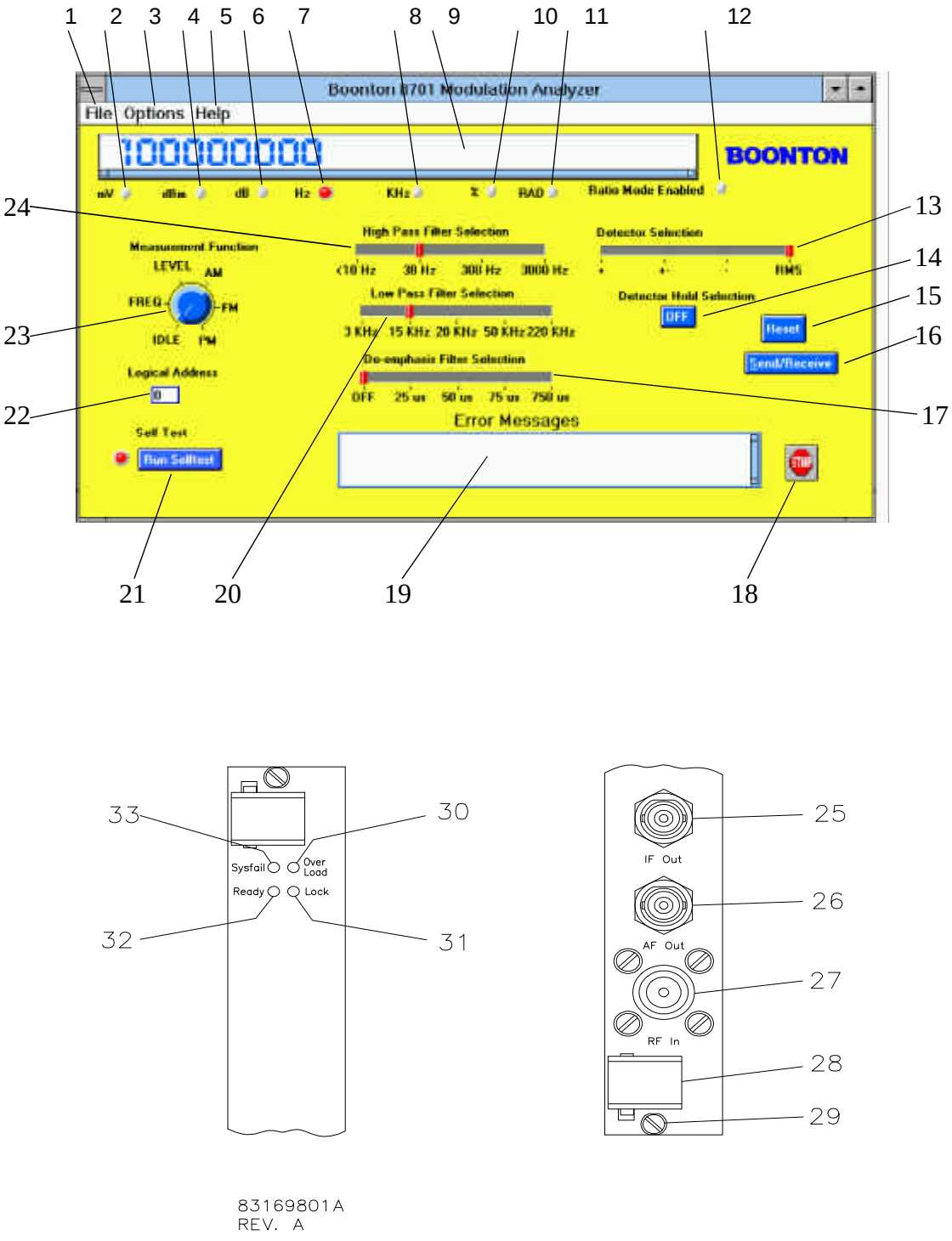


Figure 4-1. Modulation Meter-Control Fields, Connectors and Indicators

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Table 4-1. Control Fields, Indicators and Connectors

Fig. 4-1 Index No.	Screen/Panel Nomenclature	Function
1	File	File does not contain functional selection at the present time.
2	mV	Indicator only. Lights when LEVEL mode is selected.
3	Options	There are no options available at the present time.
4	dBm	Indicator only. Lights when LEVEL mode is selected.
5	Help	An on-screen Help file will be developed in the near future.
6	dB	Indicator only. Lights when "Ratio in dB" is selected on Modulation Panel sub-menu.
7	Hz	Indicator only. Lights when FREQ or FM mode is selected.
8	kHz	Indicator only. Lights when FREQ or FM mode is selected.
9	Measurement Display Field	Displays measurement.
10	%	Indicator only. Light when AM mode or "Ratio in Percent" is selected.
11	RAD	Indicator only. Light when PM mode is selected only.
12	Ratio Mode Enabled	Indicator only. Lights when AM, FM or PM modes are selected.
13	Detector Selection	Selects + or - peak detector, ± peak average or true RMS for display.
14	Detector Hold Selection ON/OFF	Used to hold the greatest peak measurement
15	Reset	Clears Modulation Meter of any errors. Restores instrument to default conditions (Bee PG99RE)
16	Send/Receive	Sends data from computer to Modulation Meter (Receive is non-functioning).

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Table 4-1. Control Fields, Indicators and Connectors (Continued)

Fig. 4-1 Index No.	Screen/Panel Nomenclature	Function
17	De-emphasis Filter Selection	Selects the 25 us, 50 us, 75 us, 750 us de-emphasis filter or de-selects (OFF) de-emphasis filter.
18	STOP	Escape from Modulation Meter program to Windows Main Menu.
19	Error Messages	Error messages from Table 3-8 are displayed in this field. Type in CL in Send/ Receive Sub-menu to clear error.
20	Low-Pass Filter Selection	Selects the 3,15,20,50 or 220 kHz low-pass filter.
21	Self Test	When selected performs a diagnostic check of Modulation Meter hardware/software.
22	Logical Address	Logical addresses of 1 to 256 are available, however 30 is currently used for the Modulation Meter.
23	Measurement Function	Selects the FREQ, LEVEL, AM FM or PM as the active Function. IDLE is a non-functioning position.
24	High-Pass Filter Selection	Selects the <10,30,300 or 3000 Hz High-Pass Filter.
25	IF OUT	Used to connect intermediate signal to external test equipment.
26	AF OUT	Used to connect demodulated signal to external test equipment.
27	RF IN	Connector used to apply an external carrier signal.
28	Front Panel Extractor Handles	Provides leverage to release 8701 from VXI chassis backplane.
29	Front Panel Retaining Screw	Secures Front Panel to VXI bus chassis.
30	OVERLOAD LED	Indicates that the input signal is greater than 30 dBm and protective relays are open.

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Table 4-1. Control Fields, Indicators and Connectors (Continued)

Fig. 4-1 Index No.	Screen/Panel Nomenclature	Function
31	LOCK LED	Indicates that the 8701 has locked onto a signal.
32	READY LED	Indicates Modulation Meter software is "up and running".
33	SYS FAIL LED	Indicates a VXI bus system failure.

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c. Connect the inner signal conductor to the test point (TP) and solder-tack in place. Make a suitable ground connection.

WARNING

To prevent injury to personnel during soldering, do not use acid-core solder or an acid flux. Use care not to burn insulation during soldering. Eye protection must be worn during soldering/unsoldering operations to prevent injury to personnel.

d. Replace the top cover on the shield assembly carefully keeping the cable free.

e. Secure the top cover to the shield assembly with 29 screws.

f. The instrument is now ready for any test within the scope of its capabilities.

4-7. Using the Modulation Meter

4-8. The Modulation Meter uses the computer monitor and mouse to select all functions, initiate and stop tests and for visual display of all results. A soft screen display (outline) of the Modulation Meter designates various fields to function as controls. When a particular mode of operation is selected by clicking on one of the "Measure Function" field modes, pop-up menus for that mode are also displayed in typical windows type screen overlays. Each pop-up menu contains control fields to provide additional operating controls and data input fields. The interaction of the main menu and pop-up menus is extremely important in learning to use the Modulation Meter quickly and effectively. The following paragraphs describe the function of the instrument controls, indicators and connectors. In addition, how to use the instrument to effect measurements is also described.

4-8.1. Mode Selection Control. The "Measurement Function" control (Figure 4-1) is used to select the function to be used and to enable the appropriate indicators. The functions are FREQ, LEVEL, AM, FM and PM. (IDLE is a nonfunctional condition.) Refer to Table 4-1 to determine which indicators function with the individual mode positions. To select a mode proceed as follows:

a. Position the cursor over the desired "Measurement Function" and click.

b. For example, select the FREQ function.

c. Note that the "Frequency Panel" sub-menu is displayed (Figure 4-3) and either the Hz or kHz indicator light comes on.

d. Select the FM function and note that the Hz or kHz indicators stay on. One of those two indicators always lights in the FREQ or FM mode of operation.

e. The other function modes operate in the same manner.

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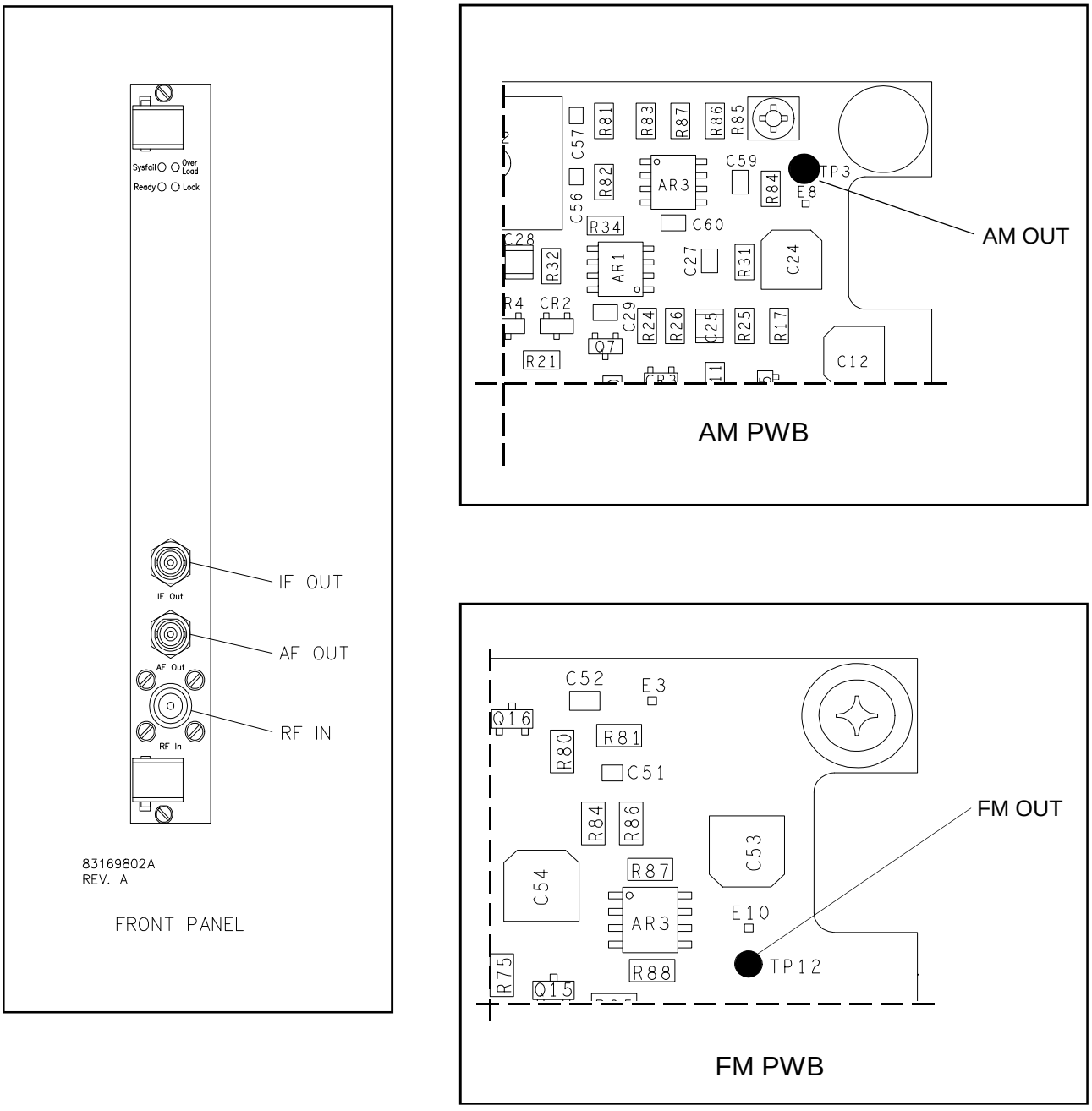


Figure 4-2. Modulation Meter Connection Points

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4-8.2. Data Keyboard. The Modulation Meter utilizes the PC keyboard for all communication between the instrument printed wiring board (PWB) in the VXI system and the computer Operation of the keyboard is conventional. Characters typed on the keyboard will appear in the appropriate fields on the pop-up menus or the "Measurement Display" Field in the Modulation Meter. Proceed as follows:

a. Set the cursor on the FREQ mode and click.

b. The Frequency Panel pop-up menu will display (See Figure 4-2) and either the Hz or kHz indicator will light.

c. The control fields on the Frequency Panel are now accessible to the user.

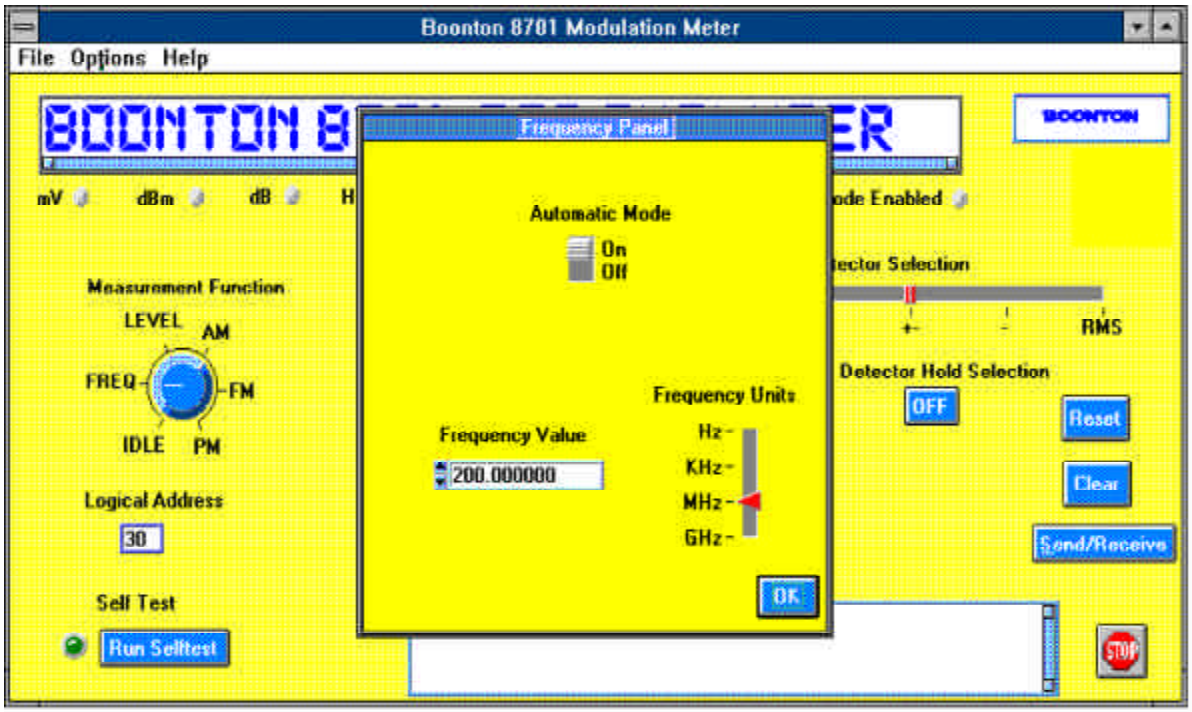


Figure 4-3. Frequency Panel Pop-up Menu

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4-8.3. Measurement Control Fields. The measurement control keys consist of the groups of switches marked FILTERS and DETECTORS (Figure 4-1). These keys may be operated at any time and will affect the MODULATION. The filter switches are arranged as self-cancelling groups. Depressing any High-Pass switch will cause the selected filter to be placed into the measurement channel and cancel any other selected High-Pass Filter. Similarly, depressing any Low-Pass Filter will cause the selected filter to be placed into the measurement channel and cancel any other selected Low-Pass Filter. The maximum Low-Pass bandwidth selection is a function of carrier frequency. The control program will automatically adjust the Low-Pass Filter cutoff frequency as required. The carrier breakpoints and Low-Pass Filters are:

Carrier	Filter
< 500 kHz	**15 kHz max.**
< 10 MHz	**50 kHz max.**
> 10 MHz	**220 kHz max.**

4-8.4. The De-emphasis Filters are normally available when measuring FM only. They are selected in the same manner as the High-Pass and Low-Pass Filters, but are automatically removed from the measurement channel when AM or PM modulation function is selected. The selected De-emphasis Filter will be restored when the FM function is again selected. Additionally, the De-emphasis Filters may be placed before or after the modulation display. This is accomplished by selecting SPCL function 7 for pre-display and SPCL function 8 for post-display De-emphasis. SPCL function 9 permits the De-emphasis Filters to be selected in the AM measurement function. This is useful for performance verification of the filter 3 dB points.

4-8.5. The second group of measurement control keys is the DETECTOR fields. The peak detectors are normally used to measure modulation, however, precision rms detectors are included in the Model 8701. These detectors are used primarily to characterize noise residuals and complex or distorted modulation signals. Two detectors are provided. The normal function of the RMS mode is to select an rms calibrated display; however, SPCL function 18 or the "PR" command can be executed to change the RMS key to select rms detection calibrated in peak for sinusoidal modulation. This is particularly useful when comparing peak and rms indications of noisy signals. The Peak +, -, and ± keys, and the RMS key, are arranged such that only one detector can be selected at a time. The Detector Hold Selection field is used to activate the hold detector mode. It is an alternate action function which can be used with any detector. In operation, as modulation measurements are made, the larger of the current measurement or the previous measurement becomes the displayed modulation. Clicking on the Detector Hold Selection activates this mode, then clicking again cancels it.

4-8.6. Display Messages. The Modulation Meter has two windows for displaying messages. The measurement display field in the top left hand portion of the Soft Panel display provides the user with the measurement in process. (This would be a maximum of 10 digits.) A normal error response is for an error message to appear in the Error Messages field followed by a number indicating the nature of the error. Error codes are tabulated in Table 4-2 along with a description of the error.

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Table 4-2. Instrument Error Codes

Error Number	Meaning
Operation:	
01	Carrier Frequency entry out of range.
02	Carrier Level entry out of range.
03	Reserved.
04	AM modulation entry out of range.
05	FM modulation entry out of range.
06	PM modulation entry out of range.
07	SPCL function entry out of range.
08	PRGM entry out of range.
09	Units do not match active function.
10	Too many characters entered into display.
11	SPCL function requires A9J1 installed.
12	SPCL function not active.
13	Requested Program is empty.
14	Program is recall only.
15	VXIbus, bus address out of range.
16	VXIbus, non-existent mnemonic.
17	VXIbus, data string format error.
18	VXIbus, input text buffer overflow.
Calibration:	
20	AM calibration fault.
21	FM calibration fault.
22	PM calibration fault.
23	RMS detector calibration fault.
24	Average detector calibration fault.
25	Quasi-peak detector calibration fault.
26	Carrier Level calibration fault.
27	< 10 Hz filter calibration fault.
28	220 kHz filter calibration fault.
Hardware:	
30	Oscillator setup error band 1.
31	Oscillator setup error band 2.
32	Oscillator setup error band 3.
33	Oscillator setup error band 4.
34	Frequency Counter self-check error.
35	Memory error, ROM.
36	Memory error, RAM.
37	Memory error, EEPROM.
38	VXIbus interface fault.
39	Instrument interface fault.

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4-8.7. Special Functions. Several of the Modulation Meters operating features are internally programmable by selecting a special function. These functions allow the operator to change measurement configuration, as well as change the hardware state of the instrument. All of the special function messages are listed in Table 4-3. To initiate a special function proceed as follows.

a. Click on the Send/Receive field (Figure 4-1) on the Soft Panel display.

b. Note that the User Interactive Send/Receive Panel pop-up menu (Figure 4-4) is displayed.

c. Position the cursor in the "Send Message" window and Type S, P, space, and 5.

d. Click on the "Send" field and the special function will be sent to the instrument via the VXIbus. In this particular example (SP5) slows the response of the peak detectors for modulation signal frequencies below 200 Hz. The detectors are optimized for signal frequencies greater than 200 Hz for maximum speed. Below 200 Hz additional filtering is required.

4-8.8. Front Panel Connectors. The Model 8701 is normally supplied with three connectors on the front panel, RF IN, IF OUT, and AF OUT. These connectors are most often used.

a. The RF IN connector is the means to apply a test signal to the Model 8701. It is a type N connector which is the preferred connector in this frequency range. The nominal input impedance at the RF IN is 50 ohms (SWR < 1.5). The RF IN is designed to accept inputs of 40 volts dc, or 35 volts ac without damage. A protection circuit automatically disconnects ac inputs exceeding about +30.2 dBm. The carrier level response is shown in Figure 3-8.

b. The AF OUT connector is a type BNC. The signal at this connector is a sample of the recovered modulation. As a result, the amplitude varies with modulation and modulation range settings and the signal is affected by the High-Pass and Low-Pass filters and the De-emphasis networks. The nominal level is 1 volt into 600 ohms at 5000 counts on the modulation display. Source impedance is 600 ohms. Amplitude variations will also occur at the AF OUT connector with carrier level if the AM measurement mode is selected even though the modulation is constant. This happens because the Model 8701 uses a microprocessor controlled discrete AGC system rather than an analog one. The AM indication is not affected since the AM detector level is measured for each displayed AM indication.

c. The connector marked IF OUT is a type BNC connector with a source impedance of 50 ohms which provides a sample of the frequency translated carrier signal. The nominal level is 0 dBm, and the frequency is determined by the carrier frequency as follows:

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Table 4-3. Special Functions

Special Function	Purpose
0	Reset all SPCL functions to defaults. Indicated by ♦
1 ♦	Set Modulation Range to AUTO.
2	Set Modulation Range to 5.000 full-scale.
3	Set Modulation Range to 50.00 full-scale.
4	Set Modulation Range to 500.0 full-scale.
5	Set slow peak detector mode.
6 ♦	Cancel slow peak detector mode.
7	Set de-emphasis to Pre-display.
8 ♦	Set de-emphasis to Post-display.
9	Enable de-emphasis for AM measurements.
10 ♦	Disable de-emphasis for AM measurements.
11	Set dB resolution to 0.001 dB for ratio measurements.
12 ♦	Set dB resolution to 0.01 dB for ratio measurements.
13 ♦	Enable IFHI and IFLO messages for FM measurements.
14	Disable IFHI and IFLO messages for FM measurements.
15 - 17	Reserved
18	Set RMS key to √2RMS.
19 ♦	Reset RMS key to RMS.
20	Set 750 uS de-emphasis gain to 1.
21 ♦	Set 750 uS de-emphasis gain to 10.
22	Activate function hold display mode.
23	Toggle fast acquisition mode.
24	Display IF frequency.
25	Display LO frequency.
26	Display calibrator frequency.
27	Reserved.
28	View firmware code.
29	View instrument serial number.
30	Execute complete detector calibration.
31	Enable 8200 error code reporting.
32 ♦	Enable 8201 error code reporting.
33	
34	
35	Activate AGC test routine.
36	Activate COUNTER test routine.
37	Activate LOCAL OSCILLATOR test routine.
38	Activate DAC test routine.
39	Activate A/D test routine.
40-79	Reserved.
80	Local Oscillator Test - Band 0 F_{OSC}=80 MHz.
81	Local Oscillator Test - Band 0, F_{OSC}=100 MHz.
82	Local Oscillator Test - Band 1, F_{OSC}=80MHz
83	Local Oscillator Test - Band 1, F_{OSC}=100 MHz.
84	Local Oscillator Test - Band 2, F_{OSC}=80 MHz.
85	Local Oscillator Test Band 2, F_{OSC}=100 MHz.
86	Local Oscillator Test Band 3, F_{OSC}=80 MHz.
87	Local Oscillaotr Test - Band 3, F_{OSC}=100MHz.
88	Calibrator Test - activate internal cal signal (based on active modulation mode).
89-99	Reserved.

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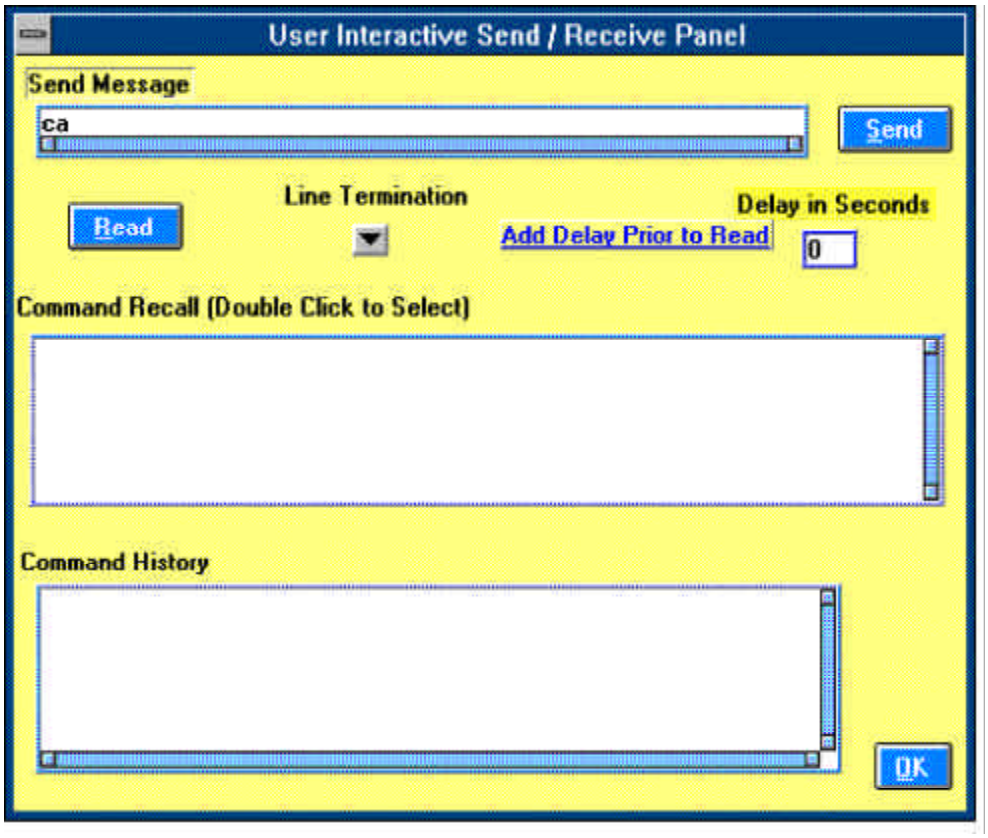


Figure 4-4. User Interactive Send/Receive Panel Pop-up Menu

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Carrier	IF Frequency
< 2 MHz	same as carrier
2 to 10 MHz	346 kHz
> 10 MHz	1.211 MHz

4-8.9. Rear Panel Connectors. The connectors on the rear panel of the Model 8701 are tandem 96 pin VXIbus connections. These connectors provide a means of incorporating the Model 8701 into an automatic test system. Complete instrument operation when connected to the VXIbus is covered in later paragraphs.

4-8.10. RF Housing Assembly Connections (Test Points). Two additional connection points are provided on individual printed wiring boards (PWB's) mounted in the RF Housing assembly. An AM OUT test point is available on the AM detector PWB and an FM OUT test point is available on the FM detector PWB. The following steps describe each of these outputs in detail. (To access these test points the top cover must be removed. Refer to paragraph 4-5).

a. The AM OUT test point is a dc coupled sample of the output of the AM detector PWB. This output is always active and has a small signal bandwidth of 220 kHz, corresponding to the 220 kHz filter setting on the front panel. Additional filtering may be required to use this signal if the carrier frequency is below 10 MHz. The nominal sensitivity is 0.2 volts peak-to-peak for 10% AM. The dc and ac portions of this signal can be used to calculate AM according to the following formula:

%AM = 100% X volts ac peak (Volts dc - offset)

b. The offset in the above equation can be determined by depressing the carrier FREQ and V/MHZ keys and removing the RF IN connection, then noting the dc voltage at the AM OUT connector.
Reconnect the carrier signal and measure the ac and dc components. For example:

offset = +7 millivolts dc
ac volts = 0.35 volts rms
= 0.5 volts peak
dc volts = 1.008 volts
% AM = 100% X 0.5 / (1.008-.007) = 49.95%

c. FM OUT test point is a dc coupled sample of the output of the FM detector PWB. This output is always active and has a small signal bandwidth of about 220 kHz, corresponding to the 220 kHz filter setting on the front panel. Additional filtering may be required to use this signal if the carrier frequency is below 10 MHz. The nominal sensitivity is 2 volts peak-to-peak for 100 kHz deviation. When the IF frequency is 1.211 MHz, the dc voltage will be approximately -1.3 volts, and at 346 kHz +7.6 volts. To determine the sensitivity at this connector, apply an unmodulated carrier at about 1 MHz. Note the dc voltage at the FM OUT connector and then change the frequency to 1.5 MHz. The sensitivity is:

volts dc @ 1.5 MHz - volts dc @ 1.0 mHz/0.5 MHz

For example:

volts dc at 1.5 MHz = -4.4
volts dc at 1.0 MHz = +0.887
sensitivity = [(-4.4) - (0.887)]/0.5
= -10.57 volts/MHz or
= -1.057 volts/100 kHz

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NOTE
The sense of the recovered audio signal is reversed for carriers below 2 MHz. The control program automatically reverses the sense of the peak detectors below 2 MHz.

4-8.11. Measuring and Setting Carrier Frequency. The Model 8701 uses a sampling technique to convert frequency. Using this technique it is necessary only that the sampling frequency (and as a result the local oscillator frequency) vary over one octave to convert frequencies over the operating range of the instrument. In practice, more than one octave is covered, but the details of operation remain the same. For any carrier in the operating range of the instrument and any local oscillator frequency, and intermediate frequency signal will be produced which is between zero and one-half of the sampling rate. This signal is used to tune the local oscillator to the correct frequency. The problem is that the harmonic number of the local oscillator creating the intermediate frequency is not known. The relationship between the three different frequencies is:

Frf = N X Flo-Fif
where Frf is the carrier frequency
Flo is the local oscillator frequency
Fif is the intermediate frequency
and N is the harmonic number

The unknown quantity in the equation is N. This can be determined by varying Flo and noting the change in Fif. The ratio of the change in Fif to the change in Flo is the harmonic number. Refer to the Theory of Operation (Chapter 3) for complete details of the operation of the frequency acquisition circuits. When the Model 8701 acquires a carrier signal, the harmonic number is determined as described. The displayed carrier frequency is then calculated from the above expression and displayed. To measure carrier frequency proceed as follows:

a. Place the cursor on FREQ mode of "Measurement Function" field and click.

b. Note that Frequency Panel pop-up menu (Figure 4-3) appears.

c. If the Automatic Mode ON/OFF field is OFF place the cursor on Auto-OFF field and click. The field should now display the ON condition.

d. At this point other functions can be selected or the frequency setting can be held by selecting one of the "Frequency Units" kHz, MHz or GHz with the mouse.

e. To cause the instrument to reacquire the carrier signal repeat step a and set Automatic Mode field to ON.

f. Repeat steps a and b and the instrument will reacquire the carrier signal.

g. The frequency of operation of the instrument can be established by manual entry using the PC keyboard. This operation does not imply any form of preselection or filtering, merely that automatic acquisition time can be eliminated.

h. Repeat step a.

i. Enter (type) the operating frequency in the "Frequency Value" field.

j. Set the cursor on OFF in the Automatic Mode field and click.

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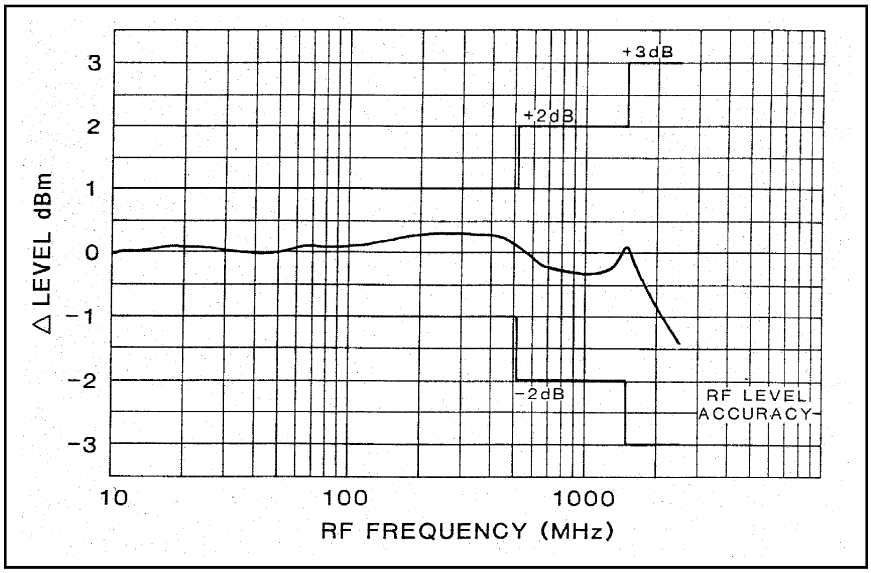


Figure 4-5. Typical Level Response

k. Terminate the numerical frequency entry by selecting one of the "Frequency Unit" parameters.

l. For example to set the Model 8701 to operate at 123.5 MHz, type in [1], [2], [3], [.] and [5] and then click on MHz to complete the entry. The Frequency Value window will display 123.50000 MHz and the Automatic Mode field will indicate AUTO OFF.

NOTE
Frequency can be entered using any consistent sets of units as previously described and trailing zeroes are not required.

m. To abort any entry place cursor on Frequency Panel OK and click, then click on "Reset" field on main menu.

4-8.12. Measuring and Setting Carrier Level. The Model 8701 measures carrier level by monitoring the DC output of the AM detector. By knowing the setting of the internal attenuators, this level can be referred to the input connector. Absolute adjustments are made in the displayed value to account for the frequency response of the sampling frequency converter. As a result, it is always necessary for the control program to know the carrier frequency to display the carrier level correctly. The typical frequency corrected response is shown in Figure 4-5. To measure carrier level proceed as follows:

a. To measure carrier level, first set carrier frequency as described in paragraph 4-8.11, steps a through d.

b. Place the cursor on LEVEL mode of "Measurement Function" field and click.

c. Note that "Carrier Level Panel" pop-up menu (Figure 4-6) appears.

d. If the "Automatic Mode" field is not indicating Auto-ON set cursor to ON and click to resume measurement.

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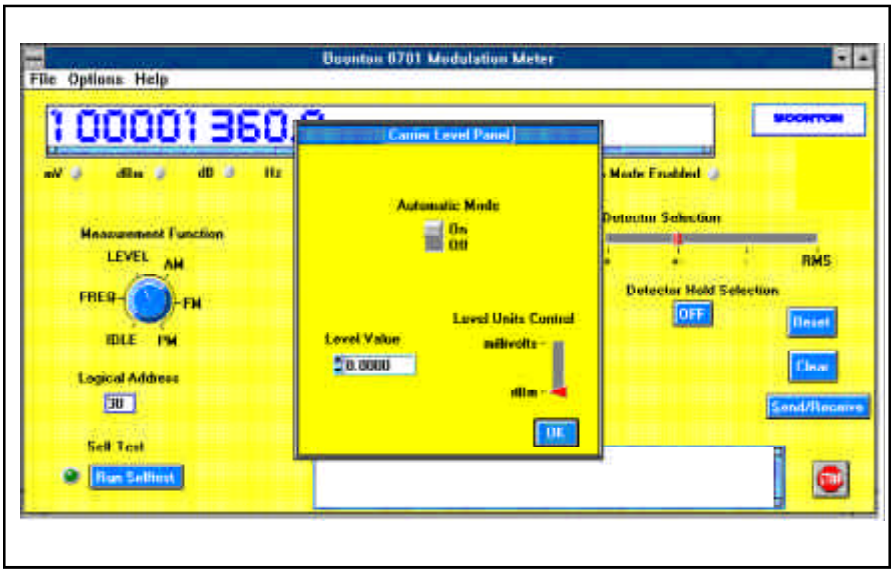


Figure 4-6. Carrier Level Pop-Up Menu

e. The Measurement Display field on the main menu is now indicating carrier level. The units may be in dBm or millivolts.

f. To change the display unit, set the cursor on the "Level Units Control" field arrow and move to desired unit.

g. Click on Auto-ON to resume measurement.

h. The carrier LEVEL measurement can be calibrated with the carrier LEVEL function active using the mnemonic special control code CA (Table 4-3). Proceed as follows:

1. Connect the RF IN connector on the front panel (Figure 4-1) to a signal with a known level such as an optional 50 MHz power calibrator.

2. Click on "Measurement Function" LEVEL mode to bring up the "Carrier Level Panel" window.

3. Using the keyboard enter the level into the "Level Value" field.

4. Click the "Automatic Mode" OFF.

5. Click on OK to return to the main Window. This value should now be displayed.

6. Click on the "Send/Receive" field to bring up the "User Interactive Send/ Receive Panel".

7. Type the mnemonic CA in the "Send Message" field, then click on "Send" field. The calibration routine will take approximately 3 seconds to complete.

8. The resulting measurement will be the entered value, or an error will be displayed (Error Message Window) if the input signal is not within 2 dB of the entered value.

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i. The carrier LEVEL can be set manually in order to eliminate acquisition time. Proceed as follows:

1. Click on "Measurement Function" LEVEL mode. The "Carrier Level Panel" window should appear.

2. Click the "Automatic Mode" OFF.

3. For example, to enter -16.5 dBm use the PC keyboard to type [-], [1], [6], [.] and [5].

4. Using the mouse move the "Level Units Control" arrow to dBm. The main window "Measurement Display" field will display -16.5 dBm.

5. To convert the input level in dBm to an equivalent voltage across the 50 ohm input impedance of the sensor, change the "Level Units Control" on the"Carrier Level Panel" to millivolts.

6. In this example the power level of -16.5 dBm will be converted to 33.45 mV. An input level may be entered in voltage units initially and displayed as a voltage level or a power ratio in dBm.

4-8.13. Selecting Modulation Mode. The Modulation Meter can detect and display amplitude (AM), frequency (FM), or phase modulation (PM). After the modulation mode is selected, instrument operation is very similar for all three types. The following paragraphs describe all three types of modulation.

4-8.13.1. AM Measurement Mode.

a. To select the AM measurement mode, first select the carrier frequency and level as described in paragraphs 4-8.11 and 4-8.12.

b. Set the cursor on the "Measurement Function" AM mode and click. Note that the AM "Modulation Panel" pop-up window (Figure 4-7) appears.

c. The "Measurement Display" field in the Main Window will show the recovered AM modulation in %.

d. The IFHI and IFL status bits are active in the AM mode, therefore the carrier is not adequate to make a calibrated measurement.

4-8.13.2. FM Measurement Mode.

a. To select the FM measurement mode, first select the carrier frequency and level as described in paragraphs 4-6.8 and 4-6.9.

b. Set the cursor on the "Measurement Function" FM mode and click. Note that the FM Modulation Panel pop-up window (Figure 4-8) appears.

c. The "Measurement Display" field in the main window will show the recovered FM in kHz.

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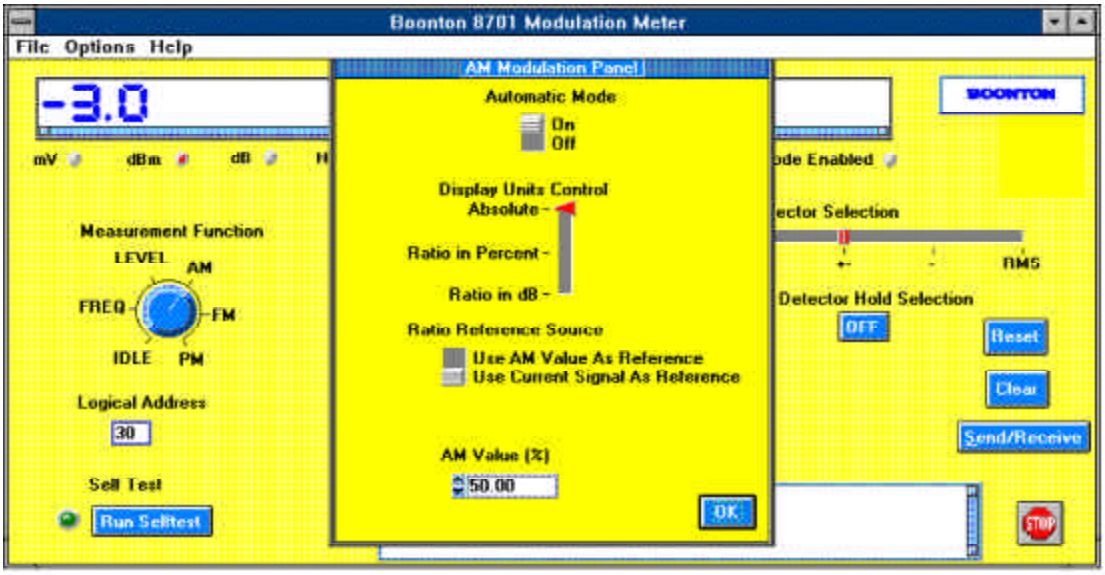


Figure 4-7. AM Modulation Panel Pop-up Window

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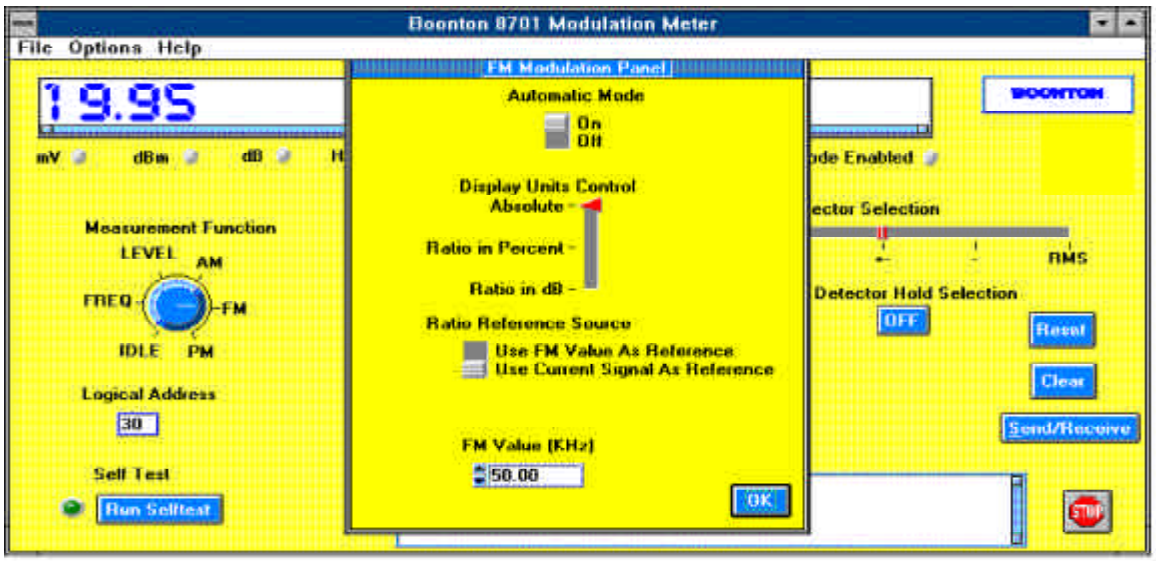


Figure 4-8. FM Modulation Panel Pop-up Window

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d. The de-emphasis filters may be selected in the FM measurement mode. In addition they may be placed before or after the modulation display. (Refer to paragraph 4-6.2.1.)

e. The de-emphasis filters are mutually exclusive, that is selecting one value will cancel the other. Using the mouse select the desired "De-emphasis Filter Selection" value.

f. The AF OUT signal and optionally the modulation being displayed will now indicate modulation with the de-emphasis filter ON.

g. To cancel the filter selection move the cursor to the "De-emphasis Filter Selection" OFF and click.

4-8.13.3. PM Measurement Mode. The PM modulation mode is a special case of the FM mode. The modulation information is determined by integrating the output of the FM detector. This is mathematically consistent with the definition of frequency as the time rate of change of phase. The integration is only accurate over a selected range of frequencies so that accuracy specifications are relaxed and modulation bandwidth is decreased. Autoranging operation is also different in the PM measurement mode. The modulation range is determined by monitoring the recover FM signal. This causes the displayed resolution to change based on phase deviation and modulation rate rather than just displayed deviation. For example, below 1 kHz modulation rate the autoranging points are 1040 and 99 counts. The displayed resolution continues to decrease with increasing modulation rate. Proceed as follows:

a. To select the PM measurement mode, first select the carrier frequency and level as described in paragraphs 4-6.8 and 4-6.9.

b. Set the cursor on the "Measurement Function" PM mode and click. Note that the Modulation Panel pop-up window (Figure 4-9) appears.

c. The Measurement Display field in the Main Window will show the recovered PM in radians.

4-8.14. Measurement and Display Controls - Ratio Measurements. The "Display Units Control" field on the Modulation Panel Window is used to change displayed values from absolute to relative (see Figure 4-8). Ratio can be displayed with respect to a previous measurement or a set value. The "Ratio in Percent" and "Ratio in dB" toggle the relative display between linear (%) units and logarithmic (dB). If the "Display Units Control" is used when the "Automatic Mode" field is on the current displayed reading becomes the reference for subsequent relative measurements. For example, if the current measurement is 25.00 kHz deviation and the "Ratio in Percent" mode is selected, the display will change to 100.00 and the kHz and the % unit fields on the main window will be ON, If the Ratio in dB of the "Display Units Control" field is selected the "Measurement Display Field on the main window will change to 0.00 and the "kHz" and "dB" unit fields on the main window will light.

NOTE
If the active function is AM and the "Ratio in Percent" mode is selected only the % unit field on the main window will light.

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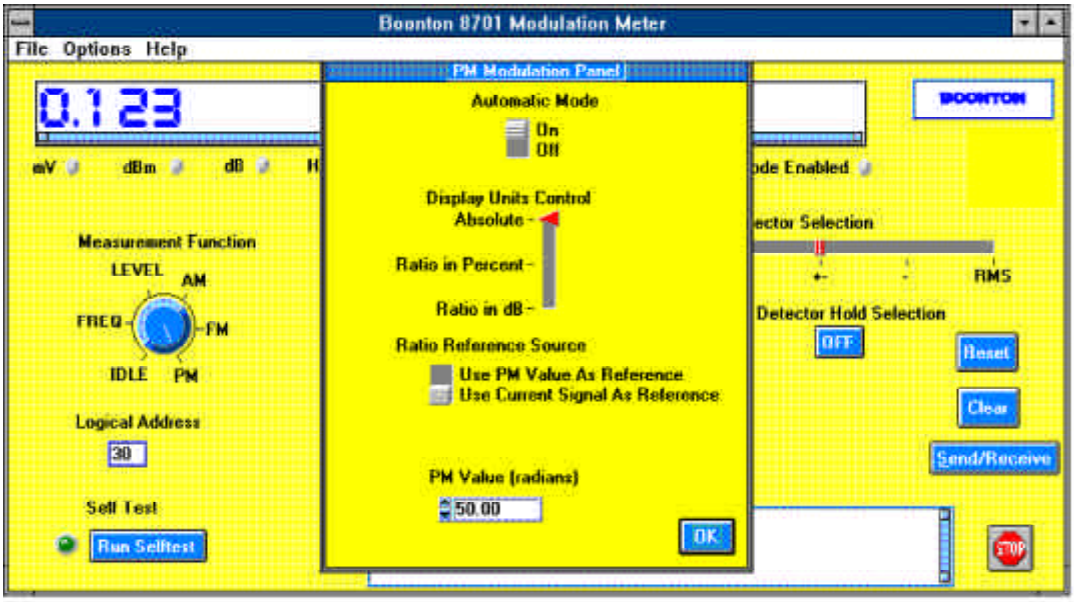


Figure 4-9. PM Modulation Panel Pop-up Window

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4-8.14.1. In our example if the deviation now changes to 20.00 kHz, the Measurement Display field on the main window will change to 80% or -1.9 dB depending on the "Display Unit Control" field selection of "Ratio in Percent" or dB. Modulation readings can also be displayed relative to a set value of modulation by setting the "Ratio Reference Source" field on the Modulation Panel to "Use AM Value As Reference" position. The value of the reference modulation is entered into the "AM Value (%) field using the PC keyboard before the Ratio mode is activated (Automatic Mode - ON). The "Automatic Mode" field will go OFF when data entry is completed. For example, to establish a reference modulation of 40.00% AM depth proceed as follows:

a. Place the cursor on the AM mode of "Measurement Function" field and click.

b. Cancel the Ratio display if it is active by setting "Display Units Control" field to Absolute position.

c. Enter 40.00% into the AM Value (%) field using the PC keyboard.

d. Set the "Display Units Control" to Ratio in Percent position to measure AM with respect to 40 %.

e. Set the "Display Units Control" to Ratio in dB to change the displayed units to dB.

f. Suppose that the actual modulation was 47.5%. In the example the main window "Measurement Display" field would indicate either 118.7% or 1.5 dB.

4-8.14.2. The "Displayed Units Control" on the Modulation Panel is a convenient way to alter the displayed units. For example, incidental AM is often expressed as a ratio in dB of indicated AM with respect to 100%. To display incidental AM enter 100% in the AM Value (%) field on the modulation panel as the reference modulation. Then set the "Display Units Control" field to Ratio in dB. Residual AM and FM and incidental FM may similarly be displayed with respect to a reference modulation. The carrier frequency can be displayed as delta or % frequency. Many other displays are possible using the Modulation Panel Ratio fields. Phase modulation may be displayed in degrees by entering 1.745 Radian as a reference and using the "Ratio in Percent" measurement mode.

4-8.15. Peak And RMS Detectors. When making modulation measurements, the desired result is normally the peak deviation or the peak or the trough of amplitude modulation. The Peak +,-, and ± Detector Selection mode field provide this display. The + Peak detector mode indicates the positive peak excursion FM or PM deviation (increasing frequency or phase), and the peak of AM modulation. The - Peak detector mode indicates the negative peak excursion of FM or PM deviation (decreasing frequency or phase), and the trough of AM modulation. The ± mode indicates the arithmetic mean of the + and - peak modes. The display in the Peak ± mode is calculated by the display program from independent measurements of the + and - peaks. For most measurement there will be a difference in the positive and negative peaks. This is usually due to even order distortion of the recovered modulation signal. For FM modulation, the distortion would also be apparent in the carrier frequency display if the magnitude of the distortion is large enough. This asymmetry is also called carrier shift. For AM a similar effect occurs, shifting the average carrier amplitude. In any case some difference in peak readings is normal since the maximum on-scale resolution of the modulation display can be 1 part in 5000, or 0.02%.

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4-8.16. Several measurement situations arise when peak indication is not very useful. The most often encountered of these is the measurement of noise residuals. Because the Model 8701 detectors and local oscillators have very low noise residuals, the instrument can be used to characterize noisy sources. Under these conditions, the rms detectors should be used to give meaningful results. Two rms detectors are provided, RMS and √RMS. The detectors differ only mathematically. Selecting SPCL function 18 or "PR" command causes the RMS key to be redefined as √2RMS. This causes the control program to scale the actual rms detector output by the square root of 2, the crest factor for a sinewave; thus, the display is calibrated in peak for sinewave modulation signals. This is very useful for quantifying noise residuals on moderately noisy carriers.

4-8.17. Root-mean-square (rms) voltage is obtained by summing the squares of the individual components of a waveform and then taking the square root of the result. Thermocouples, thermistors, and calorimeters are examples of rms detectors. The detector in the Model 8701 is a computing type of rms detector , that is, it takes the absolute value of the voltage , squares it, averages it, and finally takes the square root of the result. When the measurement situation calls for display of residual modulation, the rms detector should be used. The noise of the carrier under test is combined with the residual noise of the Model 8701 circuits in very predictable manner. This allows the Model 8701 residuals to be easily discounted. For example, if the indicated residual FM is 25 Hz rms with a carrier at 1000 MHz and -10 dBm and with the 15 kHz Low-Pass Filter Selection, the residual noise of the carrier alone is simply the square root of the difference of the square of 25 and 7.5 or 23.8 Hz rms. Residual AM and PM are handled in a similar manner. The residual responses of the instrument are shown in Figures 4-10 through 4-13.

4-8.18. Detector Hold. The detector HOLD Selection field on the main window is useful in measurement situations where the long term modulation peak is desired. The HOLD selection can be used with any of the detectors to display the larger of the previous or current measurement. To use the HOLD selection function, move the cursor over the Detector Hold Selection OFF field and click. The field will now indicate ON. The modulation display will change only if the measurement is greater than the one displayed. Depress the HOLD key again to cancel this measurement control mode.

4-8.19. Filters. The Modulation Meter includes an array of Low-Pass, High-Pass, and De-emphasis Filter Selections. (See Figure 4-1.) These filters can be used to your advantage to minimize measurement errors due to noise, or to remove unwanted components of complex modulation signals. The high-pass filters are all three-pole Butterworth design except the <10 Hz filter. The <10 Hz filter is a Gaussian response controlled by the coupling capacitors on the Filter circuit board. The three dB corner is much less than 10 Hz. This filter is also specified to have less than 10% droop with 5 Hz square wave modulation. The response of the High-Pass Filters is shown in Figure 4-14. The "Low-Pass Filter Selections" are a combination of active and passive designs. The 3 and 15 kHz Low-Pass Filters are three-pole Butterworth designs, the 20 kHz Low-Pass Filter is a three-pole Bessel design, and the 50 and 220 kHz filters are seven-pole Butterworth designs. Low-Pass Filter response is shown in Figures 4-15, 4-16 and 4-18.

4-8.20. Filter selection is critical in maintaining accuracy of displayed modulation and distortion. All carriers applied to the RF IN connector of the instrument will contain noise modulation sidebands. The magnitude of the noise can be determined by using rms detection as outlined above. Selection of the lowest Low-Pass Filter

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possible based on the modulation frequency, will usually produce the most accurate indication. For example, if the modulation frequency is 1 kHz, the 3 kHz Low-Pass Filter Selection should be used.

4-8.21. If the modulation signal is a squarewave or pulse, the 20 kHz Low-Pass Filter Selection should be used. This filter is a Bessel design which has controlled phase characteristics and modest overshoot. Filter selection is very important when measuring distortion. A reasonable distortion measurement should include at least the first three harmonics. For example, if a measurement of distortion is made at 2.5 kHz, the 15 kHz low-pass should be used. High-pass selection will also affect distortion measurements. For example, when measuring distortion at 1 kHz with the 300 Hz high-pass selected, the phase relationship of the fundamental signal, 1 kHz, is changed with respect to the harmonics and a smaller or larger indicated distortion may result. The de-emphasis filter was previously described. The response of the de-emphasis filters is shown in Figure 4-18.

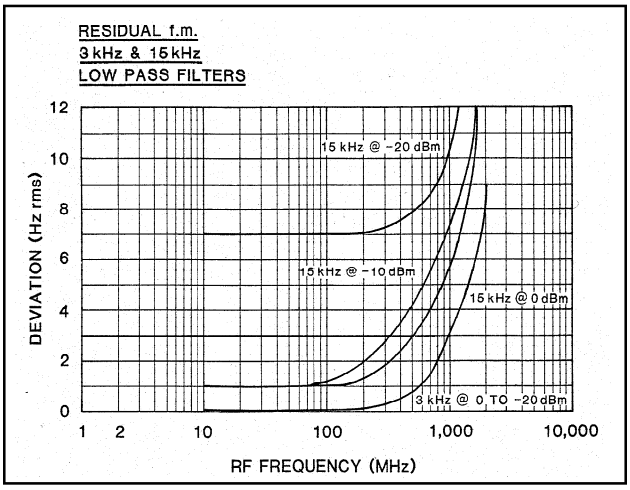


Figure 4-10. Residual FM and 15 kHz Filters

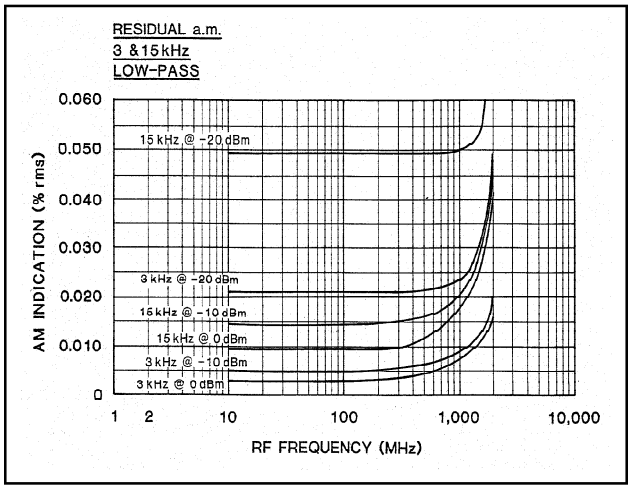


Figure 4-11. Residual AM, 3 and 15 kHz Filters

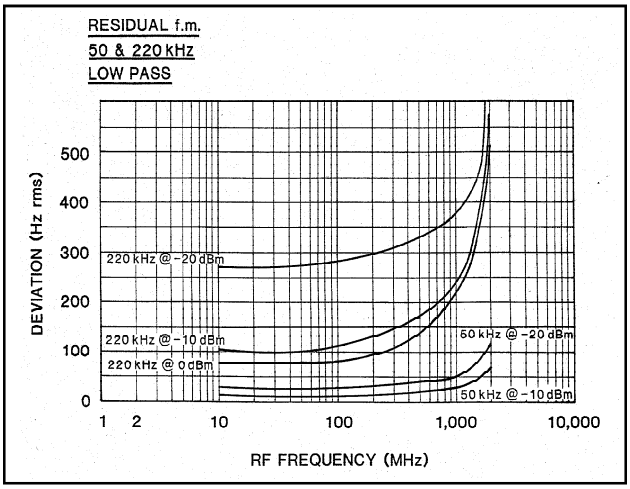


Figure 4-12. Residual FM, 50 and 220 kHz Filters

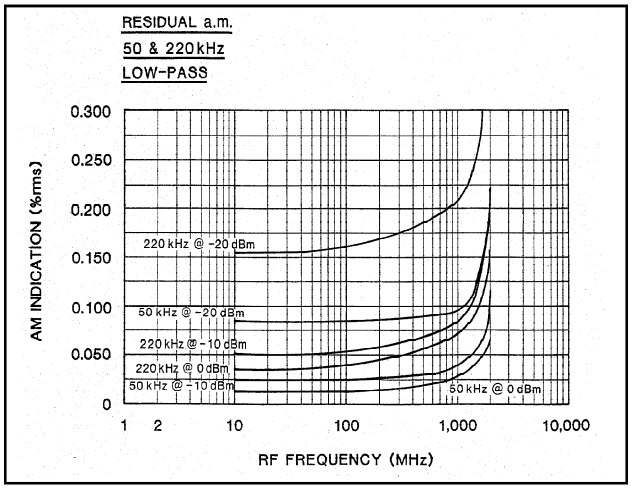


Figure 4-13. Residual AM, 50 and 220 kHz Filters

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4-8.22. <u>Program Store And Recall.</u> The Modulation Meter contains an internal program memory which will store a maximum of 99 Soft Front Panel setups. These programs represent the state the instrument when the program control for store (ST) or recall (RE) is activated. The internal memory of the instrument is volatile, that is when power is removed, the contents of the internal memory are lost. In normal operation, the internal memory is never erased. New programs or changes are simply written over the old ones. To store or recall a program proceed as follows:

a. Place the cursor on the "Send/Receive" field of the main window and click.

b. Note that the "User Interactive Send/Receive Panel" appears.

