TI 6365.6

PRELIMINARY INSTRUCTION BOOK

MODE SELECT BEACON SYSTEM (MODE S) SENSOR

TRANSMITTER

P/O INTERROGATOR TYPE FA-10202
SERIAL NO. — ALL

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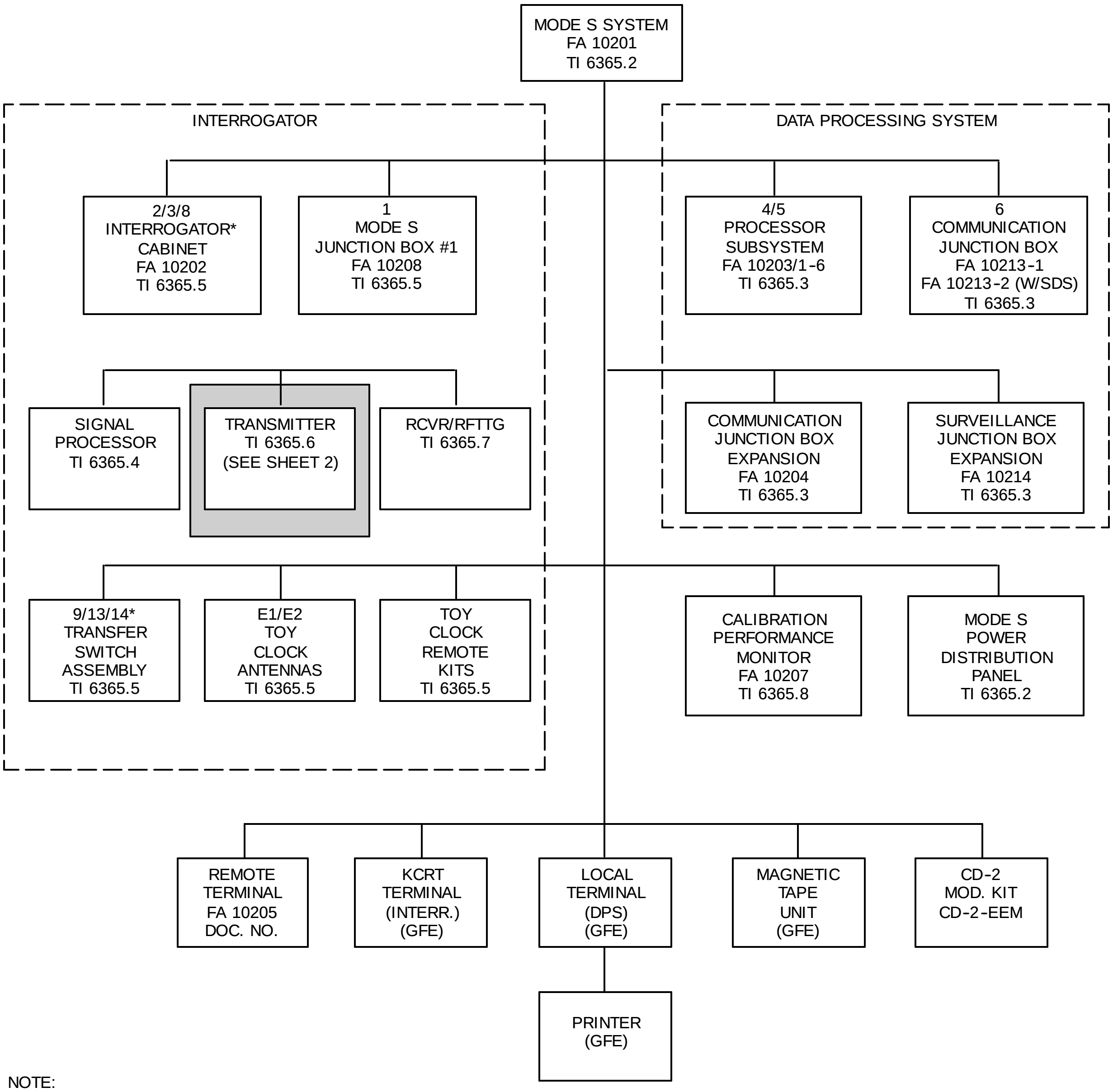
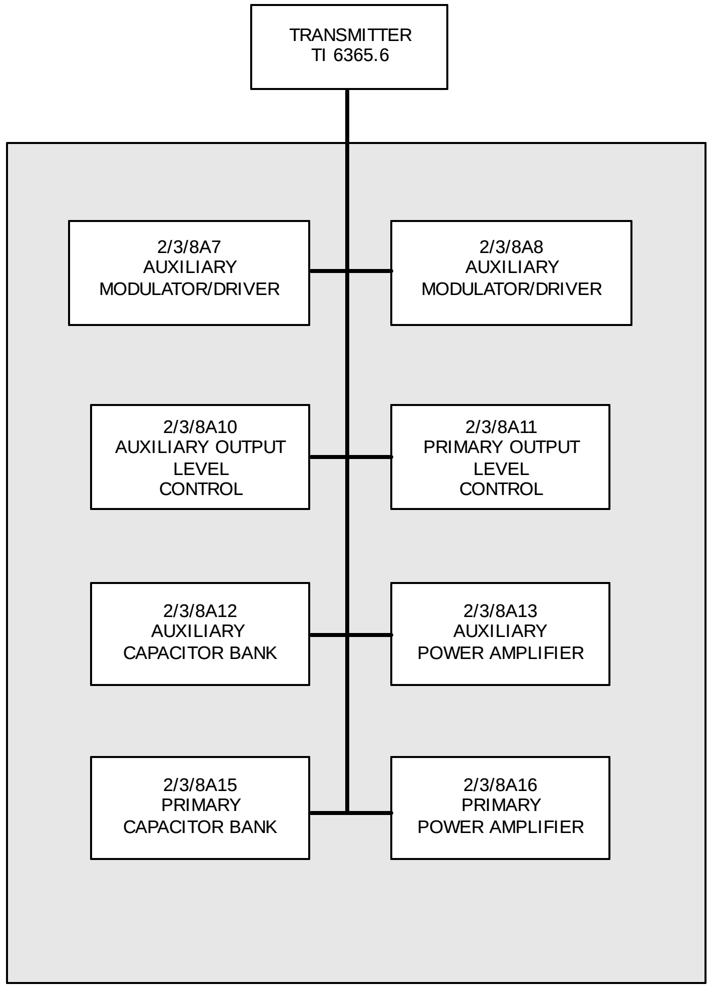