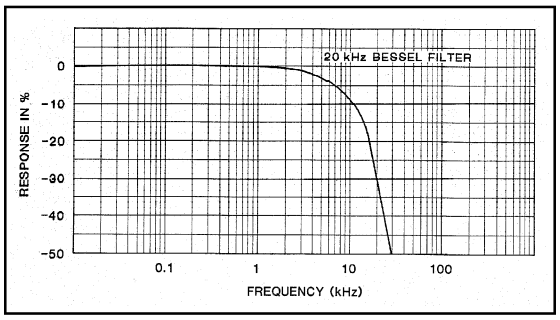


Figure 4-14. Response, 20 kHz Bessel Filter

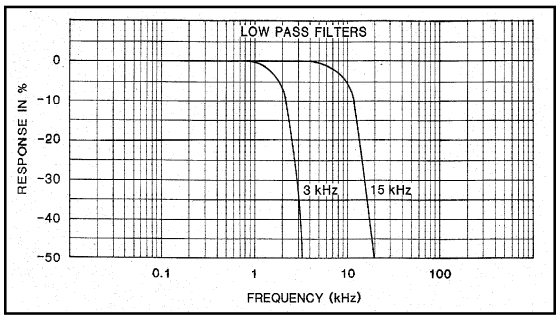


Figure 4-15. Response, 3 and 15 kHz Filters

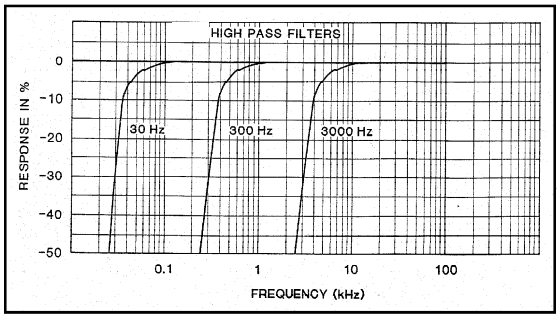


Figure 4-16. Response, High-Pass Filters

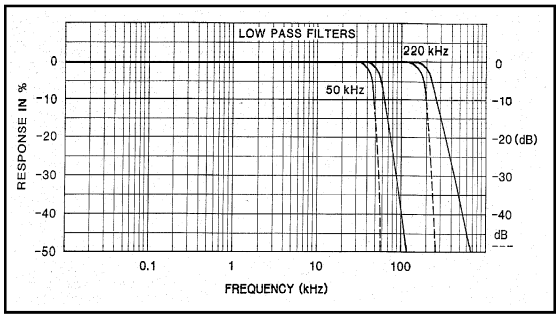


Figure 4-17. Response, 50 and 220 kHz

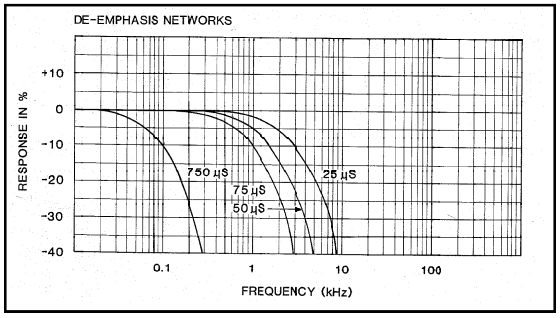


Figure 4-18. Response, De-emphasis Filters

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c. Using the keyboard, enter PG (program), a number from 1 to 98 and ST (store front panel setup) in the "Send Message" field. The actual string should look like this :

PG7ST

d. Click on the "Send" field and the command is sent from the computer to the instrument memory.

e. To recall a program enter PG7RE in the "Send Message" field and click on "Send". After recalling a program any panel setting may be changed by writing over it.

NOTE
If an attempt is made to store a program at locating 99, an error code is generated in the "Error Messages" field of the main window.

4-8.23. Triggered Operation. The instrument measurement loop operates in one of two modes, the immediate (IM command) or the wait-for-trigger (WT command) mode. The immediate mode is the default condition and results in the immediate response to read requests. The wait-for-trigger mode causes data acquisition to be deferred until a trigger (TR command) is received. This aides in the synchronizing the instrument to other system components. The wait-for-trigger mode is set when the WT command is encountered in the input string. From that point on, execution is delayed. No change will occur until one of the following events is encountered:

- the command "TR" (trigger) is interpreted.
- the "Measurement Function" has changed.
- the command IM (immediate mode) is interpreted.

To test the wait-for-trigger mode using the RF Level for example, select the LEVEL in the "Measurement Function". Once selected proceed as follows:

a. Set the cursor on the "Send/Receive" field (Figure 4-4) of the Soft front Panel and click.

b. Enter the command "WT" into the "end Message" field.

c. Click on the "Send" button to send the strong to the 8701.

d. Change the incoming RF level. Note the level display remains at the previous value.

e. Enter the command "TR" into the "end Message" field and click on the "Send" button to send the string to the 8701.

The RF Level subsystem measure and displayed the new value.

4-8.24. Talk Operation. When the talker state is set by the VXIbus controller, the instrument sends a character string which is determined by the current talk mode. One of five different talk modes is selected by sending the appropriate mnemonic with the Modulation Meter addressed as a listener. The selected mode will remain in effect until changed. To select one of the talk modes proceed as follows:

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a. Set the cursor on the "Send/Receive" field (Figure 4-4) of the Soft Front Panel and click.

b. Note that the "User Interactive Send/Receive Panel" pop-up menu appears.

c. Use the keyboard to type the appropriate mnemonic (TS, TF, TV, TP or ID) in the "Send Message" field.

d. Click on the "Send" field to relay the characters to the Modulation Meter in the VXI bus system.

e. Double click on the "Command Recall" field to receive the characters sent in step d.

f. The "Delay in Seconds" field will display the elapsed time between send and receive.

4-8.24.1. Talk Status (TS) Mode. If an error is pending, the error code will be returned, otherwise a zero is returned. The TS mode will automatically clear any error after the status is reported. Talk Status (TS) is the default talk mode after initialization of the instrument.

4-8.24.2. Talk Function (TF) Mode. The TF mode returns a four character string, in HEX notation, representing the state of the hardware and display functions. The bit assignments are arranged to allow for string or byte oriented decoding. The bit assignments and meanings are presented in Table 4-4.

4-8.24.3. Talk Value (TV) Mode. In the TV mode the argument of the active function is returned. All values returned are in basic units such as: Hz, dB, dBm, % etc. FM deviation is returned in kHz, and carrier level in millivolts.

Table 4-4. Hardware Status, Bit Assignments

Function/Status	Binary Word	ASCII string
Manual Tuning Set	0	0 C A 4
Manual Level Set	0	
Manual Range Set	0	
Alternate Filter Set	0	
Unlocked	1	
Unleveled	1	
Manual audio tuning	0	
Audio Display overrange	0	
Active Displays		
Distortion	1	
Sinad	0	
Carrier Level	1	
Carrier Frequency	0	
PM	0	
FM	1	
AM	0	
Audio Frequency	0	

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Table 4-5. VXI Bus Mnemonics

BUS MNEMONIC	RESPONSE
Function Control:	
FR	Carrier frequency, argument range: 100 kHz to 2.5 GHz. (default unit = Hz)
RL	Carrier level, argument range: -47 to +30 dBm. (1 mV to 7V)
AM	AM modulation, argument range: 0 to 100%.
FM	FM modulation, argument range: 0 to 500 kHz.
PM	PM modulation, argument range: 0 to 500 RAD.
SP	Special Function, argument range 0 to 99.
PG	Program number, argument range 0 to 99.
Number Termination:	
DB	dB for ratio, or dBm for level.
GH	Gigahertz for frequency entry.
MH	Megahertz for frequency entry.
KH	Kilohertz for frequency entry.
HZ	Hertz for frequency entry.
VO	Volts for level entry.
MV	Millivolts for level entry.
RA	Radians for phase modulation entry.
Display Control:	
AU	Activates the automatic measurement mode, for the active function. (Not active in SPCL or PRGM.)
RP	Activate relative measurements of the active modulation function in percent.
RD	Activate relative measurements of the active modulation function in dB.
RX	Turn OFF ratio mode.
WT	Enable the wait-for-trigger talk mode.
IM	Enable the immediate trigger talk mode.
TR	Trigger a measurement, same as GET.
Filter Selections:	
D1	De-emphasis, 25 us.
D2	De-emphasis, 50 us.
D3	De-emphasis, 75 us.
D4	De-emphasis, 750 us.
D5	De-emphasis, OFF.
H1	High-pass, < 10 Hz.
H2	High-pass, 30 Hz.
H3	High-pass, 300 Hz.
H4	High-pass, 3000 Hz.

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Table 4-5. VXI Bus Mnemonics (Continued)

BUS MNEMONIC	RESPONSE
Filter Selections (con.):	
L1	Low-pass, 3 kHz.
L2	Low-pass, 15 kHz.
L3	Low-pass, 50 kHz.
L4	Low-pass, 50 kHz.
L5	Low-pass, 220 kHz.
Detector Selection:	
P1	Peak +.
P2	Peak ±.
P3	Peak -.
RM	RMS detector.
PR	√2RMS detector.
PH	Peak Hold ON.
PX	Peak Hold OFF.
Program Control:	
ST	Store front panel setup.
RE	Recall front panel setup.
Test Function:	
CH	Execute self-check program.
Cancel Errors:	
CL	Clear all errors.
Talk modes:	
TV	Talk value, sends the value of the active function.
TL	Talk program, send a string representing the contents of the stored program followed by an ASCII$.
TS	Talk status, sends the current error number.
TP	Sends a string which identifies the 8701 firmware.
TF	Talk function, sends a string representing the current hard ware status.
ID	Sends a string which identifies the 8701.
Special Control codes:	
R0 or SP1	Set modulation range to auto. (Same as SP1).
R1 or SP2	Set modulation range 1,0.000 to 5.000. (Same as SP2)
R2 or SP3	Set modulation range 2,5.00 to 50.00. (Same as SP3)
R3 or SP4	Set modulation range 3,50.0 to 500.0. (Same as SP4)
PD or SP7	Force de-emphasis mode to pre-display.
AD or SP8	Force de-emphasis mode to post-display.
CA	Calibrate the active function.
SQ	Set SRQ mask, argument range 0 to 7. See text.
EI	Enable SRQ interrupts.
DI	Disable SRQ interrupts.

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4-8.24.4. Talk Program (TP) Mode. In the TP mode a six digit number is returned that uniquely identifies the instrument firmware.

4-8.24.5. Identify (ID) Mode. In the ID mode a string containing the instrument identification and serial number is returned. A typical response is:

"Boonton Model 8701, SN: 999, October 23, 2001"

which includes the model number, the serial number, and the firmware date.

NOTE
Talk modes can be concatenated. That is, the 8701's response to the command string "FM TS TF TV" would yield "0, 0CAU, 51.52". (The error code, the hardware status word and finally the FM value.)

4-8.25. SRQ Operation. (This paragraph intentionally blank.)

4-8.26. Program Function Mnemonics. Each front panel key is assigned a program mnemonic. Programming the mnemonic, followed by unit values, if appropriate, is analogous to manual the Soft Font Panel operation. In addition, other program mnemonics are used for functions that are applicable only in remote operation. Table 4-5 lists the program function mnemonics.

4-8.27. Number Formatting. Number formatting rules are as follows:
Fixed or floating formats are accepted.
The optional +or - sign may precede the mantissa or the exponent.
The optional radix point may appear at any position within the mantissa. A radix point in the exponent is ignored.
The optional "E" for exponent is keyboard selected and may be upper or lower case.
All ASCII characters having hexadecimal values of 0 to 23, and 25 to 2B are ignored.

4-8.28. Data String Format. Data string formats are as follows:
The programming sequence is in natural order, that is, a function mnemonic is sent first followed by the argument, if appropriate.
All ASCII characters having hexadecimal values of 0 to 23, and 25 to 2B are ignored. The ASCII ($), hexadecimal 24 is reserved. Lower case letters are automatically converted to upper case.
A primary function mnemonic sent without a following argument will make the specified function active.
The data string may not exceed 128 characters and may be terminated with CR or LF. Interpretation of the data string does not begin until the end-of-string character is received.
If units are unspecified for any argument, default units are automatically appended.

4-8.29. Data String Errors. Errors are detected during interpretation. The occurrence of an error will display the error code (Table 4-2) if the display is enabled. The error can be cleared by a clear error instruction (CL). All errors cause existing valid parameters to be restored. No new input can be processed until a pending error is cleared.

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4-8.30. Data String Examples. The following are examples of typical programming strings in HP BASIC:

OUTPUT 715; "SP 25"	set SPCL function to 25 and execute it.
OUTPUT 715; "H2L2"	set high-pass to 30 Hz, and low-pass to 15 kHz.
OUTPUT 715; "RD"	select ratio, dB display for the active function.
OUTPUT 715; "FMTV"	set measurement to FM, and talk mode to talk value.
OUTPUT 715; "AM CA"	set measurement to AM, and calibrate AM detector.

4-9. Shutdown Procedure

4-10. During a normal shutdown procedure the user first must determine if the current data is to be stored or discarded. Once the data has been taken care of, proceed as follows:

a. Close any open pull-down menus by clicking on OK.

b. Close the main window by clicking on the - stop icon on the soft front panel. The monitor should now display the main windows icon menu.

c. Disconnect and store all cables that are not part of a permanent test setup.

4-11. Emergency Shutdown Procedure

4-12. The emergency shut down procedure for the Modulation Meter is the same as shutdown in the previous paragraph. However, the emergency shutdown should be a one-toggle hit to de-energize the test setup. However, if this is not practical in an operator specified emergency shutdown power to the VXIbus by pushing in on the lower panel mounted power switch. The adjacent lamp indicator should go off. A specified system emergency shutdown sequence would have precedence over this procedure.

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Chapter 5

Maintenance

5-1. Introduction

5-2. This chapter contains the information to perform preventive and corrective maintenance on the Modulation Meter. Included in this section is an explanation of the maintenance concept. Maintenance is divided into two distinct categories, preventive maintenance and corrective maintenance. Preventive maintenance is performed on a scheduled basis according to elapsed time periods. Corrective maintenance repairs are faults that occur during instrument operation or testing. When a fault is discovered either by observation or displayed error messages, the troubleshooting procedures in this section are used to isolate the fault to a replaceable assembly or component. The steps required to replace and test the assembly or component are provided in the disassembly, assembly, adjustment, and testing procedures.

5-3. Preventive Maintenance

5-4. This section describes the preventive maintenance procedures required for the instrument. Preventive maintenance includes cleaning, inspection, and performance verification tests (PVT's). Refer to Table 5-1 for the schedule of performing the preventive maintenance routines.

Table 5-1. Schedule of Preventive Maintenance Routines

Routine	Monthly	Quarterly	Semi-Annually	Annually
Cleaning			X	
Inspection		X		
Testing (PVT's)				X

5-4.1. **Cleaning.** The Modulation Meter requires only general cleaning procedures to maintain all surfaces free of dirt and foreign matter. Proceed as follows to clean the instrument.

a. Using a clean, dry, lint-free cloth (Item 4, Table 1-2), remove any dust or loose dirt.

WARNING

The fumes of trichloromethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloromethane is not flammable, but exposure of the fumes to an open flame or hot metal forms highly toxic phosgene gas.

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b. With a dampened lint-free cloth containing trichloromethane (Item 6, Table 1-2) wipe surfaces of top and bottom covers.

c. Remove screws securing top and bottom cover to shield assembly. Remove both covers.

d. Blow dust and dirt from interior surfaces of shield assembly and boards using clean, dry air.

CAUTION

Set regulator on air supply for less than 30 PSIG in order to avoid damaging any components. (Refer to General Precautions.)

5-4.1.1. Corrosion Control. To prevent corrosion of the instrument follow the cleaning instructions in paragraph 5-4.1. Ensure that all parts of the modulation meter are kept clean and in good repair, including touch-up painting when required (paragraph 5-4-1.2). When shipping the instrument, enclose desiccant ( ).

5-4.1.2. Touch-up (Paint). To touch-up damaged surface areas of the modulation meter, proceed as follows.

WARNING

The fumes of trichloromethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloromethane is not flammable, but exposure of the fumes to an open flame or hot metal forms highly toxic phosgene gas.

a. Using trichloromethane (Item 6, Table 1-2) clean the surface to be touched-up and thoroughly dry (refer to paragraph 5-4.1).

b. Using an acid resistant brush (Item 1, Table 1-2) touch-up bare metal with one coat of zinc chromate primer (Item 8, Table 1-2).

c. When the primer has thoroughly dried, paint with two coats of gray semigloss enamel (Item 9, Table 1-2) allowing sufficient drying time between the two coats.

d. Reapply decal and/or stencilling as necessary.

5-4.2. Visual Inspection. A periodic visual inspection of the modulation meter should be performed to determine the presence of any damage as determined. Refer to Table 5-2 for a listing of various items to inspect, anticipated conditions, suggestions (remarks) to effect repairs or replacement. If an equipment malfunction occurs, perform a visual inspection of the instrument prior to performing any electrical tests. Correct any problems discovered, then perform an operation check to verify that the instrument is functioning properly. If a malfunction persists or the instrument fails an operational check, perform the troubleshooting procedures.

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Table 5-2. Visual Inspection

Step	Item	Condition	Remarks
1	Covers	Dented or cracked.	Local repair or replace.
2	Screws	Loose or damaged.	Tighten or replace.
3	Connectors	Loose or damaged.	Repair or replace.
4 5	Wires and cables	Frayed, cut, broken or shorted.	Repair or replace.
6	Connector receptacles	Damaged.	Replace Connector.
7	Shield Assembly feed thrus	Damaged or broken.	Replace Feed thru.
8	LED Indicator	Damaged or broken.	Replace LED (2) assembly.
9	VXI Processor/ shield assembly	Cold solder connection(s)	Reheat solder connection.
		Dirt or foreign matter	Clean (paragraph 5-2.1.) and reinspect.

5-4.3. Performance Verification Test (PVT). The following procedures verify the performance characteristics of the Modulation Meter. Detailed tests against specifications are included to verify all operational features. Each test contains a test record table with space for recording data. As each test is completed, the appropriate test blocks are filled in.

5-4.3.1. Recommended Test Equipment. The specific recommended test equipment required for performing the various Modulation Meter test is listed in Table 5-3. This table also provides the "specifications" and model number for each instrument. Equipment which meets or exceeds the specification listed may be substituted for the recommended models.

5-4.3.2. Calibration Interval. The Modulation Meter should be tested to specification at least once a year (annually).

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Table 5-3. Recommended Test Equipment

Instrument	Critical Specifications	Usage Performance Evaluation	Maintenance	Model
AM-FM Signal Generator	Frequency Range: 0.25 to 2000 MHz Level Range: -50 to +10 dBm Residual: FM < 2 Hz, 3 kHz BW at 1 GHz RF Residual: AM < -80 dBm, 3 kHz BW	X	X	Hewlett-Packard HP ESG-2000A
Audio Analyzer	Frequency Range: 20 Hz to 20 kHz Level Range: .6mV to 6V into 600 ohms Distortion < 0.05%	X	X	Boonton Model 1121
Test Oscillator	Frequency Range: 5 Hz to 500 kHz Level Range: 0 to 3 V rms Flatness: +0.15 dB	X	X	Hewlett-Packard 33120A
Spectrum Analyzer	Frequency: 1.2 MHz Resolution BW: 0.1 kHz Frequency span: 1 kHz	X	X	Hewlett-Packard 8566B
Modulator	Frequency: 30 MHz Flatness: < 0.3%, 20 Hz to 220 kHz Distortion: < 0.15% at 90% AM	X		Boonton 96400501A
Low-pass filter	5 -pole response, 3dB corner, 50 MHz	X	X	Mini-Circuits NLP-50
RF Calibrator	Frequency: 30.0 MHz, crystal Level Range: -60 to +20 dBm Accuracy: 0.105 dB	X	X	Boonton Model 2520
DC Power Supply	Range: 0.00 to 10.0 volts	X		Hewlett-Packard 6653A
Multimeter	Range: 0.001 to 100 volts, dc		X	Fluke Model 8840A

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Table 5-3. Recommended Test Equipment (Continued)

Instrument	Critical Specifications	Usage Performance Evaluation	Maintenance	Model
Power Meter	Frequency Range: 10 MHz to 1.3 GHz. Accuracy: ± 0.5 dB	X	X	Boonton Model 4220A w/51075 sensor
Network Analyzer	Frequency Range: 10 MHz to 2 GHz	X		Hewlett-Packard Model 8713L
RF Bridge	Directivity: 40 dB	X		Hewlett Packard Model 86205A
RF Millivoltmeter ♦	Frequency Range: 100 kHz to 10 MHz. Accuracy: ± 2%	X		Boonton Model 9200C
Oscilloscope	Frequency Range: DC TO 100 MHz. 0.005 TO 50 volts with 10X probes		X	Hewlett-Packard Model 54600B
Time Standard	Frequency: 10.0000 MHz Stability: 1 X 10^{-10} per day	X		House Standard

♦ This Equipment is required for VSWR tests.

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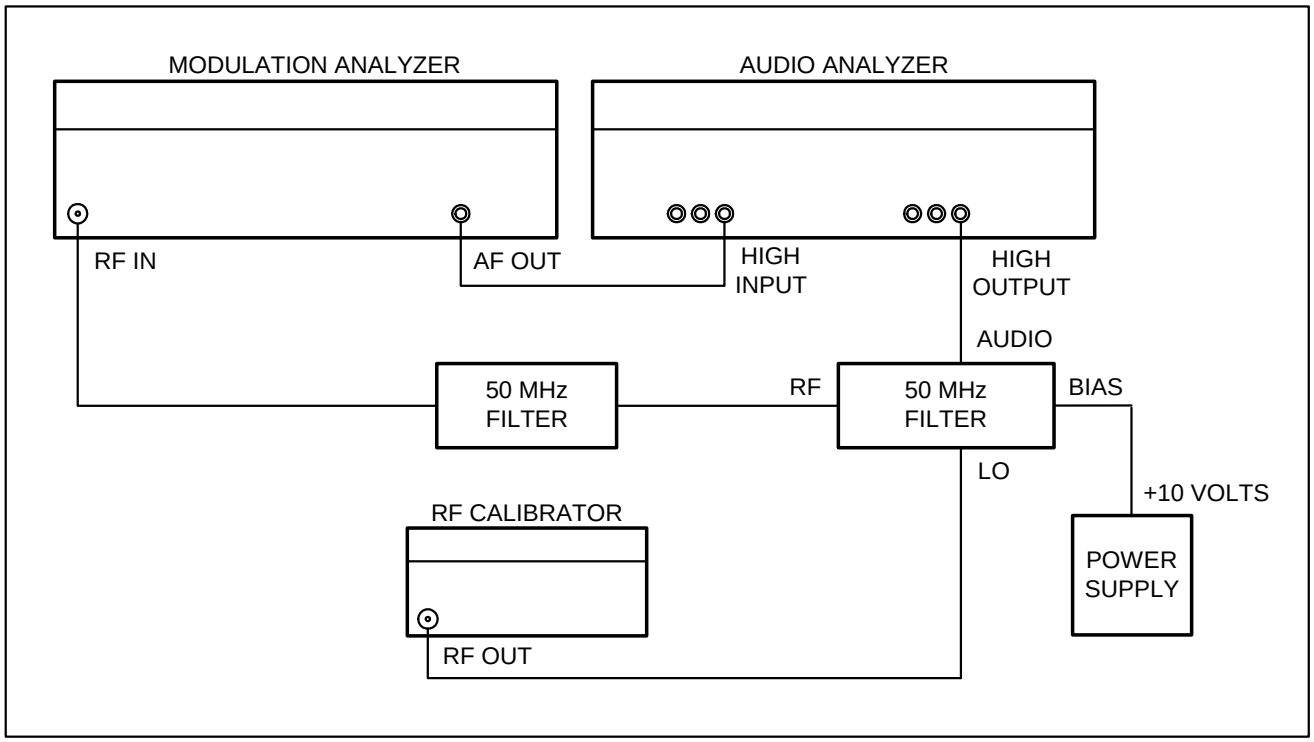


Figure 5-1. Measurement Setup No. 1

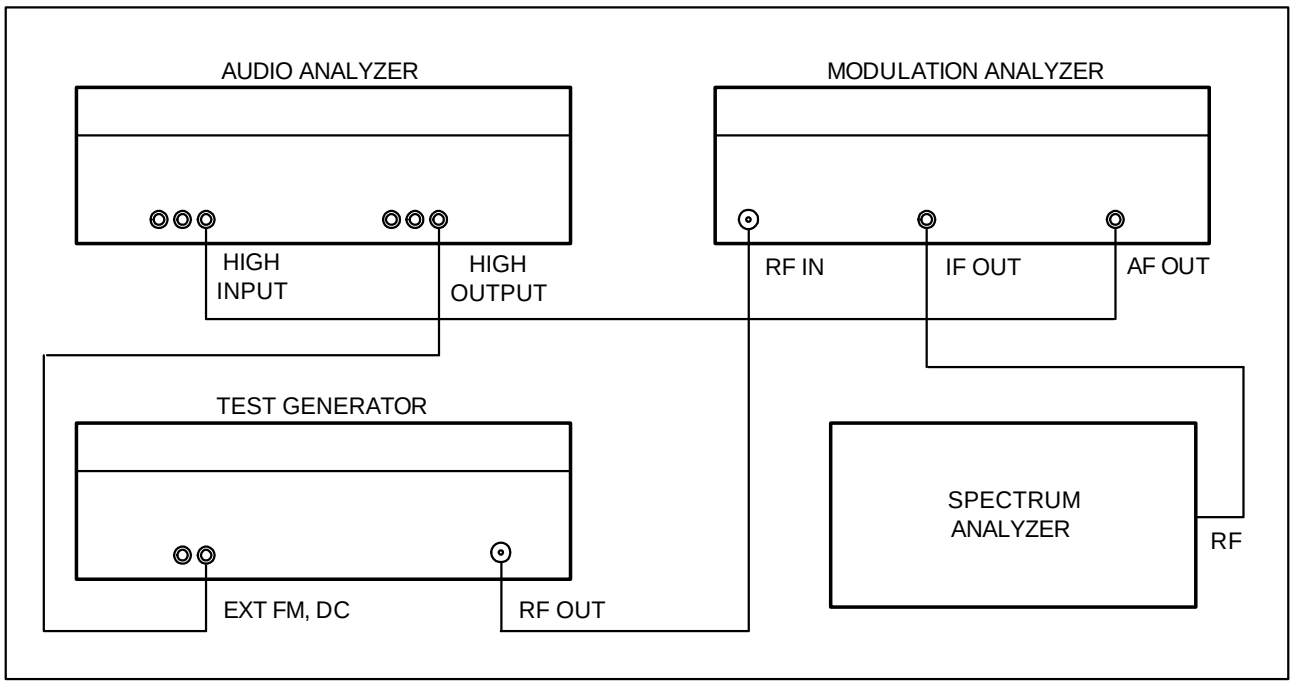


Figure 5-2. Measurement Setup No. 2

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5-4.3.3. Initial Calibration. Initial calibration should be performed before detailed performance testing, to insure that all detectors are functioning properly. Proceed as follows:

a. Make sure that system power to the computer and VXIbus chassis is ON.

b. Select the VXI Modulation Meter Soft Front Panel ICON in the windows menu.

c. Using the mouse, move the cursor to the Self Test field and click on Run Self Test. The Run Self Test will change to Running during this interval.

d. After the Self Test field returns to Run Self Test, click on the Send/Receive field. Note that the "User Interactive Send/Receive Panel" appears.

e. Using the computer keyboard type in special function SPCL 30 in the Send Message field then click on Send. Special Function 30 calibrates the modulation detectors.

f. Any errors displayed in the Measurement Display field during calibration, indicate an operational failure.

5-4.3.4. AM Modulation Accuracy And Residuals (PVT).

5-4.3.4.1. Description. The AM accuracy is verified first by using the internal calibrator which is exactly 50.00% ± 0.1% at 1.220 kHz. The AM flatness is then tested by applying the output of a low-residual, wideband linear modulator to the input of the Modulation Meter. The Audio Analyzer frequency is then varied, and a modulation RATIO change is noted. The audio frequency is then set to 1 kHz and the incidentals are checked at 50% AM. Finally, the audio signal is removed from the modulator and the residual AM is measured.

5-4.3.4.2. Specifications. Detailed tests against the following parameters are used to verify the specified operational characteristics.

a. ± 1%, 30 Hz to 5 kHz, Frf 0.1 to 0.5 MHz

b. ± 2%, 30 Hz to 7.5 kHz, Frf 0.1 to 0.5 MHz

c. ± 1%, 30 Hz to 15 kHz, Frf 0.5 to 10 MHz

d. ± 2%, 30 Hz to 30 kHz, Frf 0.5 to 10 MHz

e. ± 1%, 30 Hz to 100 kHz, Frf > 10 MHz

f. ± 2%, 30 Hz to 150 kHz, Frf > 10 MHz

g. ± 2%, 10 Hz to 30 Hz, 100 kHz to 2.5 GHz

h. residual 0.05%, 15 kHz bandwidth, level > 100 millivolts

i. residual 0.02%, 3 kHz bandwidth, level > 100 millivolts

j. incidental FM 20 Hz peak at 50% AM, 3 kHz bandwidth

k. incidental PM 0.02 RAD at 50% AM, 3 kHz bandwidth

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5-4.3.4.3. Procedure.

a. Connect the equipment as shown in Figure 5-1. Note that the power supply is set to 10.0 ± 1 volts.

b. Select the "VXI Modulation Meter Soft Front Panel" icon in the windows menu.

c. Set the RF Calibrator to +10 dBm and turn the output ON.

d. Click on the AM position of the Measurement Function field of the soft front panel.

e. Select the <10 High-Pass and 220 kHz Low-Pass Filter Selection flags on the soft front panel, and SPCL function 5 as follows to enable the slow detector mode.

1. Click on the "Send/Receive" field on the soft front panel and note that the "User Interactive Send/Receive Panel" pop-up window appears. "SP5AM"

2. Using the computer keyboard type in SPCL 5 in the "Send Message" field.

3. Click on the "Send" field to transmit the special function code to the Modulation Meter.

f. Adjust the Audio Analyzer for an AM indication of about 47.00% at a 1 kHz rate. Select the AM pop-up Modulation Panel window "Ratio in Percent" and "Use Current Signal as Reference" flags.

NOTE

The following procedures assume that the Audio Analyzer Level flatness is better than 0.5%. This should be verified before continuing.

g. Set the Audio Analyzer to the test frequencies of Table 5-4 and record the ratio indication.

h. Set the Audio Analyzer to 1 kHz and adjust the LEVEL for an indication of 50 ±1% AM. Select the AM Modulation Panel pop-up window "Absolute" flag to disable the ratio function, then "OK".

i. Select the 30 Hz High-Pass, the 3 kHz Low-Pass Filter Selection flags, and click on the FM mode of the Measurement Functions field. Increase or decrease the RF Calibrator level for a deviation null, then record the indication.

j. Click on the PM Measurement Function mode of the soft front panel and record the indication.

k. Remove the Audio Analyzer connection to the Modulator, click on the AM mode and RMS flag. Record the residual AM indication.

l. Select the 15 kHz Low-Pass Filter Selection flag and record the indication.

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Table 5-4. Amplitude Modulation

Frequency	Filter Setting (kHz)	Minimum	Actual	Maximum
30 Hz	220	99.00	_____	101.00
100 Hz	220	99.00	_____	101.00
10 kHz	220	99.00	_____	101.00
50 kHz	220	99.00	_____	101.00
100 kHz	220	99.00	_____	101.00
150 kHz	220	98.00	_____	102.00
Incidental FM	30 Hz-3 kHz		_____	20 Hz
Incidental PM	30 Hz-3 kHz		_____	0.02 RAD
Residual AM	30 Hz-3 kHz		_____	0.02%
Residual AM	30 Hz-15 kHz		_____	0.05%

5-4.3.5. Audio Filters (PVT).

5-4.3.5.1. Description. Each audio filter of the Modulation Meter is tested for corner accuracy by applying the output of a low-noise, wideband modulator to the input of the Modulation Meter. The analyzer modulation RATIO measurement mode is used with a reference set at a midband frequency. The frequency of the Audio Modulation Meter is then set to the filter corner frequency and the relative amplitude measured and the results recorded.

5-4.3.5.2. Specifications. Detailed tests against the following parameter is used to verify that the specified operational characteristic is ± 4% corner accuracy.

5-4.3.5.3. Procedure.

a. Connect the equipment as in Fig. 5-1. Note that the power supply is set to 10.0 ± 1 volts.

b. Click on the "Reset" field to initialize the instrument, then on AM mode of Measurement Function field. Execute SPCL functions 7 and 9 as follows to set pre-display de-emphasis, on AM.

1. Click on the "Send/Receive" field and note that the "User Interactive Send/Receive Panel" pop-up window appears.

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2. Using the computer keyboard type in "SP7 SP9 AM" in the "Send Message" field.

3. Click on the "Send" field to transmit the special function code to the Modulation Meter.

c. Set the RF Calibrator to +10 dBm and ON.

d. Adjust the LEVEL of the Audio Analyzer for an indication of about 47.00% at 1 kHz.

e. Select the <10 High-Pass and the 220 kHz Low-Pass Filter Selection Flags. On the AM Modulation Panel pop-up window, select the "Ratio in Percent", "Use Current Signal As Reference" and click on OK to establish a reference modulation.

f. Set the Audio Analyzer test frequency for each high-pass filter in Table 5-5, then select the appropriate filter, and record the ratio indication.

g. Select the <10 Hz High-Pass Filter Selection and set the Audio Analyzer test frequency for each de-emphasis filter in Table 5-4. Select the appropriate filter, and record the ratio indication.

h. Turn the De-Emphasis Filter Selection flag to Off, and select the 30 Hz High-Pass Filter Selection flag. Set the Audio Analyzer test frequency for each Low-Pass Filter Selection in Table 5-4 except the 50 and 220 kHz, then select the appropriate filter. Record the ratio indication.

i. For the 50 and 220 kHz Low-Pass Filter Selection, connect the Test Oscillator in place of the Audio Analyzer Source in Figure 5-1.

j. Select the "Absolute" position on the "Display Units - Control" field and adjust the Test Oscillator amplitude for an indication of about 47.00% AM at 1 kHz rate.

k. Select the 50 kHz Low-Pass Filter Selection flag. Also, select the "Ratio in percent" and "Use Current Signal as Reference" flags and increase the Test Oscillator frequency until the ratio indication is 70.7%. Record the C-Test Oscillator frequency indication.

l. Select the 220 kHz Low-Pass Filter Selection flag and continue to increase the Test Oscillator frequency until the ratio indication is again 70.7%. Record the Test Oscillator frequency indication.

5-4.3.6. Amplitude Modulation, Distortion (PVT).

5-4.3.6.1. Description. The amplitude modulation distortion is verified by applying the output of a low-residual, wideband, linear modulator to the input of the Modulation Meter. The Audio Analyzer level is then adjusted for 90% and the recovered modulation distortion is displayed using an audio distortion analyzer connected to AF Out connector on the Front panel which has to be verified before this test.

5-4.3.6.2. Specifications. Detailed tests against the following parameter is used to verify that the specified operational characteristic is 0.3% for depth of 90%.

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Table 5-5. Audio Filters

Filter	Source Setting	Minimum	Actual	Maximum
High-pass:				
<10 Hz	10 Hz	98.00	_____	102.00
<10 Hz	30 Hz	99.50	_____	100.50
30 Hz	30 Hz	67.50	_____	73.70
300 Hz	300 Hz	67.50	_____	73.70
3000 Hz	3000 Hz	67.50	_____	73.70
De-emphasis:				
25 uS	6.366 kHz	67.50	_____	73.70
50 uS	3.188 kHz	67.50	_____	73.70
75 uS	2.122 kHz	67.50	_____	73.70
750 Us	212.2 Hz	67.50	_____	73.70
Low-pass:				
3 kHz	3 kHz	67.50	_____	73.70
15 kHz	15 kHz	67.50	_____	73.70
20 kHz	20 kHz	67.50	_____	73.70
50 kHz	50 kHz approx.	48.00	_____	52.00
220 kHz	220 kHz approx.	211.2	_____	228.8

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5-4.3.6.3. Procedure.

a. Click on the "Reset" field of the soft front panel to initialize the Modulation Meter.

b. Connect the equipment as in Figure 5-1, and select the Modulation Meter AM Measurement Function mode.

c. Set the Audio Analyzer to 1 kHz and adjust the level for an AM indication of 90.0 ± 0.5%.

d. Measure and record the indicated distortion. (See Table 5-6).

Table 5-6. Amplitude Modulation, Distortion

Depth	RF Frequency	Minimum	Actual	Maximum
90%	30 MHz	– – – –	_____	0.3%

5-4.3.7. FM Modulation Accuracy And Incidental AM (PVT).

5-4.3.7.1. Description. The FM accuracy is verified by using the internal calibrator which is exactly 125.0 kHz ± 0.1% at a 1.220 kHz rate. The FM flatness is then tested by applying the FM modulated output of the Test Generator to the input of the Modulation Meter. The Audio Analyzer frequency is then varied from 30 Hz to 5 kHz, and a modulation RATIO change is noted. Higher audio frequencies are tested by using Bessel null measurements at specific audio frequencies. The audio frequency is then set to 1 kHz and the incidental AM is checked at 50 kHz and 5 kHz deviation.

5-4.3.7.2. Specifications. Detailed tests against the following parameters are used to verify the specified operational characteristics.

a. ± 1%, 30 Hz to 5 kHz, Frf 0.2 to 0.5 MHz

b. ± 2%, 30 Hz to 7.5 kHz, Frf 0.2 to 0.5 MHz

c. ± 1%, 30 Hz to 15 kHz, Frf 0.5 to 10 MHz

d. ± 2%, 30 Hz to 30 kHz, Frf 0.5 to 10 MHz

e. ± 1%, 30 Hz to 100 kHz, Frf > 10 MHz

f. ± 2%, 30 Hz to 150 kHz, Frf > 10 MHz

g. incidental AM 0.2% AM peak at 50 kHz peak deviation Frf > 10 MHz

h. incidental AM 0.2% AM peak at 5 kHz peak deviation Frf < 10 MHz

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NOTE

The following procedure is used in lieu of Bessel null measurements. The Bessel zero technique is quite tedious at frequencies below about 1 kHz, as Spectrum Analyzer adjustment is difficult, and eighth order nulls, or higher, must be used to produce enough deviation for reasonable accuracy. The test generator used for the following tests is used over less than one two-hundredth of its modulation bandwidth, and can safely be assumed to be flat.

5-4.3.7.3. Procedure.

a. Connect the equipment as shown in Figure 5-2.

b. Click on the "Reset" field of the soft front panel (Figure 4-1) to initialize the Modulation Meter.

c. Set the Test Generator to 500 MHz, 0 dBm and EXT DC FM.

d. Adjust the Audio Analyzer Source to 0.7 volts at 1 kHz, and program the Test Generator for 50 kHz deviation.

e. Click on the Modulation Meter FM mode and click on the Reset field. The program will display the Modulation Panel pop-up window and the FM indication in the FM Value (%) field during the calibration program. Record the indication.

f. Select the <10 Hz High-Pass and 220 kHz Low-Pass Filter Selection fields on the soft front panel. Adjust the Audio Analyzer LEVEL for an FM indication of about 47.00 kHz at a 1 kHz rate. On the Modulation Panel pop-up window, select the "Ratio in Percent" and "Use Current Signal as Reference" flags to set a modulation reference.

NOTE

The following procedures assume that the Audio Analyzer Level flatness is better than 0.5%. This should be verified before continuing.

g. Set the Audio Analyzer to 30, 100, and 500 Hz and record the ratio indication.

h. Temporarily disconnect the Audio Analyzer from the Test Generator and adjust the Spectrum Analyzer for a full scale indication of the unmodulated carrier. Reconnect the Audio Analyzer signal.

i. On the Modulation Meter click on FM, then select "Absolute" from the Display Units-Control Field to disable this function. Adjust the Audio Analyzer frequency to 4.1583 kHz, then set the Test Generator to 10 kHz deviation.

j. Observe the Spectrum Analyzer display and, using the Audio Analyzer LEVEL STEP function, adjust for a carrier null of greater than 50 dB. This corresponds to a deviation of exactly 10.00 kHz ± 0.3%.

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k. When the deviation reading settles, select SPCL function 3 as follows to hold the 50.00 modulation range, and temporarily disconnect the Audio Analyzer from the Test Generator.

1. Click on the "Send/Receive" field and note that the "User Interactive Send/ Receive Panel" pop-up window appears.

2. Using the keyboard type in "SP3FM" in the "Send Message" field.

3. Click on the "Send" field to transmit the special function to the Modulation Meter.

l. Subtract the residual reading from the deviation indication and record the difference. Select SPCL function 1 using procedures in step k to resume autoranging, then repeat the above procedure at 41.583 kHz and 100 kHz.

m. Replace the Audio Analyzer in the test setup with the test oscillator and perform the null at 150 kHz. Discount the residual indication as above and record the ratio indication.

n. Select the 30 Hz High-Pass and the 3 kHz Low-Pass Filter Selections flags, and adjust the Test Oscillator for a deviation of 50 kHz peak at a 1 kHz rate. Click on the AM mode of the "Measurement Function" field, and record the indication.

o. Change the Test Generator frequency to 5 MHz, and adjust the Test Oscillator for a deviation of 5 kHz peak at a 1 kHz rate. Click on the AM Measurement Function mode of the Modulation Meter and record the indication. (Refer to Table 5-7).

5-4.3.8. Frequency Modulation, Distortion (PVT).

5-4.3.8.1. Description. The Frequency Modulation distortion is verified by applying the output of the Test Generator to the input of the Modulation Meter.. A small amount of FM deviation is applied to the carrier signal, and the Modulation Meter local oscillator frequency is varied. The measurement determines the change of slope of the Frequency Modulation detector. The distortion components are then calculated and compared to the specifications. This technique is extremely sensitive and much easier than finding an FM source of sufficiently low distortion to make the test.

5-4.3.8.2. Specifications. Detailed tests against the following parameters are used to verify the specified operational characteristics.

a. 0.1% for deviations < 30 kHz, Frf 0.2 to 0.5 MHz

b. 0.1% for deviations < 75 kHz, Frf 0.5 to 10 MHz

c. 0.1% for deviations < 100 kHz, Frf > 10 MHz

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Table 5-7. Frequency Modulation Accuracy

Filter	Source Frequency	Minimum	Actual	Maximum
<10-220 kHz	30 Hz	99.00	_____	101.00
<10-220 kHz	100 Hz	99.00	_____	101.00
<10-220 kHz	500 Hz	99.00	_____	101.00
<10-220 kHz	1000 Hz		Reference	
<10-50 kHz	4.1583 kHz	9.90	_____	10.10
<10-220 kHz	41.583 kHz	99.00	_____	101.00
<10-220 kHz	100 kHz	238.1	_____	242.9
<10-220 kHz	150 kHz	353.5	_____	367.9
CALIBRATION		123.8	_____	126.3
INCIDENTAL @ 500 MHZ			_____	0.2%
INCIDENTAL @ 5 MHz			_____	0.2%

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5-4.3.8.3. Procedure.

a. Click on the "Reset" field of the soft front panel to initialize the Modulation Meter.

b. Connect the RF output of the Test Generator to Modulation Meter RF IN connector. Set the Generator for 15.211 MHz, 0 dBm, and 3 kHz FM deviation at a 1 kHz rate.

c. Select the 300 Hz High-Pass, 3 kHz Low-Pass Filter Selection flags, and the RMS Detector flag on Detector Selection field. Execute special function SPCL 18 as described in paragraph 5-4.3.7.3, steps k 1, 2 and 3 to select the RMS detector expressed in peak.

d. Click on the FREQ mode and select Automatic Mode OFF. Using the keyboard, type in 15.0 in "Frequency Value" field.

e. Select MHz in Frequency Units field and click on OK.

CAUTION

Do not change the Test Generator carrier frequency or FM deviation during this procedure, as large errors will result.

f. Click on the FM modulation mode, and when the reading settles, depress the Ratio and %/Hz keys.

g. Using the keyboard, enter the carrier frequencies listed in Table 5-8 into the "Send Message" field of the User Interactive Send/Receive Panel. Record the ratio indication.

h. The change in indication is small and represents changes in the slope of the FM detector. The second harmonic term is dominant and equal to 1/4 of the change in slope. For example, if the indication at 14.5 MHz was 99.80% and the indication at 15.5 MHz was 100.00%, the slope change would be 0.2% for a + or - 500 kHz deviation. This would indicate a distortion of 0.05%. The difference between indications at 14.9 and 15.1 MHz should be less than 0.4% corresponding to 0.1% distortion for deviations of ± 100 kHz and carriers greater than 10 MHz. The difference between any two indications should be less than 0.4% corresponding to 0.1% distortion for deviations of ± 50 kHz for carriers below 2 MHz. The difference between 14.3 and 14.4 MHz should be less than 0.4% corresponding to 0.1% distortion for deviations of ± 50 kHz for carriers between 2 and 10 MHz.

5-4.3.9. FM Residuals 3 and 15 kHz Filters (PVT).

5-4.3.9.1 Description. The FM residual modulation is determined by applying the output of a low-noise Synthesizer to the input of the Modulation Meter and noting the modulation indication using the rms detector.

5-4.3.9.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. < 60 Hz rms at 2000 MHz, 3 kHz bandwidth

b. < 30 Hz rms at 1000 MHz, 3 kHz bandwidth (linear decrease)

c. < 2 Hz rms at 100 MHz, 3 kHz bandwidth (floor)

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Table 5-8. FM Modulation Distortion

Frequency (MHz)	Minimum	Actual	Maximum
14.10	-0.40	_____	+.0.4
14.20	-0.40	_____	+.0.4
14.30	-0.40	_____	+.0.4
14.40	-0.40	_____	+.0.4
14.50	-0.40	_____	+.0.4
14.60	-0.40	_____	+.0.4
14.70	-0.40	_____	+.0.4
14.80	-0.40	_____	+.0.4
14.90	-0.40	_____	+.0.4
15.00		Reference	
15.10	-0.40	_____	+.0.4
15.20	-0.40	_____	+.0.4
15.30	-0.40	_____	+.0.4
15.40	-0.40	_____	+.0.4
15.50	-0.40	_____	+.0.4
15.60	-0.40	_____	+.0.4
15.70	-0.40	_____	+.0.4
15.80	-0.40	_____	+.0.4
15.90	-0.40	_____	+.0.4
16.00	-0.40	_____	+.0.4

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d. < 120 Hz rms at 2000 MHz, 15 kHz bandwidth

e. < 60 Hz rms at 1000 MHz, (linear decrease) 15 kHz bandwidth

f. < 4 Hz rms at 100 MHz, 15 kHz bandwidth (floor)

5-4.3.9.3. Procedure.

a. Click on the "Reset" field to initialize the Modulation Meter.

b. Connect the output of the Synthesizer to the RF IN connector of the Modulation Meter. Set the Synthesizer to 2 GHz and 0 dBm. Select the RMS flag on the Detector Selection field, and when the reading settles, record the FM deviation. (Refer to Table 5-9).

c. Change the Low-Pass Filter Selection flag setting to 3 kHz and record the FM deviation.

d. Change the Synthesizer frequency to 1000 MHz and record the FM deviation.

e. Change the Low-Pass Filter Selection flag setting to 15 kHz and record the FM deviation.

f. Change the Synthesizer frequency to 100 MHz and record the FM deviation.

g. Change the Low-Pass Filter Selection flag setting to 3 kHz and record the FM deviation.

Table 5-9. Frequency Modulation, Residuals

Filter Test Frequency	(MHz)	Minimum	Actual	Maximum (Hz)
15	2000		_____	120
3	2000		_____	60
3	1000		_____	30
15	1000		_____	60
15	100		_____	4
3	100		_____	2

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5-4.3.10. Phase Modulation, Accuracy and Flatness (PVT).

5-4.3.10.1. Description. The Modulation Meter measures Phase modulation by integrating the output of the FM detector, as this is the mathematical relationship of phase and frequency. Phase Modulation (PM) accuracy is first verified by calibrating the phase detection system with the internal calibrator. The detector flatness is then measured by applying known amounts of FM deviation and comparing the equivalent PM. Phase Modulation deviation is equal to the FM deviation divided by the modulation rate.

5-4.3.10.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. ± 3% 200 Hz to 7.5 kHz, Frf 0.2 to 0.5 MHz

b. ± 3% 200 Hz to 30 kHz, Frf > 0.5 MHz

5-4.3.10.3. Procedure.

a. Complete the FM performance verification tests (this will verify FM flatness and FM and PM distortion) then connect the equipment as in Figure 5-2, but omit the Spectrum Analyzer.

b. Select PM, Peak ± Detector Selection, 30 Hz High-Pass, and 50 kHz Low-Pass Filter Selection flag on the soft front panel. Click on the Send/Receive field; type the command "PMCA" in Send Message field on "User Interactive Send/Receive Panel" to calibrate the PM measurement.

c. Set the Test Generator to 100 MHz, 0 dBm, and FM EXT DC.

d. Click on the Modulation Meter FM mode, set the Audio Analyzer Source frequency to 1 kHz and adjust the LEVEL for a deviation of 50.00 kHz.

e. Click on the Modulation Meter PM mode and record the deviation. (Refer to Table 5-10)

f. Click on the Modulation Meter FM mode, set the Audio Analyzer Source frequency to 200.0 Hz and adjust the LEVEL for a deviation of 50.00 kHz.

g. Click on the Modulation Meter PM mode and record the deviation.

h. Click on the Modulation Meter FM mode and select the 300 Hz High-Pass Filter Selection flag. Set the Audio Analyzer Source frequency to 30.0 kHz and adjust the LEVEL for a deviation of 50.0 kHz.

i. Click on the Modulation Meter PM mode and record the deviation.

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Table 5-10. Phase Modulation, Accuracy and Flatness

Carrier Frequency (MHz)	Source Setting	Minimum	Actual	Maximum
100	1 kHz	48.50	_____	51.50
100	200.0 Hz	242.7	_____	257.5
100	30.0 kHz	1.62	_____	1.72

5-4.3.11. Carrier Level (PVT).

5-4.3.11.1. Description. The carrier LEVEL measurement is verified by applying the output of the RF Calibrator to the RF IN of the Modulation Meter and calibrating the measurement. The RF calibrator is then used to verify performance at 30 MHz. An accurate power meter is then used to verify the accuracy at other frequencies.

5-4.3.11.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. ±1 dB, 0.1 to 520 MHz, -47 to +30 dBm

b. ± 2 dB, 520 to 1500 MHz, -37 to +30 dBm

c. ± 3 dB, 1500 to 2500 MHz, -33 to +30 dBm

5-4.3.11.3. Procedure.

a. On the Modulation Meter, click on the "Reset" field to initialize the system.

b. Connect the RF Calibrator output to the RF IN connector of the Modulation Meter and set the RF Calibrator to 0 dBm and ON.

c. Click on LEVEL mode and enter 0 dBm into the Level Value field using the keyboard and click on OK. Click on "Send/Receive" field and type CA mnemonic in Send Message field. Click on OK to calibrate the measurement.

d. When the calibration routine completes, click on FREQ mode, Automatic Mode OFF and "Use Current Signal As Reference", then OK to hold the frequency setting.

e. Click on LEVEL mode and Carrier Level Panel pop-up window OK field. Record the indications for the RF Calibrator levels listed in Table 5-12.

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f. Connect the Reference Power Meter sensor to the output of the Test Generator using the same cable that is used to connect the Generator to the Modulation Meter.

g. Set the Test Generator to 1000 MHz and to the Test levels indicated in Table 5-12. Record the indications.

NOTE

Start the procedure at the highest level to insure that the Modulation Meter properly acquires the signal before depressing the MHz key.

h. Without changing any settings, disconnect the Reference Power Meter and connect the Test Generator to the Modulation Meter.

i. On the Modulation Meter click on FREQ mode, Automatic Mode ON and OK to acquire the signal. When the frequency reading settles, click on FREQ then Automatic Mode OFF to hold the measurement frequency.

j. Click on LEVEL mode and record the indications at the indicated test levels.

k. Repeat the procedure at 2000 MHz.

5-4.3.12. Frequency Accuracy and Sensitivity (PVT).

5-4.3.12.1. Description. Carrier frequency accuracy is measured by locking the Test Generator to a timebase with 1 x 10 - 10 stability and known accuracy, then applying the output of the generator to the input of the Modulation Meter. Frequency readings are taken at various frequencies and levels and the indications recorded. The test also verifies the measurement sensitivity, and audio frequency accuracy, as the same counter and timebase are used.

5-4.3.12.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. reference ± 3 counts Frf < 100 MHz

b. reference ± 3 counts or 30 Hz whichever is greatest, Frf > 100 MHz

c. sensitivity 10 m V rms, Frf < 520 MHz

d. sensitivity 15 m V rms, Frf < 1000 MHz

e. sensitivity 28 m V rms, Frf < 1500 MHz

f. sensitivity 50 m V rms, Frf > 1500 MHz

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Table 5-12. Carrier Level Accuracy

Frequency (MHz)	Test Level (dBm)	Minimum	Actual	Maximum
30	0		Reference	
30	-47.0	-48.0	_____	-46.0
30	-10.0	-11.0	_____	-9.0
30	+10.0	+9.0	_____	+11.0
30	+19.0	+18.0	_____	+20.0
1000	0	-2.0	_____	+2.0
1000	-37.0	-39.0	_____	-35.0
1000	-10.0	-12.0	_____	-8.0
1000	+10.0	+8.0	_____	+12.0
1000	+19.0	+17.0	_____	+21.0
2000	0	-3.0	_____	+3.0
2000	-33.0	-36.0	_____	-30.0
2000	-10.0	-13.0	_____	-7.0
2000	+10. 0	+7.0	_____	+13.0

5-4.3.12.3. Procedure.

a. Connect the EXT REF input of the Test Generator to the output of the Metrology Standard timebase.

b. Connect the Test Generator output to the Modulation Meter RF IN connector and set the frequency to 500 kHz and level to 10 m V. Record the settled reading. (Table 5-13).

c. Increase the Test Generator frequency to 520 MHz. Record the settled reading.

d. Increase the Test Generator frequency to 1000 MHz., and increase the level to 15 millivolts. Record the settled reading.

e. Increase the Test Generator frequency to 1500 MHz., and increase the level to 28 millivolts. Record the settled reading.

f. Increase the Test Generator frequency to 2000 MHz., and increase the level to 50 millivolts. Record the settled reading.

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Table 5-13. Carrier Frequency Accuracy and Sensitivity

Test Level (mV)	Frequency (MHz)	Minimum	Actual	Maximum
10	.500000	.49997	_____	.50003
10	520.00000	519.9997	_____	520.0003
15	1000.00000	999.9997	_____	1000.0003
28	1500.00000	1499.9997	_____	1500.0003
50	2000.00000	1999.9997	_____	2000.0003

5-4.3.13. VSWR (PVT).

5-4.3.13.1. Description. The Modulation Meter VSWR is verified by measuring return loss. Measurements are made using a Scalar Network Analyzer from 10 MHz to 2.5 GHz. For optional testing below 10 MHz, the sensor input impedance is measured at several points and the VSWR is calculated.

5-4.3.13.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. < 1.5 from 100 kHz to 2.0 GHz.

b. < 1.8 from 2.0 to 2.5 GHz.

5-4.3.13.3. Procedure.

a. Set up the Scalar Analyzer for a 10 MHz to 2.5 GHz sweep at a 0 dBm level, and calibrate the SWR autotester using the reference open and short to establish a return loss baseline.

b. Connect SWR autotester test port to the RF IN connector of the Modulation Meter, and connect the SWR autotester to the Scalar Analyzer sweep generator with a short low VSWR cable.

c. Click on "FREQ" and enter 100 MHz into the carrier "Frequency Value" field of the Frequency Panel pop-up window to keep the Modulation Meter local oscillator frequency constant. Record the minimum return loss from 0.01 to 2.5 GHz.

NOTE

The following procedure is optional as the Modulation Meter input impedance below 10 MHz is essentially the same as the DC resistance of the input protection pad and termination.

d. Connect the equipment as in Figure 5-3.

e. Set the voltmeter to display the ratio of the two channels, and vary the generator frequency from 0.1 to 10 MHz at 0 dBm and record maximum amplitude variation in Table 5-14. This variation represents the impedance variation at the RF IN connector. A ratio of -7.96 dB represents 33.3 ohms resistance, and -4.43 dB represents 75 ohms.

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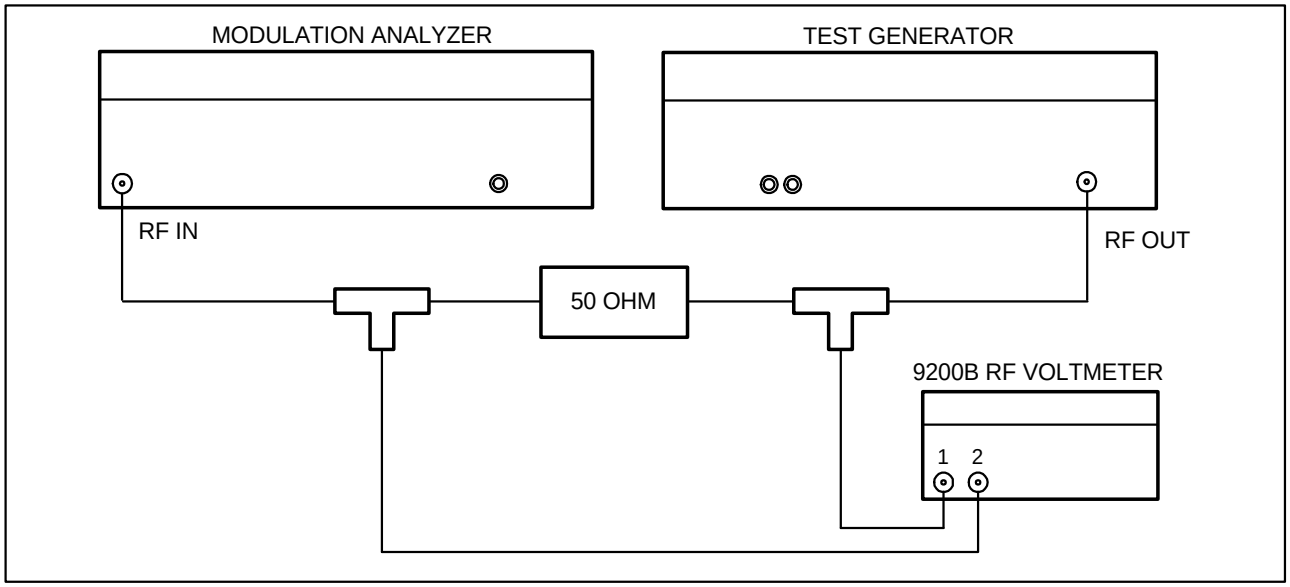


Figure 5-3. Measurement Setup No. 3

Table 5-14. VSWR

Frequency Range	Minimum (dB)	Actual	Maximum
2.0 GHz - 2.5 GHz	10.9	_____	
10 MHz - 2.0 GHz	13.9	_____	
100 kHz - 10 MHz	-7.96	_____	-4.43 dB *

* VSWR and Impedance: VSWR = 1.5, RHO = 0.2, Z max = 75 ohms, Z min = 33.3 ohms

5-4.3.14. Calibrators (PVT).

5-4.3.14.1. Description. The theory of operation of the calibrators is described in detail, and the mathematical procedures used to determine the accuracy of the calibrators is also disclosed. Since the calibrators are so precise, measurement verification of the stated accuracy is not practical. The internal calibrators of the Modulation Meter provide modulation standards for AM and FM measurements; they are activated by the operator as required by the measurement. The following paragraphs presents the design constraints and the implied accuracy.

5-4.3.14.2. Specifications. Detailed tests against the following parameters are used to verify specified operational characteristics.

a. FM, 0.1% accuracy

b. AM, 0.1% accuracy

5-4.3.14.3. FM Calibration. The calibration process consists of (1st) applying to the FM discriminator, in alternation, two accurately controlled frequencies; (2nd) measuring the resulting recovered modulation information; and (3rd) computing a correction factor for subsequent FM measurements. As an aid in following this discussion refer to Figure 7-5.

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5-4.3.14.4. The input signal to pin 1 of U21 is a 10 MHz TTL CLOCK. U21 Program-Mable Logic Device, is configured to divide this signal by 4 and output this signal to pin 12, which is the clock input to U4 a binary counter. The output of U4 is now the cal-rate which is phase coherent with the other generated signals and at a frequency of 1.2207 kHz. In the FM Cal Mode, this causes the output pin 18 of U21 to divide the 10 MHz by 10 during half the cycle of the cal-rate and to divide by 8 the other half cycle. Resulting in output frequency of 1 MHz and 1.25 MHz at a rate of 1.227 kHz. The average frequency, therefore, is 1.125 MHz, the peak-to-peak is 250 kHz and the peak deviation is 125.0 kHz.

5-4.3.14.5. From the above discussion it is clear that the frequency deviation is precisely defined by the clock frequency. Additionally, since the modulation signal is phase coherent with the carrier frequency, switching from one carrier tone to the other is consistent. In transferring the calibrator deviation to subsequent modulation measurement the primary limitation is the voltmeter resolution, in this case 1 part in 1250 or 0.08%. FM noise is of little or no consequence, since the two frequencies are crystal controlled. The calibration program accumulates ten readings, and averages them to eliminate last-digit uncertainty. Cross-correlation measurements using a Bessel null techniques indicate that the actual calibration uncertainty for 100 calibrations is close to 0.04% or one-half digit.

5-4.3.14.6. AM Calibration. The operation of the AM calibrator is similar to that of the FM calibrator. During AM calibration the fixed divide by eight output of U21 is used to generate the carrier frequency of 1.25 MHz. The TTL signal from U21 pin-18 is passed thru a low-pass filter consisting of L6, L7 C16, C17 and C18. This filter removes harmonics of the TTL signal to produce a sinewave at the input U10. Amplifier U10 increases the signal level, but more importantly provides a very low output impedance to drive precision divider R28. The increased level also reduces the effects of charge injection in switch, U17. The voltage divider comprising R28a thru R28d is a precision resistor array. The absolute value of the resistors, however, is not as important as is the match between them. Thus, resistors R28a thru R28d are guaranteed to a 0.05% match. Selecting the 3/4 and 1/4 voltage taps for the output insures that the source impedance for subsequent circuits is constant.

5-4.3.14.7. Analog switch U17 alternately switches between the 3/4 and 1/4 voltage taps at the 1.2207 kHz rate, thus producing an amplitude modulated signal with a depth of exactly 50%. The effects of the inevitable variation in analog switch on resistance (U17) is obviated by inserting a 20 k ohm resistor in series with the switch, thus reducing switch matching errors to less than 0.1%. A possible source of error in transferring the calibrator AM accuracy to the measurement is the symmetry of the modulation waveform. The problem is addressed as follows: (In the following analysis, p + indicates + peak and p- is -peak.)

$$\%p+ = (Emax - Eavg)/Eavg \times 100 \qquad (1)$$

$$\%p- = (Emax - Emin)/Eavg \times 100 \qquad (2)$$

$$\text{peak average} = (p+ - p-)/2 \times 100 \qquad (3)$$

Therefore, combining Eqs. 1, 2, and 3, for symmetrical modulation,

$$\%AM = (Emax - Emin)/(Emax + Emin) \times 100 \qquad (4)$$

and for the above system:

$$\%AM = (3/4 - 1/4)/(3/4 + 1/4) \times 100$$
$$= 50.00$$

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5-4.3.14.8. The above calculations assume that the modulation is symmetrical (i.e. perfectly so). Should that not be the case, a dc shift occurs and the plus and minus peaks are not equal. The calibrator program eliminates such an error by calculating AM as:

$$\%AM = (p+ + 3p-)/4 \qquad (5)$$

This expression is determined as follows:
Now, since the peak detectors are ac coupled (see Figure 5-4 for symbols),

$$(p+)(T1) - (p-)(T2) = 0 \quad (0 \text{ volts dc}) \qquad (6)$$

And:

$$T1 + T2 = 1 \qquad (7)$$

$$(p+)(T1)-(p-)(1-T1) = 0 \qquad (8)$$

$$T1 = p-/(p+ + p-) \qquad (9)$$

Now:

$$Eavg = Emin + (Emax - Emin)\, T1/(T1 + T2) \qquad (10)$$

And in the Modulation Meter:

$$Emax = 3\, Emin \qquad (11)$$

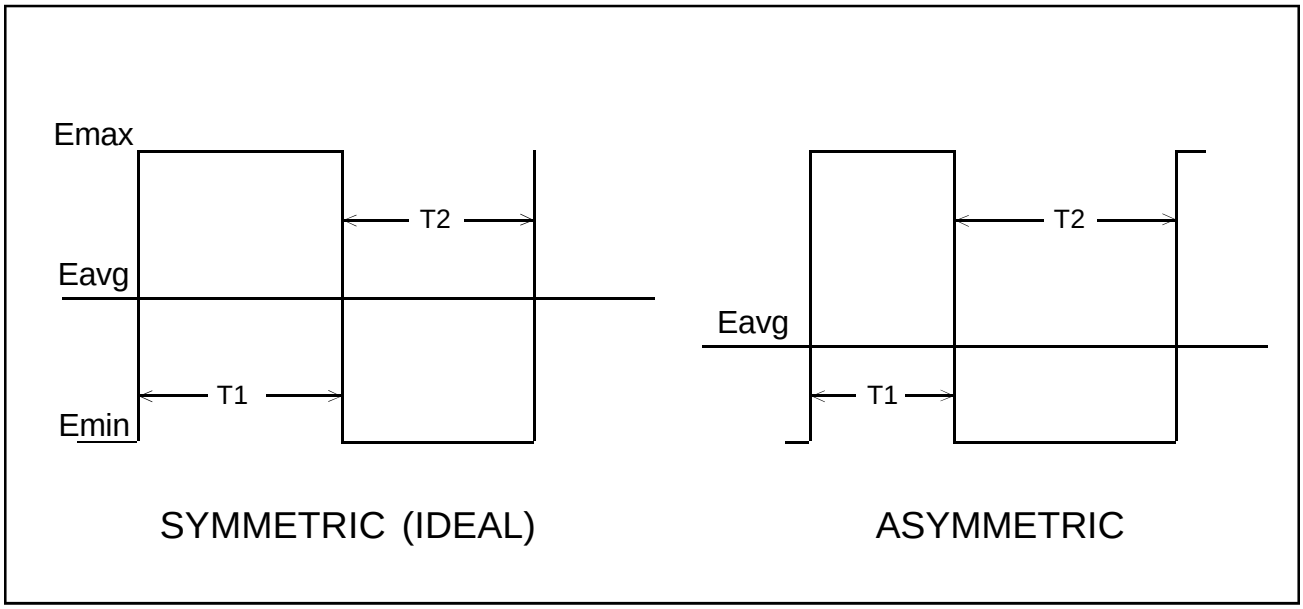


Figure 5-4. AM Calibration Emax Equals Emin

Combining Equs. 7,10, and 11:

$$Eavg = Emin + 2Emin\,(T1) \qquad (12)$$

$$Eavg = Emin\,(1 + 2T1) \qquad (13)$$

If symmetry is perfect:

$$T1 = 0.5 \text{ and } Eavg = 2\ Emin \qquad (14)$$

If symmetry is less than perfect, the dc ratio error R (that is, Eq. 13 bs Eq. 14) will be:

$$R = (1 + 2T1)/2 \qquad (15)$$

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Combining Eqs. 9 and 15:

$$R = (p+ + 3p-)/(2(p+ + p-)) \quad (16)$$

The uncorrected AM is

$$(p+ + p-)/2 \quad (17)$$

and corrected is

$$= (p+ + p-)/2 \times R \quad (18)$$

$$= (p+ + 3p-)/4 \quad (19)$$

5-4.3.14.9. Again, it should be noted that only ratios are involved in the above analysis. The absolute value of the voltages are not important to the method. As in the case of FM, the calibration program accumulates ten readings, and averages them to eliminate last digit uncertainty. The internal voltmeter can resolve the reading to 1 part in 5000 for a quantizing uncertainty of 0.02%. AM noise is of little consequence in determining calibrator depth since the original signal level is determined by TTL gates and the frequency of the carrier and modulation signals are crystal controlled. Cross-correlation measurements using a specially calibrated Modulation Meter indicate that the actual calibration uncertainty for 100 calibrations is approximately 0.15%.

5-5. Corrective Maintenance

5-6. The procedures provided in this section are for a qualified maintenance technician. As a minimum, the technician should be thoroughly familiar with the operation, theory and troubleshooting of the instrument procedures for repair of simple faults, where the repair action is apparent are not provided. Examples of such repairs include: damaged connectors, unsoldering and soldering of components and repair of cables and wiring.

5-6.1. **Corrective Maintenance Tasks.** Corrective maintenance includes various procedures required to localize a malfunction and effect the repair. These tasks and their functions are as follows:

a. Troubleshooting - Provides procedural steps to localize the malfunction to a defective printed wiring board (PWB) or component.

b. Disassembly - Provides procedural step to remove a defective PWB or component.

c. Assembly - Provides procedural step to replace a defective PWB or component.

d. Adjustments - Provides procedural steps to make adjustment to individual PWB's.

e. Testing - Provides procedural steps to ensure the repaired or replaced component corrected the original malfunction. These tests are typically performance verification tests.

5-6.2. Troubleshooting. Instrument malfunctions will normally be evident from the soft screen display or VXI bus response. The problems generally fall into two categories; selective failure of one subsystem or catastrophic failure. Selective failure of one section of the instrument or out of specification performance will be evident from use of

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the soft controls. For example, incorrect or erratic FM deviation displays would be evident from display readings only in the FM modulation mode. Therefore, the problem would most likely be associated with the FM printed wiring board (PWB). However, similar performance on both AM and FM displays will indicate a problem on the Filter or Detector PWB's.

5-6.2.1. Catastrophic failures would normally cause the modulation meter to be completely inoperative. For example, if the microprocessor was not functioning properly, the monitor would contain meaningless symbols and the soft screen controls would not be responsive. Further isolation of the malfunction requires some understanding of the simplified block diagram (Figure 3-1). Review the theory of operation (Chapter 3) before proceeding with the "trouble localization". When the malfunction is localized to a specific PWB or component, refer to the corrective maintenance procedures (disassembly/assembly) to replace the part.

5-6.2.2. Trouble Localization. Many malfunctions are evident from the "Error Messages" field on the soft instrument display on the computer monitor. (See Table 5-15.) In each case the printed wiring board associated with the malfunction should be tested first. When attempting to localize a problem between printed wiring boards in the shield assembly refer to Table 5-16, the Shield Assembly Feed thru Wiring.

5-6.2.3. Troubleshooting, RF Board. Procedures for checking the RF circuit board are given in steps a thru y. Tests points and other measurement points are indicated on the schematic diagram and circuit board overlay, Figures 6-4 and 7-4. The test equipment required is listed below. See Table 5-1 for critical specifications.

Oscilloscope
Signal Generator **Refer to Table 5-3.**
DC voltmeter

a. Turn off the instrument power and remove the top cover. Turn on the instrument power, wait for a normal power-up sequence, then click on the "Reset" field.

b. Set the signal generator to 15 MHz CW at 0 dBm and connect the RF OUT to the Model 8701 RF IN connector.

c. Click on FREQ mode and enter 15 MHz into the Frequency Panel pop-up window Frequency Value field.

NOTE

For the following oscilloscope measurements, use a high impedance probe with a very short ground connection. A spring clip type ground connection is recommended.

d. Connect the oscilloscope probe to the RF input connector at the junction of R6 and R7, and measure the incoming signal. The signal should be about 400 millivolts peak-to-peak with a period of 67 nanoseconds. Some of the local oscillator signal may be present. Incorrect signals indicate defective input connectors, A3 module, or cables.

e. Connect the oscilloscope to J3. The signal should be about 700 millivolts peak-to-peak with a period of 33 nanoseconds. No signal indicates a defective local oscillator board.

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Table 5-15. Hardware Error Displays

Error Message Display	Probable Faulty PWB
No Display	VXI Processor/Power Supply PWB
Meaningless Symbols	CPU on VXI Processor PWB
20	AM PWB*
21	FM PWB
22	FM or Filter PWB
23-25	Detector PWB
26	AM or RF PWB
27,28	Filter PWB
30-33	Local Oscillator PWB
34	Local Oscillator PWB
35-39	CPU on VXI Processor PWB

* Printed Wiring Board

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Table 5-16. RF Housing Assembly Feedthru Wiring

VXI Board Signal	NameConnector Pin	Shield Assembly Feedthru Pin	Boonton PWB -Eterm No.	Type of Feedthru
P15VDC	P4-2	DETECT-FT1	DETECT-E1	HIGH CAP.
SCLOUT	P4-3	DETECT-FT2	DETECT-E14	LOW CAP.
SDAOUT	P4-4	DETECT-FT3	DETECT-E15	LOW CAP.
VCC	P4-6	DETECT-FT4	DETECT-E3	HIGH CAP.
AF2	P4-7	DETECT-FT5	DETECT-E10	LOW CAP.
AF1	P4-8	DETECT-FT6	DETECT-E18	LOW CAP.
LO_DISC	P4-9	DETECT-FT7	DETECT-E6	LOW CAP.
LO_INT	P4-10	DETECT-FT8	DETECT-E7	LOW CAP.
AM	P4-11	DETECT-FT9	DETECT-E9	LOW CAP.
ANALOGIN_DETECTOR	P4-13	DETECT-FT10	DETECT-E12	LOW CAP.
M15VDC	P4-14	DETECT-FT11	DETECT-E2	HIGH CAP.
DETECTORGROUND	P4-15	DETECT-FT12	DETECT-E13	HIGH CAP.
P15VDC	P5-2	FILTER-FT1	FILTER-E100	HIGH CAP.
SCLOUT	P5-3	FILTER-FT2	FILTER-E11	LOW CAP.
SDAOUT	P5-4	FILTER-FT3	FILTER-E26	LOW CAP.
VCC	P5-6	FILTER-FT4	FILTER-E102	HIGH CAP.
FM	P5-7	FILTER-FT5	FILTER-E35	LOW CAP.
AM	P5-8	FILTER-FT6	FILTER-E34	LOW CAP.
AF1	P5-9	FILTER-FT7	FILTER-E21	LOW CAP.
AF2	P5-10	FILTER-FT8	FILTER-E18	LOW CAP.
M15VDC	P5-14	FILTER-FT9	FILTER-E101	HIGH CAP.
P15VDC	P6-2	FM-FT1	FM-E8	HIGH CAP.
IF	P6-7	FM-FT2	FM-E1	LOW CAP.
FM	P6-13	FM-FT3	FM-E10	LOW CAP.
M15VDC	P6-14	FM-FT4	FM-E9	HIGH CAP.
P15VDC	P7-2	AM-FT1	AM-E1	HIGH CAP.
SCLOUT	P7-3	AM-FT2	AM-E12	LOW CAP.
SDAOUT	P7-4	AM-FT3	AM-E13	LOW CAP.
VCC	P7-6	AM-FT4	AM-E2	HIGH CAP.
IF	P7-7	AM-FT5	AM-E5	LOW CAP.
AM	P7-13	AM-FT6	AM-E8	LOW CAP.
M15VDC	P7-14	AM-FT7	AM-E4	HIGH CAP.
P15VDC	P8-2	RF-FT1	RF-E4	HIGH CAP.
SCLOUT	P8-3	RF-FT2	RF-E18	LOW CAP.
SDAOUT	P8-4	RF-FT3	RF-E19	LOW CAP.
VCC	P8-6	RF-FT4	RF-E6	HIGH CAP.
IF	P8-7	RF-FT5	RF-E11	LOW CAP.

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Table 5-16. RF Housing Assembly Feedthru Wiring (Continued)

VXI Board Signal Name	Connector Pin	RF Housing Assembly Feedthru Pin	Boonton PWB -Eterm No.	Type of Feedthru
M15VDC	P8-14	RF-FT6	RF-E5	HIGH CAP.
P15VDC	P9-2	LO-FT1	LO-E4	HIGH CAP.
SCLOUT	P9-3	LO-FT2	LO-E5	LOW CAP.
SDAOUT	P9-4	LO-FT3	LO-E6	LOW CAP.
VCC	P9-6	LO-FT4	LO-E3	HIGH CAP.
LODACIN	P9-7	LO-FT5	LO-E8	LOW CAP.
LO_DISC	P9-12	LO-FT6	LO-E7	LOW CAP.
LO_INT	P9-13	LO-FT7	LO-E9	LOW CAP.
M15VDC	P9-14	LO-FT8	LO-E2	HIGH CAP.

NOTE The feedthru pin numbering corresponds to the VXI Processor connector pin numbering, so that FT1 corresponds to connector pin 1. This is done to avoid wire crossovers between the Molex connector and the feedthru pins.

f. Move the oscilloscope to pin 9 of U8. The signal should be about 3.5 volts peak-to-peak with a period of 67 nanoseconds. If not, replace defective T1.

g. Use the oscilloscope probe to trace the TTL signal to pin 8 and pin 6 of U8. If not, replace defective U8.

h. Move the oscilloscope probe to pin 3 of U1. This should be a negative going TTL pulse about 12 nanoseconds wide with a period of 62 nanoseconds. If not, replace defective U1.

i. Move the oscilloscope probe to the collector of Q1 or Q2. The signal should be a negative going pulse about 12 volts peak-to-peak. If not, replace defective Q1 or Q2.

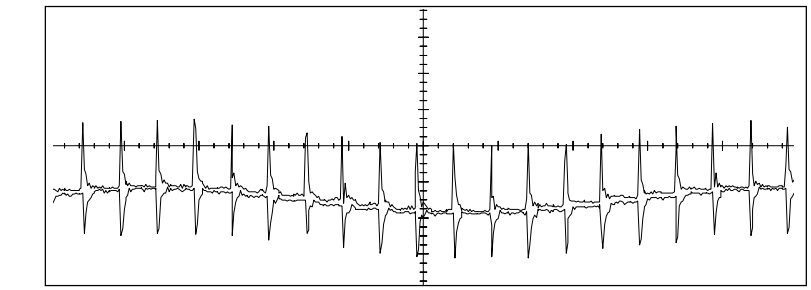
j. Move the oscilloscope probe to the anode of CR3. The signal should be as shown in Figure 5-5, D. If not, check for defective CR3.

k. The signals at pins 1 and 6 of T2 should be nearly equal amplitude, opposite polarity pulses between .7 and 1.1 volts peak with a 100 MHz oscilloscope bandwidth. If not, replace defective T2 or open CR4.

l. The signal at the junction of C3 and R13 should be indicated in Figure 5-5,B. Incorrect signals indicate defective sampling bridge or bridge bias circuits.

m. The signal at the junction of C10 and R19 should be as indicated in Figure 5-5,A. Incorrect signals indicate defective sampling bridge or bridge bias circuits.

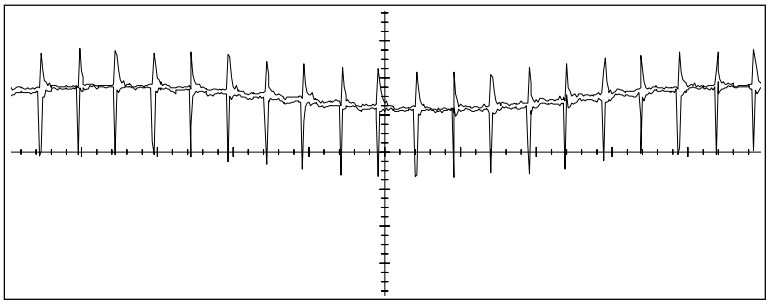
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A

Sensitivity
200 mV/div

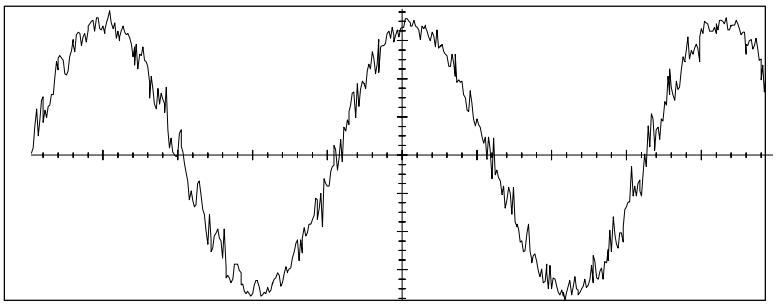
Timebase
100 ns/div



B

Sensitivity
200 mV/div

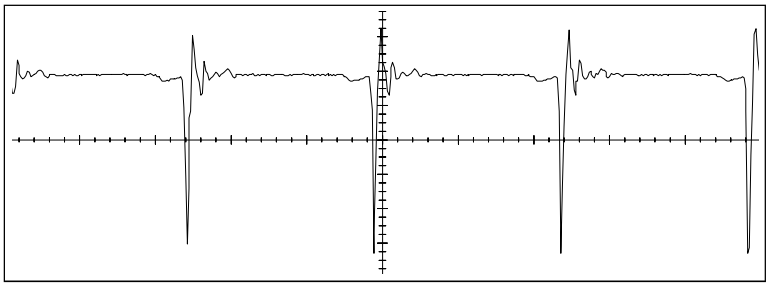
Timebase
100 ns/div



C

Sensitivity
200 mV/div

Timebase
200 ns/div



D

Sensitivity
5.00 V/div

Timebase
20.0 ns/div

Figure 5-5. RF Board Waveforms

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n. Move the oscilloscope probe to TP1. The signal should appear as in Figure 5-5, C. If the signal is not as indicated, troubleshoot the sampler amplifier, Q3-Q7 by dc and waveform measurements.

o. Connect the oscilloscope probe to the base of Q10. The signal is the same as at TP1, but ten times smaller. (40 millivolts peak-to-peak) If not, replace defective U2 or U3.

p. Connect the oscilloscope probe to TP2. The signal is the same as that at the base of Q10, but 3.6 times larger. (150 millivolts peak-to-peak). If the signal is not as indicated, troubleshoot the amplifier Q10, Q12-15 and Q17-18 by dc and waveform measurements.

q. Connect the oscilloscope probe to U12-6. The signal is the same as that at TP2. If not, replace defective K1.

r. Change the generator frequency to 500 kHz and set the Model 8701 carrier FREQ to 9 MHz. The signal at J4 pin 1 should be about 150 millivolts peak-to-peak with a period of 2 microseconds. If not, replace defective U10.

s. Move the oscilloscope probe to pin 1 of U5. The signal should be about 75 millivolts peak-to-peak. If not, replace defective U5 or troubleshoot filter L11, L3, L5, C43, 41, 37, 52.

t. Enter the following frequencies into the carrier FREQ function and observe the waveform on the indicated pins of U5. The signal is a 500 kHz signal as in step s. Incorrect signals indicate a defective U5, U6 or decoder U25.

FREQUENCY	**PIN**
11 MHz	pin 8
18 MHz	pin 2

u. Probe the signals on the collectors of Q19 and Q20. The signal should be a square wave about 3.5 volts peak-to-peak, with a 2 microsecond period. If not, replace defective U4 or associated components such as Q19 or Q20.

v. Move the oscilloscope probe to pin 6 of U12. The signal is a square wave as in step u with an amplitude of 600 millivolts.

w. The signal on pin 2 of U13 is as in step u with an amplitude of about 2 volts peak-to-peak. If not, replace defective U13, or open CR7.

x. The signal on pin 9 of U13 is a TTL waveform with a period of 14 microseconds. If not, replace defective U13.

y. Enter 2 Mhz into the carrier FREQ display. The signal on pin 9 of U13 is a TTL waveform with a period of 4 microseconds. If not, replace defective U13.

5-6.2.3.1. <u>Logic Signals.</u> Proper operation of the RF circuits depend on correct logic levels on the following control lines:

R0,R1.....IF attenuation and calibration
B1,B2.....band switching

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a. The following table indicates the TTL logic levels and the associated function for control lines R0 and R1:

Logic Line	Logic value	Operation
R0-R1	low-low	no IF attenuation
	low-high	attenuate IF by 10
	high-low	not used
	high-high	calibrator signal

b. The following table indicates the TTL logic levels and the associated function for control lines B1 and B2:

Logic Line	Logic Value	Operation
B1-B2	low-low	select filter U5, 2 divide by 7 U13 select/10
	low-high	select filter U5, 8 divide by 7 U13 select/10
	high-low	select filter U5, 2 divide by 2 U13 select/2
	high-high	select filter U5, 8 divide by 2 U13 select/2

c. Incorrect logic signals on the R0, R1, B1 or B2 lines indicate a problem with U25 8-bit Expander or a problem with I^2C lines SDA and SCL.

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5-6.2.4. Troubleshooting, Local Oscillator Board. Procedures for checking the oscillator board are given in steps a thru v. Test points and other measurement points are indicated on the schematic diagram and circuit board overlay, Figures 6-3 and 7-5. The test equipment required for troubleshooting is listed below. See Table 5-1 for critical specifications.

Oscilloscope
Signal Generator **Refer to Table 5-3.**
Multimeter

a. Turn off the instrument power and remove the top cover. Turn on the instrument power, wait for a normal power-up sequence, then click on the "Reset" field.

b. Measure the dc voltage at pin 20 of U21. The voltage should be approximately +5 volts. If not, the power supply circuits or the VXI Processor connectors are defective.

c. Measure the dc voltage at pins 7 and 4 of U23. The voltages should be +15 and -15 respectively. If not, the power supply circuits or the VXI Processor connectors are defective.

d. Measure the dc voltage at TP2. The voltage should be -14.0 volts. If not, troubleshoot regulator U1 and Q2 using dc measurements.

NOTE

For the following oscilloscope measurements, use a high impedance probe with a very short ground connection. A spring clip type ground connection is recommended. Also, due to the way the following special functions operate, it is best to send the commands using a VXIbus Interactive Control program. Special functions 80-88 operate when the command is parsed and executed until another command is received at which time the special function terminates and the 8701 control program resumes. The Soft Front panel continually sends the "tv" command for display updates and will cause these special functions to terminate prior to completing the test.

e. Send the command "SP80" to the 8701. Connect the oscilloscope probe to the source of Q1. The signal should be about 3 volts peak-to-peak with a period of 13 nanoseconds. If the indication is incorrect, troubleshoot oscillator Q1 using dc and waveform measurements.

f. Move the scope to the base of Q6. The signal should be as in the previous step except that the amplitude is 450 millivolts peak-to-peak. If not, replace defective Q3 or Q6.

g. Move the scope to pin TP3. The signal should be as in the previous step, but 700 millivolts peak-to-peak. If not, replace defective Q6.

h. Move the scope to pin 12 of U14. The signal should be a MECL level signal with a period of 13 nanoseconds. If the indication is incorrect, replace defective U12 or U15 or U14.

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i. To cancel the Active special function, first send the "cl" command. Move the scope to pin 19 of U14. The signal should be MECL level signal with a period of 100 nanoseconds. If the indication is incorrect, replace defective U14.

j. Next, send the command "SP83" to the 8701. The period of the signal in the previous step should change to 70 nanoseconds. If the indication is incorrect, troubleshoot counter U12, U14, and U15 using dc and waveform measurements.

k. Next, send the command "SP85" to the 8701. The period of the signal in the previous step should change to 60 nanoseconds. If the indication is incorrect, troubleshoot counter U12, U14, and U15 using dc and waveform measurements.

l. Next send the command "SP87" to the 8701. The period of the signal in the previous step should change to 50 nanoseconds. If the indication is incorrect, troubleshoot counter U12, U14 and U15 using dc and waveform measurements.

m. Set the signal generator to 1.211 MHz CW and 0 dBm and connect the RF OUT to the RF IN of the Model 8701.

n. Connect the oscilloscope probe to pin 2 of U13. The signal should be a TTL signal with a period of 800 nanoseconds. If not, the problem is associated with the RF circuit board.

o. Move the oscilloscope probe to pin 4 of U13. The signal should be a TTL signal with a period of 800 nanoseconds. Additionally, the time from the falling edge to the rising edge should be about 350 nanoseconds. If not, replace defective U13 or check C48 and R61.

p. Move the oscilloscope probe to TP1. The signal should be a triangular signal with a period of 800 nanoseconds and an average value of near zero volts. The oscilloscope must be dc coupled for this test. If not, replace defective U11.

q. Next send the command "SP80" to the 8701.

r. Measure the dc voltage at the end of R27 connected to R29. The voltage should be -10 volts. If not, the problem is on the VXI Processor board or in the interconnecting cable.

s. The other end of R27 should be 0 volts dc. If not, U9 or U6 is defective.

t. Measure the voltage at pin 1 of U6. The voltage should be +10 volts. If not, U9 or U6 is defective.

u. Measure the voltage at pin 3 of U22. The voltage should be -5 volts. If not, U6 is defective.

v. Measure the voltage at pin 6 of U22. The voltage should be -5 volts. If not, U22 is defective.

w. After the testing has been completed, send the "cl" to the 8701 to return the instrument to normal operation.

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NOTE

If all measurements to this point are correct, but trouble persists, the problem is with the logic circuits or U9 or possibly U20. Troubleshoot by dc voltage measurement or refer to the following logic signals troubleshooting.

5-6.2.4.1. **Calibrator Circuits.**

a.. Execute special function SPCL 30. Connect the oscilloscope probe to pin 10 of U4. The signal should be a TTL waveform with a period of 800 nanoseconds (1.25 MHz). If not, replace defective U4, U21, or switch Q7.

b. Move the oscilloscope probe to pin 1 of U4. The signal should be a TTL waveform with a period of 800 microseconds (1.221 kHz). If not, replace defective U4. If the calibration routine ends, send "SP30" to restart.

c. The signals on pins 3 and 4 of U21 control the output signals on pins 17 and 18. The logic levels and corresponding outputs are tabulated below.

Pin Numbers:

4	**3**	**18**	**17**
low	low	low	low
high	high	1.25 MHz	1.221 kHz
high	low	1.0/1.25 MHz	high
low	high	low	low

d. When special function SPCL 30 is Executed, the progression is from line 1 to line 2 to line 3 of the above table. Execute the calibration routine by selecting SPCL 30 and observe the results. The signals should be as indicated. If not, replace defective U21.

e. Execute the calibration routine by selecting SPCL 30. The initial phase of calibration is the AM detector calibration. The signals indicated in the following tests are measured during this initial phase. If the tests are not completed in the time required for one AM calibration cycle, re-send "SP30" command to resume AM calibration.

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f. Connect the oscilloscope to pin 3 of U10. The signal should be a sine wave with an amplitude of 2 volts peak-to-peak and a period of 800 nanoseconds. If not, isolate the defective component in low-pass filter L6-L7, and C16-18, and C20 by waveform measurements.

g. Move the oscilloscope to pin 6 of U10. The signals should be a sine wave with an amplitude of 6.4 volts peak-to-peak and a period of 800 nanoseconds. If not, replace defective U10.

h. Move the oscilloscope to pin 2 of U17. The signal should be as in the previous step, except the amplitude should be 4.8 volts peak-to-peak. If not, replace defective RZ8 or U17.

i. Move the oscilloscope to pin 15 of U17. The signal should be as in the previous step, except the amplitude should be 1.6 volts peak-to-peak. If not, replace defective RZ8 or U17.

j. Move the oscilloscope to pin 1 of U17. The signal should be a TTL waveform with a period of 800 microseconds. If not, check for shorted C13 or open R18 or shorted U17.

k. Move the oscilloscope to pin 3 of U17. The signal should be a sine wave with a period of 800 nanoseconds amplitude modulated by a squarewave with a period of 800 microseconds. The carrier amplitude should have two distinct levels, 1.6 and .8 volts peak-to-peak. If not, replace defective U17.

l. Move the oscilloscope to pin 6 of U16. The signal should be as in the previous step, except the amplitude should be 0.4 and 1.2 volts peak-to-peak. If not, replace defective U16.

m. If the above tests are all correct, but the problem persists, the trouble is with the RF circuits, or the interconnecting cable.

5-6.2.4.2. <u>Logic Signals.</u> Proper operation of the local oscillator circuits depend on correct logic levels on the following control lines as decoded by 8-bit Expander U26. (pins 10 and 11 of U26) (pins 4, 5 and 7 of U26)

FCO, FC1.....oscillator tuning
B0,B1,B3.....band switching

The following table indicates the logic levels and the associated function for control lines FC0 and FC1. Incorrect logic signals on the FC0,FC1, B0,B1, or B3 lines indicate a problem with U26 or with the I^2C signals.

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Logic Line	Logic Value	Operation
FC0-FC1	low-low	frequency lock, DS1 off
	low-high	frequency lock, DS1 on
	high-low	hold frequency, DS1 on
	high-high	hold frequency, DS1 off

Logic Line	Logic Value	Operation
B0, B1, B3	high-high-high	LO band 0 active
	low-high-high	LO band 1 active
	high-low-high	LO band 2 active
	low-low-high	LO band 3 active
	X - X - low	all oscillators inactive

X means does not care

5-6.2.5. Troubleshooting , FM Board. Procedures for checking the FM circuit board are given in steps a thru q below. Test points and other measurement points are indicated on the schematic diagram and circuit board overlay Figures 6-5 and 7-6. The test equipment required is listed below. See Table 5-1 for critical specifications.

Oscilloscope
Signal Generator **Refer to Table 5-3.**
DC voltmeter

a. Turn off the instrument and remove the top cover. Turn on the instrument power, wait for a normal power up sequence, then click on the "Reset" field.

b. Measure the dc voltage at pin 6 of AR1. The voltage should be approximately +5 volts. If not, troubleshoot the regulator circuit AR1 using dc measurements.

c. Measure the dc voltages at pins 7 and 4 of AR1. The voltages should be +15 and -15 volts respectively. If not, problem is in the power supply circuits or the VXI Processor interconnect.

d. Measure the dc voltage at either end of L7. The voltage should be -12.5 volts. If not, troubleshoot regulator Q14 using dc measurements.

e. Set the signal generator to 15 MHz and 0 dBm with 50 kHz FM at a 1 kHz rate.

f. Connect the RF OUT of the generator to the RF IN of the Model 8701 and click on the FM mode.

NOTE
For the following oscilloscope measurements, use a high impedance probe with a very short ground connection.

g. Connect the oscilloscope probe to the IF-IN signal located at E1. The signal should be an FM modulated signal with an amplitude of about 150 millivolts peak-to-peak and a period of 0.83 microseconds. Some of the local oscillator signal will be present. If not, the problem is on the RF board or the interconnecting cables.

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h. Move the oscilloscope probe to TP3. The signal should be as in step g except that the amplitude should be 75 millivolts peak-to-peak and the local oscillator signal should not be present. If not, check low-pass filter L3-L4, C1, and C4-C7 for open inductors or shorted capacitors.

i. Move the oscilloscope probe to TP2. The signal should be a clipped sinewave with an amplitude of 1 volt peak-to-peak. If not, troubleshoot limiter stages 1 and 2 (Q3) using dc and waveform measurements.

j. Move the oscilloscope probe to TP6. The signal should be a squarewave with an amplitude of 1 volt peak-to-peak. If not, troubleshoot limiter stages 3 and 4 (Q8) using dc and waveform measurements.

k. Move the oscilloscope probe to TP7. The signal should be as shown in Figure 5-6, A. If not, troubleshoot level shifter Q13 and associated components using dc and waveform measurements.

l. Move the oscilloscope probe to pin 5 of U1. The signal should be as shown in Figure 5-6, B. If not, replace defective U1.

m. Move the oscilloscope probe to TP8. The signal should be as shown in Figure 5-6, C. If not, troubleshoot comparator Q4-Q7 and current source Q2 using dc and waveform measurements. Additionally, check for defective Q1 or Q10.

n. Move the oscilloscope probe to TP1. The signal should be as shown in Figure 5-6, D. If not, troubleshoot comparator Q4-Q7 and current source Q2 using dc and waveform measurements. Additionally, check for defective Q1 or Q10.

o. Move the oscilloscope probe to TP9. The signal should be as shown in Figure 5-6, E. If not, troubleshoot current switch Q11 and Q12, or current source AR2 and Q9 using dc and waveform measurements. Additionally, check for defective Q1 or Q10.

p. Move the oscilloscope probe to TP11. The signal should be a sinewave with an amplitude of 300 millivolts peak-to-peak and a period of 1 millisecond. If not, check low-pass filter L5, L6, L9, L10, and C27, C28, C32, C33, C36, C39, C41, C42, and C44 for open inductors or shorted capacitors.

q. Move the oscilloscope probe to TP12. The signal should be a sinewave with an amplitude of 1 volts peak-to-peak and a period of 1 millisecond. If not, replace defective AR3, Q15, or Q16.

5-6.2.5.1. Logic Signals. The operation of the FM circuits does not require interface to the control logic.

5-6.2.6. Troubleshooting, AM Board. Procedures for checking the AM circuit board are given in steps a thru p. Test points and other measurement points are indicated on the schematic diagram and circuit board overlay Figures 6-6 and 7-7. The test equipment required is listed below. See Table 5-3 for critical specifications.

Oscilloscope	
Signal Generator	**Refer to Table 5-3.**
DC voltmeter	

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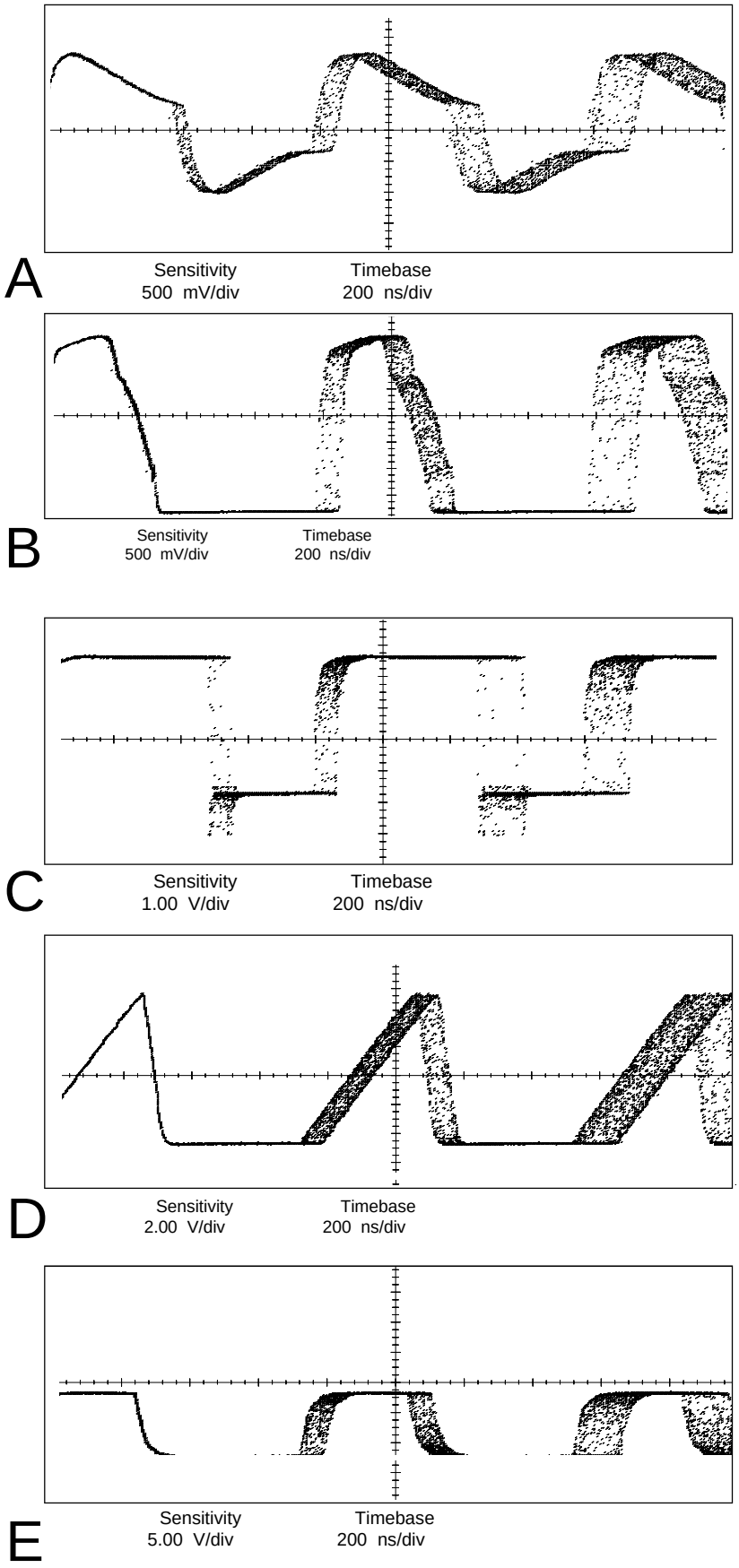


Figure 5-6. FM Board Waveforms

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a. Turn off the instrument and remove the top cover. Turn on the instrument power, wait for a normal power up sequence, then click on the "Reset" field.

b. Measure the dc voltage at pin 16 of U1. The voltage should be approximately +5 volts. If not, the power supply circuits or the VXI Processor connectors are defective.

c. Measure the dc voltage at pin 1 and pin 7 of U2. The voltages should be +15 and -15 volts respectively. If not, the power supply circuits or the VXI Processor connectors are defective.

d. Measure the dc voltage at either end of L7. The voltage should be +12 volts. If not, troubleshoot regulator Q1 and Q2 using dc measurements.

e. Set the signal generator to 15 MHz and 0 dBm with 50% AM at a 1 kHz rate.

f. Connect the RF OUT of the generator to the RF IN of the Model 8701 and click on the AM mode.

NOTE

For the following oscilloscope measurements, use a high impedance probe with a very short ground connection. A spring clip type ground connection is recommended.

g. Connect the oscilloscope probe to the IF-IN signal at E5. The signal should be an amplitude modulated signal with amplitude of about 200 millivolts peak-to-peak. The carrier period should be 0.83 microseconds and the modulation period should be 1 millisecond. Some local oscillator signal will be present. If not, the problem is on the RF board or the interconnecting cables.

h. Move the oscilloscope probe to TP1. The signal should be as in the previous step, except that the amplitude should be 350 millivolts peak-to-peak. Additionally, the local oscillator signal should not be present, and the dc level should be about 0 volts. If not, troubleshoot amplifier Q3-Q7 using dc and waveform . Move the oscilloscope probe to TP6. The signal should be as in the previous step, except that the amplitude should be 120 millivolts peak-to-peak and the dc level should be -0.5 volts. If not, proceed to logic signals troubleshooting for additional tests.

j. Move the oscilloscope probe to TP2. The signal should be as in the previous step, except that the amplitude should be 2.5 volts peak-to-peak. If not, troubleshoot feedback amplifier Q10 and Q13-Q16 using dc and waveform measurements.

k. Move the oscilloscope probe to pin 3 of Q22. The signal should be as shown in Figure 5-7, A. If not, troubleshoot active detector Q19-Q21 using dc and waveform measurements.

l. Move the oscilloscope probe to pin 7 of Q22. The signal should be as in the previous step, except it is inverted. If not, troubleshoot active detector Q19-Q21 using dc and waveform measurements.

m. Move the oscilloscope probe to pin 6 of AR2. The signal should be as shown in Figure 5-7, B. If not, troubleshoot buffer stage Q22 and AR2 using dc and waveform measurements.

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n. Move the oscilloscope probe to pin 3 of AR3. The signal should be a 0.55 volt peak-to-peak sine wave with a period of 1 millisecond and a dc level of +0.5 volts. If not, check for open inductors or shorted capacitors in low-pass filter L10-L12 and C50-C56.

o. Move the oscilloscope probe to TP3. The signal should be as in the previous step, except that the amplitude should be 1.1 volt peak-to-peak at a dc level of about 1 volt. If not, replace defective AR3.

p. Move the oscilloscope probe to the emitter lead of Q18. The signal should be an amplitude modulated signal with an amplitude of 2 volts peak-to-peak. The carrier period should be 0.83 microseconds and the modulation period should be 1 millisecond. If not, troubleshoot IF OUT buffer Q12 and Q17-Q18 using dc and waveform measurements.

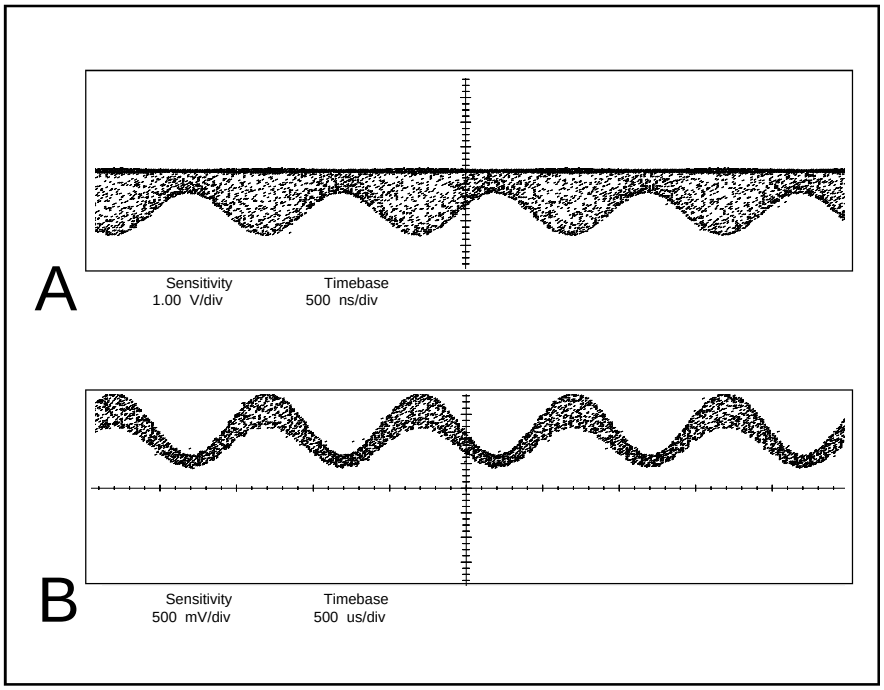


Figure 5-7. AM Board Waveforms

5-6.2.6.1 Logic Signals. Proper operation of the AM AGC circuits depend on correct logic levels on the following control lines:

Bits 1-8 ..... U2 DAC-08

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U1 is a serial to 8-bit Expander using I^2C protocol to decode the programming byte for AGC digital-to-analog (DAC). To troubleshoot the logic and the AGC circuits proceed as follows:

a. With the Model 8701 powered up normally and no carrier signal connected, click on "Reset" field.

b. Use the oscilloscope to monitor activity on the I^2C lines SCL and SDA on pins 14 and 15 on U1. The lines should show activity and normal TTL levels. If not, the problem is on the VXI Processor board or the interconnect.

c. Program the Model 8701 to FREQ mode, 15 MHz Frequency Value, and enter special function SPCL 35 to activate the AGC test program.

d. Enter special function SPCL 35 to activate the AGC attenuator test program. Enter 15 into the AM Modulation display to set maximum attenuation. The levels on the B1-B8 pins (9-16) of U2 should be:

B1	B2	B3	B4	B5	B6	B7	B8
Low	Low	Low	Low	High	High	High	High

If the TTL levels are incorrect, U1 or U2 is defective.

e. Enter 250 into the modulation display to set minimum attenuation. The levels on the B1-B8 pins (5-12) of U2 are tabulated below. (If the TTL levels are incorrect, U1 or U2 is defective.)

B1	B2	B3	B4	B5	B6	B7	B8
High	High	High	High	High	Low	High	Low

5-6.2.6.2. AGC Attenuator. The AGC attenuator in the Model 8701 is a programmable L-pad whose series and shunt arm resistance is controlled by adjusting the current thru a light dependent resistor while holding the dc voltage across the resistance constant. To troubleshoot the agc attenuator, proceed as follows:

a. Program the Model 8701 to FREQ mode, Frequency Value of 15 MHz carrier and 0 dBm carrier Level Value.

b. Measure the dc voltage from TP6 to ground. The voltage should be -0.5 volts. If the indication is incorrect, troubleshoot the shunt arm control loop consisting of AR1b and Q11 and associated components by dc voltage measurements, or replace defective Q9.

c. Measure the dc voltage across R28. The voltage should be -0.5 volts (+ 0.5 volts if the voltmeter polarity is reversed) If the indication is incorrect, troubleshoot the series arm control loop consisting of AR1a and Q7 and associated components by dc voltage measurements, or replace defective Q8.

5-6.2.7. Troubleshooting, Filter Board. Procedures for checking the FILTER circuit board are given in steps a thru ad. Test points and other measurement points are indicated on the schematic diagram and circuit board overlay, Figures 6-7 and 7-8. The test equipment required is listed below. See Table 5-1 for critical specifications.

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Oscilloscope
Audio Analyzer **Refer to Table 5-3.**
DC Voltmeter

a. Turn off the instrument and remove the top cover. Turn the instrument ON , click on FREQ mode and enter 15 MHz into the pop-up window Frequency Panel Frequency Value field.

b. Measure the dc voltage at pin 16 of U2. The voltage should be approximately +5 volts. If not the power supply circuits or the VXI Processor connectors are defective.

c. Measure the dc voltage at pins 7 and 4 of AR1. The voltages should be +15 and -15 volts respectively. If not the power supply circuits or the VXI Processor connectors are defective.

d. Set the audio analyzer source to 1 kHz and 600 millivolts.

e. First remove the wire from E10 on the FM Board to feed-thru FL25. Next connect the audio analyzer source output to FL25.

NOTE

For the following oscilloscope measurements, use a high impedance probe. E19 may be used as a convenient ground terminal.

f. Connect the oscilloscope probe to E35. The signal should be a sinewave signal with an amplitude of about 800 millivolts peak-to-peak and a period of 1 millisecond. If not, the problem is with the VXI Processor interconnect.

g. Move the oscilloscope probe to TP1. The signal should be as in the previous step, except that the amplitude should be 400 millivolts peak-to-peak. If not, check for defective relay K1, K2, or K3, or open inductor L4, L5, L6, or shorted capacitor C9-C12 or C14.

h. Change the audio analyzer frequency to 50 kHz. The signal should be as in the previous step, except that the amplitude should be about 250 millivolts peak-to-peak. If not, troubleshoot defective 50 kHz low-pass filter L4-L6 and C9-C12 and C14.

i. Select the Modulation Meter 220 kHz Low-Pass Filter Selection field flag. The signal should be as in the previous step, except that the amplitude should be 0.4 volts peak-to-peak. If not, check for defective relay K1, K2, or K3, or defective attenuator R4-R6.

j. Move the oscilloscope probe to TP2. The signal should be as in the previous step, except that the amplitude should be 4 volts peak-to-peak. If not, check for defective U3 or amplified AR1, or proceed to logic troubleshooting for additional tests.

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k. Move the oscilloscope probe to TP9. The signal should be as in the previous step, except that the amplitude should be 0.4 volts peak-to-peak. If not, check for defective U3 or amplifier AR12 or proceed to logic troubleshooting for additional tests.

l. Reduce the audio analyzer level to 60 millivolts. The Model 8701 should autorange and the signal at TP9 should be as in the previous step. If not, check for defective U3 or proceed to logic troubleshooting for additional tests.

m. Increase the audio analyzer level to 6 volts. The Model 8701 should autorange and the signal at TP9 should be as in the previous step. If not, check for defective U3 or proceed to logic troubleshooting for additional tests.

n. Move the oscilloscope probe to TP3 and set the audio analyzer frequency to 30 Hz. Depress the < 10 Hz high-pass filter key. The signal should be 1.8 volts peak-to-peak with a period of 33 milliseconds. If not, check for defective U4 or amplifier AR5, or proceed to logic troubleshooting for additional tests.

o. Depress the 30 Hz high-pass key. The signal should be as in the previous step, except that the amplitude should be 1.3 volts peak-to-peak. If not, check for defective U4 or amplifier AR2, or proceed to logic troubleshooting for additional tests.

p. Change the audio analyzer frequency to 300 Hz and depress the 300 Hz high-pass key. The signal should be 1.3 volts peak-to-peak and the period should be 3.3 milliseconds. If not, check for defective U4 or amplifier AR3, or proceed to logic troubleshooting for additional tests.

q. Change the audio analyzer frequency to 3000 Hz and select the 3000 Hz High-Pass Filter Selection flag. The signal should be 1.3 volts peak-to-peak and the period should be 0.33 milliseconds. If not, check for defective U4 or amplifier AR4, or proceed to logic troubleshooting for additional tests.

r. Change the audio analyzer frequency to 1 kHz and select the 30 Hz High-Pass Filter Selection flag. Move the oscilloscope probe to TP4. The signal should be 1.8 volts peak-to-peak and the period should be 1 millisecond. If not, check for defective U5 or amplifier AR8, or proceed to logic troubleshooting for additional tests.

s. Change the audio analyzer frequency to 20 kHz and depress the 20 kHz Low-Pass Filter Selection flag. The signal should be 1.3 volts peak-to-peak and the period should be 50 microseconds. If not, check for defective U5 or amplifier AR7, or proceed to logic troubleshooting for additional tests.

t. Change the audio analyzer frequency to 15 kHz and depress the 15 kHz Low-Pass filter Selection flag. The signal should be 1.3 volts peak-to-peak and the period should be 67 microseconds. If not, check for defective U5 or amplifier AR6a, or refer to logic signals troubleshooting for logic troubleshooting.

u. Change the audio analyzer frequency to 3 kHz and depress the 3 kHz low-pass key. The signal should be 1.3 volts peak-to-peak and the period should be 333 microseconds. If not, check for defective U5 or amplifier AR6b, or proceed to logic troubleshooting for additional tests.

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v. Change the audio analyzer frequency to 1 kHz and depress the 50 kHz Low-Pass Filter Selection flag. Move the oscilloscope probe to TP5. The signal should be 1.8 volts peak-to-peak and the period should be 1 millisecond. If not, check for defective U7 or amplifier AR10, or proceed to logic troubleshooting for additional tests.

w. Change the audio analyzer frequency to 6.366 kHz and depress the 25 µs De-emphasis Filter Selection flag. The signal should be 1.25 volts peak-to-peak and the period should be 157 microseconds. If not, check for defective U7 or filter R44, C49 or proceed to logic troubleshooting for additional tests.

x. Change the audio analyzer frequency to 3.183 kHz and select the 50 us De-emphasis Filter Selection flag. The signal should be 1.25 volts peak-to-peak and the period should be 314 microseconds. If not, check for defective U7 or filter R45, C50, or proceed to logic troubleshooting for additional tests.

y. Change the audio analyzer frequency to 2.122 kHz and select the 75 us De-emphasis Filter Selection flag. The signal should be as 1.25 volts peak-to-peak and the period should be 471 microseconds. If not, check for defective U7 or filter R46, C51, or proceed to logic troubleshooting for additional tests.

z. Change the audio analyzer frequency to 212 Hz and select the 750 us De-emphasis Filter Selection flag. The signal should be 1.25 volts peak-to-peak and the period should be 4.7 milliseconds. If not, check for defective U7 or filter R47, C52, or proceed to logic troubleshooting for additional tests.

aa. Change the audio analyzer frequency to 1 kHz and select the De-emphasis Filter Selection OFF flag. Note the amplitude of the signal, then click on the PM mode. The signal should remain the same. If not, check for defective U7 or amplifier AR9, or proceed to logic troubleshooting for additional tests.

ab. Change the audio analyzer frequency to 2 kHz. The signal amplitude should decrease to one-half of that in step aa. If not, troubleshoot filter circuit AR9 and associated components.

ac. Move the oscilloscope probe to E8. The signal should be as in the previous step. If not, replace defective analog-switch U8.

ad. Move the oscilloscope probe to TP6. The signal should be as in the previous step, except that the amplitude should be 2.4 volts peak-to-peak. If not, replace defective AR11.

5-6.2.7.1. **Logic Signals.** Proper operation of the FILTER circuits depend on correct logic levels on the following control lines:

D0 - D7, D10-D15 ..... Filter Board

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Logic signals from the instrument I^2C lines are transferred into 8-bit Expander, U2. Similarly data is transferred into U6 via I^2C protocol. To troubleshoot the logic circuits proceed as follows:

a. With the Model 8701 powered up normally and configured as above, depress the "Reset" key.

b. Use the oscilloscope to monitor activity on the instrument I^2C lines SDA, SCL pins 14 and 15 of U2. The data lines should show activity and normal TTL levels. If not, the problem is on the VXI Processor or the interconnect.

c. Set the audio analyzer level to 600 millivolts at 1 kHz and enter 15 MHz into the Model 8701 Frequency Panel pop-up window, Frequency Value field.

d. Move the oscilloscope probe to pin 4 of U2. Alternately click on the AM and FM modes. The signal should change from TTL high to low. If not, replace defective U2 or shorted Q1.

e. Move the oscilloscope probe to pin 5 of U2. Alternately depress the low-pass 220 and 50 keys. The signal should change from TTL high to low. If not, replace defective U2 or shorted U9.

f. Enter the following SPCL functions and note the corresponding activity on pins 6 and 7 of U2. If the indications are incorrect, replace defective U2 or U3.

SPCL	**PIN 6**	**PIN 7**
2	low	low
3	high	low
4	low	high

g. Operate the High-Pass Filter selection field flags and note the corresponding activity on pins 9, 10 and 11 of U2. If the indications are incorrect, replace defective U2 or U4.

KEY	**PIN 9**	**PIN 10**	**PIN 11**
<10	high	low	low
30	high	high	low
300	high	high	high
3000	high	low	high

h. Alternately click on the FM and PM modes and observe the corresponding activity on pin 12 of U2. If the indications are incorrect, replace defective U2 or U8.

KEY	**PIN 12**
FM	high
PM	low

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i. Operate the Low-Pass Filter Selection field flags and note the corresponding activity on pins 7, 9, and 10 of U6. If the indications are incorrect, replace defective U6 or U5.

KEY	PIN 7	PIN 9	PIN 10
3	high	low	high
15	high	low	low
20	low	low	high
50	high	high	high
220	high	high	high

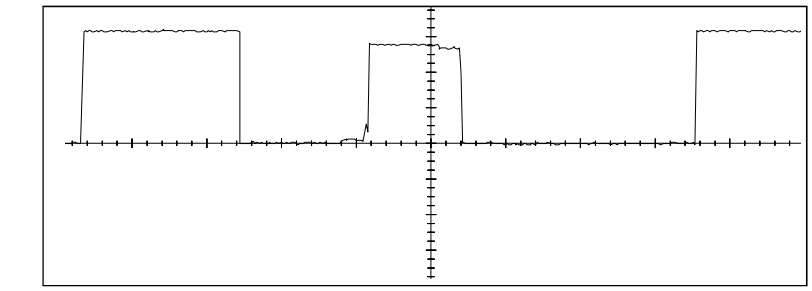
j. Click on the Modulation FM mode and operate the De-emphasis Filter Selection field flags. Note the corresponding activity on pins 4, 5, and 6 of U6. If the indications are incorrect, replace defective U6 or U7.

KEY	PIN 4	PIN 5	PIN 6
25	low	low	low
50	low	low	high
75	high	low	low
750	high	high	low
OFF	low	high	low

5-6.2.8. Troubleshooting, Detector Board. Procedures for checking the DETECTOR circuit board are given in steps a thru ac. Test points and other measurement points are indicated on the schematic diagram and circuit board Figures 6-8 and 7-9. The test equipment required is listed below. See Table 5-1 for critical specifications.

Oscilloscope
Audio Analyzer
Signal Generator **Refer to Table 5-3.**
DC Voltmeter

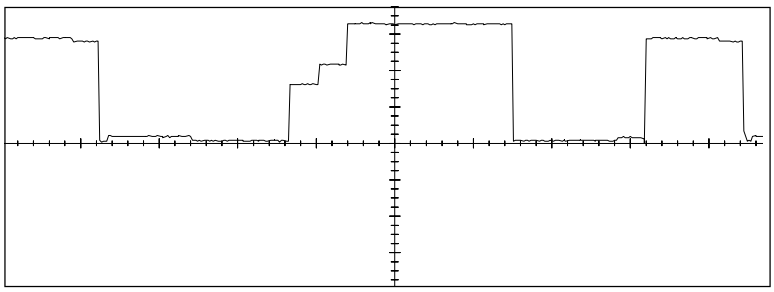
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A

Sensitivity
1.00 V/div

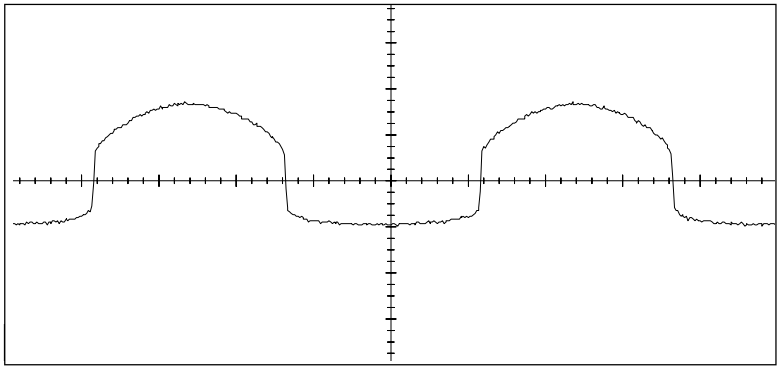
Timebase
20.0 ms/div



B

Sensitivity
2.00 V/div

Timebase
20.0 ms/div



C

Sensitivity
500 mV/div

Timebase
200 us/div

Figure 5-8. Detector Board Waveforms

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a. Turn off the instrument and remove the top cover. Turn the instrument power ON, click on FREQ mode and enter 15 MHz into the Frequency Value field.

b. Measure the dc voltage at pin 16 of U3. The voltage should be approximately +5 volts. If not the power supply circuits or the VXI Processor connectors are defective.

c. Measure the dc voltage at pins 7 and 4 of U14. The voltages should be +15 and -15 volts respectively. If not, the power supply circuits or the VXI Processor connectors are defective.

d. Measure the dc voltage at pins 7 and 1 of U23. The voltages should be +5 and -5 volts respectively. If not, troubleshoot regulator U23 using dc measurements.

e. Set the audio analyzer source to 1 kHz and 600 millivolts and connect the audio analyzer source output to the AUDIO (FM) OUT test point FL25 on the FM board of the Model 8701. Set the signal generator to 15 MHz, CW, at 0 dBm and connect the generator RF OUT to the RF IN connector on the Model 8701.

NOTE
For the following oscilloscope measurements, use a high impedance probe. TP2 can be used as a ground terminal.

f. Connect the oscilloscope probe to E18 on the Detector PWB. The signal should be a sinewave with an amplitude of about 1.8 volts peak-to-peak and a period of 1 millisecond. If not, the problem is on the Filter board or the VXI Processor interconnect.

g. Move the oscilloscope probe to TP5. The signal should be as in the previous step, except it is gated on and off about every 1.5 seconds. If not, check for defective switch U1, or amplifier U13, or proceed to logic troubleshooting for additional tests.

h. Move the oscilloscope probe to TP7. The signal should be as in the previous step. If not, replace defective U13.

i. Move the oscilloscope probe to TP8. The signal should be a low frequency rectangular waveform switching from the ground to about +0.8 volts at a 1.5 second rate. If not, check for defective switch U6, or amplifier U15 or U19, or proceed to logic troubleshooting for additional tests.

j. Move the oscilloscope probe to TP9. The signal should be as in the previous step. If not, check for defective switch U6, or amplifier U16 or U19, or proceed to logic troubleshooting for additional tests.

k. Measure the dc voltage at pin 13 of U7. The voltage should be 1 volt. If not, check filter R30 and C24, or the problem is on the AM board.

l. Move the oscilloscope probe to TP13. The signal should be as in Figure 5-8,A. If not, check for defective switch U7, or amplifier U22, or proceed to logic troubleshooting for additional tests.

m. Measure the dc voltages at E6 and E7 on the Detector PWB. The voltages should be about 0.210 and 0.319 volts respectively. If not, the problem is on the RF board or in the interconnecting cable.

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n. Measure the dc voltages at pins 4 and 5 of U9. The voltages should be about 2.1 and 2.2 volts respectively. If not, check the resistive attenuators R33-R35, and R38, R40 and R41, or replace defective U9.

o. Move the oscilloscope probe to TP14. The signal should be as in Figure 5-8, B. If not, check for defective switch U9, or amplifier U22, or proceed to logic troubleshooting for additional tests.

p. Select the Detector Selection RMS flag and move the oscilloscope probe to pin 6 of U11. The signal should be 5 volts peak-to-peak with a period of 1 millisecond. If not, check resistors R60-62, capacitor C22 or replace defective U11.

q. Move the oscilloscope probe to pin 3 of U14. The signal should be 0.5 volts peak-to-peak. If not, check for defective switch U5, or amplifier U14, or proceed to logic troubleshooting for additional tests.

r. Move the oscilloscope probe to pin 6 of U14. The signal should be 5.6 volts peak-to-peak. If not, check for defective switch U5, or amplifier U14, or proceed to logic troubleshooting for additional tests.

s. Move the oscilloscope probe to pin 3 of U18. The signal should be 0.56 volts peak-to-peak. If not, check for defective switch U5, or amplifier U18, or refer to logic signals troubleshooting below.

t. Move the oscilloscope probe to pin 6 of U18. The signal should be 6.6 volts peak-to-peak. If not, check for defective switch U5, or amplifier U18, or proceed to logic troubleshooting for additional tests.

u. Move the oscilloscope probe to TP3. The signal should be 0.66 volts peak-to-peak. If not, check for defective switch U4, or amplifier U20, or proceed to logic troubleshooting for additional tests.

v. Move the oscilloscope probe to TP10. The signal should be 7.6 volts peak-to-peak. If not, check for defective rms converter U8, or amplifier U20, or proceed to logic troubleshooting for additional tests.

w. Move the oscilloscope probe to TP11. The signal should be about 2.8 volts dc. If not, check for defective rms converter U8, or switch U9.

x. Move the oscilloscope probe back to TP10 and enter special function SPCL3 to set the 50.00 modulation range. Set the audio analyzer to the following levels and observe the resulting waveforms. The '*' in front of the indication means that the voltage will be initially higher and then change to the indicated value.

Analyzer Level (millivolts)	**Indication (volts peak-peak)**
0	baseline noise
0.5	6
1	*6
2	*5
5	*6
10	*6
20	*5
50	*6

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Analyzer Level (millivolts)	Indication (volts peak-peak)
100	*6
200	*5
500	*6
1000	12.4

y. If the indications are incorrect, isolate the defective analog switch U5 or U4, or refer to logic signals troubleshooting below.

z. Set the audio analyzer to 600 millivolts and move the oscilloscope probe to E18 on the Detector board. The signal should be 380 millivolts peak-to-peak with a period of 1 millisecond. If not, the problem is on the Filter board.

aa. Move the oscilloscope probe to pin 6 of U21. The signal should be as in Figure 5-8, C. If not, replace defective U21.

ab. Move the oscilloscope probe to the cathode of CR5. The signal should be a half-wave rectified signal 380 millivolts peak with a period of 1 millisecond. If not, isolate defective component in average detector circuit using dc and waveform measurements.

ac. Move the oscilloscope probe to pin 10 of U9. The voltage should be about 0.12 volts dc. If not, isolate defective component R45, C33, or U9.

5-6.2.8.1. **Logic Signals.** Proper operation of the DETECTOR circuits depend on correct logic levels on the following control lines: D0 - 13 detector board data lines. Logic signals from the instrument I^2C are transferred into 8-bit Expander U3. Similarly, data is transferred into U10 via I2C protocol. To troubleshoot the logic circuits proceed as follows:

a. With the Model 8701 powered up normally and configured as in the troubleshooting section, click on the "Reset" field.

b. Use the oscilloscope to monitor activity on the instrument I^2C lines SDA, SCL, pins 14 and 15 of U10. All of the data lines should show activity and normal TTL levels. If not, the problem is on the VXI Processor board or the interconnect.

c. Set the audio analyzer level to 600 millivolts at 1 kHz, enter 15 MHz into the Model 8701 Frequency Value field, and select the Detector Selection RMS flag.

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LEVEL	PIN 4	PIN 5	PIN 6	PIN 7	PIN 9	PIN 10
0	low	low	low	high	low	low
1	high	low	low	low	low	low
2	low	high	low	low	low	low
5	low	low	high	low	low	low
10	high	low	low	low	low	high
20	low	high	low	low	low	high
50	low	low	high	low	low	high
100	high	low	low	low	high	high
200	low	high	low	low	high	high
500	low	low	high	low	high	high
1000	low	low	high	low	high	high

d. Enter special function SPCL3 to hold the 50.00 modulation range, then set the audio analyzer to the indicated levels, in millivolts, and note the activity on pins 4, 5, 6, 7, 9 and 10 of U3. If the indications are incorrect, replace defective U3.

e. Select the PEAK ± detector and move the oscilloscope probe to pin 5 of U10. The signal should be alternating between logic high and logic low with a period of about 1.5 seconds. If not, replace defective U10 or U1.

f. Move the oscilloscope probe to pin 6 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U6.

g. Move the oscilloscope probe to pin 7 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U7.

h. Move the oscilloscope probe to pin 9 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U7.

i. Move the oscilloscope probe to pin 10 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U9.

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j. Move the oscilloscope probe to pin 11 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U9.

k. Move the oscilloscope probe to pin 12 of U10. The signal should be similar to the previous step. If not, replace defective U10 or U9.

l. Move the oscilloscope probe to pin 4 of U10. The signal should be a logic 0 (0 volts). If not, replace defective U10 or U1.

5-7. Disassembly

5-8. Disassembly of the Modulation Meter board is performed to the extent necessary to remove the defective attenuator assembly, control panel or printed wiring assembles (PWA). Figures 6-1 thru 6-8 and 7-1 thru 7-11 are the component location diagrams and schematic diagrams which support the disassembly procedures. The individual component(s), circuit boards should only be disassembled to the extent necessary to replace the defective part.

5-8.1. Preliminary Procedures.

a. Place the Modulation Meter on a suitable work surface.

b. Disconnect the IF OUT, AF OUT and RF IN cables from the front panel (5) (if necessary).

c. Remove the 29 flat head screws (14) securing the top cover (3) to the RF Housing Assembly (2).

d. Carefully turn the Modulation Meter over and remove the 6 flat head screws (14) securing the bottom cover (4) to the RF Housing (2).

e. Remove the screw (20) securing the bottom extractor handle to the bottom cover.

f. Carefully remove the bottom extractor handle (13) and the metal pivot sleeve inside the handle. Place all the hardware in a plastic bag to prevent loss of any part.

5-8.2. Front Panel.

a. Carefully disconnect the cable assemblies (3) at the rear of the front panel (5).

b. Remove the screw (20) and flat washer securing the top extractor handle kit (12) to the VXI Processor board (1).

c. Remove the front panel (5) and extractor handle (12) from the VXI Processor board (1).

5-8.3. Attenuator Assembly.

a. Perform preliminary disassembly procedures in paragraph 5-8.1.

b. Carefully disconnect and tag 2 cable assemblies from attenuator assembly (1) and unsolder 3 wires..

c. Remove 4 screws (18) and lock washers (19) securing attenuator assembly to VXI Processor board (1). Remove attenuator assembly.

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d. Remove two flathead screws (5) securing attenuator cover (2) to Housing (1). Remove cover.

e. To remove the attenuator printed wiring board assembly (3) proceed as follows:

1. Remove 2 screws and lock washers (6) securing both SMA connectors, J1 & J2 to the housing (1).

2. Remove two screws (4) and lock washers (6) securing printed wiring board (3) to housing (1).

WARNING

To prevent injury to personnel during soldering, do not use acid-core solder or an acid flux. Use care not to burn insulation during soldering. Eye protection must be worn during soldering/unsoldering operations to prevent injury to personnel.

3. Tag and unsolder both connector center conductors and three wires (8) at the rear of the board connecting it to the feed thru terminals (FL1, 2 and 3).

4. Remove the printed wiring board assembly (3) and place it in a ESD storage bag.

5-8.4. **VXI Processor/Power Supply.** To remove the VXI Processor board proceed as follows:

a. Perform preliminary disassembly procedures in paragraph 5-8.1.

b. Remove the front panel (5) and attenuator assembly (6) using the procedures in paragraphs 5-8.2 and 5-8.3 respectively.

c. Tag and remove the RF Housing assembly feed thru wiring from the VXI Processor connectors.

d. Remove five mounting nuts (17) and lock washers (26) securing the VXI Processor to the RF Housing assembly.

e. Separate the components and bag the hardware. Place the VXI Processor in a static free bag, if available, or cover it to keep foreign particles off its surfaces. The same precautions apply to the RF Housing assembly.

5-8.5. **Printed Wiring Board(s).** To remove a printed wiring board from the RF Housing assembly proceed as follows:

a. Perform preliminary disassembly procedure in paragraph 5-8.1.

b. Perform VXI Processor/power supply disassembly procedure in paragraph 5-8.4.

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CAUTION

This equipment (AM PWB) contains parts sensitive to damage by electrostatic discharge (ESD). Use ESD precautionary procedures as described in T0 00-25-234 when touching, removing, or inserting parts or assemblies. When handling static sensitive devices, wear a skin contact wrist strap.

c. Tag and unsolder all wires to feed thru terminals.

d. Remove four screws (15) securing printed wiring board to RF Housing assembly.

WARNING

To prevent injury to personnel during soldering, do not use acid-core solder or an acid flux. Use care not to burn insulation during soldering.

Eye protection must be worn during soldering/unsoldering operations to prevent injury to personnel.

5-9. Reassembly

5-10. Reassemble the component parts of the Modulation Meter in accordance with the following procedures. See figures 6-1 thru 6-12 and 7-1 thru 7-11 for the printed wiring board component location diagrams and schematic diagrams. It should be noted that the Modulation Meter component parts are reassembled in the reverse order of disassembly.

5-10.1. Replacement of Printed Wiring Board(s). To replace any one of the six printed wiring boards in the RF Housing assembly proceed as follows:

a. Place the printed wiring board in its slot in the RF Housing (1).

b. Secure the board to the RF Housing assembly with four screws (15).

WARNING

To prevent injury to personnel during soldering, do not use acid-core solder or an acid flux. Use care not to burn insulation during soldering.
Eye protection must be worn during soldering/unsoldering operations to prevent injury to personnel.

c. Resolder all the wiring to the board and remove tags.

d. Reassemble the Modulation Meter using the procedures in paragraph 5-10.1 thru 5-10.4.

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e. Perform the performance verification tests in paragraph 5-4.3.

5-10.2. VXI Processor/Power Supply. To reassemble the VXI Processor/power supply proceed as follows:

a. Place the RF Housing assembly on a clean work surface with the printed wiring boards face down.

b. Position VXI Processor board (1) over spacers (27).

c. Install the five mounting nuts (17) and lock washers (26) securing the VXI Processor to the RF Housing assembly.

d. Insert the RF Housing assembly feed thru terminal wiring into the appropriate connectors on the VXI Processor board (1).

5-10.3. Attenuator Assembly. To reassemble and replace the attenuator assembly proceed as follows: See figures 6-1 and 6-2.

a. Remove the attenuator printed wiring board from its protective bag and install it in the RF Housing (1).

WARNING

To prevent injury to personnel during soldering, do not use acid-core solder or an acid flux. Use care not to burn insulation during soldering.

Eye protection must be worn during soldering/unsoldering operations to prevent injury to personnel.

b. Replace and solder the three wires at the rear of the board to the chassis feed thru terminals. Remove and discard wire tags.

c. Secure the printed wiring board (3) to the RF Housing (1) with 2 lock washers (6) and screws (4).

d. Replace and secure the two SMA connectors (J1 and J2) to the RF Housing (1) with 2 screws (4) and lock washers (6) each.

e. Resolder both connectors to the printed wiring board.

WARNING

Isopropyl alcohol is flammable and toxic to eyes, skin, and respiratory tract. Skin and eye protection required. Avoid repeated/prolonged contact. Good general ventilation is normally adequate. Keep away from open flames or other sources of ignition.

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f. Carefully place the cover (2) on the housing (1) and secure in place with 2 flat head screws (5).

g. Position the attenuator assembly (6) on the VXI Processor and secure in place with 4 screws (18) and lock washers (19).

h. Connect two cable assemblies (9 and 11) to the attenuator assembly and resolder 3 wires.

i. Connect the free side of one cable (9) to the feed thru connector on the RF Housing assembly (2).

5-10.4. Modulator Meter Assembly. To reassemble the Modulator Meter assembly proceed as follows:

a. Make sure that all three connectors are securely fastened to the front panel.

b. Position the front panel (5) on the VXI Processor board making sure that both panel handles are installed.

c. Position the front panel extractor handle assembly adjacent to their anchor points and secure the bottom handle (13) to the bottom cover (4) with a screw and flat washer (20). Also, secure the top handle assembly (12) to the anchor point on the VXI Processor with a screw and flat washer (20).

NOTE
Make sure that both extractor handles have a metal pivot sleeve installed prior to fastening.

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5-11. Adjustments

5-12. The instrument adjustment procedure is described in the following paragraphs. The adjustment order is not critical, however, the following sequence is recommended.

5-12.1. RF Board Adjustments. There are four adjustments associated with the RF circuit board. These are:

ADJUSTMENT	PURPOSE
R14	sampling bridge balance
R12	sampling bridge bias, low bands
R77	sampling bridge bias, high bands
C46	IF flatness

5-12.1.1. Equipment Required. The equipment required to make the adjustments is listed below. See Table 5-2 for critical specifications.

Low-pass Filter **Oscilloscope** **Signal Generator** **Power Meter**	**Refer to Table 5-3.**

5-12.1.2. Procedure.

a. Connect the power meter to the RF IN connector on the instrument front panel.

b. Set the cursor on the FREQ mode of the "Measurement Function" field of the soft front panel and click. Note that the "Frequency Panel" pop-up window appears.

c. Set the "Frequency Units" field on MHz.

d. Using the computer keyboard set the "Frequency Value" field to 11.00 MHz.

e. Adjust variable resistor R14 for a minimum power indication.

f. Set the signal generator to 9.9 MHz, +10 dBm and about 100 kHz deviation at a 1 kHz rate.

g. Set the signal generator AM modulation to OFF.

h. Set the cursor on the "Reset" field of the soft front panel and click.

i. Using the keyboard enter 9.9 MHz into the "Frequency Value" field.

j. Select the 300 Hz High-Pass Filter Selection, 3 kHz Low-Pass Filter Selection and the OFF De-emphasis Filter Selection.

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k. Disconnect the Power Meter from the RF IN on the front panel.

l. Connect the generator, thru the Low-Pass Filter, to the RF IN connector the Model 8701.

m. Adjust the signal generator deviation for a Model 8701 indication of 100 + -5 kHz deviation.

n. Set the oscilloscope to 0.05 V/DIV and 0.5 mSEC/DIV and connect the Model 8701 AF OUT to the vertical input of the oscilloscope using a shielded BNC cable.

o. Click on the AM mode of the "Measurement Function" field and adjust variable resistor R12 on Figure 5-9 for minimum peak-to-peak deflection on the oscilloscope.

p. Change the signal generator and Model 8701 frequency to 18.5 MHz.

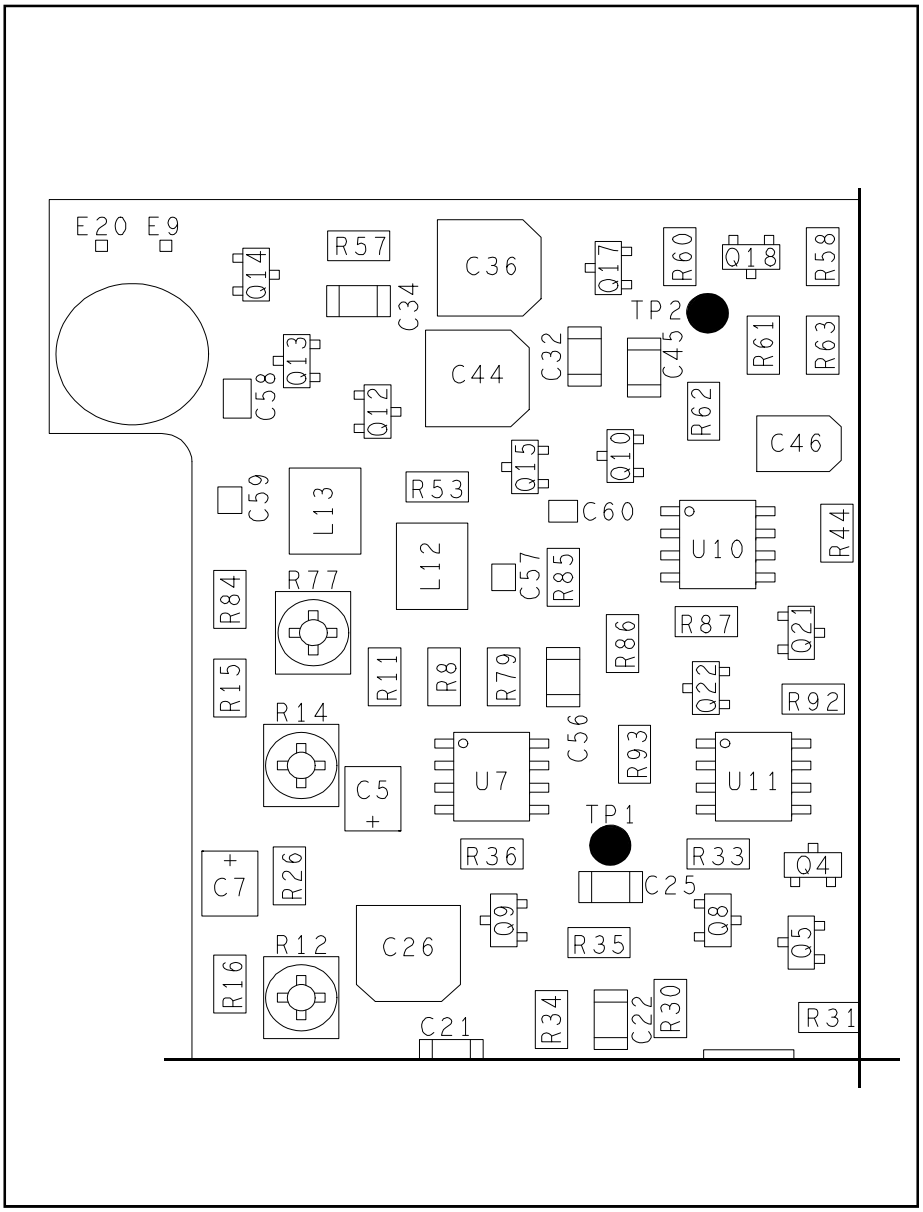


Figure 5-9. RF Board Adjustment

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q. Adjust variable capacitor C46 for minimum peak-to-peak deflection on the oscilloscope.

r. Change the signal generator and Model 8701 frequency to 10.02 MHz.

s. Adjust variable resistor R77 for minimum peak-to-peak deflection on the oscilloscope. Note that R77 may be at or near one end when the deflection is minimum.

5-12.2. AM Board Adjustments. There is one adjustment on the AM circuit board. This is the variable resistor R85 which adjusts the offset in the AM detector circuit.

5-12.2.1. Equipment Required. No additional equipment is required to make this adjustment.

5-12.2.2. Procedure.

a. Power up the VXI bus chassis and click on the "Reset" field of the soft front panel.

b. Set the cursor on the FREQ mode of the "Measurement Function" field of the soft front panel and click. Note that the "Frequency Panel" pop-up window appears.

c. Set the "Frequency Units" field on MHz.

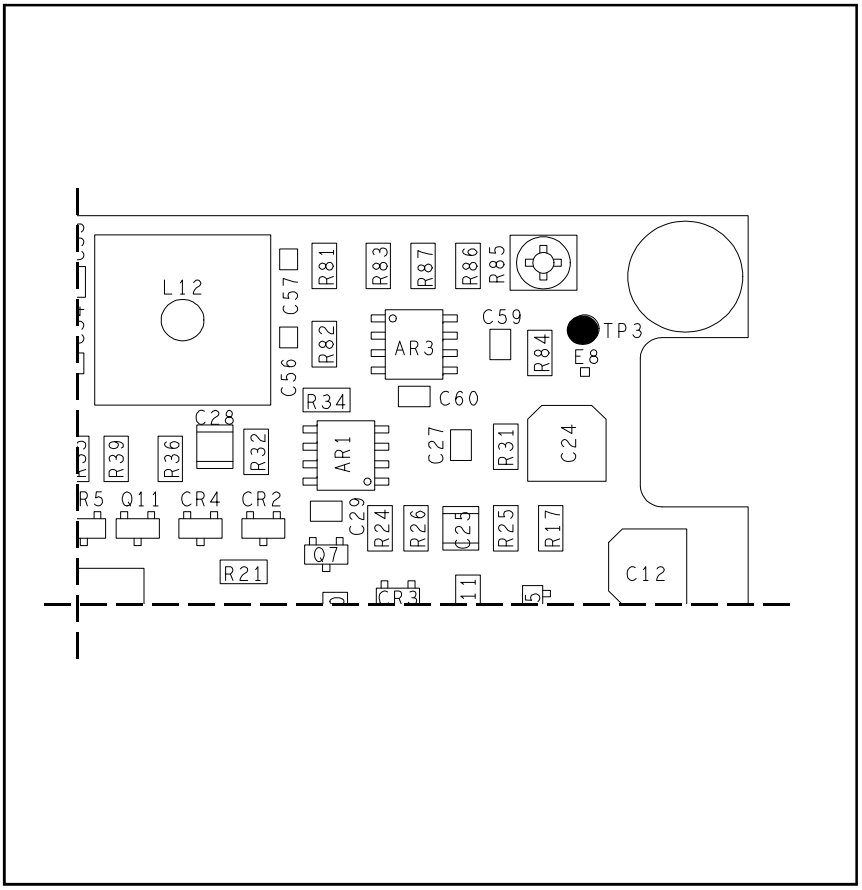


Figure 5-10. AM Board Adjustment

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d. Using the computer keyboard set the "Frequency Value" field to 100 MHz.

e. Observe the "Measurement Display" field on the soft front panel and adjust variable resistor R85 full clockwise. Then adjust R85 (Figure 5-10) counterclockwise for an indication of -70.8 dBm. Note that the indication will jump in approximately 1 dB increments during the adjustment.

5-12.3. Detector Board Adjustments. There is one adjustment on the DETECTOR circuit board. This adjustment is variable capacitor C23 which adjusts the RMS detector frequency response.

5-12.3.1. Equipment Required. The equipment required to make this adjustment is listed below. See Table 5-2 for critical specifications.

Audio Analyzer	
DC Voltmeter	**Refer to Table 5-3.**

5-12.3.2. Procedure.

a. With the instrument power off disconnect the wire from E10 on the FM Board at FL25.

b. Set the audio analyzer to 600 millivolts at a 1 kHz rate.

c. Connect the audio analyzer source to the FM OUT feed thru (FL25).

d. Turn on the instrument power and depress the "Reset" key.

e. Execute SPCL function 18, enter 15 MHz into the carrier FREQ display, and select the 220 kHz low-pass filter When the MODULATION display settles, select the "RATIO in Percent" display mode.

f. Set the audio analyzer to 100 kHz and note the modulation ratio indication.

g. Change the audio analyzer frequency back to 1 kHz, and select the RMS detector. Re-establish a ratio reference to a 100.0% indication.

h. Set the audio analyzer to 100 kHz and adjust C23 (Figure 5-11 on the detector board) until the ratio indication on the Model 8701 display is 100.0%.

i. Turn the instrument power OFF, remove the audio analyzer connection, and reconnect the FM board into the RF Housing Feed thru.

5-12.4. Oscillator Board Adjustments. There is one adjustment on the OSCILLATOR circuit board. This adjustment is variable resistor R37 which adjusts the IF centering.

5-12.4.1. Equipment Required. The equipment required to make the adjustment is listed as follows. See Table 5-1 for critical specifications.

Signal Generator	
Multimeter	**Refer to Table 5-3.**

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5-12.4.2. Procedure.

a. Set the generator frequency to 1.211 MHz CW and 0 dBm and connect the RF OUT to the RF IN on the front panel of the Model 8701.

b. Click on the "Send/Receive" field of the soft front panel. Note that the "User Interactive Send/Receive Panel" pop-up window appears.

c. Using the keyboard type in "SP28" in the "Send Message" field and click on "Send".

d. Monitor the dc voltage at pin 6 of U11, and adjust variable resistor R37 (Figure 5-12) for an indication of 0 ±0.02 volts.
5-64

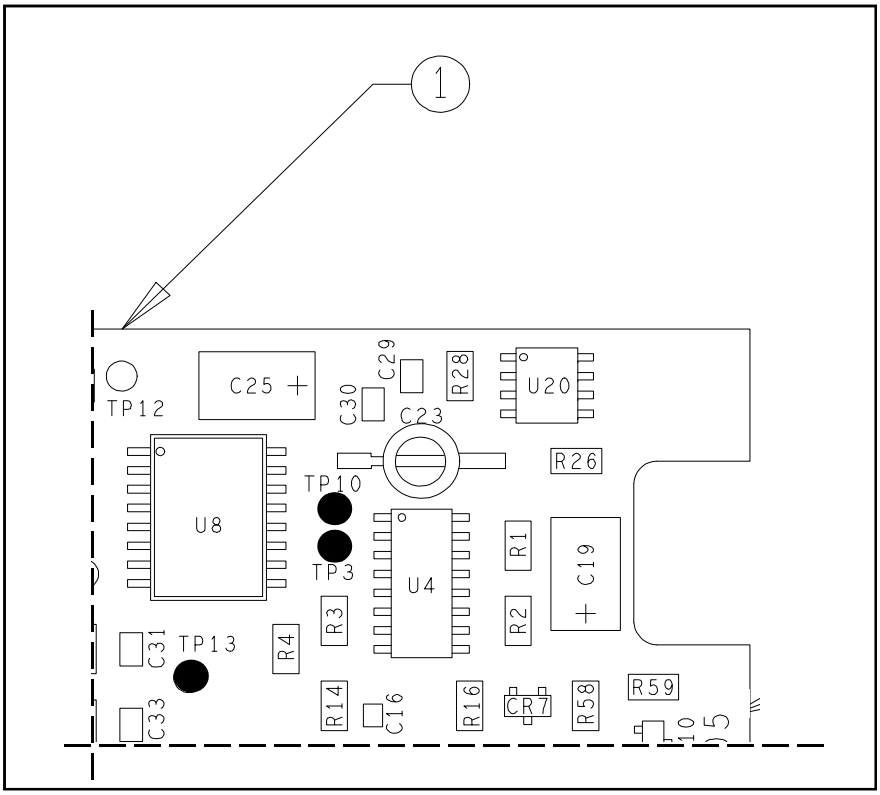


Figure 5-11. Detector Board

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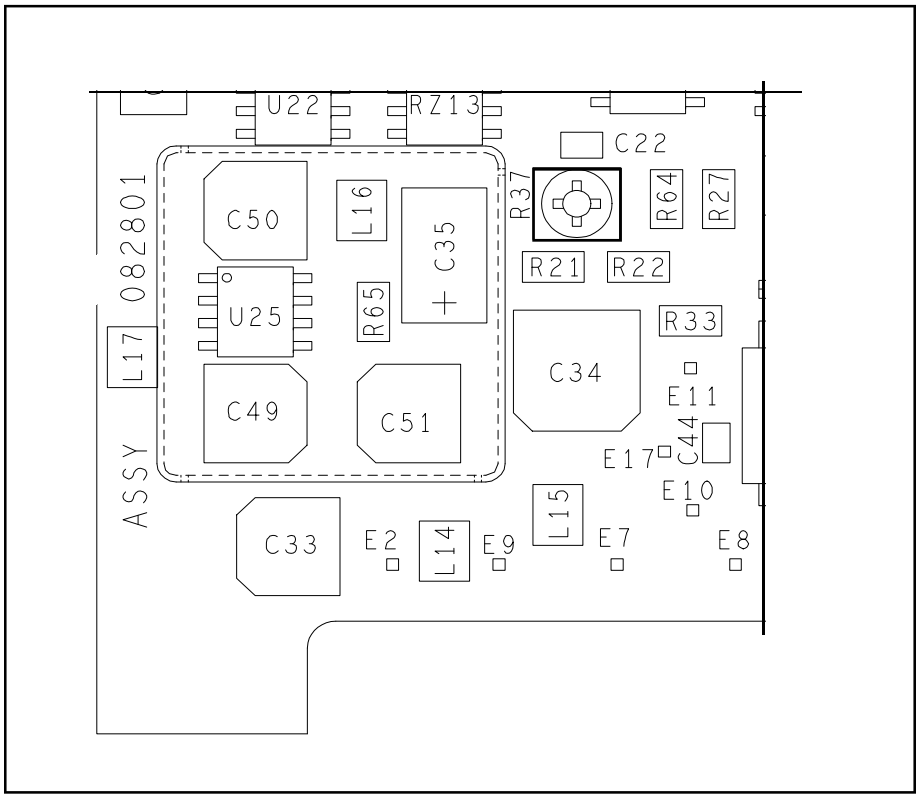


Figure 5-12. Oscillator Board Adjustment

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Chapter 6

Parts List

6-1. Introduction

6-2. This chapter contains a parts listing of the assemblies and components comprising the Modulation Meter, Model 8701. Each page of the listing contains the information necessary to locate the specific part(s) of the Modulation Meter. The maintenance parts list is composed of four columns, each which contains information applicable to the end item. The contents of each of the four columns is described in the following paragraphs.

6-3. The first column "Reference Designator", items are identified by index numbers appearing in the applicable illustrations. These index numbers are arranged in the first column of the parts list in consecutive numerical order.

6-4. In the second column, DESCRIPTION, the assembly or detail part is listed first by a noun name which is then followed by modifiers. (i.e. screw, flat head, stainless, etc.). Sufficient modifiers are used to provide an accurate description of the item.

6-5. The third column, PART NUMBER, identifies the part by a Boonton Electronics Corporation part number, a federal stock number or a vendor's part number.

6-6. The fourth column, QUANTITY (QTY), represents the amount of the specified part required for one assembly or subassembly. The abbreviation AR (as required), is used when the quantity required is determined when the parts are installed.

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99402800A	REV: AA 8701 MODULATION METER MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
(1)	PWA VXI PROCESSOR	08280600A	1
(2)	RF HOUSING ASSEMBLY	08280900A	1
(3)	COVER, TOP, RF HOUSING	60066200A	1
(4)	COVER, BOTTOM, RF HOUSING	60066300A	1
(5)	FRONT PANEL MARKED	60356000A	1
(6)	PROTECT ATTENUATOR ASSY	08280700A	1
(7)	CABLE ASSY COAX GPO/SMA	57232200A	2
(8)	CABLE ASSY COAX GPO/OSX	57232300A	2
(9)	CABLE ASSY COAX SEMI-FLEX	1-3636-601-2177	1
(10)	CONN RF BLKHD BNC TO SMA	3284-2240-00	2
(11)	CABLE ASSY COAX N TO SMA	57232500A	1
(12)	EXTRACTOR HANDLE KIT TOP	48338211A	1
(13)	EXTRACTOR HANDLE KIT BOT	48338222A	1
(14)	SCR 4-40X1/4 FH SL SS	911102000	35
(15)	SCR 4-40X3/8 BH SL SS SEMS	911004000	9
(16)	WASHER FLAT #4	840104000	5
(17)	NUT HEX SS 4-40 X 1/4	74527600	9
(18)	SCR 2-56X1/4 BH SL BR NP	793241000	4
(19)	WASHER LOCK #2 INT	843024000	4
(20)	HARDWARE KIT EXT HANDLE	21100-745	1
(23)	LOCTITE 222-31 THDLOCKER	222-31	0
(24)	LABEL MODEL/ SERIAL NUMBER	782642000	1
(25)	LABEL “MADE IN USA”	78290900A	1
(26)	WASHER LOCK #4 EXT	843005000	5
(27)	STANDOFF .09H M/M 4-40	74245100A	5
(28)	WIRE 24 AWG STRD PVC RED	920222020	2.5"
(28)	WIRE 24 AWG STRD PVC YEL	920222040	2.5"
(28)	WIRE 24 AWG STRD PVC BLU	920222060	2.5"

Table 6-1. Modulation Meter Assembly Parts List
Ref. Figure 7-1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

99402891A	REV: AA 8701 MODULATION METER MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
(1)	PWA VXI PROCESSOR	08280600A	1
(2)	RF HOUSING ASSEMBLY	08280900A	1
(3)	COVER, TOP, RF HOUSING	60066200A	1
(4)	COVER, BOTTOM, RF HOUSING	60066300A	1
(5)	FRONT PANEL UNIT	60356600A	1
(6)	PROTECT ATTENUATOR ASSY	08280700A	1
(7)	CABLE ASSY COAX GPO/SMA	57232200A	2
(8)	CABLE ASSY COAX GPO/OSX	57232300A	2
(9)	CABLE ASSY COAX SEMI-FLEX	1-3636-601-2177	1
(10)	CONN RF BLKHD BNC TO SMA	3284-2240-00	2
(11)	CABLE ASSY COAX N TO SMA	57232500A	1
(12)	EXTRACTOR HANDLE TOP	20817-330	1
(13)	EXTRACTOR HANDLE BOTTOM	20817-329	1
(14)	SCR 4-40X1/4 FH SL SS	911102000	35
(15)	SCR 4-40X3/8 BH SL SS SEMS	911004000	9
(16)	WASHER FLAT #4	840104000	5
(17)	NUT HEX SS 4-40 X 1/4	74527600	9
(18)	SCR 2-56X1/4 BH SL BR NP	793241000	4
(19)	WASHER LOCK #2 INT	843024000	4
(20)	HARDWARE KIT EXT HANDLE	21100-745	1
(23)	LOCTITE 222-31 THDLOCKER	222-31	0
(24)	LABEL MODEL/ SERIAL NUMBER	782642000	1
(25)	LABEL “MADE IN USA”	78290900A	1
(26)	WASHER LOCK #4 EXT	843005000	5
(27)	STANDOFF .09H M/M 4-40	74245100A	5
(28)	WIRE 24 AWG STRD PVC RED	920222020	2.5"
(28)	WIRE 24 AWG STRD PVC YEL	920222040	2.5"
(28)	WIRE 24 AWG STRD PVC BLU	920222060	2.5"
(29)	DECAL (RF-3 MEAS)	78291001A	1
(30)	DECAL (TETS LOGO)	78291002A	1

Table 6-1. Modulation Meter Assembly Parts List
Ref. Figure 7-1

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280900A	REV: AA RF HOUSING ASSEMBLY A2 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
(1)	HOUSING	81245100A	1
(2)	PWA RF	08280000A	1
(3)	PWA LO	08280100A	1
(4)	PWA AM	08280200A	1
(5)	PWA FM	08280300A	1
(6)	PWA FILTER	08280400A	1
(7)	PWA DETECTOR	08280500A	1
(8)	WASHER LOCK #4 SPLIT ST CP	743009000	47
(11)	CABLE ASSY SSMT	9960-1050-24	3
(13)	SCR 2-26X3/16 BH SL SS	793193000	2
(14)	WASHER LOCK #2 INT	843024000	2
(15)	SCR 4-40X1/4 BH SL SS SEMS	911002000	24
(16)	LOCTITE 222-31 THDLOCKER	222-31	0
(17)	CABLE ASSY RF HSNG 6 CIR RF	57131301A	1
(18)	CABLE ASSY RF HSNG 8 CIR LO	57131302A	1
(19)	CABLE ASSY RF HSNG 7 CIR AM	57131303A	1
(20)	CABLE ASSY RF HSNG 4 CIR FM	57131304A	1
(21)	CABLE ASSY RF HSNG 9 CIR FIL	57131305A	1
(22)	CABLE ASSY RF HSNG 12 CIR DET	57131306A	1
(23)	WIRE 24 AWG STRD PVC BLK	920222000	13.5"
(23)	WIRE 24 AWG STRD PVC BRN	920222010	19.5"
(23)	WIRE 24 AWG STRD PVC RED	920222020	19"
(23)	WIRE 24 AWG STRD PVC ORN	920222030	11.75"
(23)	WIRE 24 AWG STRD PVC YEL	920222040	9.25"
(23)	WIRE 24 AWG STRD PVC GRN	920222050	9.5"
(23)	WIRE 24 AWG STRD PVC BLU	920222060	12.25"
(23)	WIRE 24 AWG STRD PVC VIO	920222070	13.75"
(23)	WIRE 24 AWG STRD PVC GRY	920222080	3.75"
(23)	WIRE 24 AWG STRD PVC WHT	920222090	4.25"
(23)	WIRE 24 AWG STRD PVC W/BLK	920222900	1"
(23)	WIRE 24 AWG STRD PVC W/BRN	920222910	2"
P1-4	CONNECTOR M RF GPO	0119-612-3	4
J1	CONNECTOR SMA	SF-2950-6060	1
FL1	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL2-3	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL4	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL5	CAP FT 50pF 200VDC 4-40 THD	B4C500D	1
FL6	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL7	CAP FT 50pF 200VDC 4-40 THD	B4C500D	1
FL8	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL9-10	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL11	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL12-14	CAP FT 50pF 200VDC 4-40 THD	B4C500D	3
FL15-16	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	2
FL17-18	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL19	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL22-23	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	2

Table 6-2. RF Housing Assembly
Ref. Figure 7-2

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08280900A	REV: AA RF HOUSING ASSEMBLY A2 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
FL24-25	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL26-27	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	2
FL28-29	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL30	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL31-34	CAP FT 50pF 200VDC 4-40 THD	B4C500D	4
FL35-36	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	2
FL37-38	CAP FT 50pF 200VDC 4-40 THD	B4C500D	2
FL39	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	1
FL40-45	CAP FT 50pF 200VDC 4-40 THD	B4C500D	6
FL46-47	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	2

Table 6-2. RF Housing Assembly
Ref. Figure 7-2

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08280700A	REV: AA PROTECT ATTENUATOR ASSEMBLY A3 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
(1)	HOUSING ATTENUATOR	81245200A	1
(2)	COVER ATTENUATOR	60066400A	1
(3)	PWA PROTECT ATTENUATOR	08280800A	1
(4)	SCR 2-56X3/16 BH SL SS	793193000	8
(5)	SCR 2-56X3/16 FH SL BR NP	793243000	2
(6)	WASHER LOCK #2 INT	843024000	8
(7)	LOCTITE 222-31 THDLOCKER	222-31	0
(8)	WIRE 24 AWG STRD PVC RED	920220020	2"
(8)	WIRE 24 AWG STRD PVC YEL	920220040	2"
(8)	WIRE 24 AWG STRD PVC BLU	920220060	2"
J1-2	CONNECTOR SMA	SF-2950-606	2
FL1-3	CAP FT 5000pF 200VDC 4-40 THD	SCI-9120-502	3

Table 6-3. Protect Attenuator Assembly Parts List
Ref. Figure 7-3

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280000A	REV: BB PWA, 8701 RF A2A1 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C1	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C2	CAP FXD 680 pF, 10%, 50V	11C106COG681K050NB	1
C3	CAP FXD 6.8 pF,+- 0.25pF,50V	GRM426COG6R8C050AB	1
C4	CAP FXD 100pF, 5%,50V	11C1206CO101J050NB	1
C5	CAP FXD 1UF,10%,35V	T491B105K035AS	1
C6	CAP FXD 100pF, 5%,50V	11C1206CO101J050NB	1
C7	CAP FXD 1UF,10%,35V	T491B105K035AS	1
C8	CAP FXD 270 pF,10%,50V	C1206C271K5GAC	1
C9	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C10	CAP FXD 6.8 pF,+- 0.25pF,50V	GRM426COG6R8C050AB	1
C11	CAP FXD 8.2pF, 5%,50V	GRM426COG8R2C050AB	1
C12	CAP FXD 33pF, 5%,50V	11C1206COG330J050AB	1
C13	CAP FXD 270 pF,10%,50V	C1206C271K5GAC	1
C14	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C15	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C16	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C17	CAP FXD 270 pF,10%,50V	C1206C271K5GAC	1
C18	CAP FXD 680 pF, 10%, 50V	11C106COG681K050NB	1
C19-22	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	4
C23	CAP FXD 270 pF,10%,50V	C1206C271K5GAC	1
C24	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C25	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C26-27	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	2
C28	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C29	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C30-34	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	5
C35	CAP FXD 100pF, 5%,50V	11C1206CO101J050NB	1
C36	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C38	CAP FXD 100pF, 5%,50V	11C1206CO101J050NB	1
C39	CAP FXD 120pF, 5%,50V	ECU-V1H121JCH	1
C40	CAP FXD 100pF, 5%,50V	11C1206CO101J050NB	1
C41	CAP FXD 120pF, 5%,50V	ECU-V1H121JCH	1
C42	CAP FXD 33pF, 5%,50V	11C1206COG330J050AB	1
C43	CAP FXD 47pF, 5%, 50V	11C1206COG470J050AB	1
C44	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C45	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C46	CAP VAR 3-10 pF, 10%, 50V	GKY10000	1
C47-48	CAP FXD 100UF, 20%, 25V	NACEW101M25V6.3X8TR13	2
C49-50	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	2
C51	CAP FXD 33pF, 5%,50V	11C1206COG330J050AB	1
C52	CAP FXD 47pF, 5%, 50V	11C1206COG470J050AB	1
C55	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C56	CAP FXD 0.1UF,10%,50V	11C1206X7R104K050NB	1
C57	CAP FXD 300pF, 1%, 50V	0504N301F500N	1
C58	CAP FXD 1000 pF, 1%, 50V	0805N102F500N	1
C59	CAP FXD 300pF, 1%, 50V	0504N301F500N	1
C60	CAP FXD 100pF, 5%, 50V	0504N101J500N	1

Table 6-4. RF PWB Parts List
Ref. Figure 7-4

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280000A	REV: BB PWA, 8701 RF A2A1 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C61-63	CAP FXD 0.1UF, 10%, 50V	0805B104K250N	3
C64	CAP FXD 47pF, 5%, 50V	0504N470J500N	1
C65	CAP FXD 1UF,10%,35V	T491B105K035AS	1
C66	CAP FXD 10UF, 20%,35V	NACEW100M35V5X5.5TR13	1
C67	CAP FXD 22pF, 5%, 50V	0805N220J500N	1
CR1	DIODE HSMS2813 L30	HSMS-2813-L30	1
CR2	DIODE HSMS2814 L30	HSMS-2814-L30	1
CR3	DIODE SR 50820180	5082-0180	1
CR4-5	DIODE HSMS-2800	HSMS-2800#T30	2
CR7	DIODE HSMS-2800	HSMS-2800#T30	1
L1	INDUCTOR 33UH,10%	GLB33010	1
L2	INDUCTOR 8.2UH,20%	GLB8R220	1
L3	INDUCTOR 15UH,10%	SM3-152K	1
L4	INDUCTOR 8.2UH,20%	GLB8R220	1
L5	INDUCTOR 15UH,10%	SM3-152K	1
L6	INDUCTOR VAL,TOL,CURR	400409000 (VK-200—20/4B)	1
L7-9	INDUCTOR 1.5UH,10%	SM3-151K	3
L10	INDUCTOR 8.2UH,20%	GLB8R220	1
L11	INDUCTOR 15UH,10%	SM3-152K	1
L12-13	INDUCTOR 150UH,5%	1812LS-154XJBB	2
Q1-2	TRANSISTOR MRF3866	MRF3866	2
Q3	TRANSISTOR MMBF4416	MMBF4416L	1
Q4	TRANSISTOR MMBT3904	MMBT3904	1
Q5-6	TRANSISTOR MMBT3906	MMBT3906	2
Q7-8	TRANSISTOR MMBT3904	MMBT3904	2
Q9	TRANSISTOR MMBT3906	MMBT3906	1
Q10	TRANSISTOR MMBT3904	MMBT3904	1
Q11	TRANSISTOR,GENNFET	2N7016	1
Q12	TRANSISTOR MMBT3904	MMBT3904	1
Q13-14	TRANSISTOR MMBT3906	MMBT3906	2
Q15	TRANSISTOR MMBT3904	MMBT3904	1
Q17	TRANSISTOR MMBT3904	MMBT3904	1
Q18	TRANSISTOR MMBT3906	MMBT3906	1
Q19-20	TRANSISTOR MMBT3904	MMBT3904	2
Q21-22	TRANSISTOR SST108	SST108	2
R6-7	RES FXD 100,1%,1/4W	RCI-1206-1000F	2
R8	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	1
R9	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R10	RES FXD 332,1%,1/4W	RCI-1206-3320F	1
R11	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	1
R12	RES, VARIABLE 50K	3314G-1-503E	1
R13	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R14	RES, VARIABLE 10K	3314G-1-103	1

Table 6-4. RF PWB Parts List
Ref. Figure 7-4

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08280000A	REV: BB PWA, 8701 RF A2A1 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R15	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	1
R16	RES FXD 3.92K,1%,1/4W	RC1206-3.92K-1%	1
R17	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R18	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	1
R19	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R20	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R21	RES FXD 475,1%,1/4W	RC1206-475-1%	1
R22	RES FXD 33.2,1%,1/4W	RC1206-33.2-1%	1
R23	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R24	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R25	RES FXD 1.0K,1%,1/4W	RC1206-1.0K-1%	1
R26	RES FXD 3.92K,1%,1/4W	RC1206-3.92K-1%	1
R27	RES FXD 20.0K,1%,1/4W	RC1206-20.0K-1%	1
R28	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	1
R29	RES FXD 511,1%,1/4W	RC1206-511-1%	1
R30	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R31	RES FXD 511,1%,1/4W	RC1206-511-1%	1
R32-34	RES FXD 47.5,1%,1/4W	RC1206-47.5-1%	3
R35	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R36	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R37	RES FXD 909, 0.1%, 1/8W	RN73E2B9090B	1
R38	RES FXD 100,0.1%,1/4W	RN73E2B1000B	1
R39-40	RES FXD 100,1%,1/4W	RCI-1206-1000F	2
R41	RES FXD 47.5,1%,1/4W	RC1206-47.5-1%	1
R42	RES FXD 475,1%,1/4W	RC1206-475-1%	1
R43	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R44	RES FXD 47.5,1%,1/4W	RC1206-47.5-1%	1
R45	RES FXD 1.0K,1%,1/4W	RC1206-1.0K-1%	1
R46	RES FXD 3.92K,1%,1/4W	RC1206-3.92K-1%	1
R47	RES FXD 20.0K,1%,1/4W	RC1206-20.0K-1%	1
R48-50	RES FXD 6.81K,1%,1/4W	RCI-1206-6811F	3
R52	RES FXD 511,1%,1/4W	RC1206-511-1%	1
R53	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R54	RES FXD 511,1%,1/4W	RC1206-511-1%	1
R55	RES FXD 3.32K,1%,1/4W	RC1206-3.32K-1%	1
R56	RES FXD 15, 1%,1/4W	RC1206-15.0-1%	1
R57-58	RES FXD 47.5,1%,1/4W	RC1206-47.5-1%	2
R59	RES FXD 3.32K,1%,1/4W	RC1206-3.32K-1%	1
R60	RES FXD 22.1, 1%,1/4W	RC1206-22.1-1%	1
R61	RES FXD 1.0K,1%,1/4W	RC1206-1.0K-1%	1
R62	RES FXD 392,1%,1/4W	RC1206-392-1%	1
R63	RES FXD 2.0K,1%,1/4W	RC1206-2.0K-1%	1
R64	RES FXD 100,1%,1/4W	RCI-1206-1000F	1
R65	RES FXD 475,1%,1/4W	RC1206-475-1%	1
R67	RES FXD 3.32K,1%,1/4W	RC1206-3.32K-1%	1
R68	RES FXD 332,1%,1/4W	RCI-1206-3320F	1
R71	RES FXD 3.32K,1%,1/4W	RC1206-3.32K-1%	1

Table 6-4. RF PWB Parts List
Ref. Figure 7-4

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280000A	REV: BB PWA, 8701 RF A2A1 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R73	RES FXD 33.2,1%,1/4W	RC1206-33.2-1%	1
R77	RES, VARIABLE 50K	3314G-1-503E	1
R78	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R79	RES FXD 432,1%,1/4W	RK73H2B432RF	1
R80-81	RES FXD 100,1%,1/4W	RCI-1206-1000F	2
R82	RES FXD 825,1%,1/4W	RK73H2B825RF	1
R83	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R84	RES FXD 432,1%,1/4W	RK73H2B432RF	1
R85	RES FXD 68.1,1%,1/4W	RK73H2B68R1F	1
R86-89	RES FXD 1.0K,1%,1/4W	RC1206-1.0K-1%	4
R90-91	RES FXD 47.5K,1%,1/4W	RK73H2B4752F	2
R92-94	RES FXD 110K,1%,1/4W	RK73H2B1103F	3
R95	RES FXD 13K,1%,1/4W	RK73H2B1302F	1
R96	RES FXD 1.5K,1%,1/4W	RK73H2B1501F	1
R97	RES FXD 221,1%,1/4W	RK73H2B221RF	1
R98	RES FXD 332,1%,1/4W	RCI-1206-3320F	1
R99	RES FXD 221,1%,1/4W	RK73H2B221RF	1
T1	TRANSFORMER XFMRSYM	41009000B (BOONTON)	1
T2	TRANSFORMER ,GENPUR	RTC-1-1	1
T3	TRANSFORMER XFMRSYM	41009000B (BOONTON)	1
J1-J3	CONNECTOR SSMT COAXIAL	2367-0000-54	3
U1	MICROCKT SN74S00N	SN74S00D	1
U2-3	MICROCKT DG419	DG419DY	2
U4	MICROCKT MC10116FN	MC10116FN	1
U5-7	MICROCKT DG419	DG419DY	3
U8	MICROCKT 74F00SC	SN74F00D	1
U9	MICROCKT 74LS90	DM74LS90M	1
U10	MICROCKT NE5534A	TLN5534A	1
U11	MICROCKT DG419	DG419DY	1
U12	MICROCKT LF356	LF356BM	1
U13	MICROCKT SN74LS163AN	SN74LS163AM	1
U24	MICROCKT DG419	DG419DY	1
U25	MICROCKT PCF8574	PCF8574AT	1

Table 6-4. RF PWB Parts List
Ref. Figure 7-4

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280100A	REV: BB PWA, 8701 LO A2A2 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C1	CAP FXD 150PF, 1%, 300V	175B151JCP300X	1
C2	CAP FXD 120PF, 1%, 50V	1206N121F500N	1
C3	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	1
C4	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C5	CAP CER 2.2PF, +-0.25PF, 500V	175B2RR2CP500	1
C6	CAP FXD 47PF,5%,50V	1206N470J500N	1
C7	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	1
C8	CAP FXD 0.001UF, 10%, 100V	0805N102K500N	1
C9	CAP FXD 22PF,5%,50V	1206N220J500N	1
C10	CAP FXD 0.1UF ,5%, 50V	NSPC104J50TRD2	1
C11	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C12	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C13	CAP FXD 0.001UF, 10%, 100V	0805N102K500N	1
C14	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	1
C15	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C16	CAP FXD 300PF,5%,50V	0504N301J500N	1
C17	CAP FXD 560PF,5%,50V	0504N561J500N	1
C18	CAP FXD 300PF,5%,50V	0504N301J500N	1
C19	CAP FXD 0.1UF ,5%, 50V	NSPC104J50TRD2	1
C20-21	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	2
C22	CAP FXD 0.001UF, 10%, 100V	0805N102K500N	1
C28	CAP FXD 10PF, 5%, 50V	0504N100J500N	1
C29	CAP CER 3PF, +-0.5PF, 50V	0504N3R3D500N	1
C30	CAP FXD 100PF, 5%, 50V	0504N101J500N	1
C31-33	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	3
C34	CAP ELEC 100UF, 20%, 25V	NACEW101M25V6.3X8TR13	1
C35	CAP TANT 10UF, 20%, 35V	ECS-T1VD106R	1
C36	CAP FXD 0.01UF, 20%, 50V	0805U103MXAMT	1
C37	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	1
C40-41	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	2
C42	CAP FXD 0.1UF, 20%, 50V	1206U104MXAMT	1
C43	CAP ELEC 100UF, 20%, 25V	NACEW101M25V6.3X8TR13	1
C44	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C46-47	CAP ELEC 100UF, 20%, 25V	NACEW101M25V6.3X8TR13	2
C48	CAP FXD 250PF, 5%, 50V	0504N251J500N	1
C49-51	CAP ELEC 10UF, 20%, 35V	NACEW100M35V5X5.5TR13	3
CR2	DIODE HSMS-2800	HSMS-2800 L30	1
CR3-4	DIODE SEMICOND MV2115	MV2115	2
CR7-8	DIODE MMBD914	FMMD914CT-ND	2
CR9-10	DIODE HSMS-2800	HSMS-2800 L30	2

Table 6-5. Local Oscillator PWB, Parts List
Ref. Figure 7-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280100A	REV: BB PWA, 8701 LO A2A2 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
J1-J3	CONNECTOR SSMT COAXIAL	2367-0000-54	3
L1	INDUCTOR 15UH, 10%, CURR	1812LS-153XJBB	1
L2	INDUCTOR 0.22UH,10%,CURR	SM3-220K	1
L3	INDUCTOR 15UH, 10%, CURR	1812LS-153XJBB	1
L5	INDUCTOR 4.7UH,10%,CURR	SML32-471K	1
L6-7	INDUCTOR 82UH,5%,CURR	GLB82010	2
L12	INDUCTOR 330UH,10%,CURR	1812LS-334XJBB	1
L13-17	INDUCTOR 5.6UH,10%,CURR	SML32-561K	5
Q1	TRANSISTOR MMBF4416	MMBF4416	1
Q2	TRANSISTOR MMBT4403	MMBT4403	1
Q3	TRANSISTOR CMPT918	CMPT918	1
Q6	TRANSISTOR MMBT3904	MMBT3904	1
Q7	TRANSISTOR MMBT4403	MMBT4403	1
Q8	TRANSISTOR MMBT4401	MMBT4401	1
Q9	TRANSISTOR MMBT3906	MMBT3906	1
R1	RES FXD 15K,1%,1/4W	RK73H2B1502F	1
R3	RES FXD 4.99K,1%,1/4W	RK73H2B4991F	1
R4	RES FXD 243,1%,1/4W	RK73H2B2430F	1
R5	RES FXD 14K,1%,1/4W	RK73H2B1402F	1
R6	RES FXD 1.10K,1%,1/4W	RK73H2B1101F	1
R7	RES FXD 1K,1%,1/4W	RK73H2B1001F	1
R8	RES FXD 4.7M,1%,1/4W	RK73H2B4754F	1
R9	RES FXD 100,1%,1/4W	RK73H2B100RF	1
R10	RES FXD 243,1%,1/4W	RK73H2B2430F	1
R11	RES FXD 464,1%,1/4W	RK73H2B464RF	1
R14	RES FXD 1.5K,1%,1/4W	RK73H2B1501F	1
R15	RES FXD 1.82K,1%,1/4W	RK73H2B1821F	1
R16	RES FXD 3.32K,1%,1/4W	RK73H2B3321F	1
R17	RES FXD 464,1%,1/4W	RK73H2B464RF	1
R18	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R21	RES FXD 1K,1%,1/4W	RK73H2B1001F	1
R22	RES FXD 51.1K,1%,1/4W	RK73H2B5112F	1
R23	RES FXD 243,1%,1/4W	RK73H2B2430F	1
R24	RES FXD 464,1%,1/4W	RK73H2B464RF	1
R25	RES FXD 2K,1%,1/4W	RK73H2B2001F	1
R26	RES FXD 1K,1%,1/4W	RK73H2B1001F	1
R27	RES FXD 51.1K,1%,1/4W	RK73H2B5112F	1

Table 6-5. Local Oscillator PWB, Parts List
Ref. Figure 7-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280100A	REV: BB PWA, 8701 LO A2A2 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
R29	RES FXD 511K,1%,1/4W	RK73H2B5113F	1
R31	RES FXD 51.1K,1%,1/4W	RK73H2B5112F	1
R32	RES FXD 20K,1%,1/4W	RK73H2B2002F	1
R33	RES FXD 1K,1%,1/4W	RK73H2B1001F	1
R37	RES VARIABLE 5K,10%,1/2W	3314G-1-502E	1
R38	RES FXD 4.75K,1%,1/4W	RK73H2B4751F	1
R39	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R40	RES FXD 511,1%,1/4W	RK73H2B511RF	1
R42	RES FXD 5.11K,1%,1/4W	RK73H2B5111F	1
R44	RES FXD 5.11K,1%,1/4W	RK73H2B5111F	1
R47	RES FXD 243,1%,1/4W	RK73H2B2430F	1
R48	RES FXD 1K,1%,1/4W	RK73H2B1001F	1
R49	RES FXD 2K,1%,1/4W	RK73H2B2001F	1
R50	RES FXD 464,1%,1/4W	RK73H2B464RF	1
R51-52	RES FXD 4.99K,1%,1/4W	RK73H2B4991F	2
R56	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R57	RES FXD 511,1%,1/4W	RK73H2B511RF	1
R58	RES FXD 100,1%,1/4W	RK73H2B100RF	1
R59	RES FXD 3.92M,1%,1/4W	RK73H2B3924F	1
R60	RES FXD 4.75K,1%,1/4W	RK73H2B4751F	1
R61	RES FXD 24.9K,1%,1/4W	RK73H2B2492F	1
R62	RES FXD 511K,1%,1/4W	RK73H2B5113F	1
R64	RES FXD 8.25K,1%,1/4W	RK73H2B8251F	1
R65	RES FXD 200,1%,1/4W	RK73H2B200RF	1
R66	RES FXD 10K,1%,1/4W	RK73H2B1002F	1
R67	RES FXD 2K,1%,1/4W	RK73H2B2001F	1
R99	RES FXD 22.1,1%,1/4W	RK73H2B22R1F	1
R100	RES FXD 39.0,1%,1/4W	RK73H2B39R0F	1
R101	RES FXD 220,1%,1/4W	RK73H2B2200F	1
RZ8	RES,FXD,NTWK 500, 0.5%	4K08T-001-5000DCB	1
RZ13	RES,FXD,NTWK 50K, 0.5%	4K08T-001-5002DBB	1
RZ34	RES,FXD,NTWK 470, 1%	766-161-R470	1
RZ46	RES,FXD,NTWK 470 1%	4K08T-001-4700FAD	1
T1	OSC TRSFORMER XFMRSYM	40046200A (Boonton)	1
U1	MICROCKT LF356	LF356M	1
U4	MICROCKT 74HC4040	MM74HC4040M	1
U6	MICROCKT TLO72	TL072ACD	1
U9	MICROCKT ADG509A	ADG509AKR	1

Table 6-5. Local Oscillator PWB, Parts List
Ref. Figure 7-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280100A	REV: BB PWA, 8701 LO A2A2 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
U10	MICROCKT LM318	LM318M	1
U11	MICROCKT LF356	LF356M	1
U12	MICROCKT MC10109	MC10109FN	1
U13	MICROCKT 74LS123	DM74LS123M	1
U14	MICROCKT MC10131	MC10131FN	1
U15	MICROCKT MC10136	MC10136FN	1
U16	MICROCKT HA2625	HA9P2625-5	1
U17	MICROCKT LF13333	LF13333M	1
U20	MICROCKT DG419	DG419DY	1
U21	MICROCKT PEEL18CV8	18CV8J-10	1
U22	MICROCKT LT1012	LT1012S8	1
U23	MICROCKT LF356	LF356M	1
U25	MICROCKT LTC1144	LTC1144CS8	1
U26	MICROCKT PCF8574	PCF8574AT4371W	1
Y1	OSC,XTAL 10.000MHz	SE2209CT-ND	1

Table 6-5. Local Oscillator PWB Parts List
Ref. Figure 7-5

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280200A	REV: BB PWA, 8701 AM A2A3 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
AR1	AMPLIFIER ,TL072	TL072ACD	1
AR2	AMPLIFIER ,LM318M	LM318M	1
AR3	AMPLIFIER ,LF356	LF356M	1
C1	CAP FXD, 100pF, 1%, 50V	0504 N 101 F 500 N	1
C2	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C3	CAP FXD, 100uF, 20%, 25V	NACEW 101 M 25V 6.3X8 TR 13	1
C4	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C5	CAP FXD, 100uF, 20%, 25V	NACEW 101 M 25V 6.3X8 TR 13	1
C6	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C7	CAP FXD, 180pF, 1%, 50V	0504 N 181 F 500N	1
C8	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C9	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C10	CAP FXD, 100pF, 1%, 50V	0504 N 101 F 500 N	1
C11-12	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	2
C13	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C14	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C15	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C16-18	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	3
C19	CAP FXD, 470pF, 1%, 50V	0805 N 471 F 500 N	1
C20-21	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	2
C22	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C23	CAP FXD, 0.01uF, 10%, 50V	0805 B 103 K 500 N	1
C24	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C25	CAP FXD, 0.1uF, 2%, 16V	NSPC 104 G 16 BC3	1
C26	CAP FXD, 1uF, 20%	1812 Z 105 M 500 N	1
C27	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C28	CAP FXD, 0.1uF, 2%, 16V	NSPC 104 G 16 BC3	1
C29	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C30	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C31	CAP FXD, 0.5pF, +-0.1pF, 50V	0805 N 0R5 B 500 N	1
C32	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C33	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C34	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C35	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C36	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C37	CAP FXD, 1000pF, 1%, 50V	0805 N 102 F 500 N	1
C38-39	CAP FXD, 10uF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	2
C40	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C41	CAP TANT, 10UF, 20%, 25V	T491D 106 M 025 AS	1
C42	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C43	CAP FXD, 1uF, 20%	1812 Z 105 M 500 N	1
C44	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	1
C45	CAP FXD, 22pF, 5%, 50V	0504 N 220 J 500 N	1
C46-47	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	2
C48	CAP FXD, 22pF, 5%, 50V	0504 N 220 J 500 N	1
C50	CAP FXD, 300pF, 1%, 50V	0504 N 301 F 500 N	1

Table 6-6. AM PWB Parts List
Ref. Figure 7-6

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08280200A	REV: BB PWA, 8701 AM A2A3 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C51	CAP FXD, 1000pF, 1%, 50V	0805 N 102 F 500 N	1
C52	CAP FXD, 300pF, 1%, 50V	0504 N 301 F 500 N	1
C53	CAP FXD, 1000pF, 1%, 50V	0805 N 102 F 500 N	1
C54	CAP FXD, 300pF, 1%, 50V	0504 N 301 F 500 N	1
C56	CAP FXD, 300pF, 1%, 50V	0504 N 301 F 500 N	1
C57	CAP FXD, 15pF, 5%, 50V	0504 N 150 J 500 N	1
C58	CAP TANT, 1.0uF, 10%, 35V	T491B 105 K 035 AS	1
C59-60	CAP FXD, 0.1uF,20%, 50V	0805 U 104 MXAMT	2
C61	CAP FXD, 100uF, 20%, 25V	NACEW 101 M 25V 6.3X8 TR 13	1
C62	CAP FXD, 75pF, 1%, 50V	0504 N 750 F 500 N	1
CR1-5	DIODE, MMBD914	FMMD914CT	5
CR6	DIODE, HSMS2812	HSMS-2812#T30	1
DS1-2	DIODE, NSL-28-005	CLM6500	2
L1-3	IND, 5.6UH, 10%	SML32-561K	3
L4	IND, 33UH, 5%	1812 LS-333 XJBB	1
L5-6	IND, 47UH, 10%	SML32-472J	2
L7-8	IND, 5.6UH, 10%	SML32-561K	2
L9	IND, 820UH, 5%	1812LS-824XJBB	1
L10	IND VAR, 902UH	40047601A (BOONTON)	1
L11	IND VAR, 1450 UH	40047602A (BOONTON)	1
L12	IND VAR, 902UH	40047601A (BOONTON)	1
L13	IND, 1000 UH, 5%	43CS 300SS-102 JC	1
Q1	TRANSISTOR , MMBT3906	MMBT3906	1
Q2	TRANSISTOR, PZT2222AT1	FZT2222A	1
Q3-4	TRANSISTOR , MMBT3906	MMBT3906	2
Q5-6	TRANSISTOR, MMBT3904	MMBT3904	2
Q7	TRANSISTOR, MMBT4401	MMBT4401	1
Q8-10	TRANSISTOR, MMBF4416	MMBF4416	3
Q11	TRANSISTOR, MMBT4401	MMBT4401	1
Q12	TRANSISTOR, MMBT3904	MMBT3904	1
Q13-14	TRANSISTOR , MMBT3906	MMBT3906	2
Q15-17	TRANSISTOR, MMBT3904	MMBT3904	3
Q18-20	TRANSISTOR , MMBT3906	MMBT3906	3
Q21	TRANSISTOR, MMBT3904	MMBT3904	1
Q22	TRANSISTOR, SST440	SST440	1
R1	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
R2	RES FXD, 2.49K, 1%, 1/4W	RK73H2B2491F	1
R3	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R4-5	RES FXD, 15K, 1% , 1/4W	RK73H2B1502F	2
R6	RES FXD, 562, 1%, 1/4W	RK73H2B5620F	1
R7	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
R8	RES FXD, 3.32K, 1%, 1/4W	RK73H2B3321F	1

Table 6-6. AM PWB Parts List
Ref. Figure 7-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280200A	REV: BB PWA, 8701 AM A2A3 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R9	RES FXD, 1.5K, 1%, 1/4W	RK73H2B1501F	1
R10	RES FXD, 5.36K, 1%, 1/4W	RK73H2B5361F	1
R11	RES FXD, 7.5K 1%, 1/4W	RK73H2B7501F	1
R12	RES FXD, 5.11K, 1%, 1/4W	RK73H2B5111F	1
R13	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R14	RES FXD, 332, 1%, 1/4W	RK73H2B332RF	1
R15	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R17	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
R18	RES FXD, 75, 1%, 1/4W	RK73H2B75R0F	1
R19	RES FXD, 1.5K, 1%, 1/4W	RK73H2B1501F	1
R20-21	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	2
R22	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
R23	RES FXD, 1.5K, 1%, 1/4W	RK73H2B1501F	1
R24	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R25	RES FXD, 9.31K, 1%, 1/4W	RK73H2B9311F	1
R26	RES FXD, 14K, 1%, 1/4W	RK73H2B1402F	1
R27	RES FXD, 49.9K, 1%, 1/4W	RK73H2B4992F	1
R28	RES FXD, 75K, 1%, 1/4W	RK73H2B7502F	1
R29	RES FXD, 100K, 1%, 1/4W	RK73H2B1003F	1
R30	RES FXD, 499K, 1%, 1/4W	RK73H2B4993F	1
R31	RES FXD, 267K, 1%, 1/4W	RK73H2B2673F	1
R32	RES FXD, 9.31K, 1%, 1/4W	RK73H2B9311F	1
R33	RES FXD, 75K, 1%, 1/4W	RK73H2B7502F	1
R34	RES FXD, 267K, 1%, 1/4W	RK73H2B2673F	1
R35	RES FXD, 499K, 1%, 1/4W	RK73H2B4993F	1
R36	RES FXD, 14K, 1%, 1/4W	RK73H2B1402F	1
R37	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R38	RES FXD, 3.01K, 1%, 1/4W	RK73H2B3011F	1
R39	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R40-41	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	2
R42	RES FXD, 9.09K, 1%, 1/4W	RK73H2B9091F	1
R43	RES FXD, 2K, 1%, 1/4W	RK73H2B2001F	1
R44	RES FXD, 3.32K, 1%, 1/4W	RK73H2B3321F	1
R45	RES FXD, 1.5K, 1%, 1/4W	RK73H2B1501F	1
R46	RES FXD, 11K, 1%, 1/4W	RK73H2B1102F	1
R47-48	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	2
R49	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R50	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R51	RES FXD, 3.01K, 1%, 1/4W	RK73H2B3011F	1
R52	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R53-54	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	2
R55	RES FXD, 2K, 1%, 1/4W	RK73H2B2001F	1
R56	RES FXD, 22.1 , 1%, 1/4W	RK73H2B22R1F	1
R57	RES FXD, 8.25K, 1%, 1/4W	RK73H2B8251F	1
R58	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
R59	RES FXD, 1.62K , 1%, 1/4W	RK73H2B1621F	1
R60	RES FXD, 3.32K, 1%, 1/4W	RK73H2B3321F	1

Table 6-6. AM PWB Parts List
Ref. Figure 7-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280200A	REV: BB PWA, 8701 AM A2A3 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
R61	RES FXD, 4.75K, 1%, 1/4W	RK73H2B4751F	1
R62	RES FXD, 3.32K, 1%, 1/4W	RK73H2B3321F	1
R63	RES FXD, 8.25K, 1%, 1/4W	RK73H2B8251F	1
R64-65	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	2
R66-67	RES FXD, 221, 1%, 1/4W	RK73H2B221RF	2
R68	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R69	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R70	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R71	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R72	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R73	RES FXD, 9.09K, 1%, 1/4W	RK73H2B9091F	1
R74	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	1
R75	RES FXD, 9.09K, 1%, 1/4W	RK73H2B9091F	1
R76	RES FXD, 47.5, 1%, 1/4W	RK73H2B47R5F	1
R77-79	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	3
R80	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R81	RES FXD, 12.7K, 1%, 1/4W	RK73H2B1272F	1
R82	RES FXD, 1K, 1%, 1/4W	RK73H2B1001F	1
R83-84	RES FXD, 10K, 1%, 1/4W	RK73H2B1002F	2
R85	RES VAR, 100K, 10%, 1/2W	3314G-1-104E	1
R86	RES FXD, 301K, 1%, 1/4W	RK73H2B3013F	1
R87	RES FXD, 4.7M, 5%, 1/4W	RM73B2B475J	1
R88	RES FXD, 511, 1%, 1/4W	RK73H2B5110F	1
U1	MICROCKT, PCF8574	PCF8574AT4371W	1
U2	MICROCKT, DAC08	DAC08CS	1

Table 6-6. AM PWB Parts List
Ref. Figure 7-6

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280300A	REV: AA PWA, 8701 FM A2A4 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
AR1	AMPLIFIER , NE5534	TLN5534A	1
AR2	AMPLIFIER , LF356BM	LF356BM	1
AR3	AMPLIFIER , NE5534	TLN5534A	1
C1	CAP FXD, 240PF, 5%, 50V	0504 N 241 J 500 N	1
C2	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C3	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C4	CAP FXD, 8.2PF, +-0.5PF, 50V	0504 N 8R2 D 500 N	1
C5	CAP FXD, 91pF, 5%, 50V	0504 N 910 J 500 N	1
C6	CAP FXD, 8.2PF, +-0.5PF, 50V	0504 N 8R2 D 500 N	1
C7	CAP FXD, 22pF, 5%, 50V	0504 N 220 J 500 N	1
C8	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C9	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C10	CAP FXD, 100PF, 1%, 50V	0504 N 101 F 500 N	1
C11	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C12	CAP FXD 100UF,20%,25V	NACEW 101 M 25V 6.3X8 TR 13	1
C13	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C14-15	CAP FXD 0.01UF,10%,50V	0805 B 103 K 500 N	2
C17	CAP FXD 100UF,20%,25V	NACEW 101 M 25V 6.3X8 TR 13	1
C18	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C19	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C20-21	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	2
C22-23	CAP FXD 0.01UF,10%,50V	0805 B 103 K 500 N	2
C24	CAP FXD 100UF,20%,25V	NACEW 101 M 25V 6.3X8 TR 13	1
C25	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C26	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C27	CAP FXD, 200PF, 1%, 50V	0805 N 201 F 500 N	1
C28	CAP FXD, 240PF, 5%, 50V	0504 N 241 J 500 N	1
C29	CAP FXD, 680PF, 1%, 50V	0805 N 681 F 500 N	1
C30-31	CAP FXD 0.01UF,10%,50V	0805 B 103 K 500 N	2
C32	CAP FXD, 200PF, 1%, 50V	0805 N 201 F 500 N	1
C33	CAP FXD, 470PF, 1%, 50V	0805 N 471 F 500 N	1
C34-35	CAP FXD 100UF,20%,25V	NACEW 101 M 25V 6.3X8 TR 13	2
C36	CAP FXD, 1000PF, 1%, 50V	0805 N 102 F 500 N	1
C37-38	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	2
C39	CAP FXD, 15PF, 5%, 50V	0504 N 150 J 500 N	1
C40	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C41	CAP FXD, 15PF, 5%, 50V	0504 N 150 J 500 N	1
C42	CAP FXD, 1000PF, 1%, 50V	0805 N 102 F 500 N	1
C43	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C44	CAP FXD, 200PF, 1%, 50V	0805 N 201 F 500 N	1
C45	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	1
C46-47	CAP FXD 100UF,20%,25V	NACEW 101 M 25V 6.3X8 TR 13	2
C48	CAP FXD, 27PF, 5%, 50V	0504 N 270 J 500 N	1
C49	CAP FXD 0.01UF,10%,50V	0805 B 103 K 500 N	1
C50	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C52	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1

Table 6-7. FM PWB Parts List
Ref. Figure 7-7

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08280300A	REV: AA PWA, 8701 FM A2A4 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C53-54	CAP FXD, 10UF, 20%, 35V	NACEW 100 M 35V 5X5.5 TR 13	2
C55	CAP FXD, 22pF, 5%, 50V	0504 N 220 J 500 N	1
CR1-3	DIODE MMBD914	FMMD914CT	3
L1-2	IND, 5.6UH, 10%	SML32-561K	2
L3	IND, 33UH, 5%	1812LS-333XJBB	1
L4	IND, 15UH, 10%	1812LS-153XJBB	1
L5	IND, 680UH, 5%	1812LS-684XJBB	1
L6	IND VAR, 902 UH	40047601A (BOONTON)	1
L7	IND, 5.6UH, 10%	SML32-561K	1
L8	IND, 120UH, 10%	GLB12110	1
L9	IND VAR, 1450 UH	40047602A (BOONTON)	1
L10	IND VAR, 902 UH	40047601A (BOONTON)	1
L11	IND, 5.6UH, 10%	SML32-561K	1
L12	IND, 68UH, 5%	1812LS-683XJBB	1
Q1	TRANSISTOR, SST215	SST215	1
Q2	TRANSISTOR, MMBT3906	MMBT3906	1
Q3	TRANSISOR ARRAY, CA3054	CA3054M	1
Q4-5	TRANSISTOR, MMBT3904	MMBT3904	2
Q6	TRANSISTOR, MMBT3906	MMBT3906	1
Q7	TRANSISTOR, MMBT3904	MMBT3904	1
Q8	TRANSISOR ARRAY, CA3054	CA3054M	1
Q9	TRANSISTOR, MMBT3906	MMBT3906	1
Q10	TRANSISTOR, SST215	SST215	1
Q11-13	TRANSISTOR, MMBT3906	MMBT3906	3
Q14-16	TRANSISTOR, MMBT4403	MMBT4403	3
R1	RES FXD, 475, 1%, 1/4W	RK73H2B 4750 F	1
R2	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	1
R3	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R4	RES FXD, 2.61K, 1%, 1/4W	RK73H2B 2611 F	1
R5-7	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	3
R8-9	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R10	RES FXD, 2.21K, 1%, 1/4W	RK73H2B 2211 F	1
R11	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R12	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R13	RES FXD, 750, 1%, 1/4W	RK73H2B 7500 F	1
R14	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	1
R15	RES FXD, 4.99K, 1%, 1/4W	RK73H2B 4991 F	1
R16	RES FXD, 681, 1%, 1/4W	RK73H2B 6810 F	1
R17	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R18-19	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R20	RES FXD, 2K , 1%, 1/4W	RK73H2B 2001 F	1
R22	RES FXD, 200, 1%, 1/4W	RK73H2B 2000 F	1
R23-24	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	2

Table 6-7. FM PWB Parts List
Ref. Figure 7-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280300A	REV: AA PWA, 8701 FM A2A4 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R25-26	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R27	RES FXD, 2.21K, 1%, 1/4W	RK73H2B 2211 F	1
R28	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	1
R29	RES FXD, 681, 1%, 1/4W	RK73H2B 6810 F	1
R30	RES FXD, 4.99K, 1%, 1/4W	RK73H2B 4991 F	1
R31	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R32-34	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	3
R35-36	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R37-39	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	3
R40-41	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R42	RES FXD, 2.21K, 1%, 1/4W	RK73H2B 2211 F	1
R43	RES FXD, 576, 1%, 1/4W	RK73H2B 5760 F	1
R44	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	1
R45	RES FXD, 3.92K, 1%, 1/4W	RK73H2B 3921 F	1
R46	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R47-48	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	2
R49-50	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R51	RES FXD, 1.5K, 1%, 1/4W	RK73H2B 1501 F	1
R52	RES FXD, 182, 1%, 1/4W	RK73H2B 1820 F	1
R53-54	RES FXD, 332, 1%, 1/4W	RK73H2B 3320 F	2
R55-56	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	2
R57-58	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R59	RES FXD, 2.21K, 1%, 1/4W	RK73H2B 2211 F	1
R60	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R61	RES FXD, 499, 1%, 1/4W	RK73H2B 4990 F	1
R62	RES FXD, 1.13K, 1%, 1/4W	RK73H2B 1131 F	1
R63	RES FXD, 3.74K, 1%, 1/4W	RK73H2B 3741 F	1
R64	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R65-66	RES FXD, 10K, 1%, 1/4W	RK73H2B 1002 F	2
R67	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R68	RES FXD, 332, 1%, 1/4W	RK73H2B 3320 F	1
R69	RES FXD, 221, 1%, 1/4W	RK73H2B 2210 F	1
R70	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R71	RES FXD, 499, 1%, 1/4W	RK73H2B 4990 F	1
R72	RES FXD, 9.09K, 1%, 1/4W	RK73H2B 9091 F	1
R73	RES FXD, 1.13K, 1%, 1/4W	RK73H2B 1131 F	1
R74	RES FXD, 511, 1%, 1/4W	RK73H2B 5110 F	1
R75	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R76	RES FXD, 5.62K, 1%, 1/4W	RK73H2B 5621 F	1
R77	RES FXD, 1K, 1%, 1/4W	RK73H2B 1001 F	1
R78	RES FXD, 432, 1%, 1/4W	RK73H2B 4320 F	1
R79	RES FXD, 68.1, 1%, 1/4W	RK73H2B 68R1 F	1
R80-83	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	4
R84-85	RES FXD, 1K, 1%, 1/4W	RK73H2B 1001 F	2
R87-88	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2
R89	RES FXD, 681, 1%, 1/4W	RK73H2B 6810 F	1

Table 6-7. FM PWB Parts List
Ref. Figure 7-7

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08280300A	REV: AA PWA, 8701 FM A2A4 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
U1	MICROCKT,DGTL , 74F74	SN74F74D	1

Table 6-7. FM PWB Parts List
Ref. Figure 7-7

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280400A	REV: BB PWA, 8701 FILTER A2A5 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
AR1	AMPLIFIER OP37GS	OP37GS	1
AR2-4	AMPLIFIER LM310	LM310M	2
AR5	AMPLIFIER LF357	LF357M	1
AR6	AMPLIFIER TLO72	TL072ACD	1
AR7-8	AMPLIFIER LM310	LM310M	2
AR9	AMPLIFIER TLO72	TL072ACD	1
AR10	AMPLIFIER LM310	LM310M	1
AR11	AMPLIFIER NE5534	NE5534AD	1
AR12	AMPLIFIER LF356	LF356BM	1
AR13	AMPLIFIER TLO72	TL072ACD	1
C1-2	CAP FXD 10UF, 20%, 35V	NACE100M35V5X5.5TR13	2
C3	CAP FXD 100UF, 20%, 25V	NACE101M25V6.3X8TR13	1
C4	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C5	CAP FXD 910PF, 5%, 50V	0805N911J500N	1
C6	CAP FXD 1000PF, 1%, 50V	0805N102F500N	1
C7	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C8	CAP FXD 180PF, 1%, 50V	0504N181F500N	1
C9	CAP FXD 470PF, 1%, 50V	0805N471F500N	1
C10-11	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	2
C12	CAP FXD 1000PF, 1%, 50V	0805N102F500N	1
C13	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	10
C14	CAP FXD 470PF, 1%, 50V	0805N471F500N	1
C15-16	CAP TANT 100UF, 20%, 10V	T491D107M010AS	2
C17	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C18	CAP FXD 6.8PF, +-0.5PF, 50V	0504N6R8D500N	1
C19-20	CAP FXD 0.1UF, 2%, 16V	NSPC 104 G 16 TR C3	2
C21	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	1
C22-23	CAP FXD 0.1UF, 2%, 16V	NSPC 104 G 16 TR C3	2
C24	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	1
C25-26	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	2
C27-28	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	2
C29	CAP FXD 0.047UF, 2%, 16V	NSPC 473 G 16 TR B3	1
C30	CAP FXD 100UF, 20%, 25V	NACE101M25V6.3X8TR13	1
C31	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
C32	CAP FXD 1000PF, 1%, 50V	0805N102F500N	1
C33	CAP FXD 240PF, 1%, 50V	0504N241F500N	1
C34	CAP FXD 1000PF, 1%, 50V	0805N102F500N	1
C35	CAP FXD 200PF, 2%, 50V	0504N201F500N	1
C36	CAP FXD 100PF, 1%, 50V	0504N101F500N	1
C37	CAP FXD 120PF, 1%, 50V	0504N121F500N	1
C38	CAP FXD 100PF, 1%, 50V	0504N101F500N	1
C39	CAP FXD 1000PF, 1%, 50V	0805N102F500N	1
C40	CAP FXD 470PF, 1%, 50V	0805N471F500N	1
C41	CAP FXD 75PF, 1%, 50V	0504N750F500N	1
C42-43	CAP FXD 10UF, 20%, 35V	NACE100M35V5X5.5TR13	2

Table 6-8. Filter PWB Parts List
Ref. Figure 7-8

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08280400A	REV: BB PWA, 8701 FILTER A2A5 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
C46-47	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	2
C48	CAP FXD 100UF, 20%, 25V	NACE101M25V6.3X8TR13	1
C49-51	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	3
C52	CAP FXD 0.1UF, 2%, 16V	NSPC 104 G 16 TR C3	1
C53	CAP FXD 0.01UF, 2%, 50V	NSPC 103 G 50 TR B2	1
C54-55	CAP FXD 0.1UF, 2%, 16V	NSPC 104 G 16 TR C3	2
C56	CAP FXD 22PF, 5%, 50V	0504N220J500N	1
C57	CAP FXD 150PF, 5%, 50V	0504N151J500N	1
C58	CAP FXD 5PF, +-0.5PF, 50V	0504N5R0D500N	1
C59	CAP FXD 0.1UF, 20%, 50V	0805U104MXAMT	1
CR1-3	DIODE MMBD914	FMMD914CT	3
CR4	DIODE FDSO1503	MMBD1503	1
CR7-8	DIODE MMBD914	FMMD914CT	2
K1-3	RELAY-DPDT	TQ2E-12V	3
L1-3	INDUCTOR 5.6UH, 10%	SML32-561K	3
L4	IND VAR 2270UH	40047603A	1
L5	IND VAR 3641UH	40047604A	1
L6	IND VAR 2270UH	40047603A	1
Q1	TRANSISTOR MMBT3904	MMBT3904	1
R1	RES FXD 562, 1%, 1/4W	RK73H2B5620F	1
R2	RES FXD 619, 1%, 1/4W	RK73H2B6190F	1
R3	RES FXD 7.5K, 1%, 1/4W	RK73H2B7501F	1
R4	RES FXD 619, 1%, 1/4W	RK73H2B6190F	1
R6	RES FXD 619, 1%, 1/4W	RK73H2B6190F	1
R7	RES FXD 7.5K, 1%, 1/4W	RK73H2B7501F	1
R8	RES FXD 619, 1%, 1/4W	RK73H2B6190F	1
R9-10	RES FXD 9.09K, 0.1%, 1/4W	RN73E2B9091B	2
R11-12	RES FXD 1K, 0.1%, 1/4W	RN73C2B1001B	2
R13	RES FXD 9.09K, 0.1%, 1/4W	RN73E2B9091B	1
R15	RES FXD 100, 1%, 1/4W	RK73H2B5100RF	1
R17	RES FXD 1K, 0.1%, 1/4W	RN73C2B1001B	1
R19	RES FXD 26.7, 1%, 1/4W	RK73H2B26R7F	1
R20	RES FXD 26.7K, 1%, 1/4W	RK73H2B2672F	1
R21	RES FXD 105K, 1%, 1/4W	RK73H2B1053F	1
R22	RES FXD 2.67K, 1%, 1/4W	RK73H2B2671F	1
R23	RES FXD 10.5K, 1%, 1/4W	RK73H2B1052F	1
R24	RES FXD 2.61K, 1%, 1/4W	RK73H2B2611F	1
R25	RES FXD 10.5K, 1%, 1/4W	RK73H2B1052F	1
R26	RES FXD 6.19K, 1%, 1/4W	RK73H2B6191F	1
R27	RES FXD 536K, 1%, 1/4W	RK73H2B5363F	1
R28	RES FXD 53.6K, 1%, 1/4W	RK73H2B5362F	1

Table 6-8. Filter PWB Parts List
Ref. Figure 7-8

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280400A	REV: BB PWA, 8701 FILTER A2A5 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R30	RES FXD 1K, 1%, 1/4W	RK73H2B1001F	1
R31	RES FXD 3.65K, 1%, 1/4W	RK73H2B3651F	1
R32	RES FXD 26.7K, 1%, 1/4W	RK73H2B2672F	1
R33	RES FXD 182K, 1%, 1/4W	RK73H2B1823F	1
R34	RES FXD 80.6K, 0.1%, 1/4W	RN73E2B8062B	1
R35	RES FXD 11.5K, 1%, 1/4W	RK73H2B1152F	1
R36	RES FXD 16.5K, 1%, 1/4W	RK73H2B1652F	1
R37	RES FXD 73.2K, 1%, 1/4W	RK73H2B7322F	1
R38	RES FXD 80.6K, 0.1%, 1/4W	RN73E2B8062B	1
R39	RES FXD 4.87K, 1%, 1/4W	RK73H2B4871F	1
R40	RES FXD 80.6K, 0.1%, 1/4W	RN73E2B8062B	1
R41	RES FXD 9.76K, 1%, 1/4W	RK73H2B9761F	1
R42	RES FXD 48.7K, 1%, 1/4W	RK73H2B4872F	1
R43	RES FXD 5.76K, 1%, 1/4W	RK73H2B5761F	1
R44	RES FXD 2.49K, 1%, 1/4W	RK73H2B2491F	1
R45	RES FXD 4.99K, 1%, 1/4W	RK73H2B4991F	1
R46-47	RES FXD 7.5K, 1%, 1/4W	RK73H2B7501F	2
R48	RES FXD 243K, 1%, 1/4W	RK73H2B2433F	1
R49	RES FXD 3.92K, 0.1%,1/4W	RK73H2B3921B	1
R50	RES FXD 56.2K, 0.1%,1/4W	RK73H2B5622B	1
R51	RES FXD 11.5K, 1%, 1/4W	RK73H2B1152F	1
R52	RES FXD 48.7K, 1%, 1/4W	RK73H2B4872F	1
R53	RES FXD 1.54K, 1%, 1/4W	RK73H2B1541F	1
R54	RES FXD 2.21K, 1%, 1/4W	RK73H2B2211F	1
R55	RES FXD 604, 0.25%, 1/4W	RN73E2B6040C	1
R56	RES FXD 4.99K, 1%, 1/4W	RK73H2B4991F	1
R57-58	RES FXD 243, 1%, 1/4W	RK73H2B243RF	2
U2	MICROCKT PCF8574	PCF8574AT4371W	1
U3	MICROCKT ADG509A	ADG509AKR	1
U4-5	MICROCKT ADG508A	ADG508AKR	2
U6	MICROCKT PCF8574	PCF8574AT4371W	1
U7	MICROCKT ADG508A	ADG508AKR	1
U8-9	MICROCKT DG419	DG419DY	2

Table 6-8. Filter PWB Parts List
Ref. Figure 7-8

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280500A	REV: AA PWA, 8701 DETECTOR A2A6 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
C1	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	1
C2	CAP FXD 100UF, 20%, 25V	NACE 101 M 25V 6.3X8	1
C3	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	1
C4-5	CAP FXD 100UF, 20%, 10V	T491D 107 M 010 AS	2
C6	CAP FXD 10UF, 20%, 25V	T491D 106 M 025 AS	1
C7	CAP FXD 5PF, 10%, 50V	0504 N 5R0 J 500 N	1
C8	CAP FXD 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C9	CAP FXD 100UF, 20%, 10V	T491D 107 M 010 AS	1
C10-11	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	2
C12	CAP FXD 47UF, 20%, 25V	NACEW 470 M 25V 6.3X6.3	1
C13	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	1
C14-15	CAP FXD 0.1UF, 20%, 50V	0805 U 104 MXAMT	2
C16	CAP FXD 5PF, 10%, 50V	0504 N 5R0 J 500 N	1
C17-18	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	2
C19	CAP FXD 100UF, 20%, 10V	T491D 107 M 010 AS	1
C20-21	CAP FXD 0.1UF, 2%, 16V	NSPC 104 G 16 TR C3	2
C22	CAP FXD 10UF, 20%, 35V	NACE 100 M 35V 5X5.5	1
C23	CAP VAR 5-50PF, 10%, 250V	TZBX4R500BB110	1
C24	CAP FXD 1UF, 10%, 35V	T491B 105 K 035 AS	1
C25	CAP FXD 100UF, 20%, 10V	T491D 107 M 010 AS	1
C26	CAP FXD 2.2UF, 20%, 35V	T491C 225 M 035 AS	1
C27-30	CAP FXD 0.1UF, 20%, 50V	0805 U 104 MXAMT	3
C31	CAP FXD 0.001UF, 10%, 50V	0805 N 102 K 500 N	1
C32-34	CAP FXD 0.1UF, 20%, 50V	0805 U 104 MXAMT	3
C35	CAP FXD 10UF, 20%, 25V	T491D 106 M 025 AS	1
C36	CAP FXD 100UF, 20%, 10V	T491D 107 M 010 AS	1
C37	CAP FXD 0.022UF, 10%, 50V	2221 N 223 K 500 N	1
C38	CAP FXD 12PF, 5%, 50V	0504 N 120 J 500 N	1
C39	CAP FXD 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
CR1-2	DIODE HSMS-2800	HSMS-2800#T30	2
CR3-4	DIODE FDSO1503	MMBD1503	2
CR5-10	DIODE MMBD914	FMMD914CT-ND	6
L1-3	INDUCTOR 5.6UH, 10%	SML32-561K	3
R1	RES FXD 4.99K, 0.1%, 1/4W	RN73E2B 4991 B	1
R2	RES FXD 3.01K, 0.1%, 1/4W	RK73E2B 3011 B	1
R3-4	RES FXD 1.00K, 0.1%, 1/4W	RN73E2B 1001 B	2
R5	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	1
R6	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R7	RES FXD 10.5K, 1%, 1/4W	RK73H2B 1052 F	1
R8	RES FXD 9.09K, 0.1%, 1/4W	RN73E2B 9091 B	1
R9	RES FXD 1.00K, 0.1%, 1/4W	RN73E2B 1001 B	1
R11	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	1
R12	RES FXD 301, 1%, 1/4W	RK73H2B 3010 F	1

Table 6-9. Detector PWB Parts List
Ref. Figure 7-9

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280500A	REV: AA PWA, 8701 DETECTOR A2A6 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
R14	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R15	RES FXD 11K, 1%, 1/4W	RK73H2B 1102 F	1
R16	RES FXD 10.5K, 1%, 1/4W	RK73H2B 1052 F	1
R17	RES FXD 11K, 1%, 1/4W	RK73H2B 1102 F	1
R18	RES FXD 9.09K, 0.1%, 1/4W	RN73E2B 9091 B	1
R19	RES FXD 1.00K, 0.1%, 1/4W	RN73E2B 1001 B	1
R20	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R21	RES FXD 22.1K, 1%, 1/4W	RK73H2B 2212 F	1
R22	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R23	RES FXD 200, 1%, 1/4W	RK73H2B 2000 F	1
R24	RES FXD 22.1K, 1%, 1/4W	RK73H2B 2212 F	1
R25	RES FXD 200, 1%, 1/4W	RK73H2B 2000 F	1
R26	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R27	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	1
R28	RES FXD 10.5K, 1%, 1/4W	RK73H2B 1052 F	1
R29	RES FXD 4.99K, 1%, 1/4W	RK73H2B 4991 F	1
R30	RES FXD 47.5K, 1%, 1/4W	RK73H2B 4752 F	1
R31	RES FXD 4.99K, 1%, 1/4W	RK73H2B 4991 F	1
R32-33	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	2
R34	RES FXD 12.1K, 1%, 1/4W	RK73H2B 1212 F	1
R35	RES FXD 2.49K, 1%, 1/4W	RK73H2B 2491 F	1
R36-38	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	3
R39	RES FXD 2.67K, 1%, 1/4W	RK73H2B 2671 F	1
R40	RES FXD 33.2K, 1%, 1/4W	RK73H2B 3322 F	1
R41	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	1
R42	RES FXD 2.49K, 1%, 1/4W	RK73H2B 2491 F	1
R43	RES FXD 20K, 1%, 1/4W	RK73H2B 2002 F	1
R44	RES FXD 4.99K, 1%, 1/4W	RK73H2B 4991 F	1
R45	RES FXD 100K, 1%, 1/4W	RK73H2B 1003 F	1
R46	RES FXD 750K, 1%, 1/4W	RK73H2B 7503 F	1
R47	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	1
R48	RES FXD 100, 1%, 1/4W	RK73H2B 1000 F	1
R49	RES FXD 10.5K, 1%, 1/4W	RK73H2B 1052 F	1
R53	RES FXD 750K, 1%, 1/4W	RK73H2B 7503 F	1
R54	RES FXD 2.43K, 1%, 1/4W	RK73H2B 2431 F	1
R55	RES FXD 10K, 0.5%, 0.1W	664-A-1002-D	1
R56	RES FXD 2M, 5%, 1/4W	RM73B2B 205 J	1
R57-59	RES FXD 10K, 1%, 1/4W	RK73H2B 1002 F	3
R60	RES FXD 100K, 1%, 1/4W	RK73H2B 1003 F	1
R61	RES FXD 1K, 1%, 1/4W	RK73H2B 1001 F	1
R62	RES FXD 1.82K, 1%, 1/4W	RK73H2B 1821 F	1
U1	MICROCKT, LF13333	LF13333M	1
U3	MICROCKT, PCF8574	PCF8574AT4371W	1
U4	MICROCKT, LF13202	LF13202M	1
U5	MICROCKT, LF13333	LF13333M	1

Table 6-9. Detector PWB Parts List
Ref. Figure 7-9

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280500A	REV: AA PWA, 8701 DETECTOR A2A6 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
U8	MICROCKT, AD536A	MX536AJCWE	1
U9	MICROCKT, ADG508A	ADG508AKR	1
U10	MICROCKT, PCF8574	PCF8574AT4371W	1
U11	MICROCKT, LF356	LF356BM	1
U13	MICROCKT, TL074	TL074C	1
U14	MICROCKT, HA2625	HA9P2625-5	1
U15-16	MICROCKT, CA3080	CA3080AM	2
U18	MICROCKT, HA2625	HA9P2625-5	1
U19	MICROCKT, TL072	TL072ACD	1
U20-21	MICROCKT, NE5534	TLN5534A	2
U22-23	MICROCKT, TL072	TL072ACD	2

Table 6-9. Detector PWB Parts List
Ref. Figure 7-9

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280600A	REV: BB PWA, 8701 VXI PROCESSOR A1 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
AR1	AMPLIFIER LT1012	LT1012S8	1
AR2	AMPLIFIER TLO72	TL072ACD	1
AR4	AMPLIFIER INA105	INA105KU	1
C1-15	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	15
C16-17	CAP FXD, 1UF, 20%, 50V	1812 Z 105 M 500 N	2
C18-22	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	5
C23	CAP TANT, 10UF, 20%, 35V	ECS-T1VD106R	1
C24	CAP FXD, 330PF, 5%, 50V	0504 N 331 J 500 N	1
C25	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C26	CAP TANT, 10UF, 20%, 35V	ECS-T1VD106R	1
C27	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C28	CAP ELEC, 220uF, 20%, 35V	NACE 221 M 35 8X10.8 TR 13	1
C29	CAP FXD, 0.001UF, 20%, 50V	0805 N 102 M 500 N	1
C30-31	CAP TANT, 10UF, 20%, 25V	T491D 106 M 025 AS	2
C32	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C33	CAP FXD, 270PF, 5%, 50V	0504 N 271 J 500 N	1
C34	CAP ELEC, 220uF, 20%, 35V	NACE 221 M 35 8X10.8 TR 13	1
C35	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	1
C40-42	CAP TANT, 10UF, 20%, 35V	ECS-T1VD106R	3
C100-101	CAP ELEC, 220uF, 20%, 35V	NACE 221 M 35 8X10.8 TR 13	2
C110-114	CAP FXD, 0.1UF, 20%, 50V	0805 U 104 MXAMT	5
CR1-2	DIODE MMBD914	FMMD914CT	2
CR3	DIODE HLED	SSF-LXH240GGD	1
CR4	DIODE HLED	50F6028	1
CR5-6	DIODE ZENER 1N5242B	1N5242B	2
D1-4	DIODE 1N4001	1N4001	4
J1	SHUNT 2 CIRCUIT	15-38-1024	1
P1-2	CONNECTOR 96 POSN	M55302/131-01 91662 9330	2
P3	CONN 0.100 SP, FLAT HEADER, STR.	MFSS100-3-A	1
P4-P9	CONNECTOR 15POSN	53048-1510	6
P10-11	CONNECTOR SMAST	5862-5004-10	2
Q1	TRANSISTOR MMBT4401	MMBT4401	1
R1	RES FXD, 475, 1%, 1/4W	RK73H2B 4750 F	1
R2-3	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2
R4-5	RES FXD, 130, 1%, 1/4W	RK73H2B 1300 F	2
R6	RES FXD, 82.5, 1%, 1/4W	RK73H2B 82R5 F	1
R7-8	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2
R9	RES FXD, 698, 1%, 1/4W	RK73H2B 6980 F	1
R10-11	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2

Table 6-10. VXI Processor PWB Parts List
Ref. Figure 7-10

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

08280600A	REV: BB PWA, 8701 VXI PROCESSOR A1 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
R13-15	RES FXD, 82.5, 1%, 1/4W	RK73H2B 82R5 F	3
R16-17	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2
R18	RES FXD, 1K, 1%, 1/4W	RK73H2B 1001 F	1
R19	RES FXD, 825, 1%, 1/4W	RK73H2B 8250 F	1
R20	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	1
R21	RES FXD, 301, 1%, 1/4W	RK73H2B 3010 F	1
R22	RES FXD, 47.5K, 1%, 1/4W	RK73H2B 4752 F	1
R23	RES FXD, 10K, 1%, 1/4W	RK72H2B 1002 F	1
R24-25	RES FXD, 3.32K, 1%, 1/4W	RK73H2B 3321 F	2
R50	RES FXD, 51.1, 1%, 1/4W	RK73H2B 51R1 F	1
RZ1	RES NET, 10K, 0.5%, 1/10W	664-A-1002-D	1
RZ2	RES NET, 1K, 1%, 1/10W	664-A-1001-F	1
RZ3	RES NET, 4.7K, 2%, 1/10W	767-161-R4.7K	1
RZ4	RES NET, 10K, 0.5%, 1/10W	698-3R10KD	1
S1	SWITCH DIPSWITCH	CT2098LPST	1
T1	TRANSFORMER STEPUP	TC8-1	1
U1	MICROCKT X24C16	X24C16S8	1
U2	MICROCKT uPD43256BGU	D43256BGU-70L	1
U3-4	MICROCKT 74ACT245	74ACT245 (SO-20)	2
U5	MICROCKT MAX941	MAX941CSA	1
U7	MICROCKT uPD43256BGU	D43256BGU-70L	1
U10	MICROCKT XC3164A	XC3164A-3PC84C-ND	1
U11	MICROCKT EPM7128E	EPM7128EQC100-15	1
U12	MICROCKT IT9010M	IT9010M-PQFP	1
U13	MICROCKT MAX942	MAX942CSA	1
U14	MICROCKT MC145406	MC145406DW	1
U15	MICROCKT MAX941	MAX941CSA	1
U16	MICROCKT AT29C1024	AT29C1024-12JC	1
U17	MICROCKT N7407	N7407M	1
U18	MICROCKT 74F760	N74F760D	1
U19	MICROCKT DAC725	DAC725JP	1
U20	MICROCKT SCC2691	SCC2691AC1A28	1
U21	MICROCKT M68000	MC68HC000FN12	1
U23	MICROCKT LM311	LM311M	1
U24	MICROCKT REF01	REF01CS	1
U26	MICROCKT MC79M05	MC7905CT	1
U27	MICROCKT MC7805	MC7805ACT	1
U28-29	MICROCKT DG419	DG419DY	2
Y1	OSC,XTAL 10.000MHz	SE2209CT-ND	1
(2)	HEATSINK (TO220 FORM)	6071B	2

Table 6-10. VXI Processor PWB Parts List
Ref. Figure 7-10

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08280600A	REV: BB PWA, 8701 VXI PROCESSOR A1 MODEL: 8701		
REFERENCE DESIGNATOR	**DESCRIPTION**	**PART NUMBER**	**QTY**
(4)	Screw, Pan Hd .086-56 2-56 X 3/8		4
(5)	Nut, Plain, Hex .086-56		4
(6)	WASHER, LOCK #2		4
(7)	SCREW, 4-40 X 5/16 BH SEMS		2
(8)	NUT, 4-40 X 3/16		2
(9)	WASHER, LOCK #4 INT		2

Table 6-10. VXI Processor PWB Parts List
Ref. Figure 7-10

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08280800A	REV: AA PWA, 8701 PROTECT/ATTENUATOR A3A1 MODEL: 8701		
REFERENCE DESIGNATOR	DESCRIPTION	PART NUMBER	QTY
AT1	CHIP ATTEN. PRETINNED VALUE 3DB	TS0303S	1
C1	CAP CER CHIP 0.1uF, 10%, 50V	1206-B-104-K-500-N	1
C2-4	CAP CER CHIP 1000pF, 10%, 50V	C1206 C102 K5GAH	3
C5	CAP CER CHIP 0.1uF, 10%, 50V	1206-B-104-K-500-N	1
C6-8	CAP CER CHIP 0.2pF, +0.1pF, 150V	100A 0R2 BCA 150X	3
C9	CAP CER CHIP 0.7pF, +0.25pF, 500V	C17AH0R7C4TXL	1
C10	CAP CER CHIP 0.3pF, +0.1pF, 150V	100A 0R3 BCA 150X	1
CR1	DIODE 2813	HSMS-2813-T30	1
DS1	LED RED HLMP-1002	HLMP-1002	1
K1-2	RELAY 12V DPDT 2 FORM C	172D-12	2
Q1	TRANSISTOR 3906	MMBT3906	1
R1	RES CHIP 2K, 1%, 2W	IMS-202-2-2001-F	1
R2	RES CHIP 100K, 1%, 1/4W	RCI-1206-1003-F	1
R3	RES CHIP 221 OHM, 1%, 1/4W	RCI-1206-2210-F	1
R4	RES CHIP 27.4K, 1%, 1/4W	RCI-1206-2742-F	1
R5	RES CHIP 47.5K, 1%, 1/4W	RCI-1206-4752-F	1
R6	RES CHIP 61.9 OHM, 1%, 2W	IMS-202-2-61R9-F	1
R7	RES CHIP 249 OHM, 1%, 1/4W	RCI-1206-2490-F	1
R8	RES CHIP 61.9 OHM, 1%, 1/4W	RCI-1206-61R9-F	1
R9	RES CHIP 100 OHM, 1%, 1/4W	RCI-1206-1000-F	1
U1	IC LM10CWM OP AMP/VOLT REG	LM10CWM	1

Table 6-11. Attenuator PWB Parts List
Ref. Figure 7-11

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Chapter 7

Drawings and Schematic Diagrams

7-1. Introduction

The drawings and schematic diagrams for the Model 8701, Modulation Meter are listed in Table 7-1. Figures with multiple sheets maintain the same figure number and are identified by ascending sheet numbers (i.e., sheet 1 of 3, sheet 2 of 3, etc.).

Fig. No.	Description	Page
7-1	Modulation Meter Assembly (2 sheets)	7-2
7-2	RF Housing Assembly (2 sheets), A2	7-4
7-3	Protect Attenuator Assembly, A3	7-6
7-4	RF PWB Component Location (2 sheets), A2A1	7-7
7-5	Local Oscillator PWB Component Location, A2A2	7-9
7-6	AM PWB Component Location, A2A3	7-10
7-7	FM PWB Component Location, A2A4	7-11
7-8	Filter PWB Component Location, A2A5	7-12
7-9	Detector PWB Component Location, A2A6	7-13
7-10	VXI Processor PWB Component Location (2 sheets), A1	7-14
7-11	Attenuator PWB Component Location, A3A1	7-16
7-12	Main Frame Schematic Diagram	7-17
7-13	RF PWB, Schematic Diagram (3 sheets), A2A1	7-18
7-14	Local Oscillator PWB Schematic Diagram (3 sheets), A2A2	7-21
7-15	AM PWB Schematic Diagram (3 sheets), A2A3	7-24
7-16	FM PWB Schematic Diagram (3 sheets), A2A4	7-27
7-17	Filter PWB Schematic Diagram (3 sheets), A2A5	7-30
7-18	Detector PWB Schematic Diagram (3 sheets), A2A6	7-33
7-19	VXI Processor PWB Schematic Diagram (16 sheets), A1	7-36
7-20	Protect Attenuator PWB Schematic Diagram, A3A1	7-52

Table 7-1. Drawings and Schematic Diagrams

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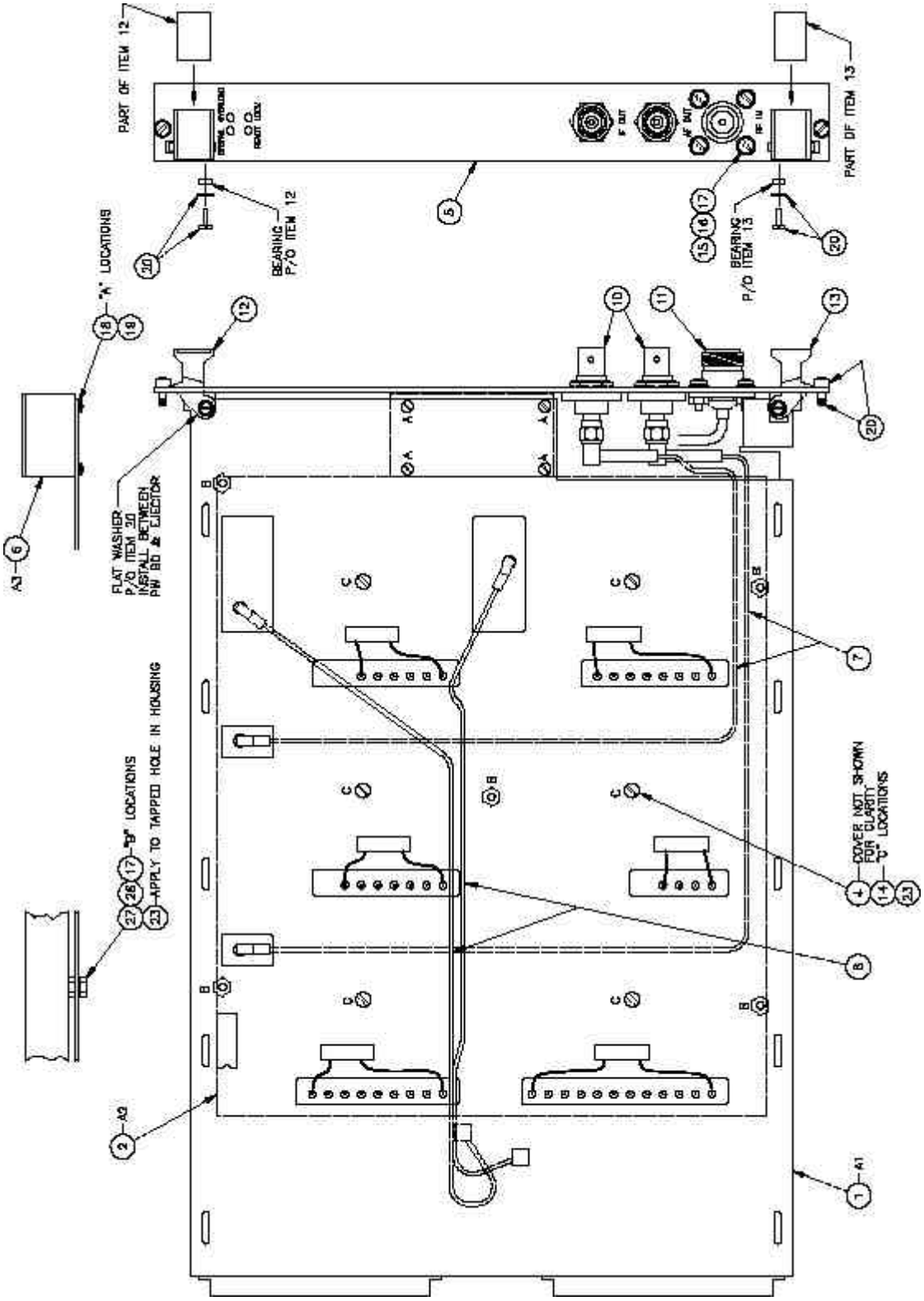


Figure 7-1. Modulation Meter Assembly (sheet 1 of 2)

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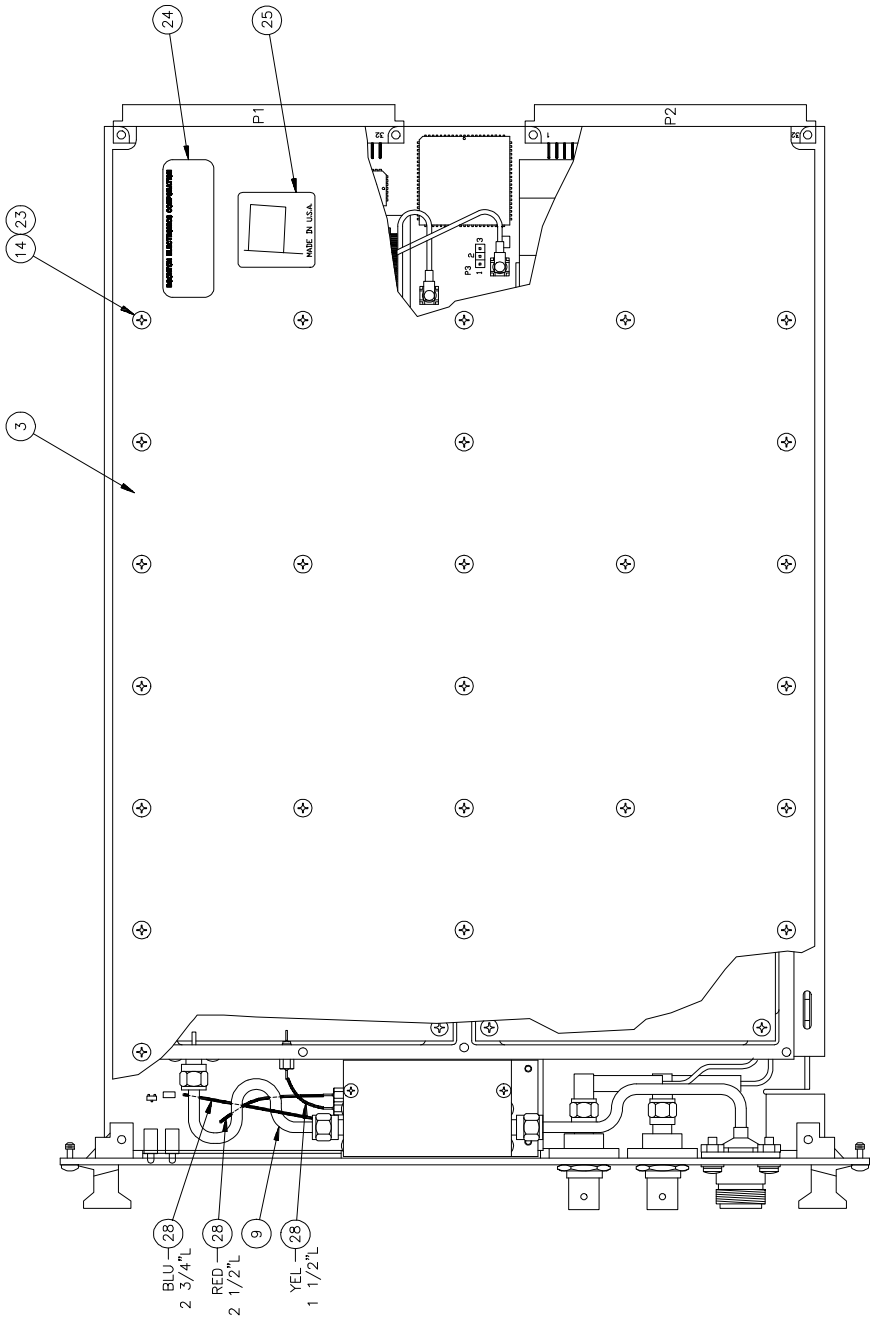


Figure 7-1. Modulation Meter Assembly (sheet 2 of 2)

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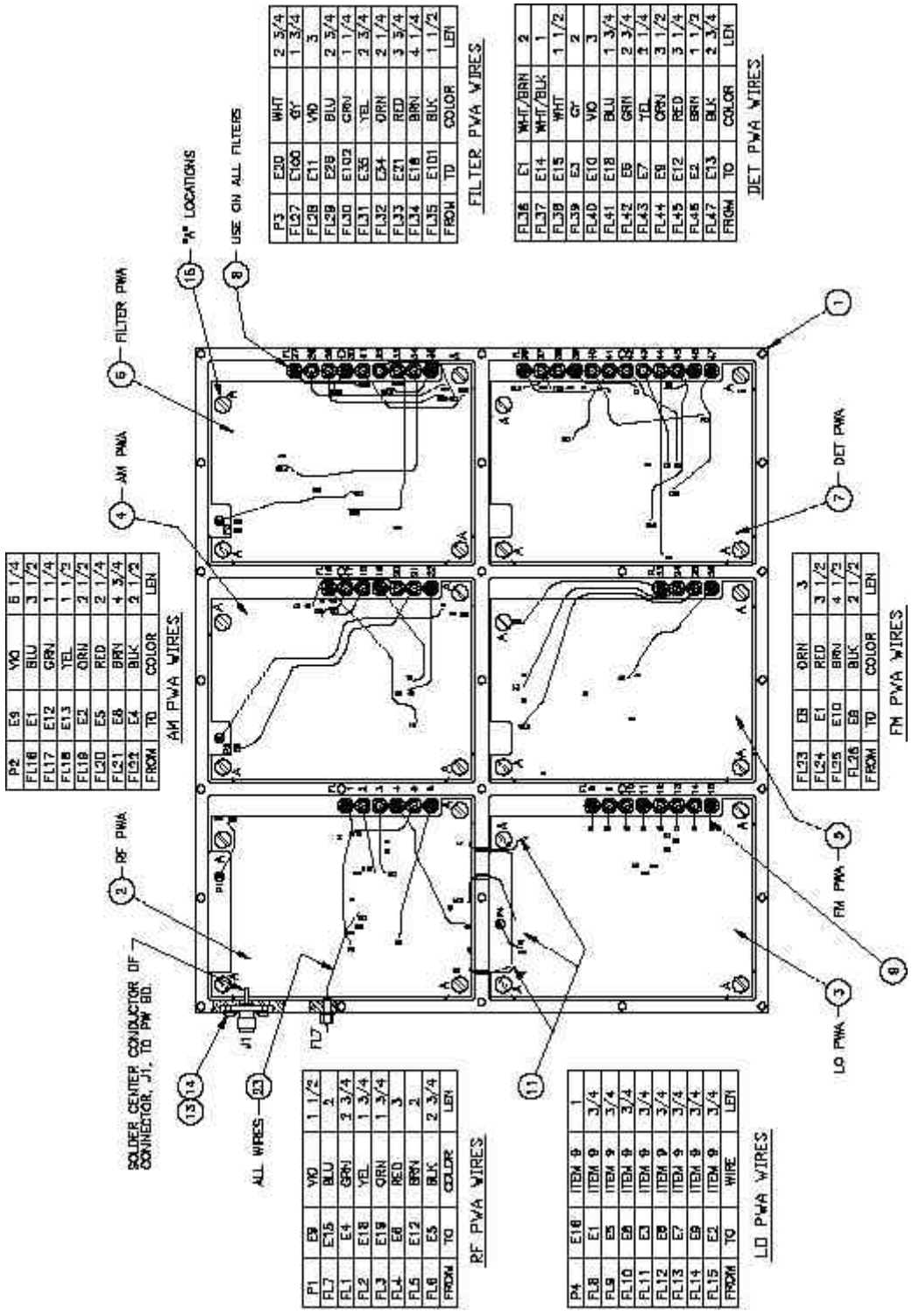


Figure 7-2. RF Housing Assembly, A2 (sheet 1 of 2)

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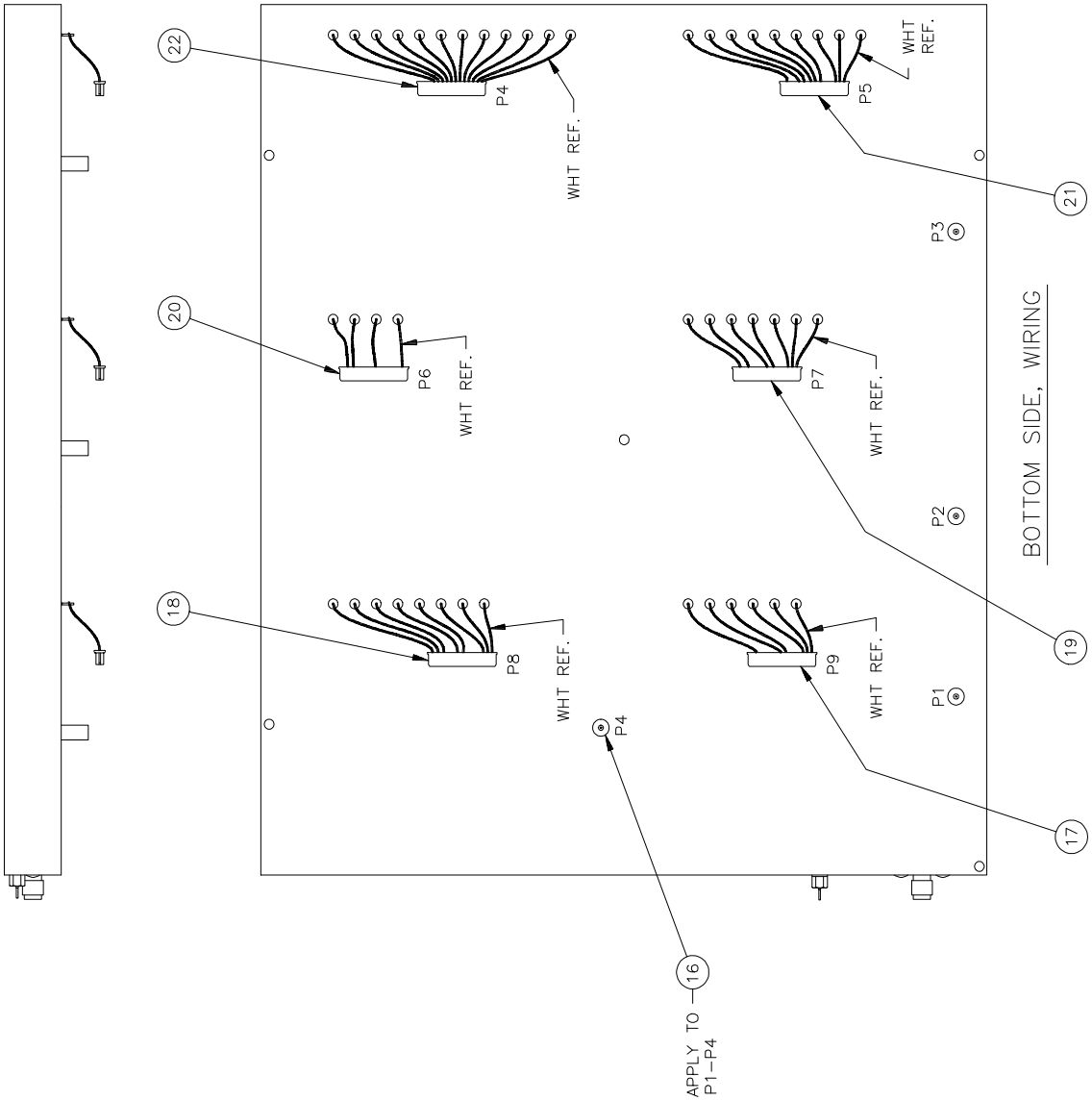


Figure 7-2. RF Housing Assembly, A2 (sheet 2 of 2)

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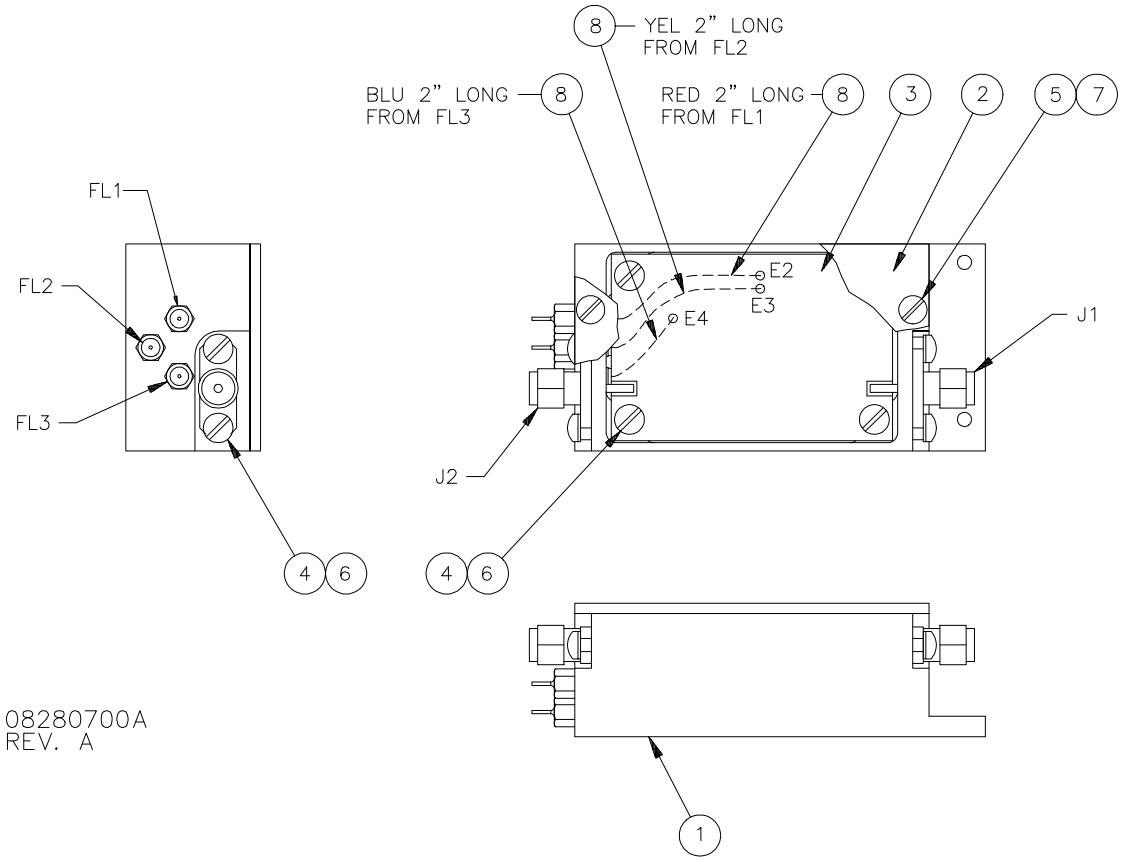


Figure 7-3. Protect Attenuator Assembly, A3

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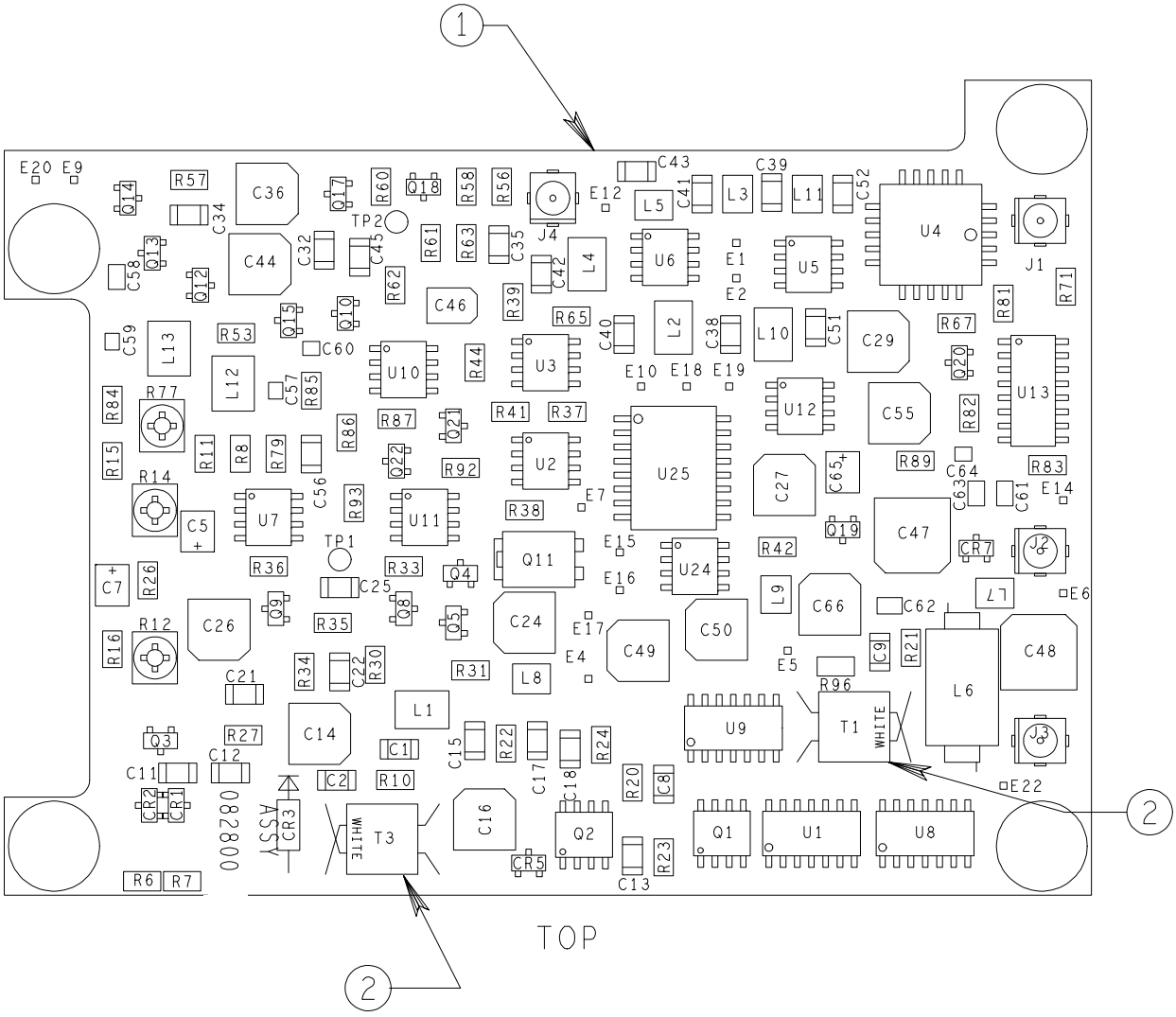


Figure 7-4. RF PWB, A2A1 Component Location - Top (sheet 1 of 2)

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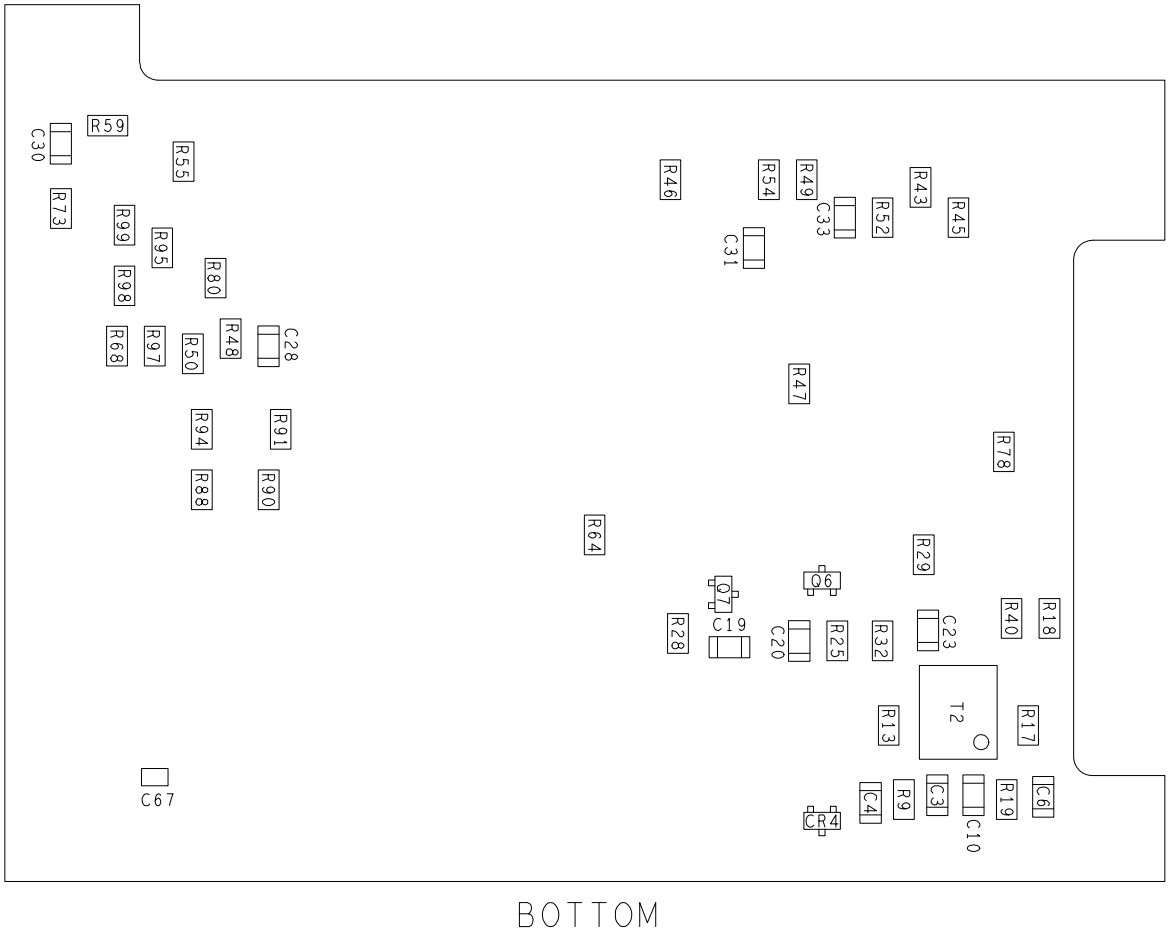


Figure 7-4. RF PWB, A2A1 Component Location - Bottom (sheet 2 of 2)

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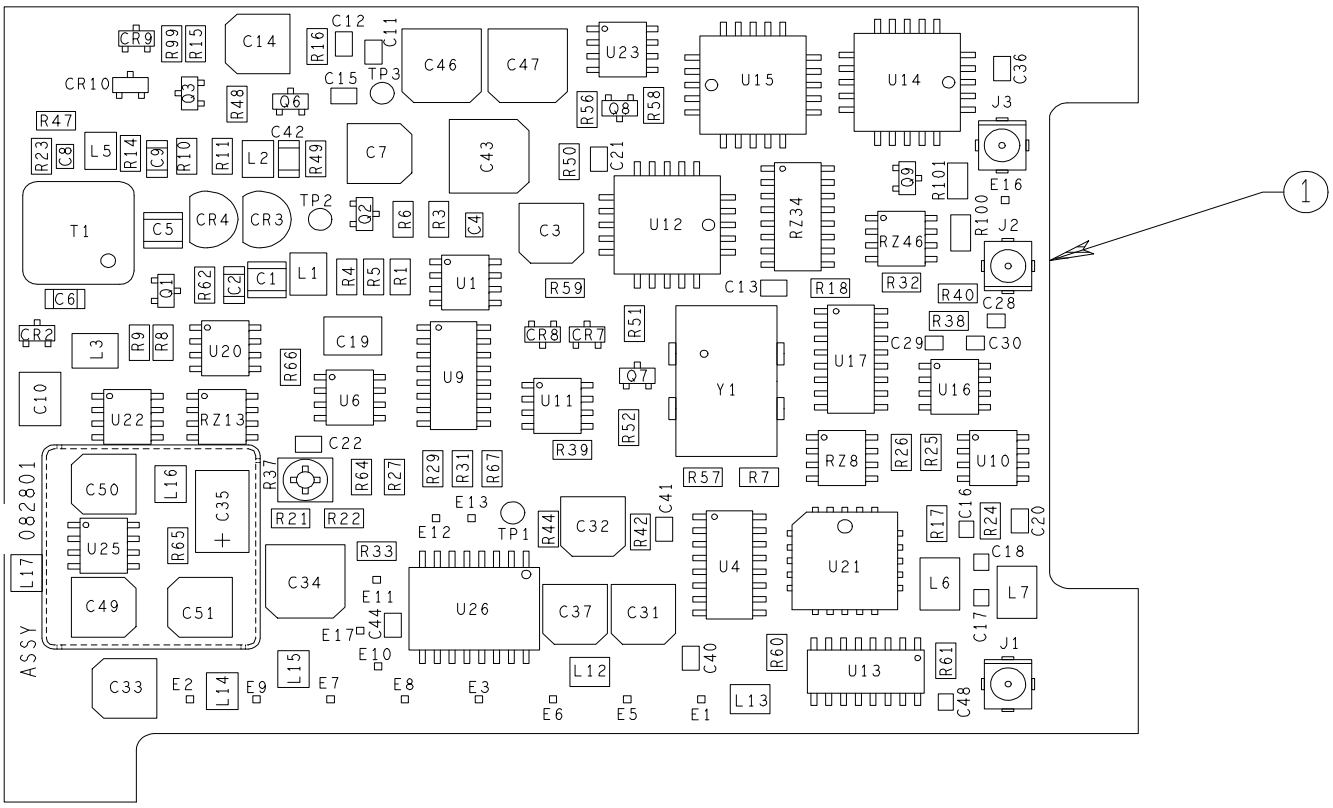


Figure 7-5. Local Oscillator PWB, A2A2 Component Location

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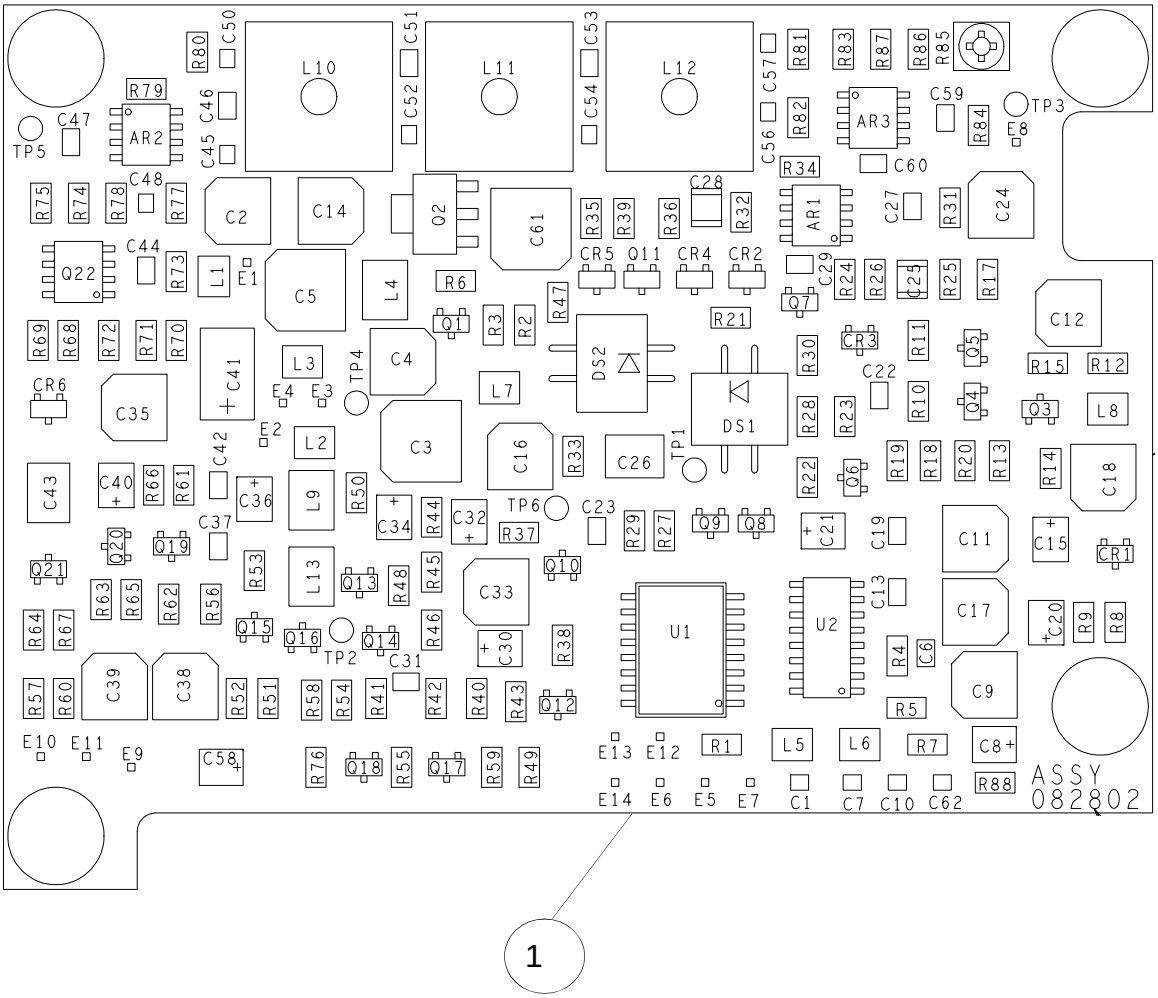


Figure 7-6. AM PWB, A2A3 Component Location

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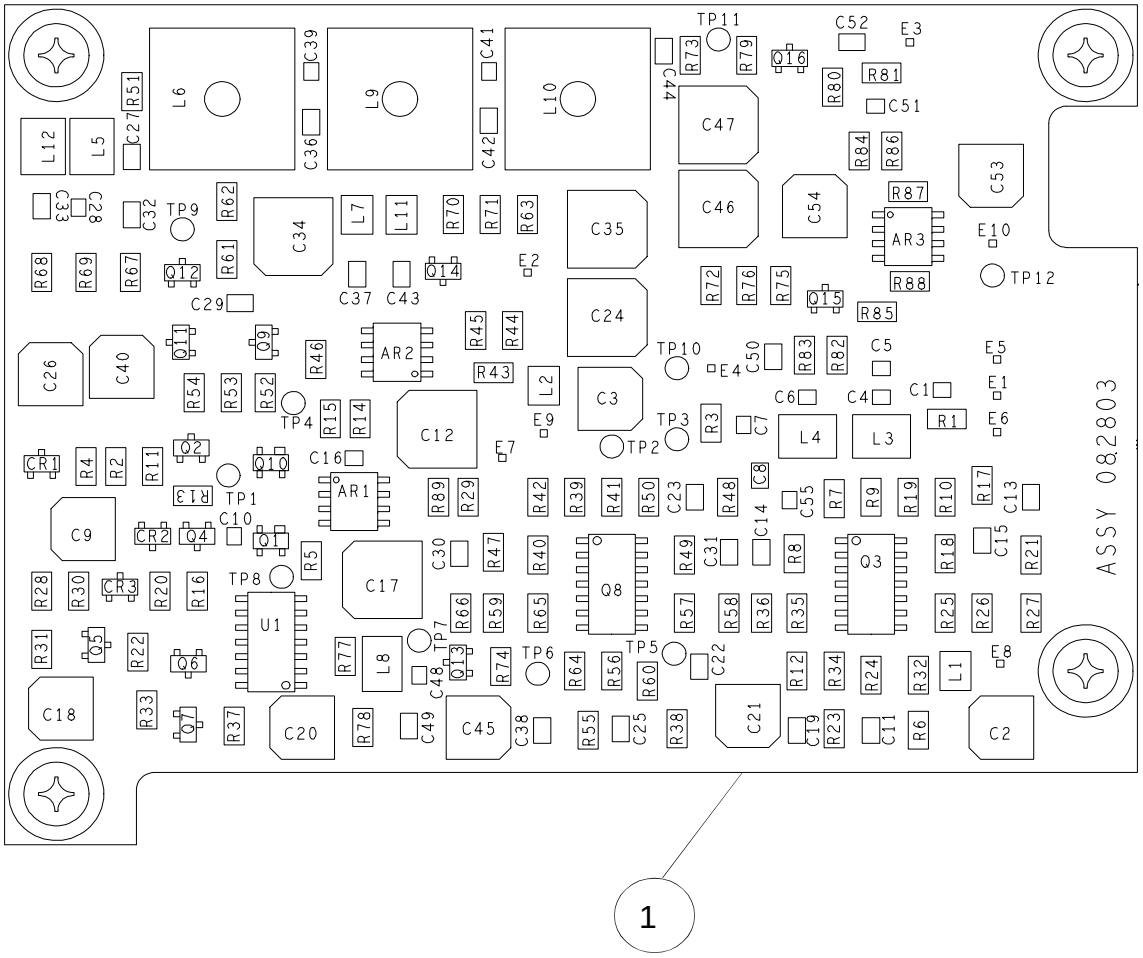


Figure 7-7. FM PWB, A2A4 Component Location

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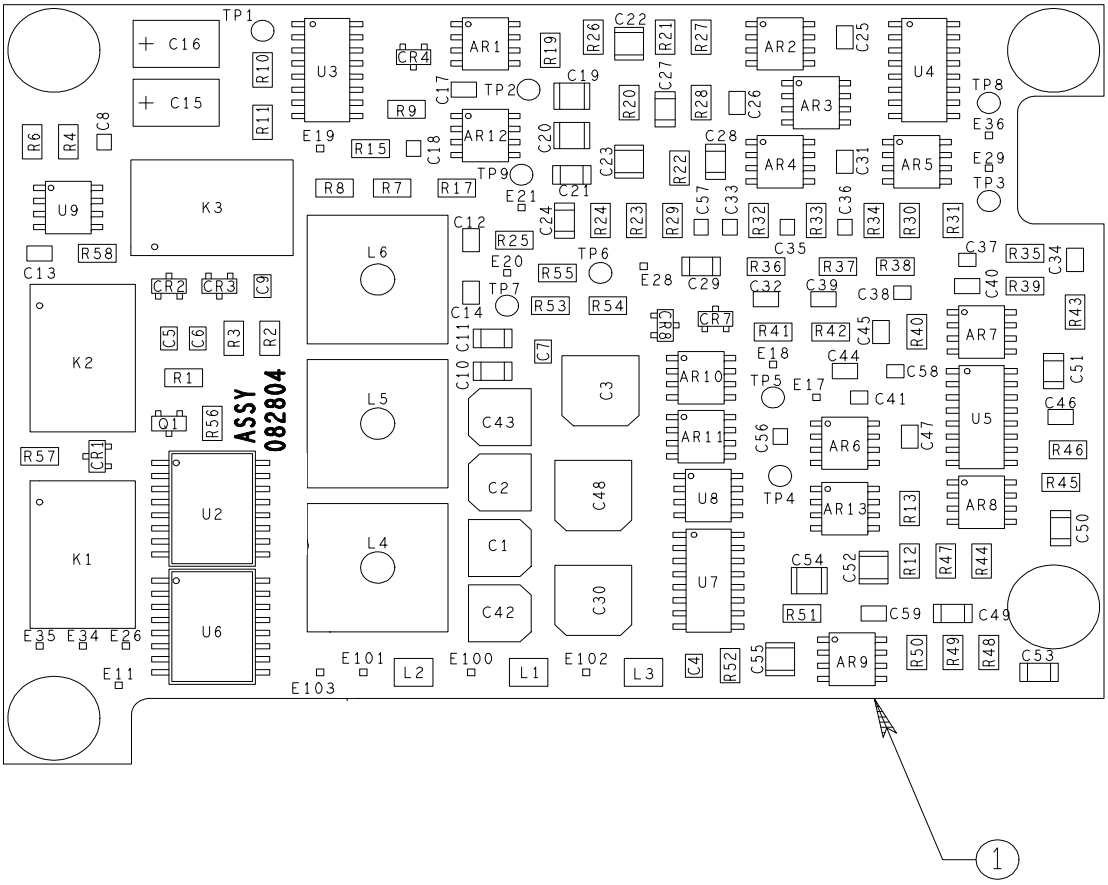


Figure 7-8. Filter PWB, A2A5

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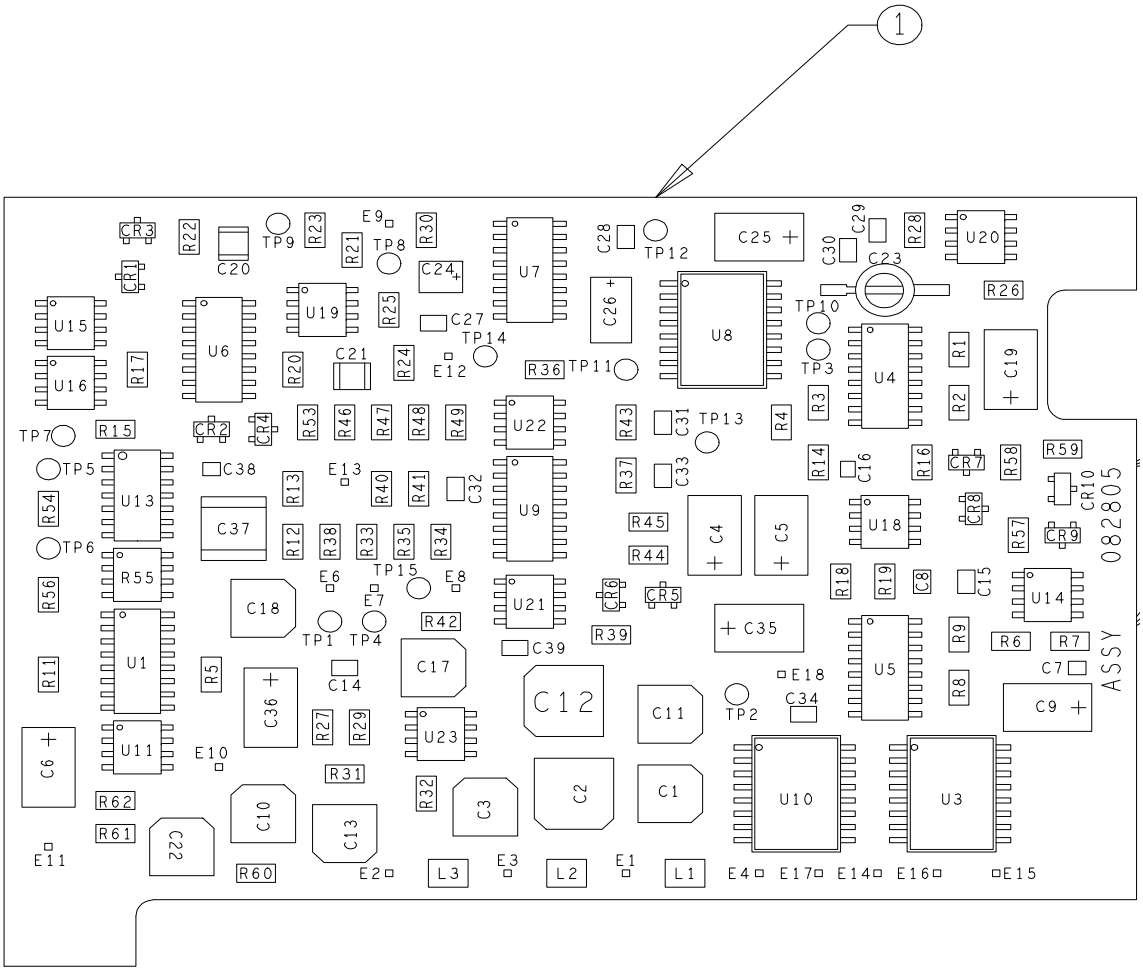


Figure 7-9. Detector PWB, A2A6 Component Location

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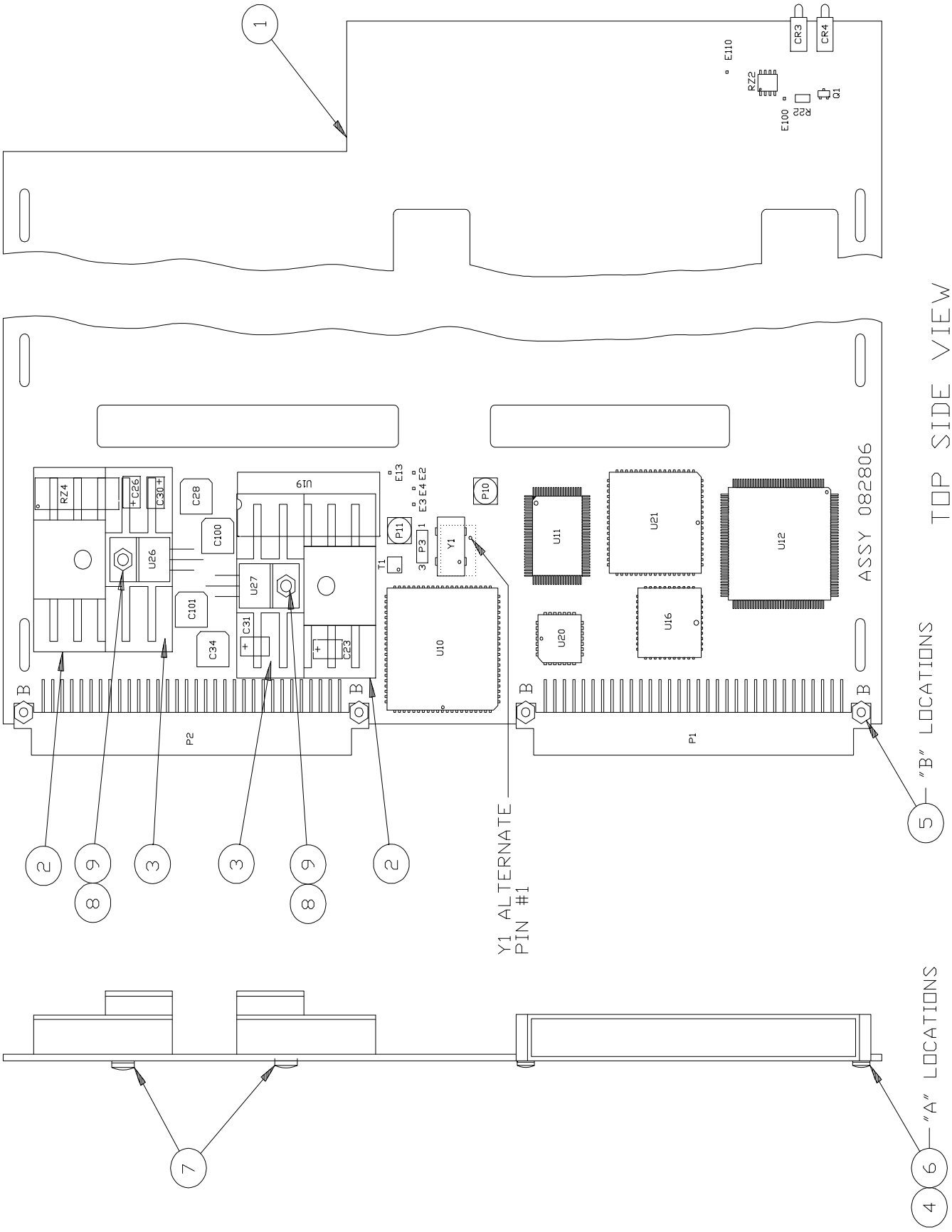


Figure 7-10. VXI Processor PWB, A1 Component Location (sheet 1 of 2)

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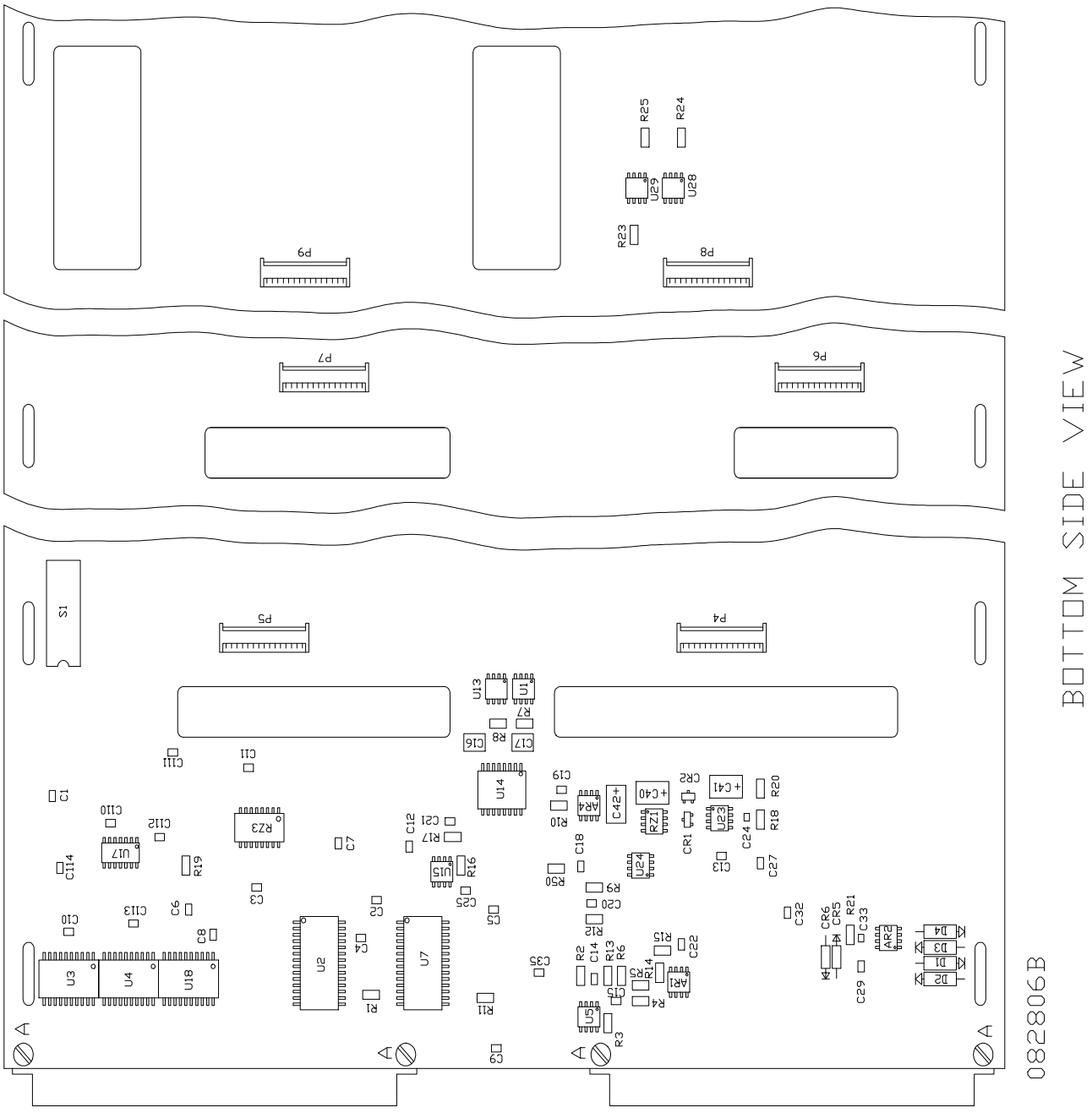


Figure 7-10. VXI Processor PWB, A1 Component Location (sheet 2 of 2)

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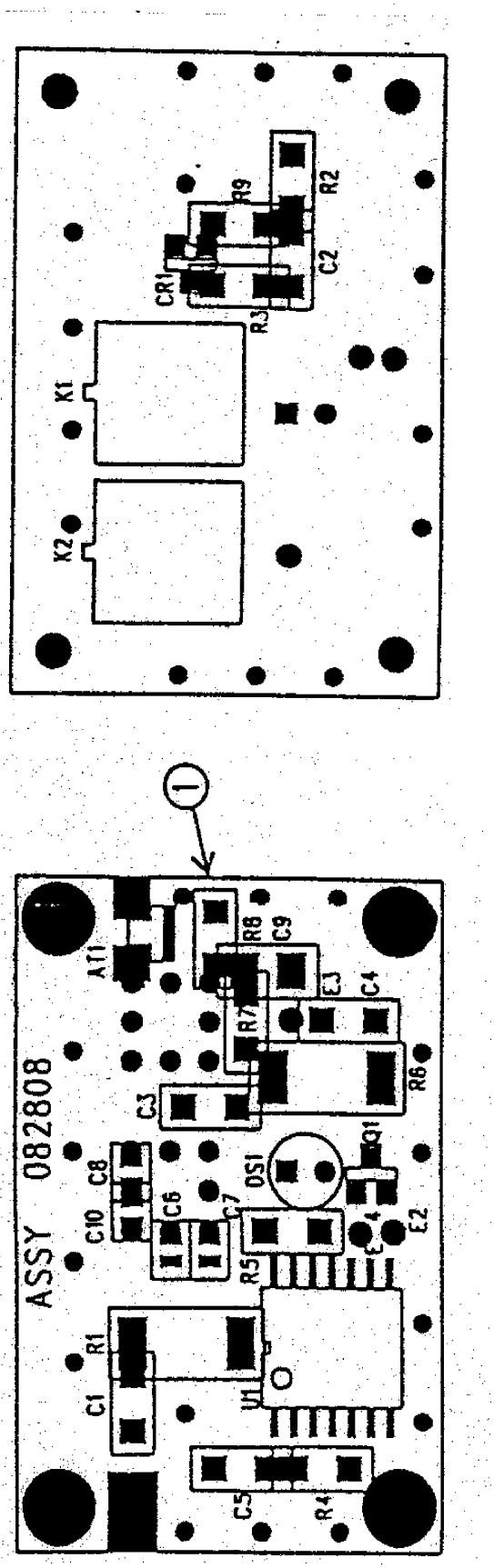


Figure 7-11. Attenuator PWB, A3 Component Location

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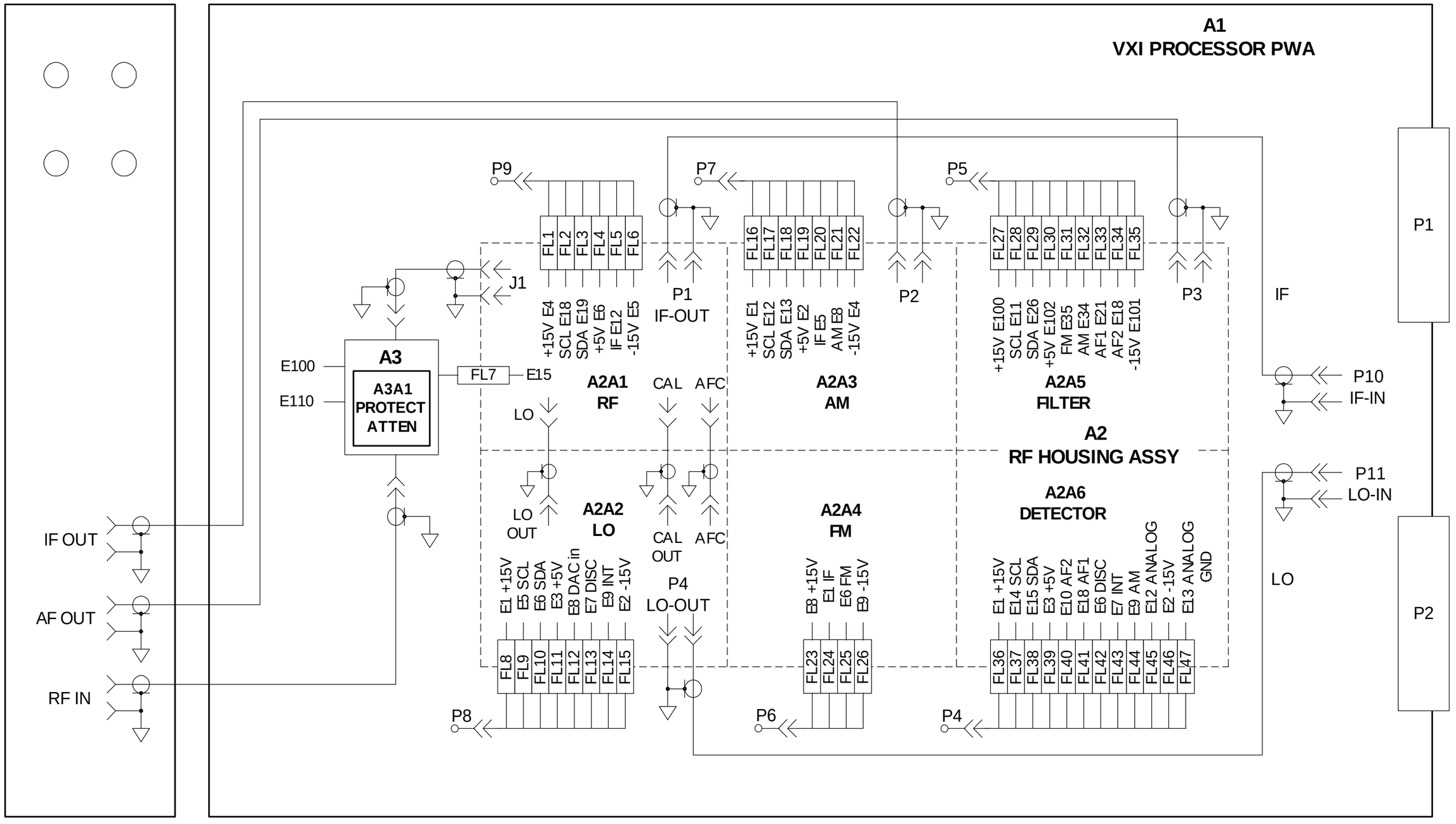
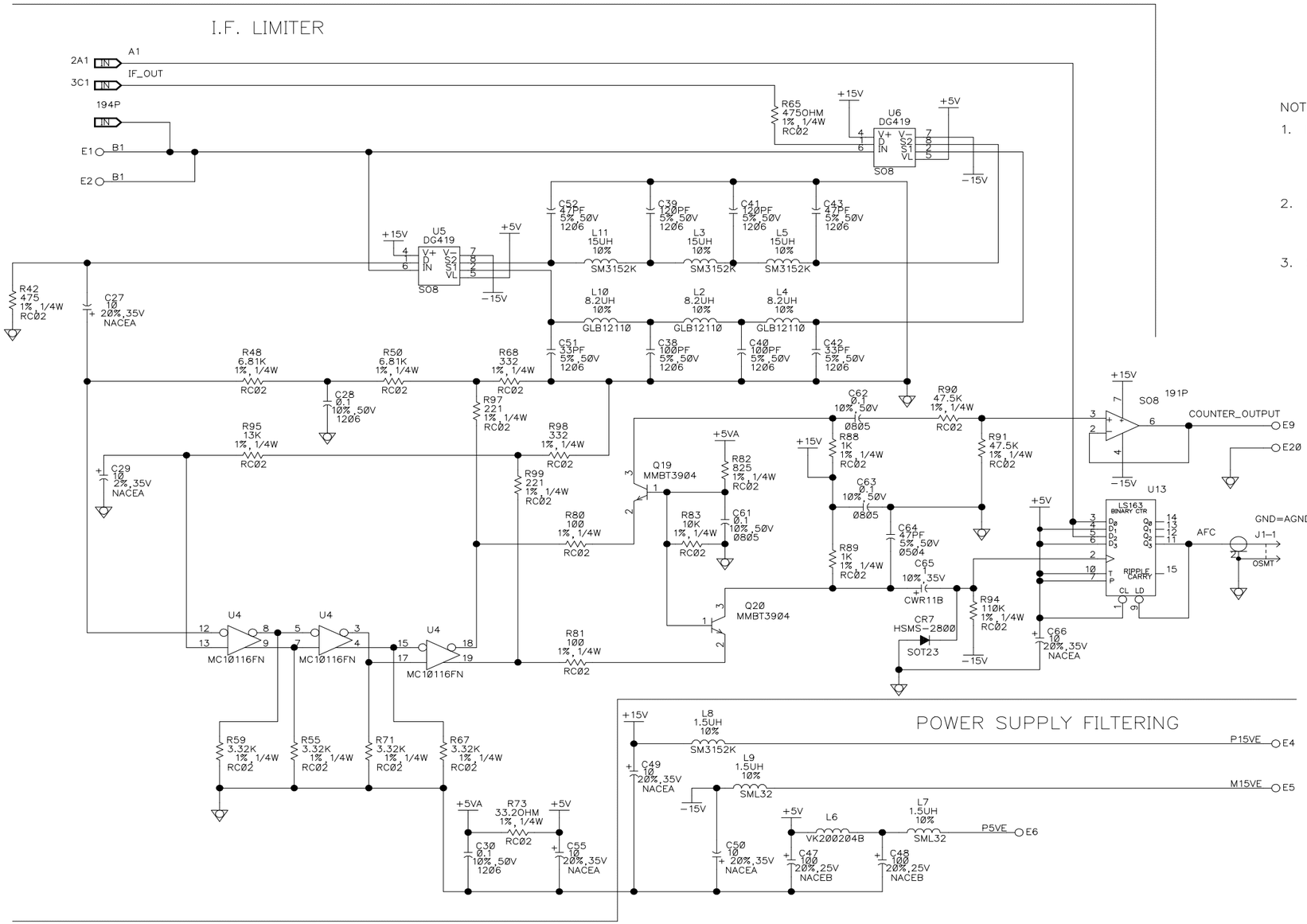


Figure 7-12.
Main Frame Schematic Diagram

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NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATION1 ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%,1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%,50V. MICROFARADS.

3. SYMBOLS:

   XXX IN OUT INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT) OR BIDIRECTIONAL (BI).

HIGHEST REFERENCE DESIGNATION				
C67	CR7	E22	L13	Q22
R99	T3	TP2	U25	
REFERENCE DESIGNATIONS NOT USED				
C37	C53−54		CR6	E8
Q16	R1−5	R51	R66	
R69−70		R72	R74−76	
	U14−23			

PWR & GND MATRIX			
REF DES	PIN NO.		
	AGND	P5V	P5VA
U1,8	7	14	
U2−3,5−7,11,24	3		
U4	10		20,2
U9	10	5	
U13,25	8	16	

Figure 7-13. RF PWB, A2A1 Schematic Diagram (sheet 1 of 3)

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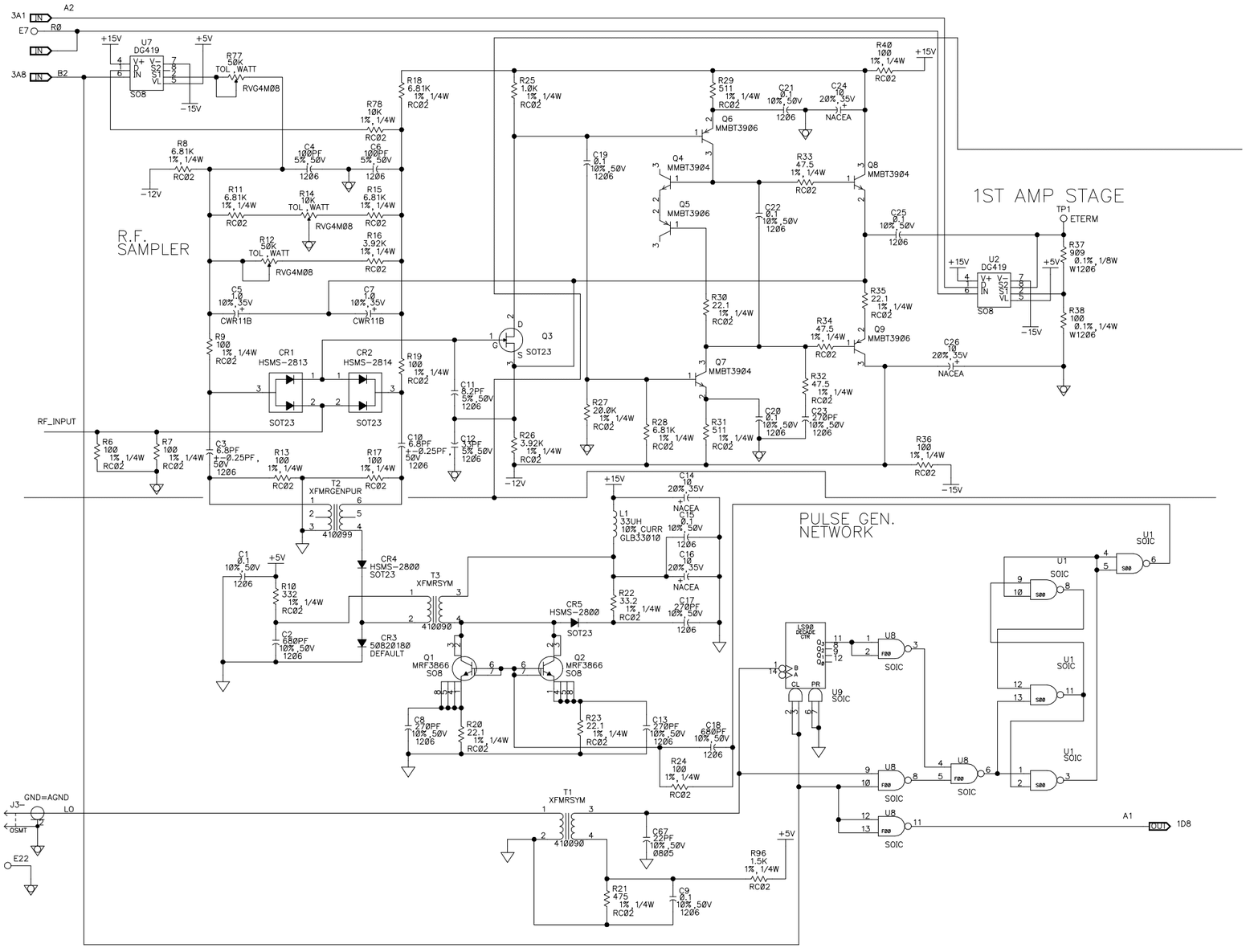


Figure 7-13. RF PWB, A2A1 Schematic Diagram (sheet 2 of 3)

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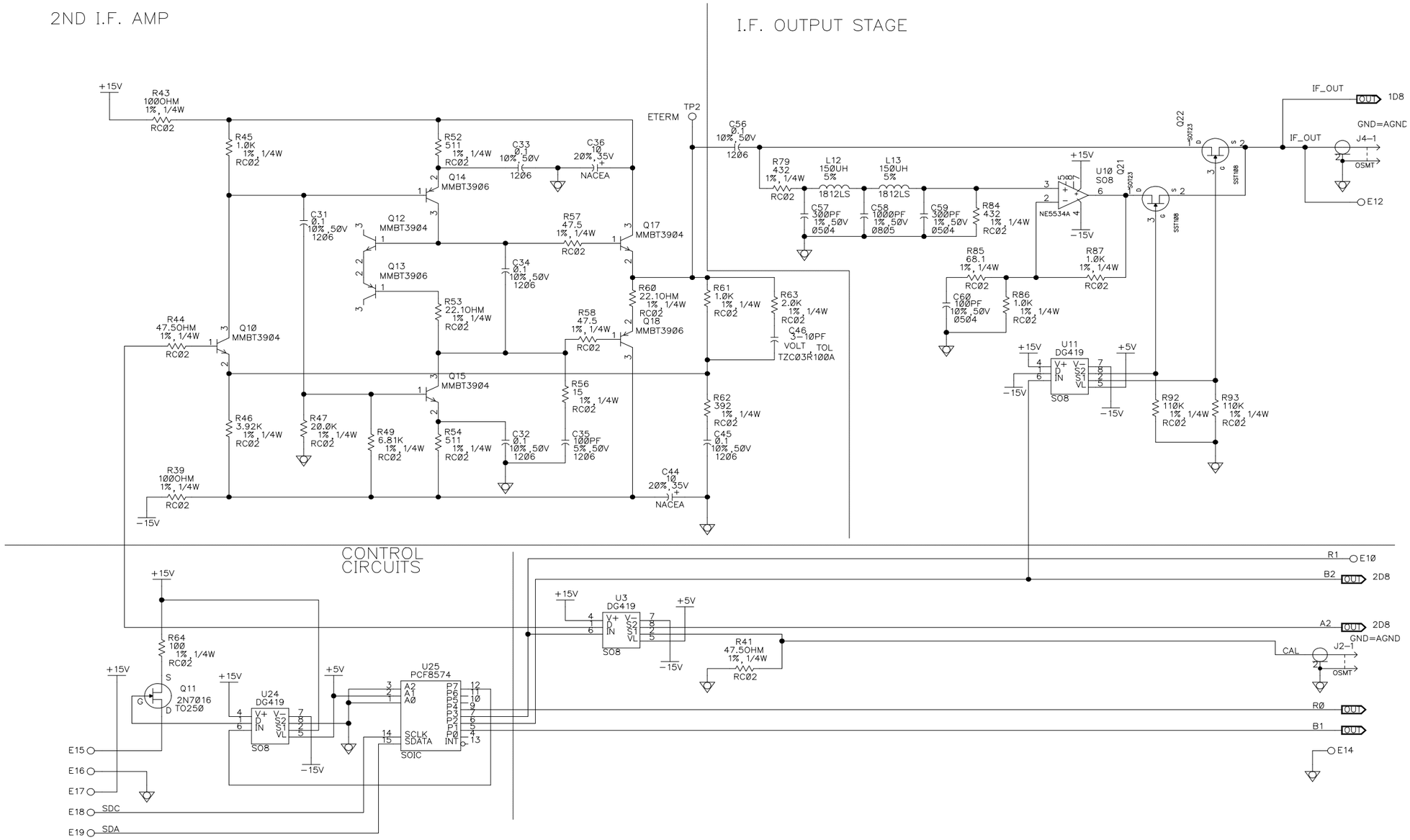
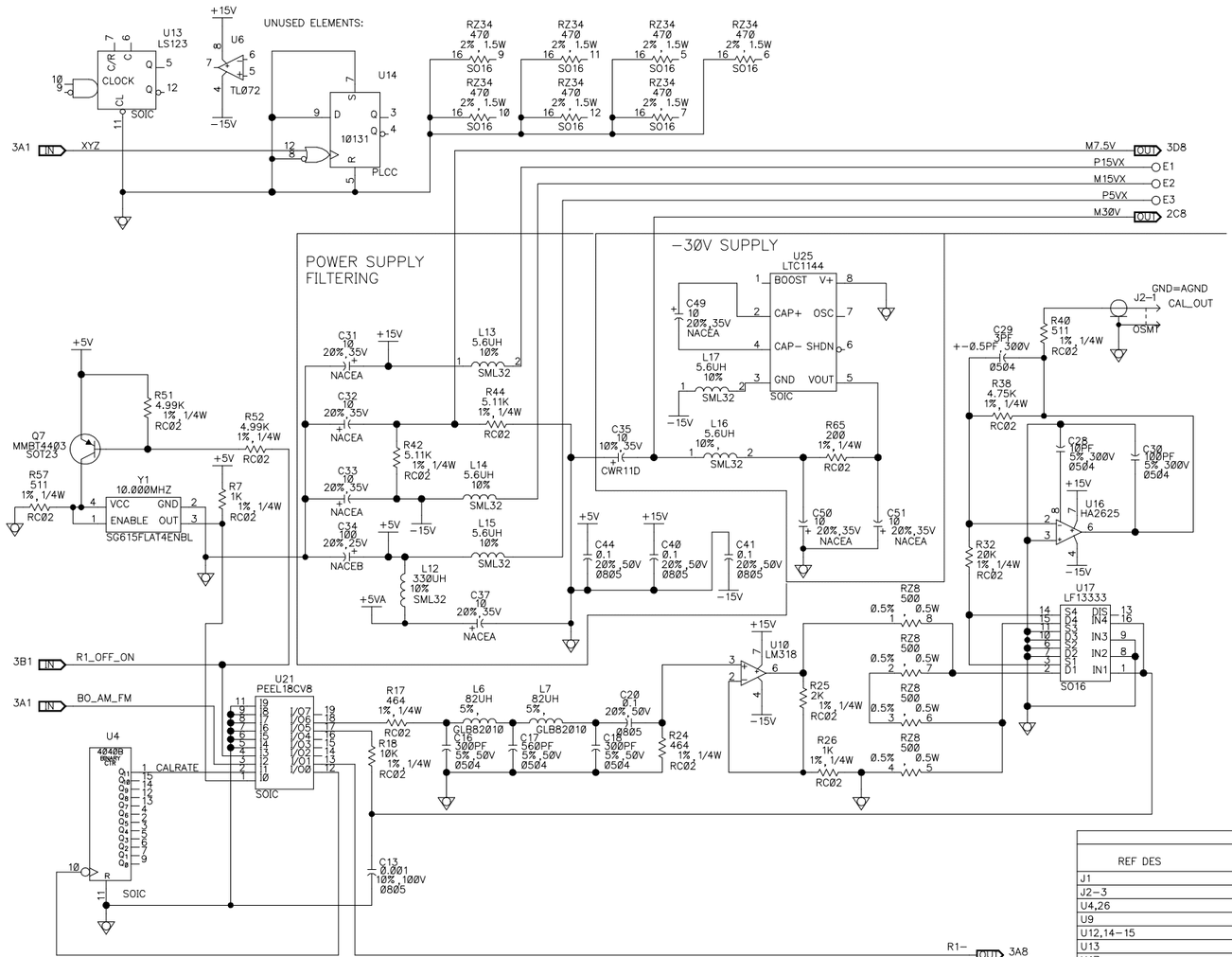


Figure 7-13. RF PWB, A2A1 Schematic Diagram (sheet 3 of 3)

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NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%,1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%,50V. MICROFARADS.

3. SYMBOLS:

   XXX IN , OUT INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT) OR BIDIRECTIONAL (BI).

HIGHEST REFERENCE DESIGNATION				
C51	CR1Ø	E17	J3	L17
Q9	R1Ø1	RZ46	T1	TP3
U26	Y1			

REFERENCE DESIGNATIONS NOT USED			
C23−27	C38−39		C45
CR1	CR5−6	E4	E14−15
L4	L8−11	Q4−5	R12−13
R19−2Ø	R28	R3Ø	
R34−36	R41	R43	R66
R45−46	R53−55		R57
R63	R68−98	RZ1−7	
RZ9−12	RZ14−33		
RZ35−45	U2−3	U5	U7−8
U18−19	U24		

PWR & GND MATRIX							
REF DES	PIN NO.						
	AGND	P5V	P5VB	P5VA	P15V	M15V	M7.5V
J1	2,3,4						
J2−3	2,3,4						
U4,26	8	16					
U9	15						
U12,14−15	1Ø		2,2Ø				
U13	8			16			
U17	4				12	5	
U2Ø							3
U21	1Ø	2Ø					

CALIBRATOR

Figure 7-14. Local Oscillator PWB,A2A2 Schematic Diagram (sheet 1 of 3)

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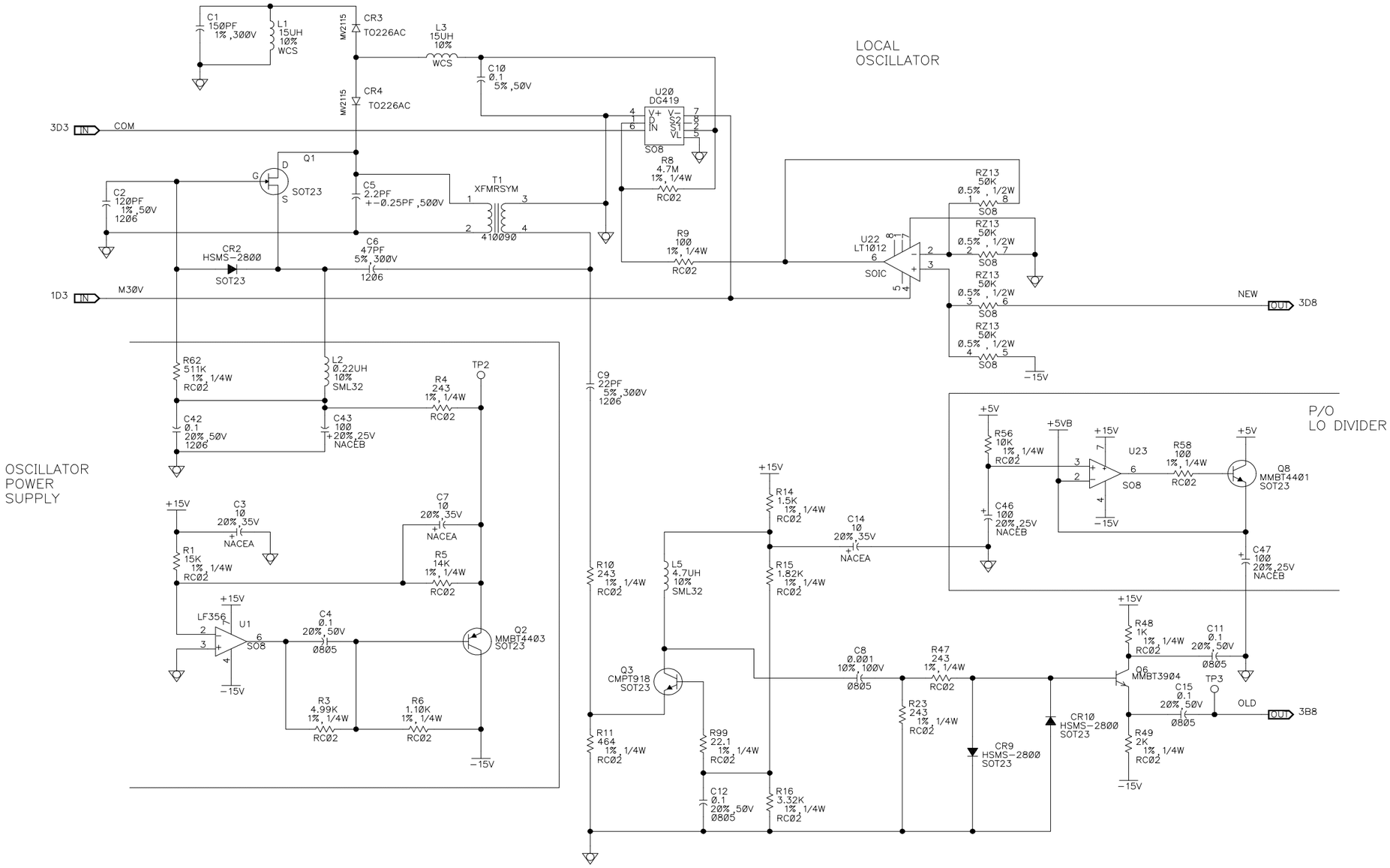


Figure 7-14. Local Oscillator PWB, A2A2 Schematic Diagram (sheet 2 of 3)

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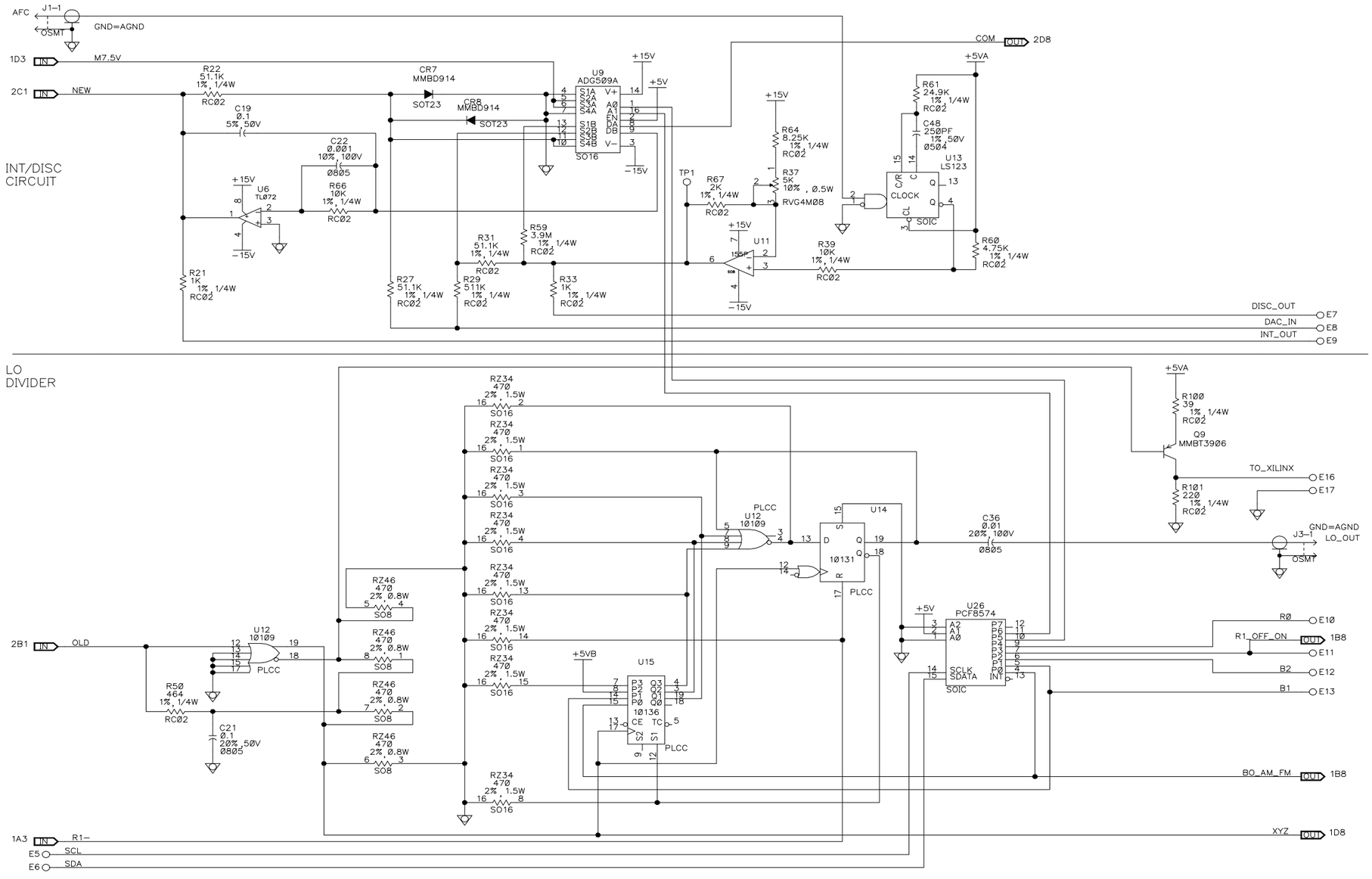
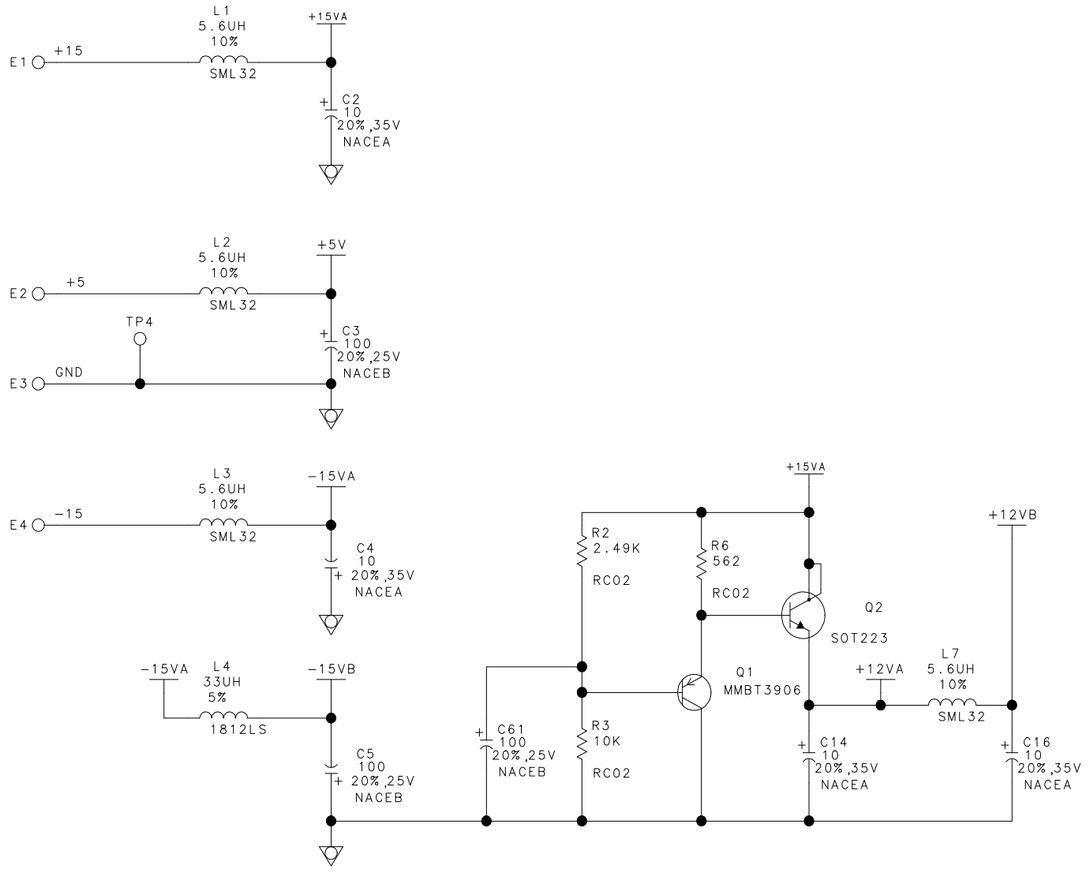


Figure 7-14. Local Oscillator PWB, A2A2 Schematic Diagram (sheet 3 of 3)

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UNUSED ELEMENTS:



NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%,1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%,50V. MICROFARADS.

3. SYMBOLS:

   XXX IN OUT — INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT) OR BIDIRECTIONAL (BI).

HIGHEST REFERENCE DESIGNATION				
AR3	C62	CR6	DS2	E14
L13	Q22	R88	TP6	U2
REFERENCE DESIGNATIONS NOT USED				
C49	C55	R16		

PWR & GND MATRIX		
REF DES	PIN NO.	
	GND	VCC
L10-12	1	
U1	8	16

Figure 7-15. Am PWB, A2A3 Schematic Diagram (sheet 1 of 3)

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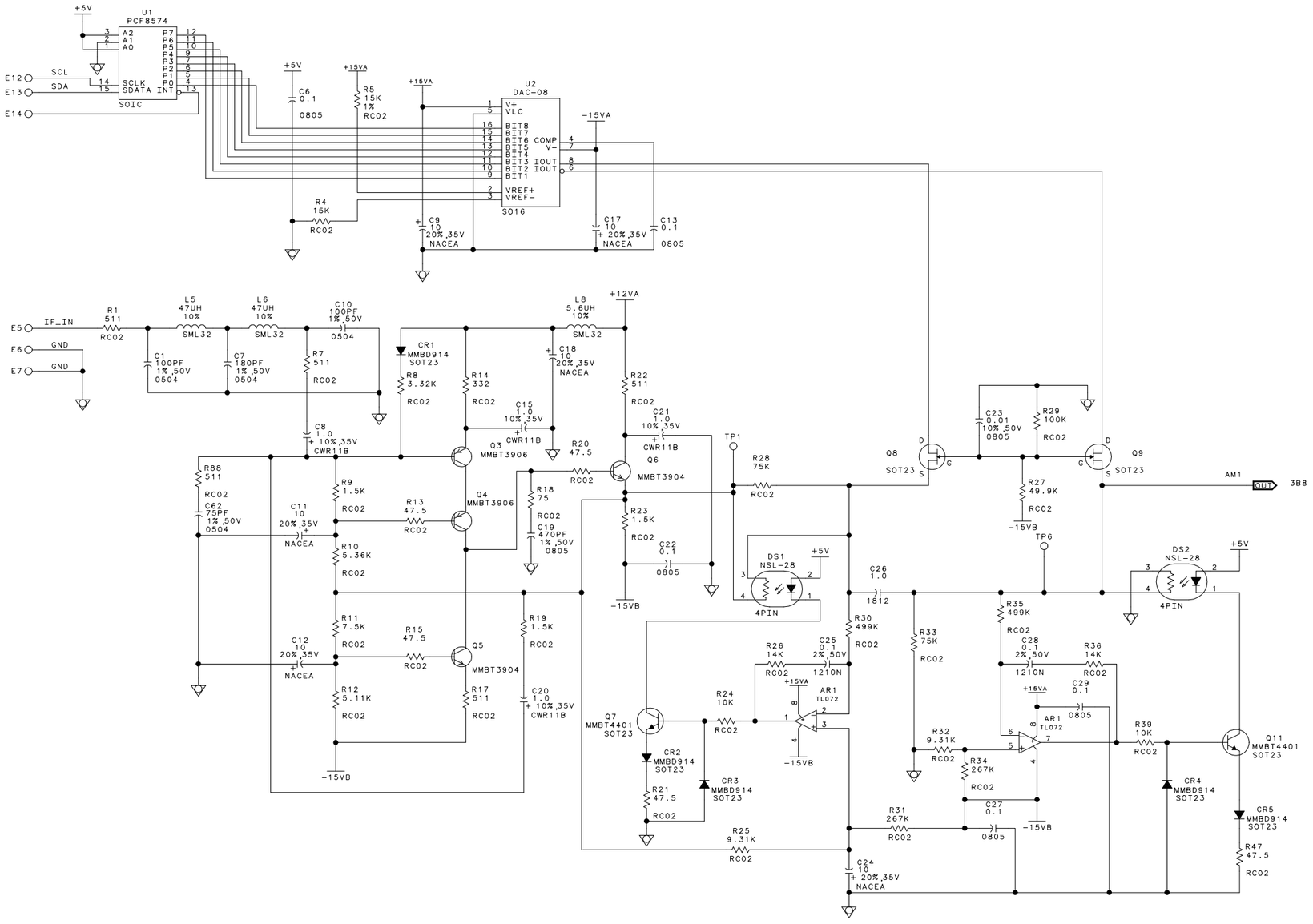


Figure 7-15. Am PWB, A2A3 Schematic Diagram (sheet 2 of 3)

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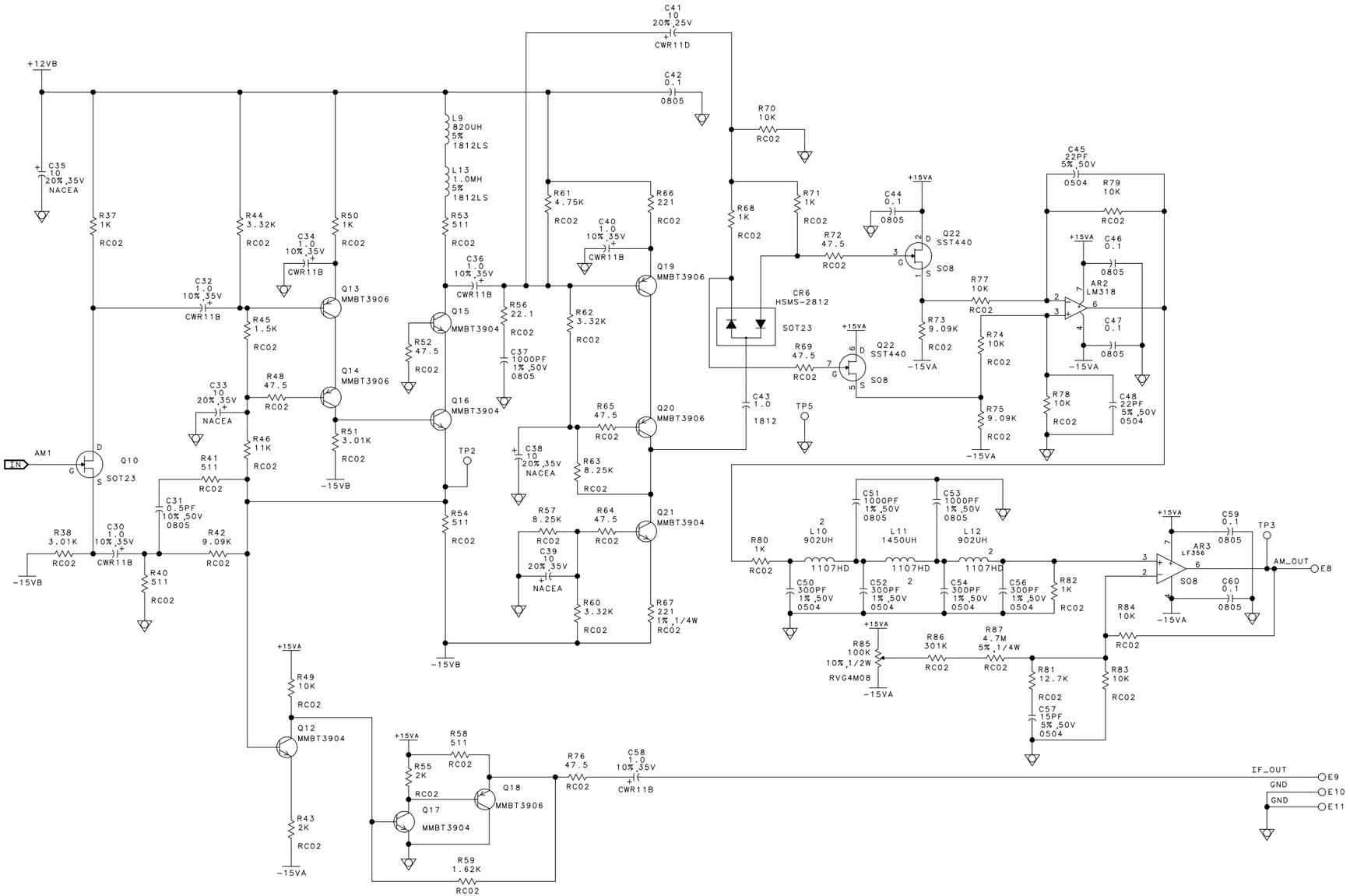


Figure 7-15. Am PWB, A2A3 Schematic Diagram (sheet 3 of 3)

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NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%, 1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%, 50V.

3. SYMBOLS:

   XXX [IN]— , —[OUT] INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT) OR BIDIRECTIONAL (BI).

HIGHEST REFERENCE DESIGNATION				
AR3	C55	CR3	E10	L12
Q16	R89	TP12	U1	
REFERENCE DESIGNATIONS NOT USED				

PWR & GND MATRIX		
REF DES	PIN NO.	
	AGND	P5V
L6, 9-10	1	
Q3, 8	5	
U1	7	14

Figure 7-16. FM PWB,A2A4 Schematic Diagram (sheet 1 of 3)

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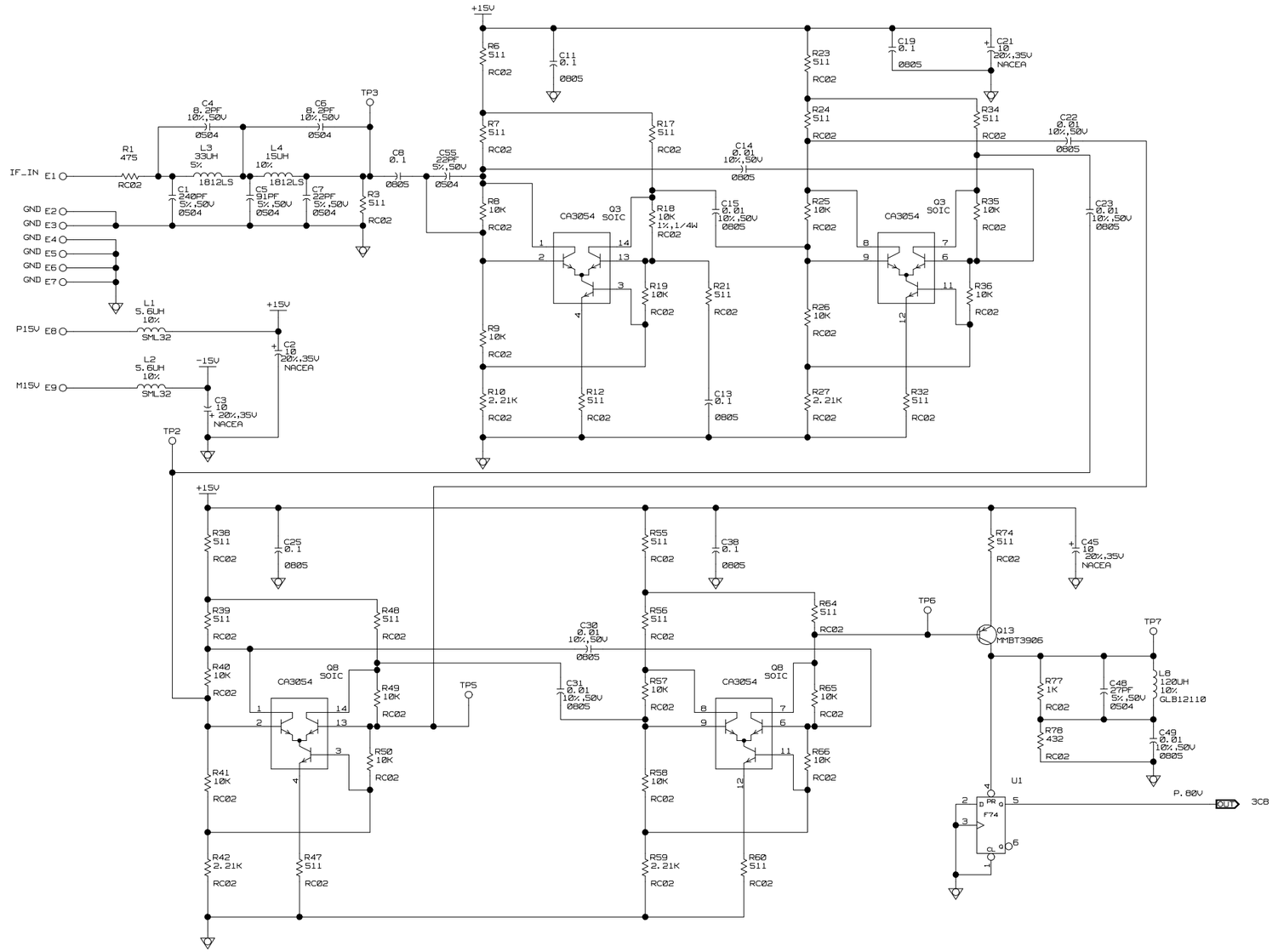


Figure 7-16. FM PWB, A2A4 Schematic Diagram (sheet 2 of 3)

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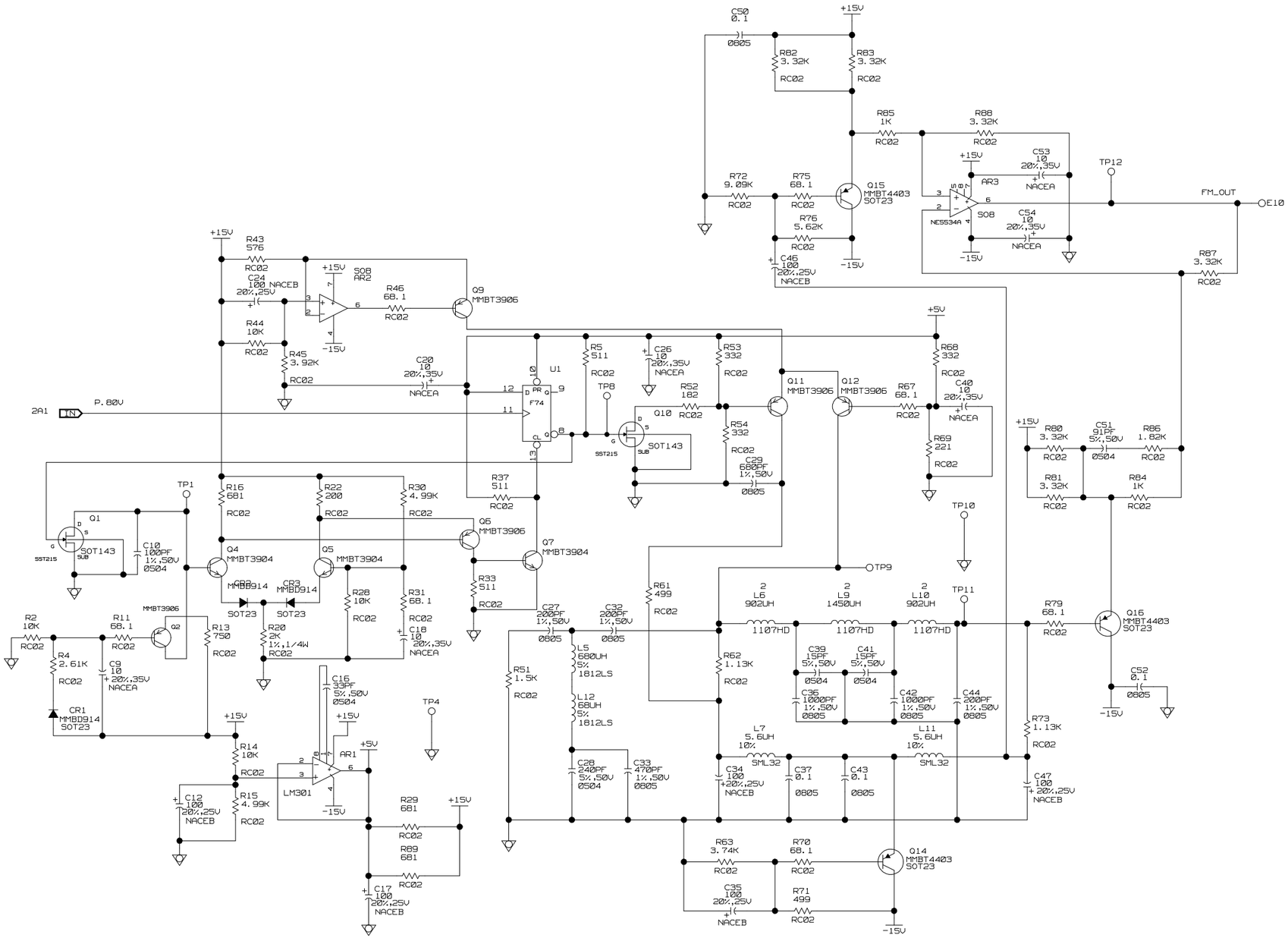
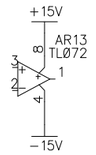
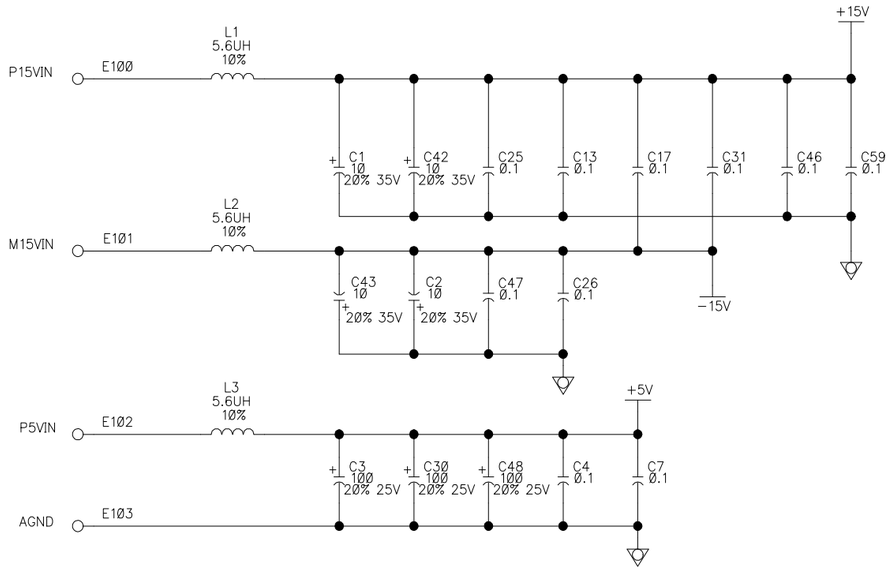


Figure 7-16. FM PWB, A2A4 Schematic Diagram (sheet 3 of 3)

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UNUSED ELEMENTS:





HIGHEST REFERENCE DESIGNATION				
AR13	C59	CR8	E103	K3
L6	Q1	R58	TP9	U9
REFERENCE DESIGNATIONS NOT USED				
CR5−6	E1−10	E12−16		
E22−25		E27	E30−33	
E37−99		R5	R14	R16
R18	U1			

PWR & GND MATRIX		
REF DES	PIN NO.	
	AGND	P5V
L4−6	1	
U2,6	8	16
U3	15	
U4−5,7	14	
U8−9	3	

NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%,1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%,50V.

3. SYMBOLS:

   XXX IN , OUT , INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT).

Figure 7-17. Filter PWB, A2A5 Schematic Diagram (sheet 1 of 3)

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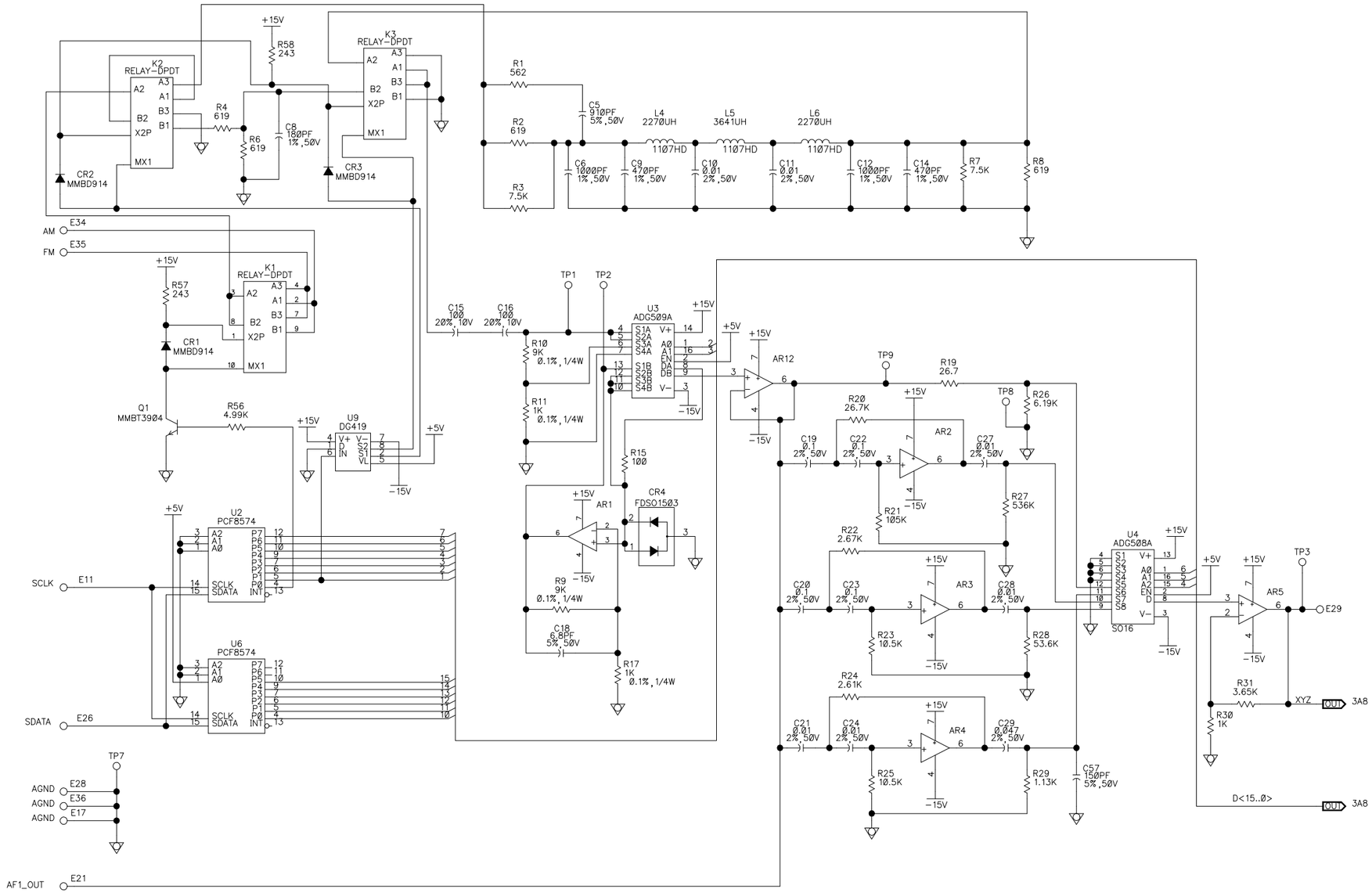


Figure 7-17. Filter PWB, A2A5 Schematic Diagram (sheet 2 of 3)

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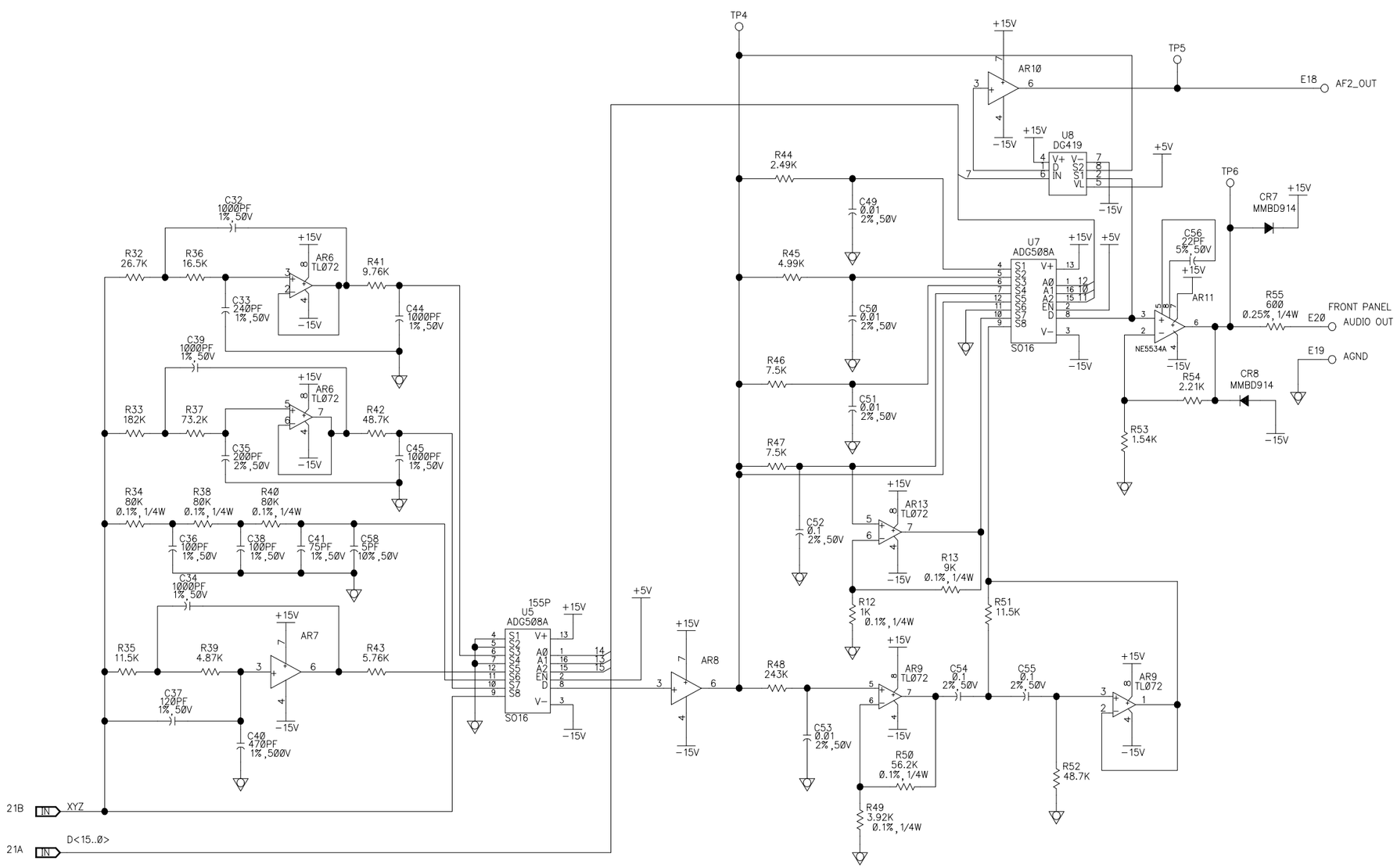
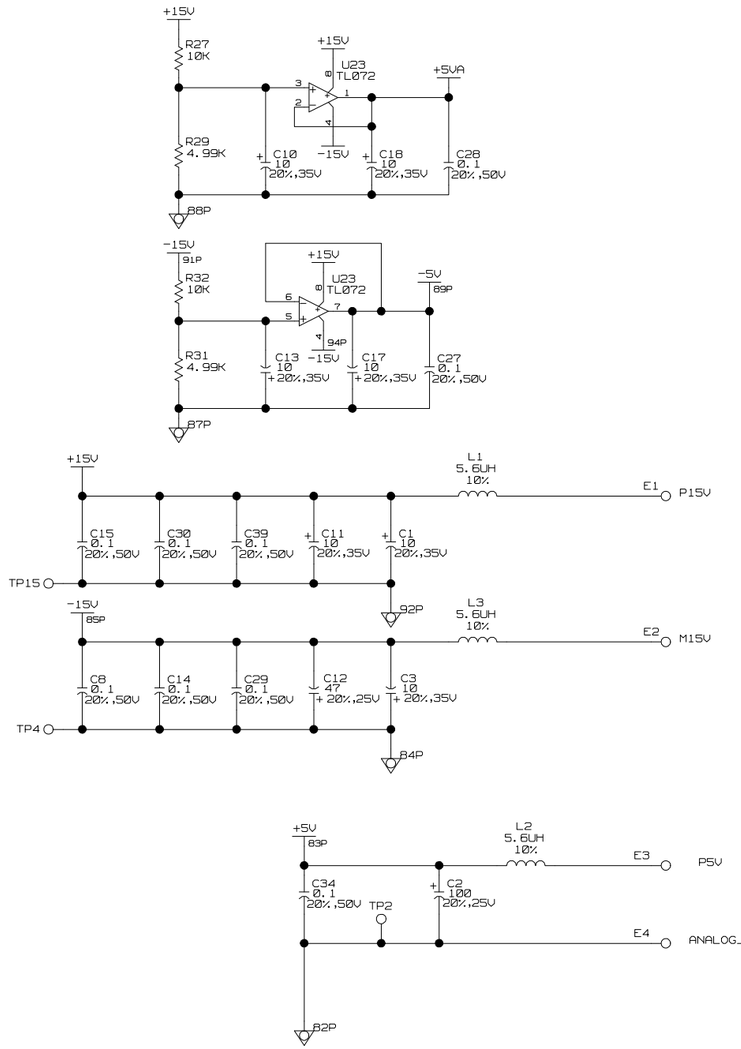


Figure 7-17. Filter PWB, A2A5 Schematic Diagram (sheet 3 of 3)

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NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%, 1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%, 25V.

3. SYMBOLS:

   XXX IN , OUT INDICATES SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT).

HIGHEST REFERENCE DESIGNATION				
C39	CR10	E18	L3	R62
TP15	U23			
REFERENCE DESIGNATIONS NOT USED				
E5	R10	R50-52		U2
U12	U17			

PWR & GND MATRIX				
REF DES	PIN NO.			
	P15V	M15V	AGND	P5V
U1,5	12	5	4	
U3,10			8	16
U4	13	4	5	
U6-7			15	
U9			14	

Figure 7-18. Detector PWB, A2A6 Schematic Diagram (sheet 1 of 3)

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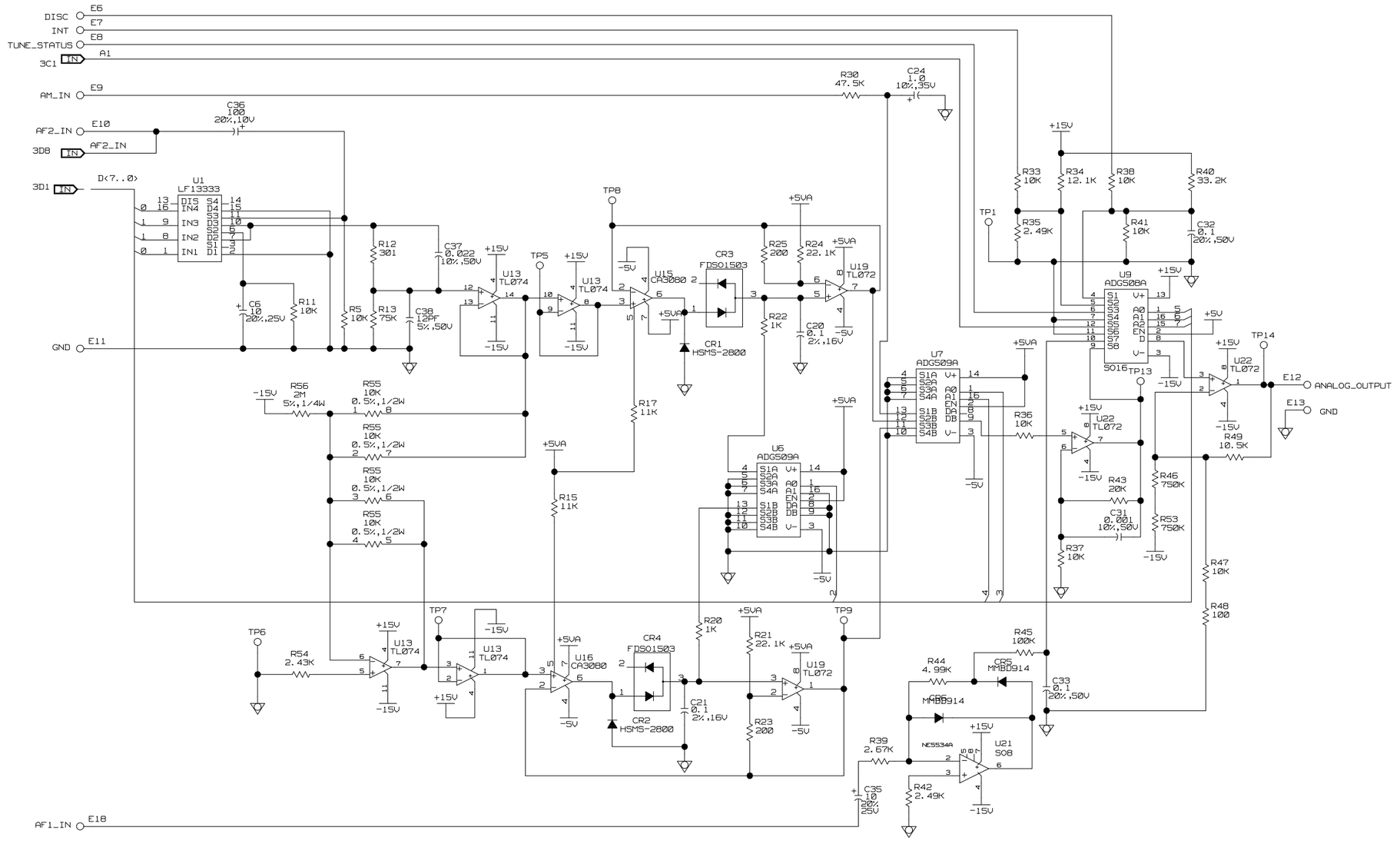


Figure 7-18. Detector PWB,A2A6 Schematic Diagram (sheet 2 of 3)

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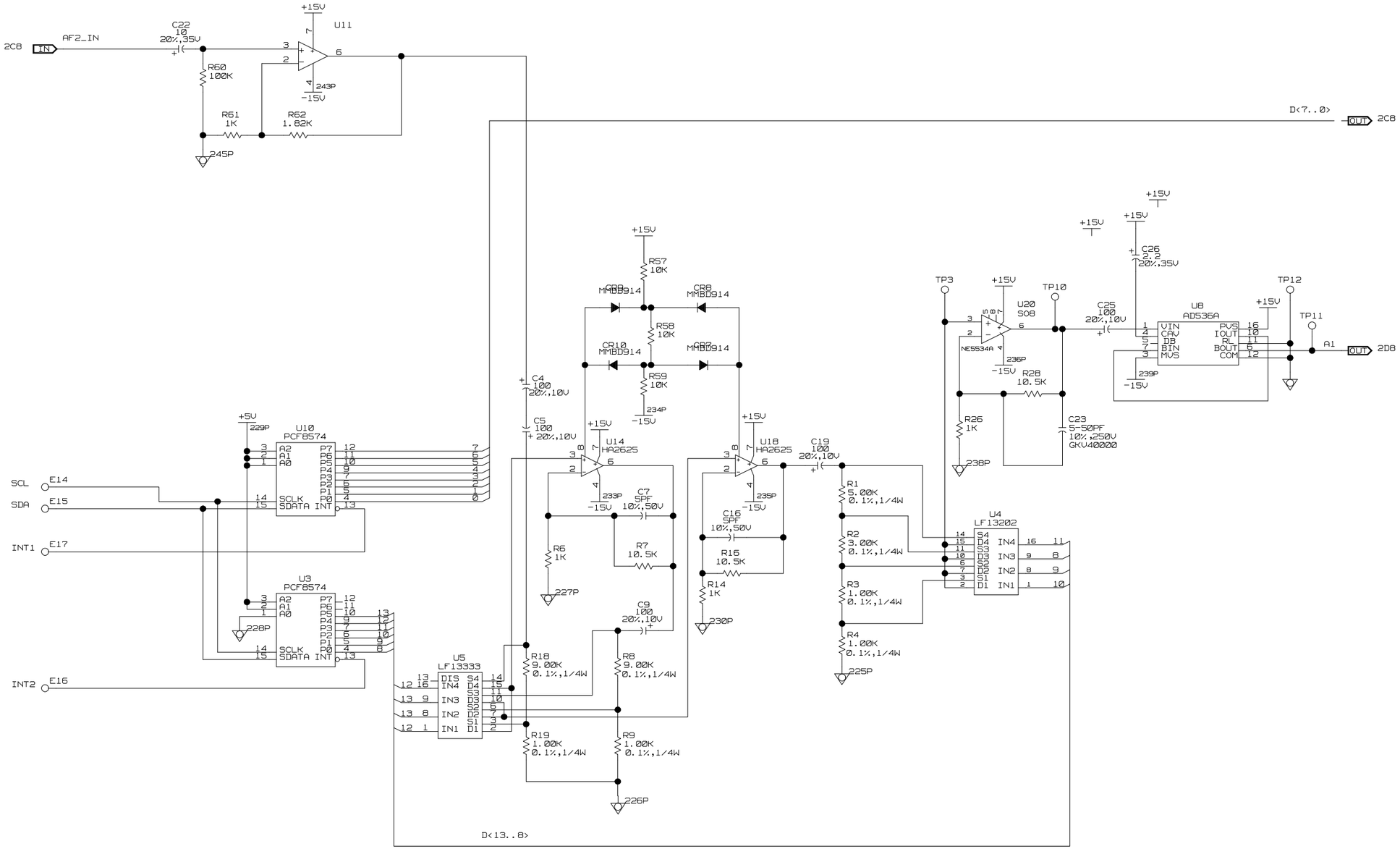
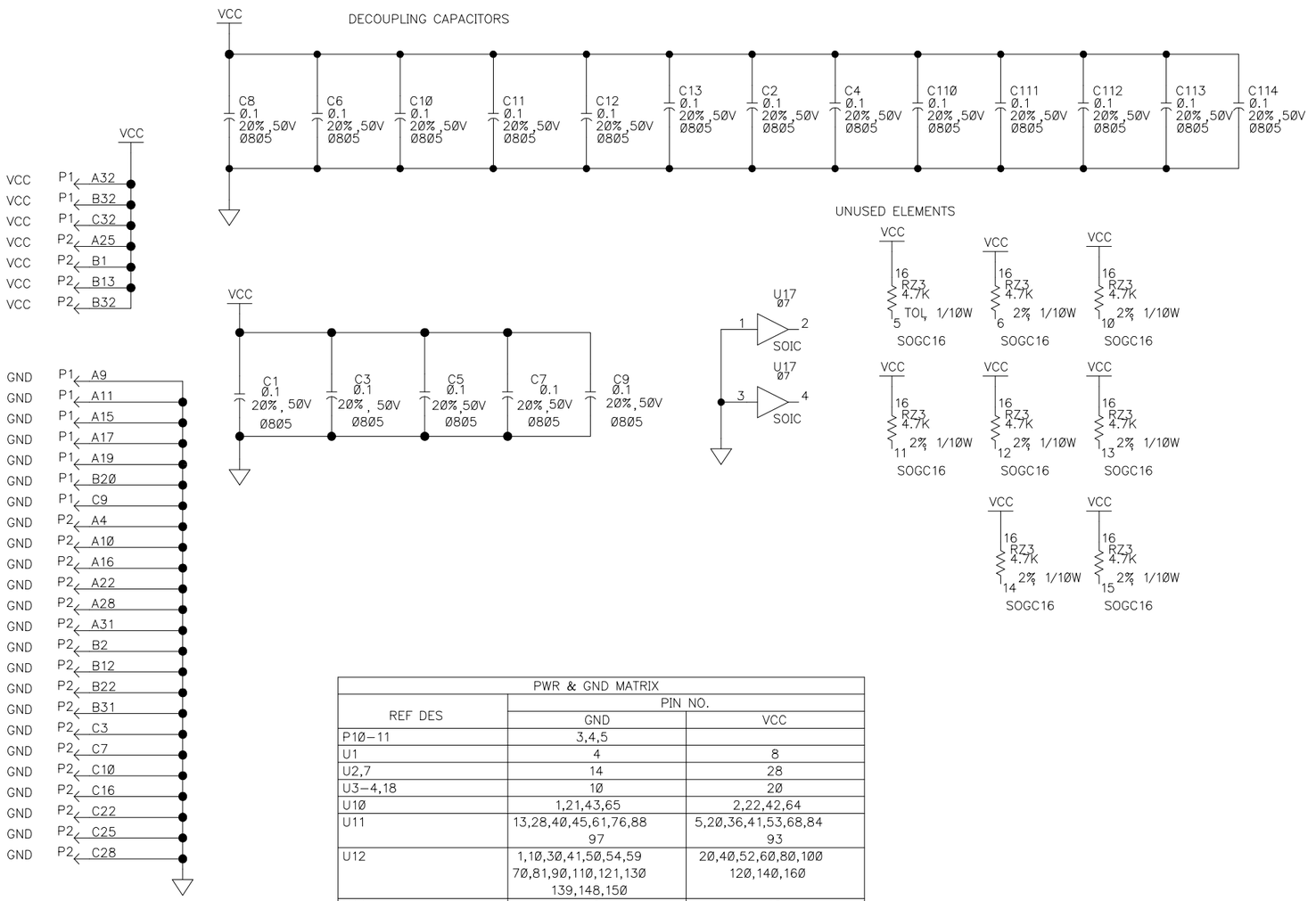


Figure 7-18. Detector PWB, A2A6 Schematic Diagram (sheet 3 of 3)

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NOTES: UNLESS OTHERWISE SPECIFIED;

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION, PREFIX WITH UNIT NUMBER AND SUBASSEMBLY DESIGNATIONS.

2. RESISTANCE VALUES ARE IN OHMS, 1%,1/4W. CAPACITANCE VALUES ARE IN MICROFARADS, 20%,50V. MICROFARADS.

3. SYMBOLS:

   INDICATES

   XXX IN OUT

   SHEET TO SHEET CONNECTION. FIRST DIGIT IS SHEET NUMBER, SECOND AND THIRD ARE ZONES ON THE SHEET. DESIGNATION WITHIN SYMBOL INDICATES INPUT (IN), OUTPUT (OUT) OR BIDIRECTIONAL (BI).

PWR & GND MATRIX		
REF DES	PIN NO.	
	GND	VCC
P10–11	3,4,5	
U1	4	8
U2,7	14	28
U3–4,18	10	20
U10	1,21,43,65	2,22,42,64
U11	13,28,40,45,61,76,88 97	5,20,36,41,53,68,84 93
U12	1,10,30,41,50,54,59 70,81,90,110,121,130 139,148,150	20,40,52,60,80,100 120,140,160
U14	9	16
U16	12,34	44
U17	7	14
U20	15	1
U21	16,17,56,57	14,52
U23	1	
U28–29	3	

HIGHEST REFERENCE DESIGNATION				
AR4	C114	CR6	D4	E110
P11	Q1	R50	S1	T1
U29	Y1			
REFERENCE DESIGNATIONS NOT USED				
AR3	C36–39		C43–99	
C102–109	E1	E5–12		
E14–99	E101–109			
R26–49	U22			

Figure 7-19. VXI Processor PWB,A1 Schematic Diagram (sheet 1 of 16)

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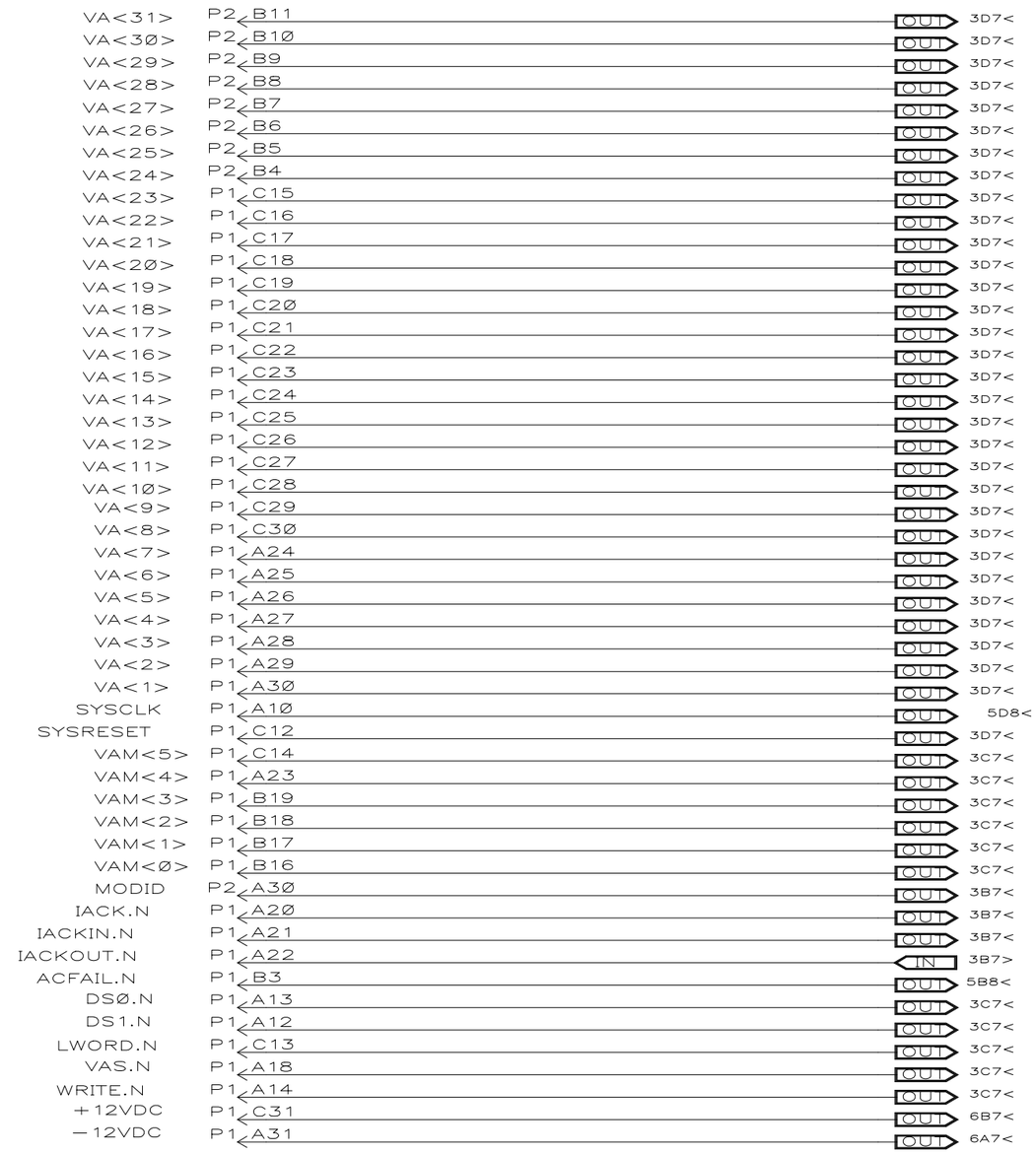


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 2 of 16)

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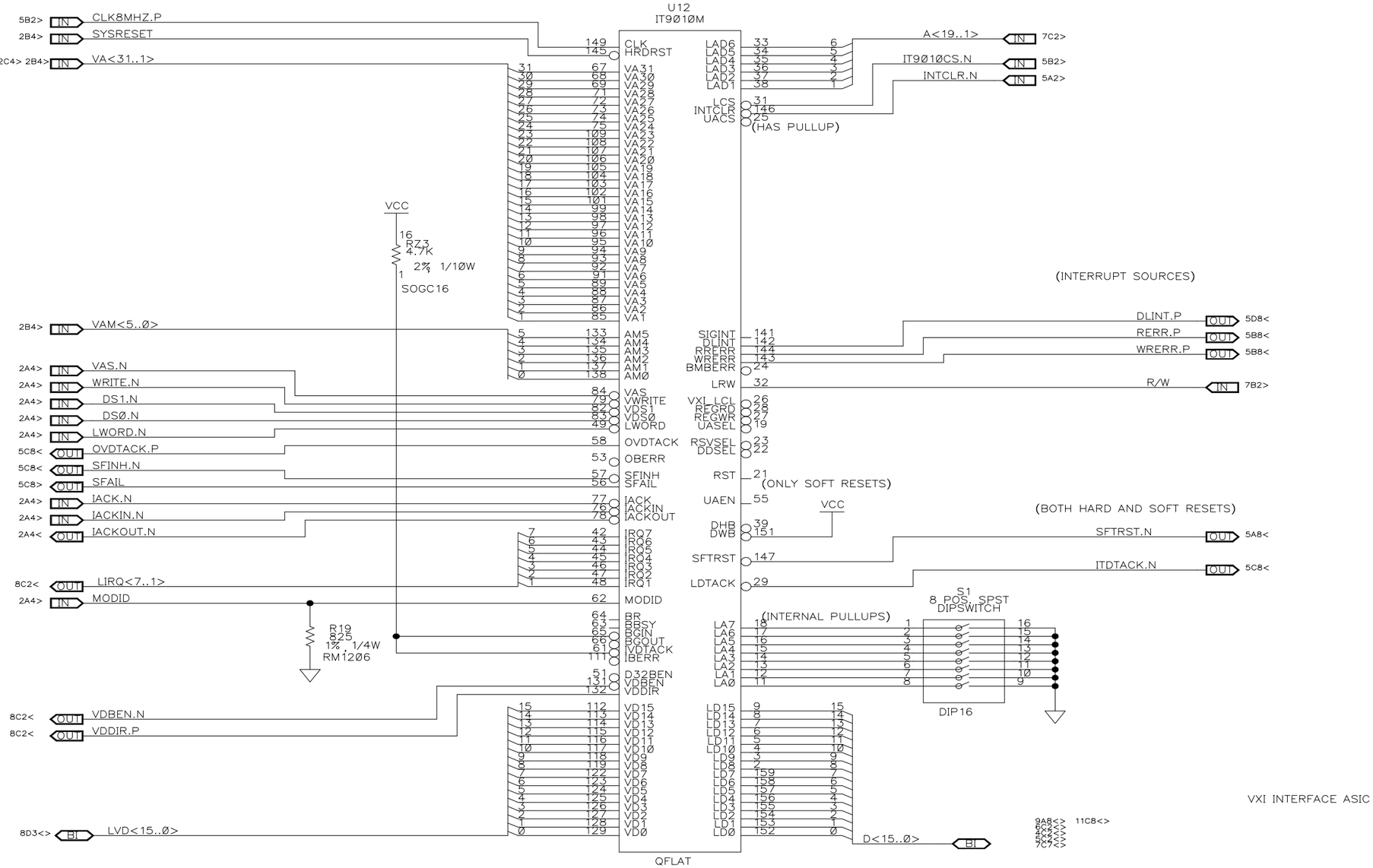


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 3 of 16)

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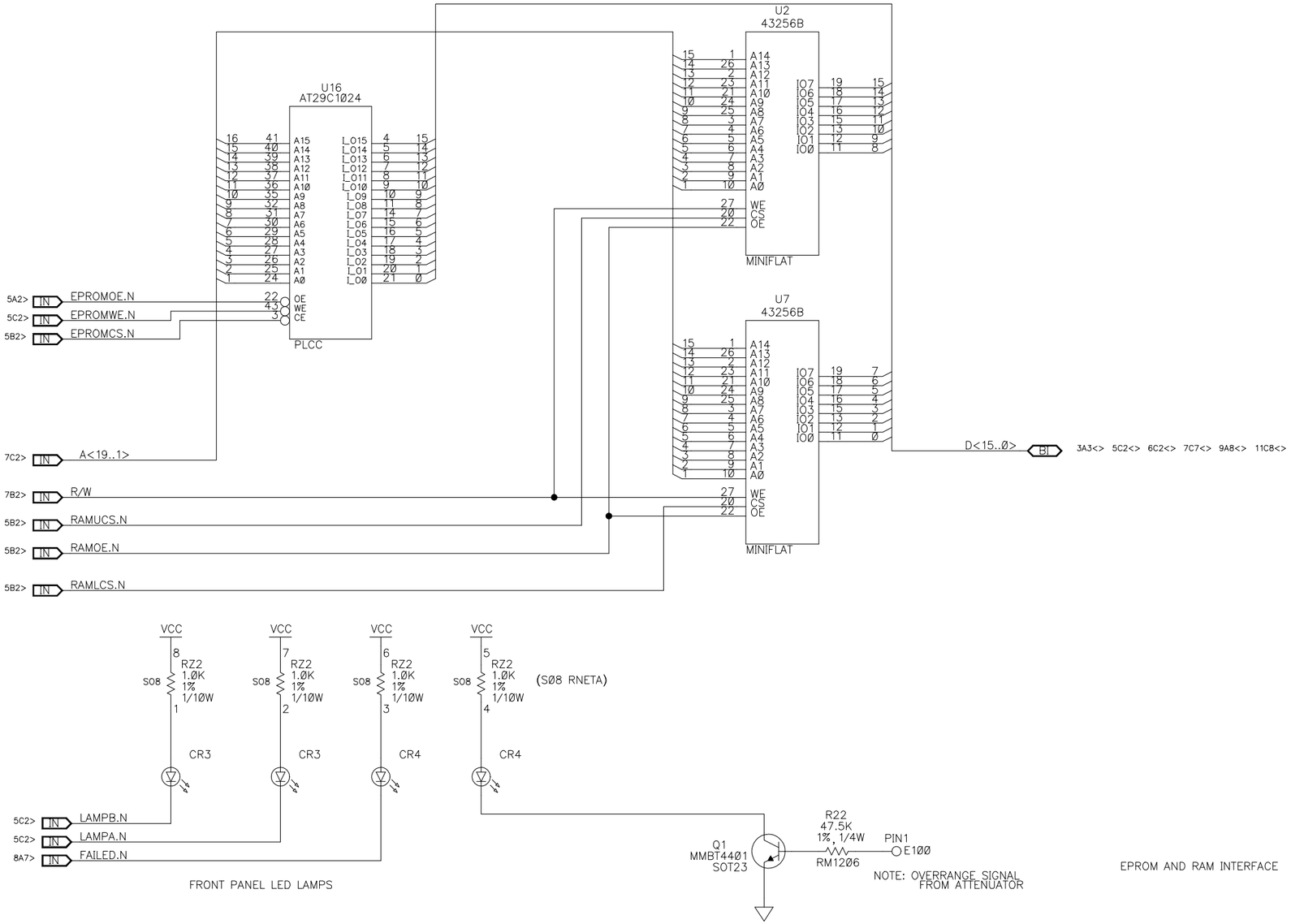


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 4 of 16)

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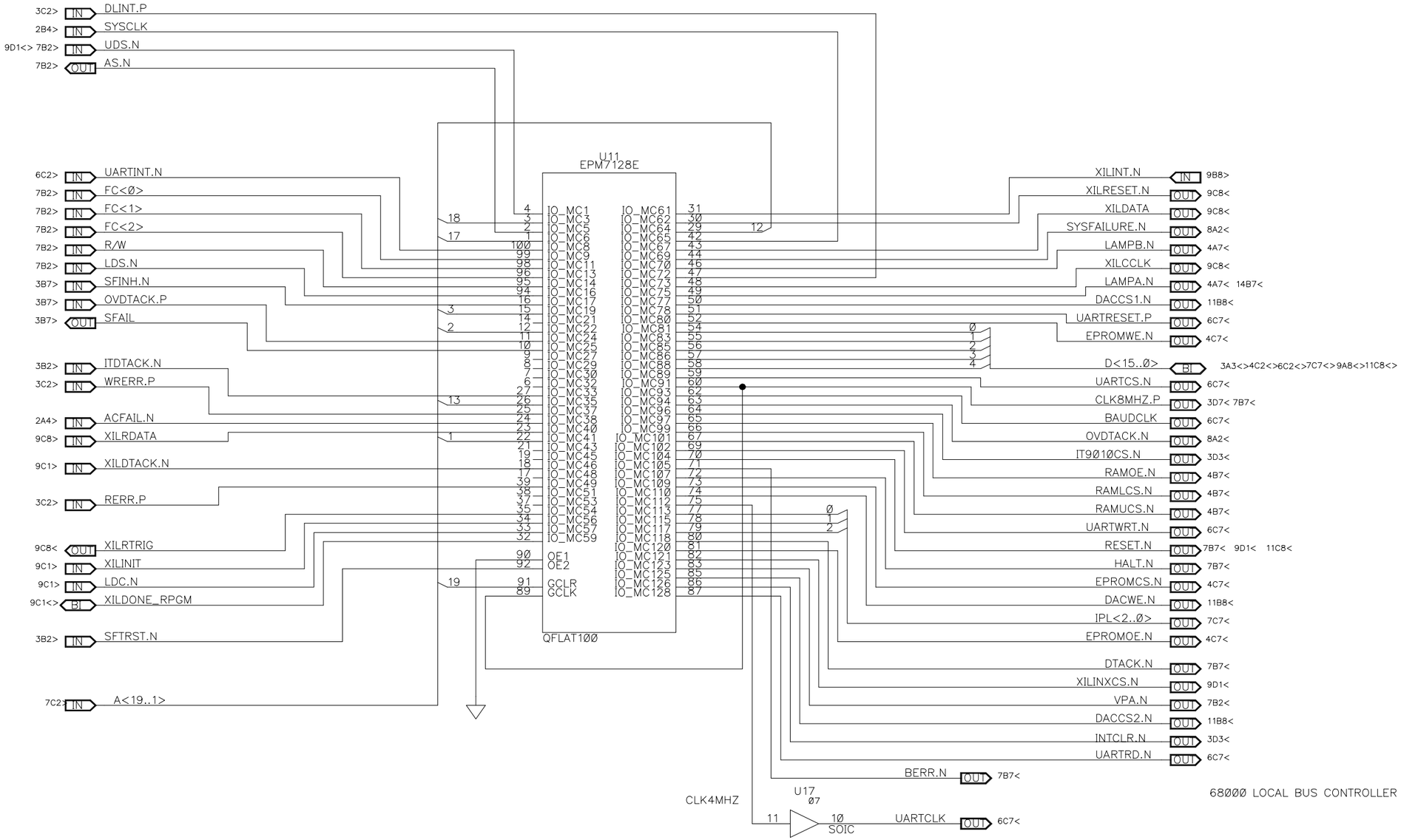


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 5 of 16)

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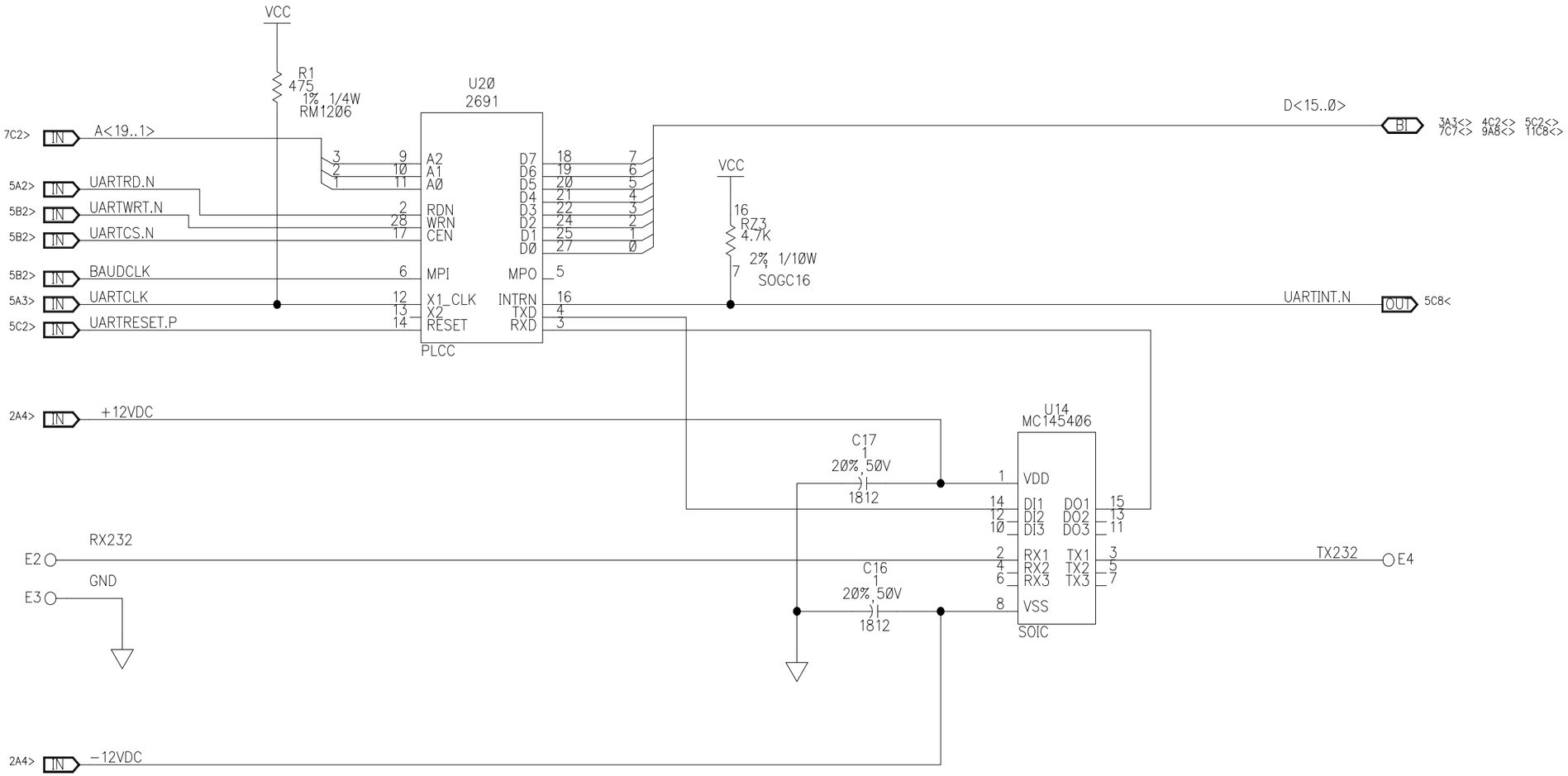


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 6 of 16)

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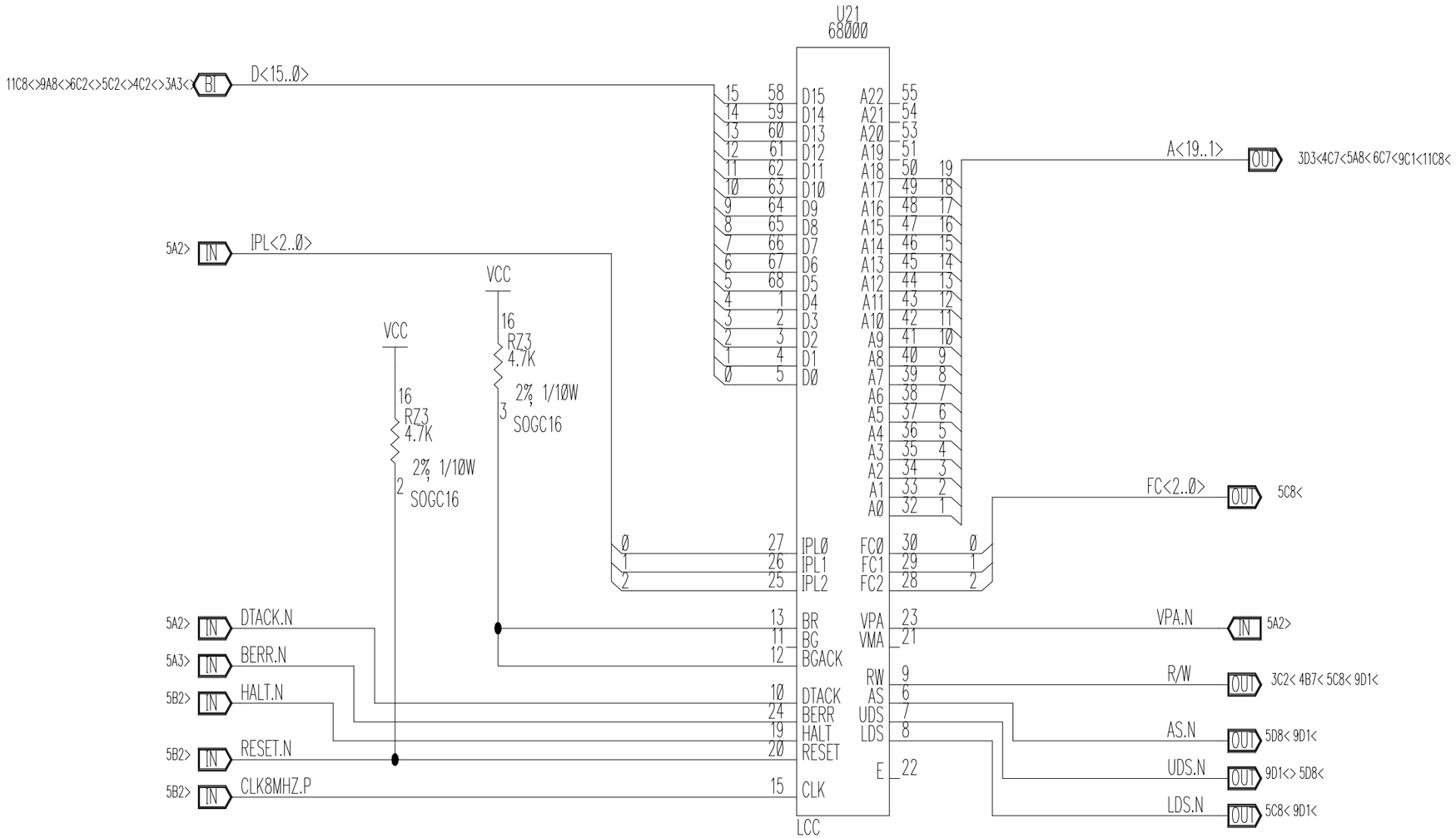


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 7 of 16)

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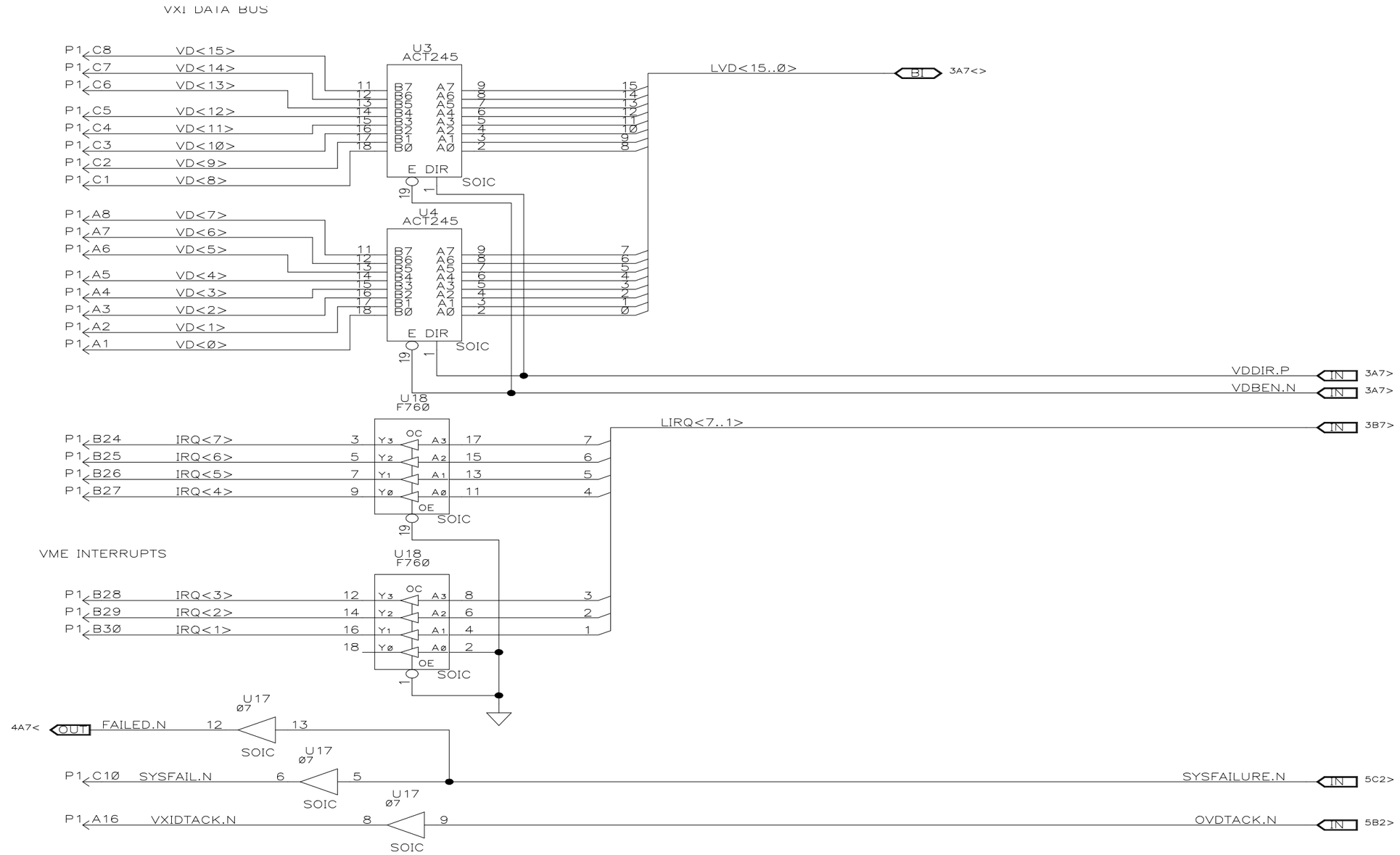


Figure 7-19. VXI Processor PWB,A1 Schematic Diagram (sheet 8 of 16)

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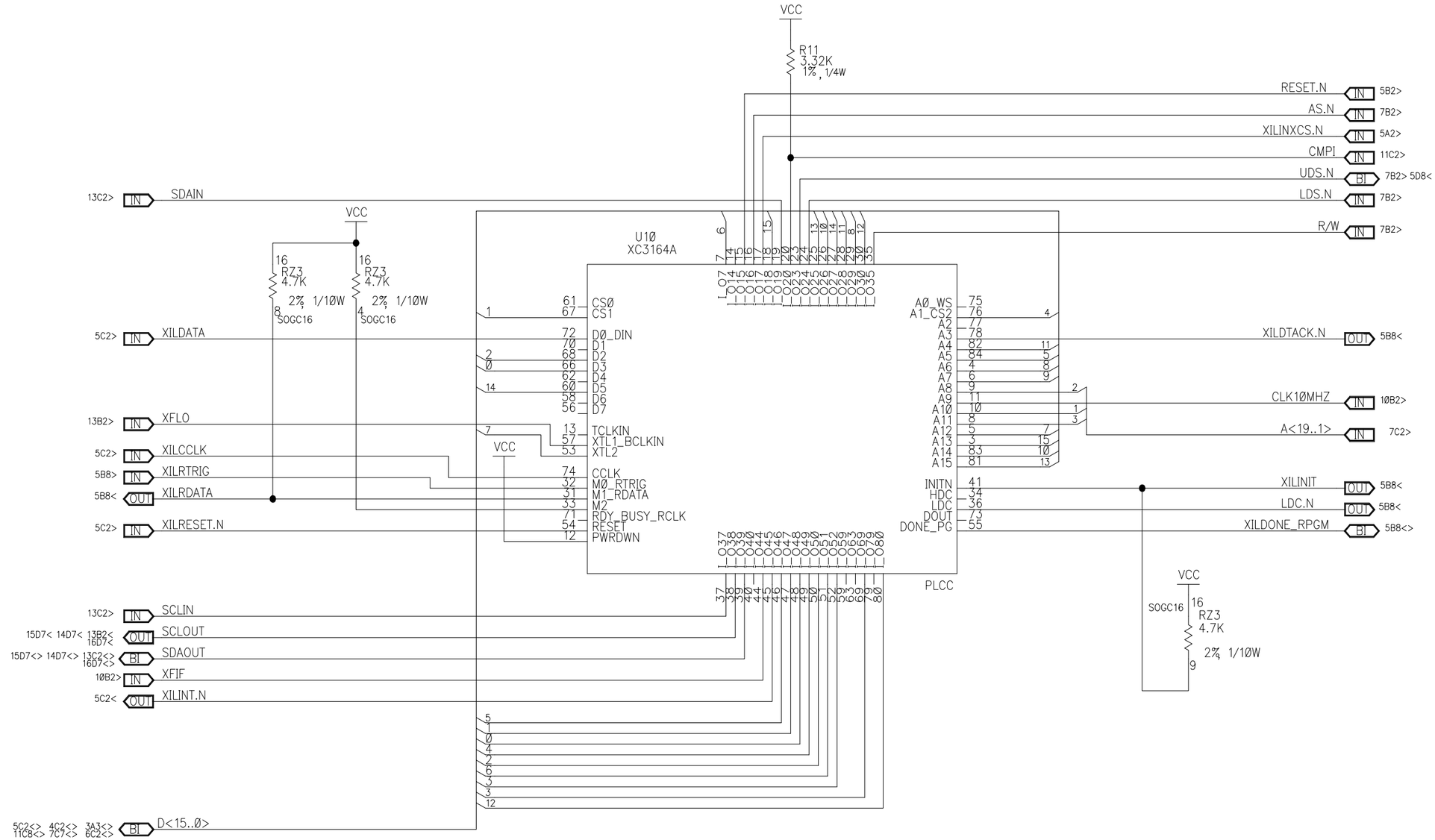


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 9 of 16)

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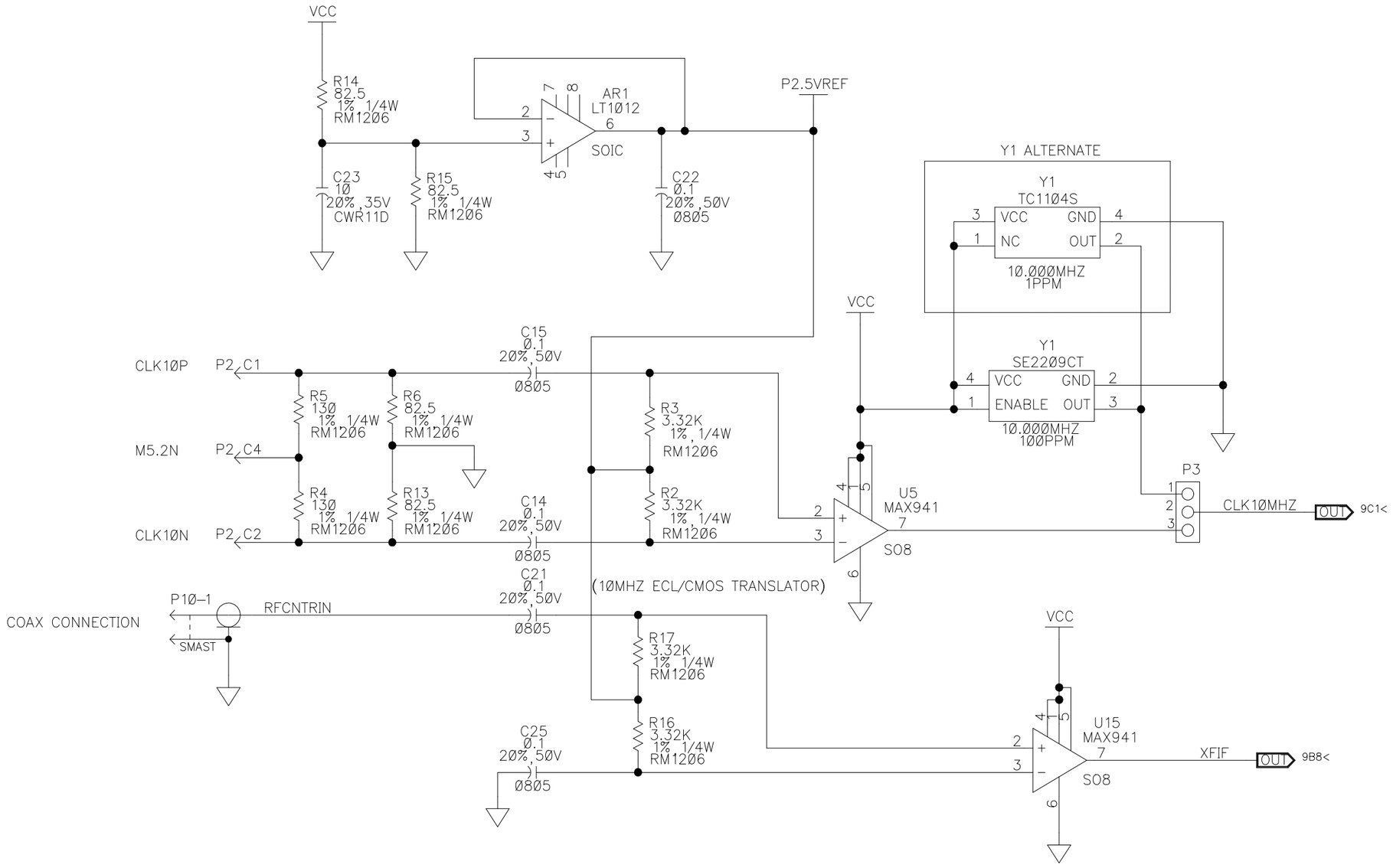


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 10 of 16)

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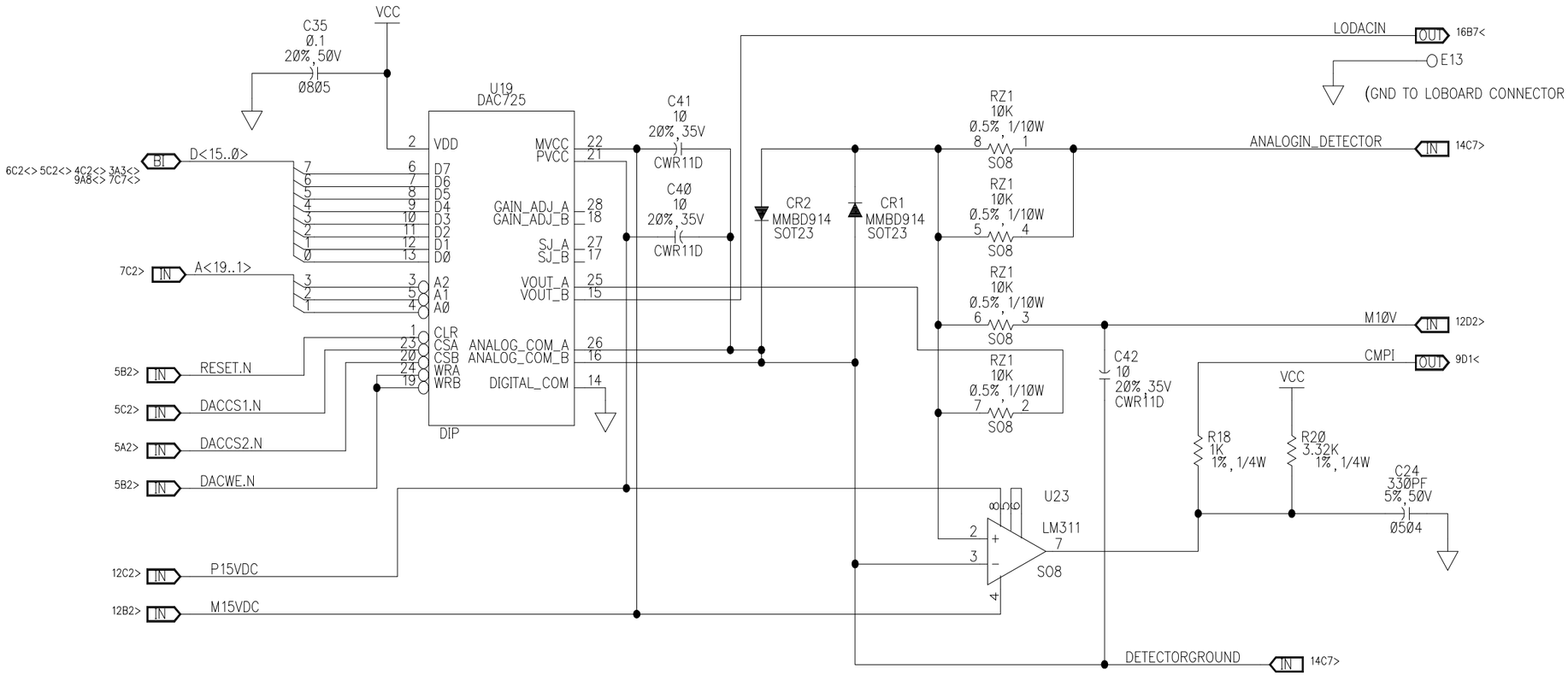


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 11 of 16)

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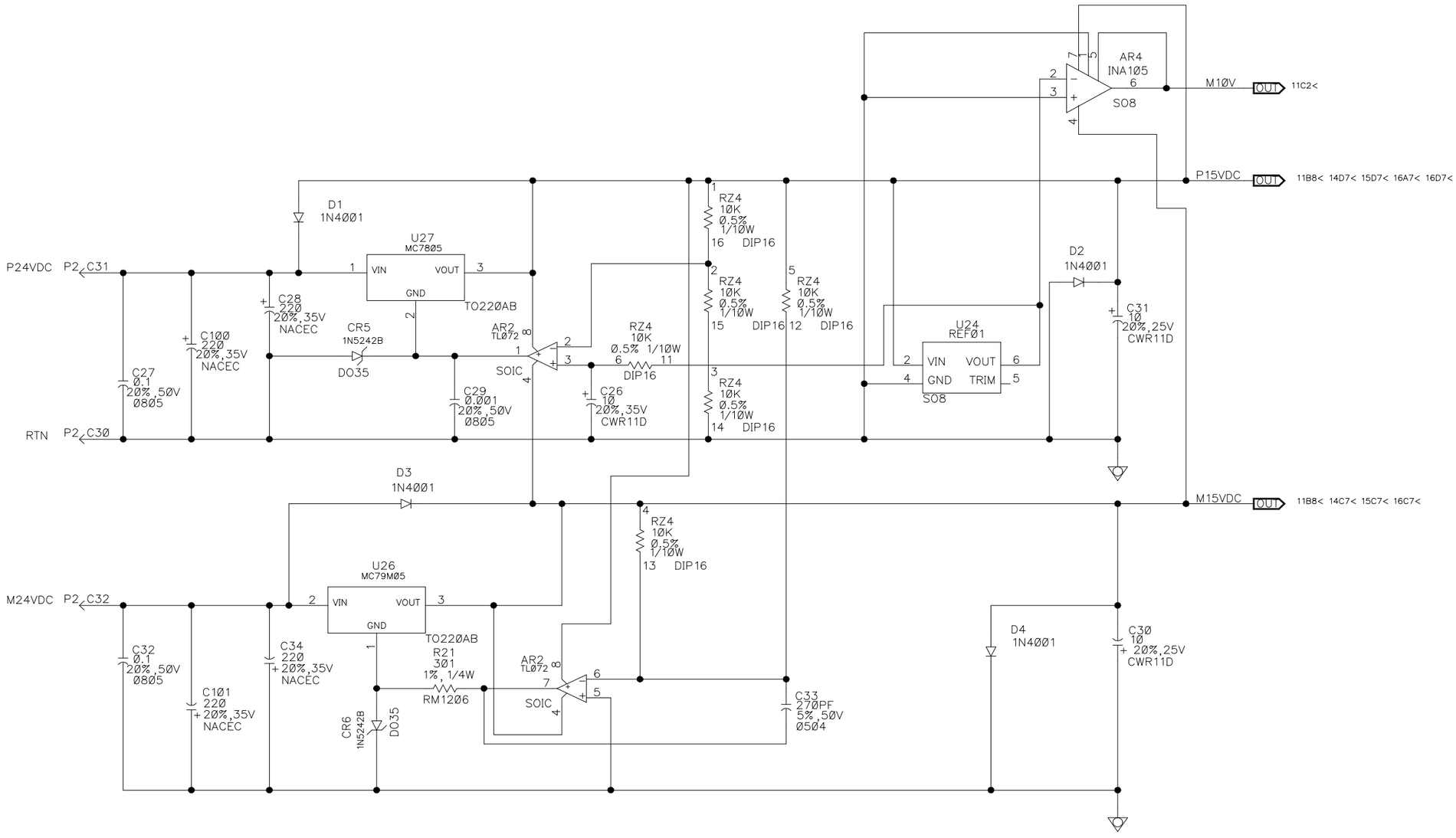


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 12 of 16)

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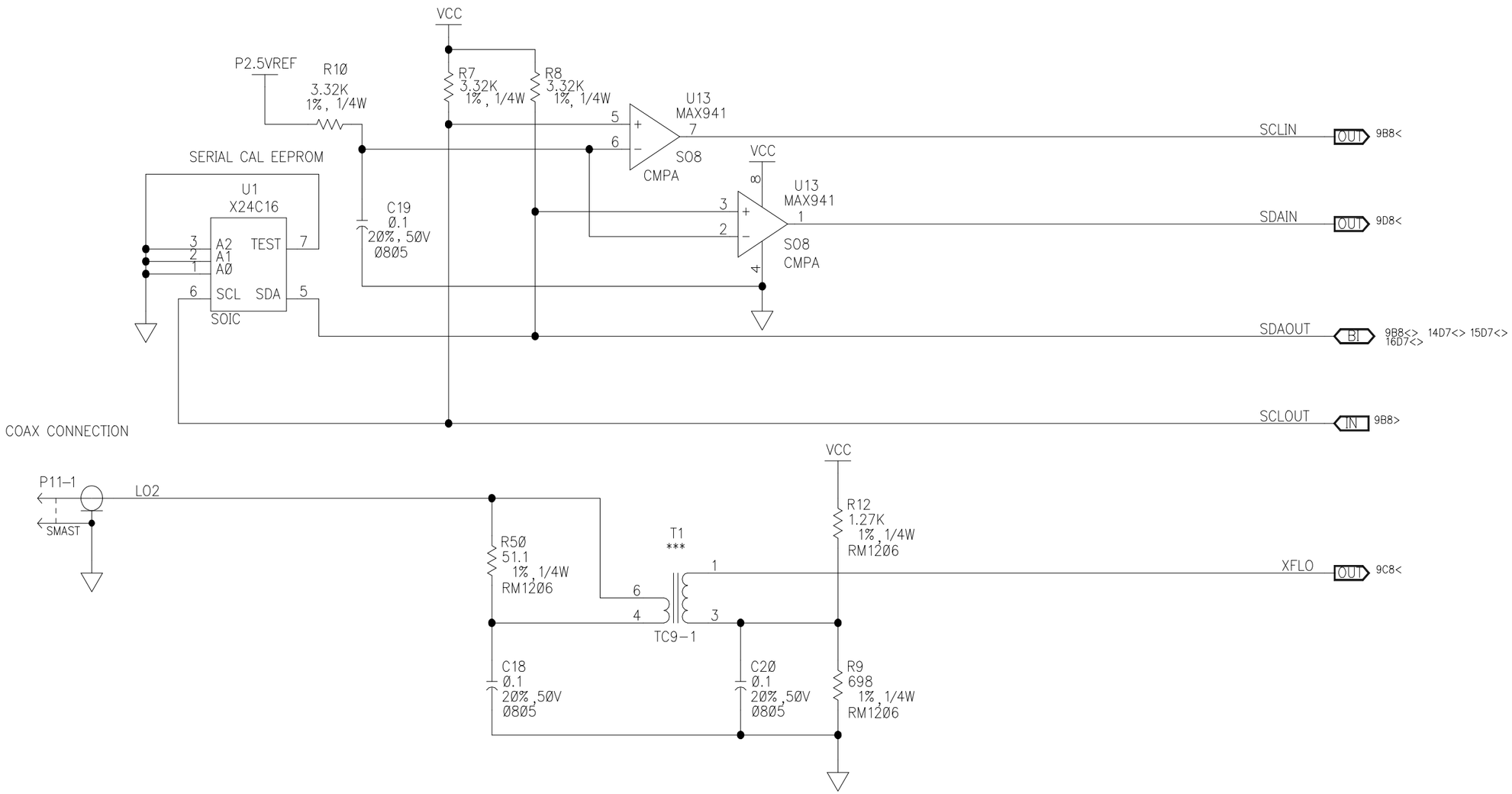
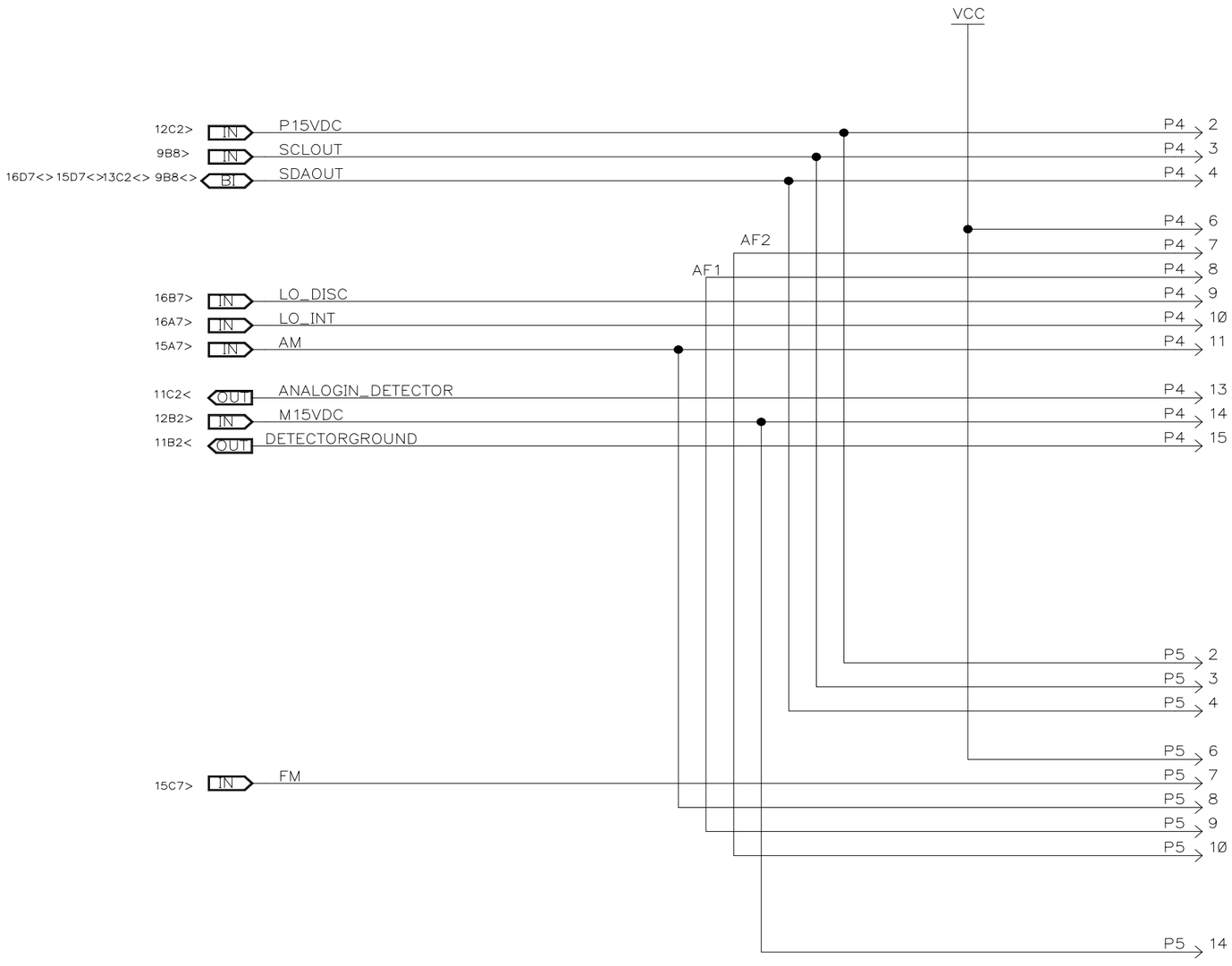


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 13 of 16)

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P4 TO DETECTOR

DETECTOR ETERM NUMBER AND SIGNAL NAME:

E1–P15V
E14–SCL
E15–SDA

E3–P5V
E10–AF2_IN
E18–AF1_IN
E6–DISC
E7–INT
E9–AM_IN

E12–ANALOG_OUTPUT
E2–M15V
E13–AGND

P5 TO FILTER

FILTER ETERM NUMBER AND SIGNAL NAME:

E100–P15VIN
E11–SCL
E26–SDA

E102–P5VIN
E35–FM
E34–AM
E21–AF1_OUT
E18–AF2_OUT

E101–M15VIN

Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 14 of 16)

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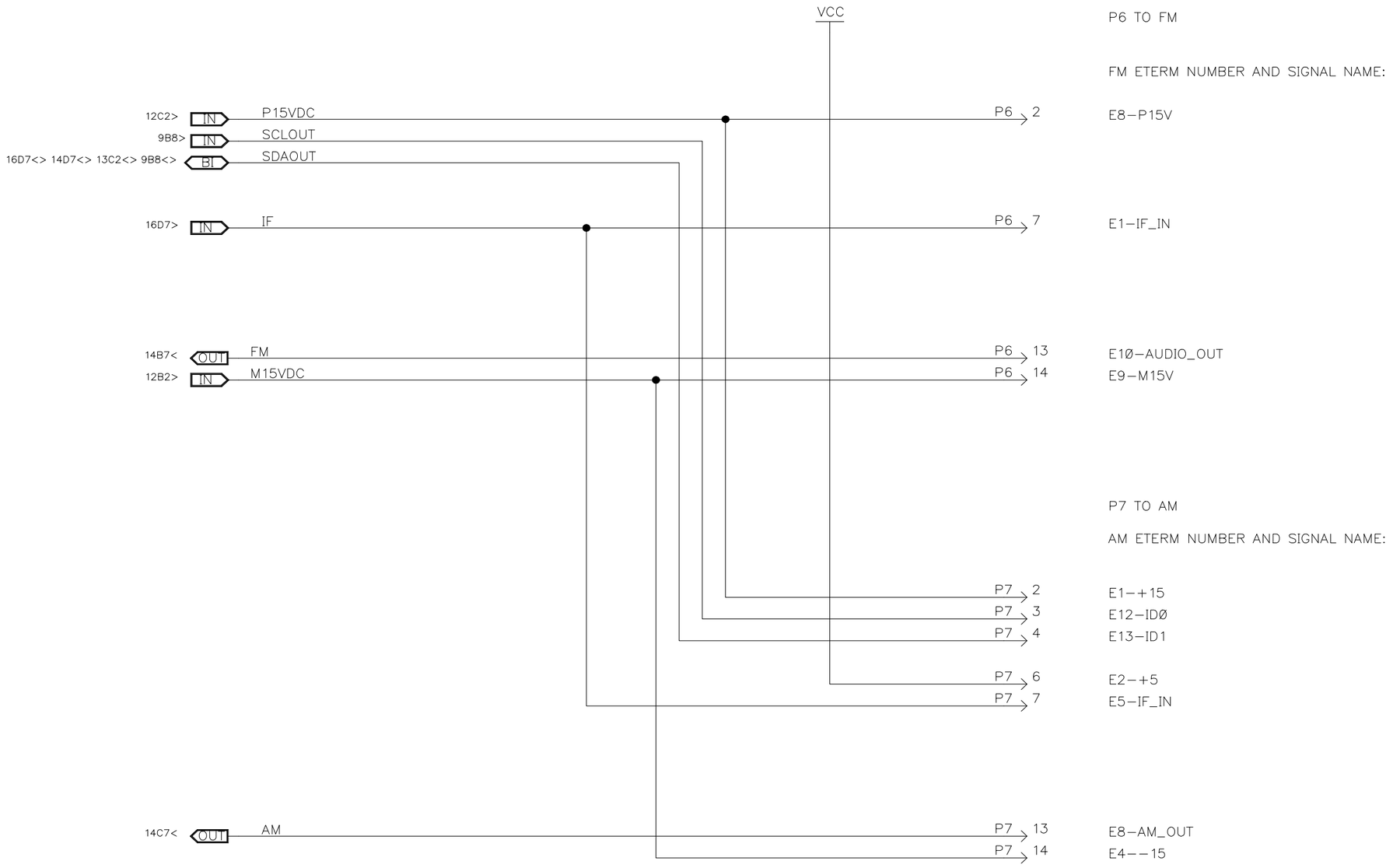
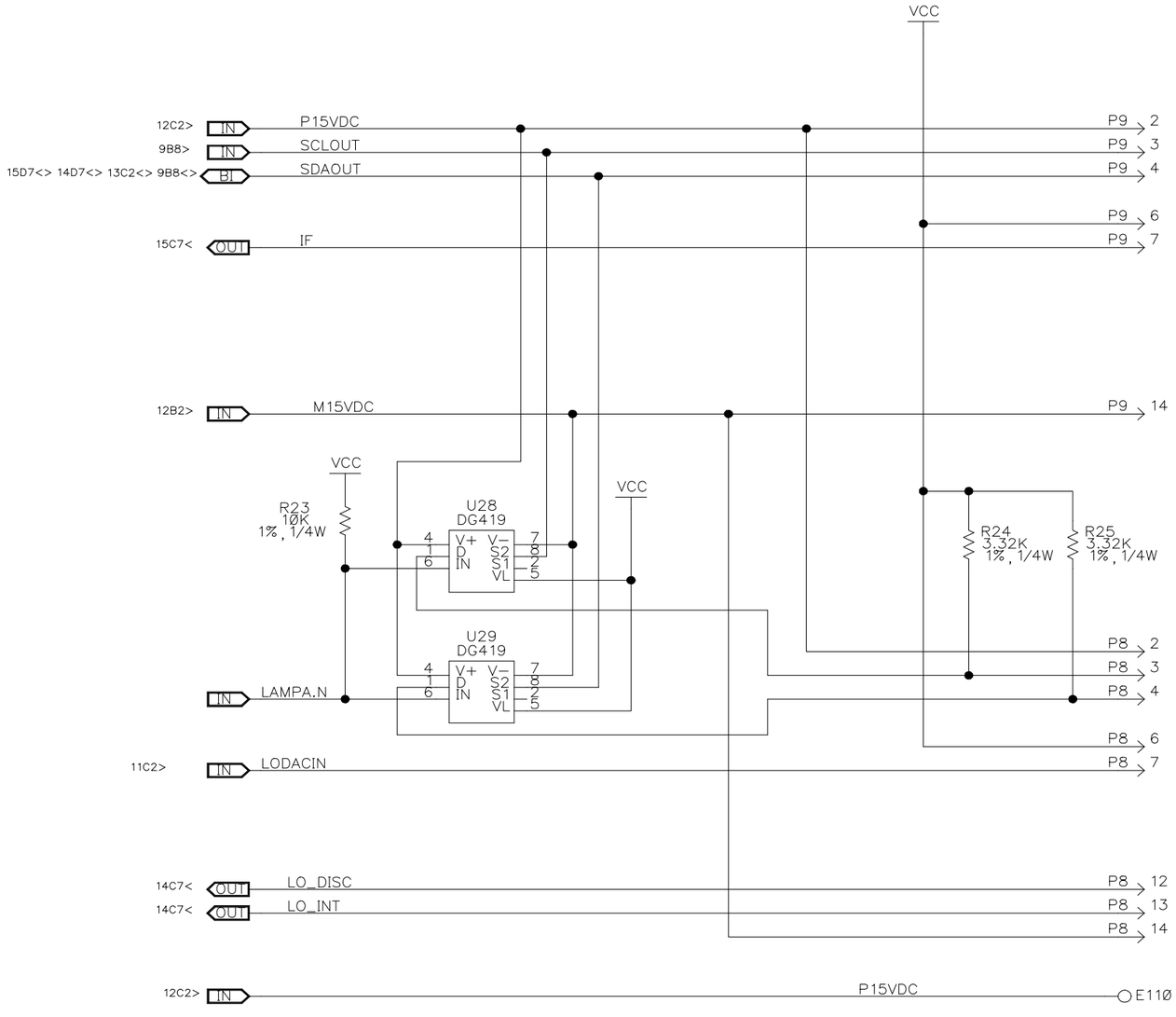


Figure 7-19. VXI Processor PWB, A1 Schematic Diagram (sheet 15 of 16)

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P9 TO RF

RF ETERM NUMBER AND SIGNAL NAME:

E4–P15VE
E18–SCL
E19–SDA

E6–P5VE
E11–IF_OUT

E5–M15VE

P8 TO LO

LO ETERM NUMBER AND SIGNAL NAME:

E1–P15VX
E5–SCL
E6–SDA

E3–P5VX
E8–DAC_IN

E7–DISC_OUT
E9–INT_OUT
E2–M15VX

P15VDC TO ATTENUATOR
E2– THROUGH ATTENUATOR FEEDTHROUGH 1(HIGH–CAP.)

Figure 7-19. VXI Processor PWB,A1 Schematic Diagram (sheet 16 of 16)

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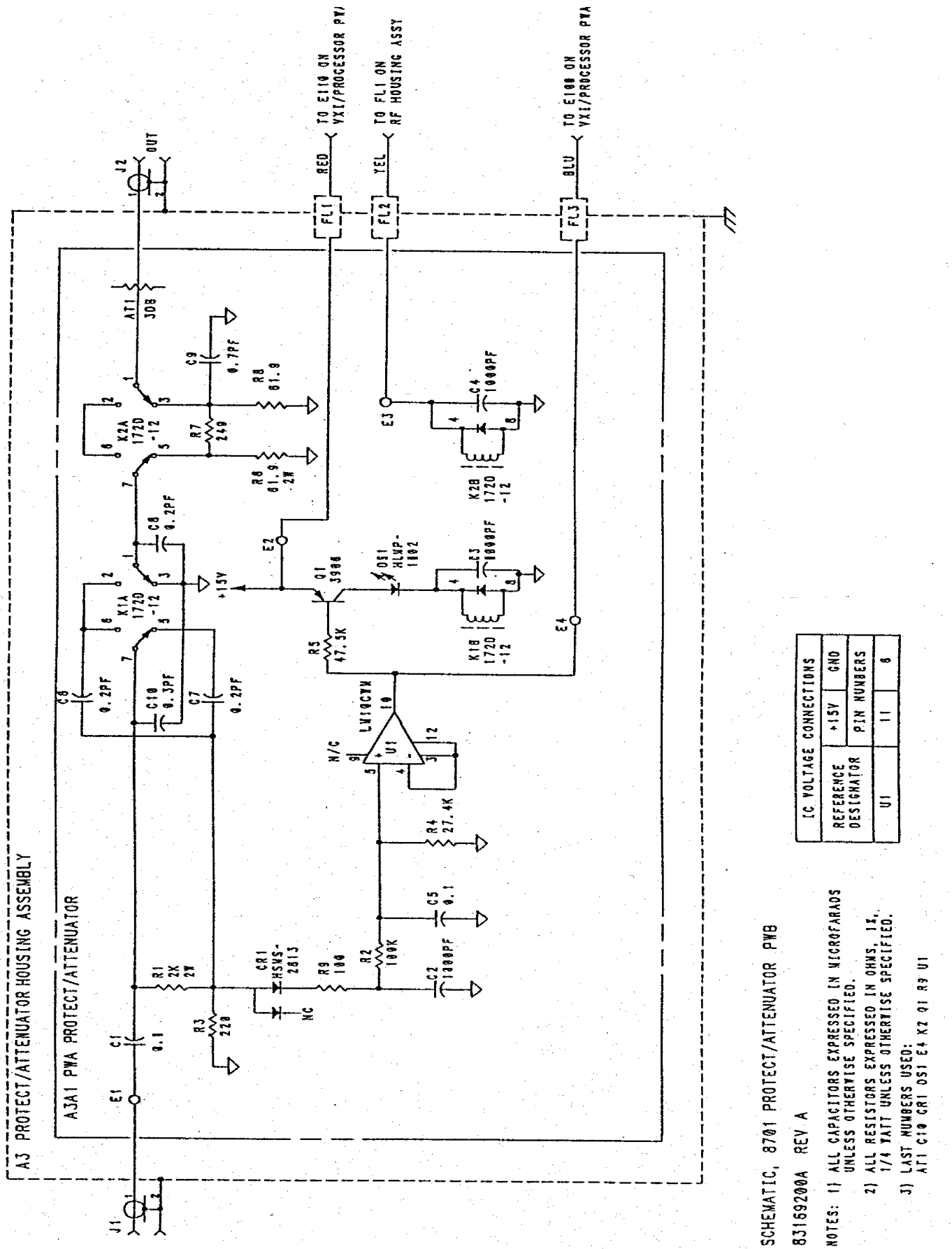


Figure 7-20. Protect Attenuator, A3A1 Schematic Diagram

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