NOTE:
AN * INDICATES THAT THE THIRD INTERROGATOR AND RF TRANSFER SWITCH (UNIT 14) ARE RESERVED FOR FUTURE EXPANSION.

MODE S FAMILY TREE CHART (SHEET 1)



MODE S FAMILY TREE CHART (SHEET 2 — END)

1.0 GENERAL INFORMATION AND REQUIREMENTS

1.1 INTRODUCTION

This equipment instruction book is the onsite maintenance book for the Mode Select Beacon System (Mode S) Sensor Transmitter. Data provided includes theory of operation; operating instructions; periodic maintenance instructions; troubleshooting data; remove/install instructions; calibration/adjustment instructions; checkout/ retest instructions; parts list; and references to installation, integration, checkout, and software information. Sheet 1 of the Mode S Family Tree Chart shows the entire Mode S system with associated equipment instruction books. Sheet 2 shows the transmitter units which appear in this book.

1.2 EQUIPMENT DESCRIPTION

The Mode S transmitter modulates and amplifies RF signals from the receiver/RF Test Target Generator (receiver/RFTTG) for transmission to aircraft. The transmitter consists of an auxiliary and a primary channel. Each channel consists of four units: modulator/driver, power amplifier, capacitor bank, and output level control. The transmitter receives +5V DC, ? 15V DC, +36V DC, and +52V DC power from the interrogator power distribution system. The primary power amplifier is air cooled by fan B1. The transmitter modulates local oscillator (LO) frequencies from the receiver/RFTTG in the modulator/driver unit; amplifies the modulated signal in the power amplifier unit; adjusts the output power in the output level control unit, and sends the output power to the antenna via the diplexer and transfer switch. The capacitor banks supply power to the power amplifiers during transmit times. The transmitter modulator/driver and the power amplifier supply fault monitor data to transmitter fault monitor circuitry in the receiver/RFTTG. External interfaces between the transmitter and Mode S system units are listed in table 1–1, Transmitter External Interfaces. Figure 1–1 shows the transmitter units and their relationship. The following paragraphs describe the units that make up the transmitter.

TABLE 1–1. TRANSMITTER EXTERNAL INTERFACES

Equipment	Input To Transmitter	Output From Transmitter
Receiver/RFTTG	1. Primary and auxiliary low-power transmit frequency signals 2. Primary and auxiliary fault reset signals	1. Primary and auxiliary RF interrogation signals 2. Primary and auxiliary fault monitor signals
Signal Processor	1. Power Level Control 2. Pulse Amplitude Modulation Control (P1, P2, P3, P4, P5, P6) 3. Interrogation (DPSK)	1. None
Power Supplies	1. +5V from PS3 2. +15V from PS1 3. - 15V from PS2 4. +36V from PS4 5. +52V from PS5	1. None

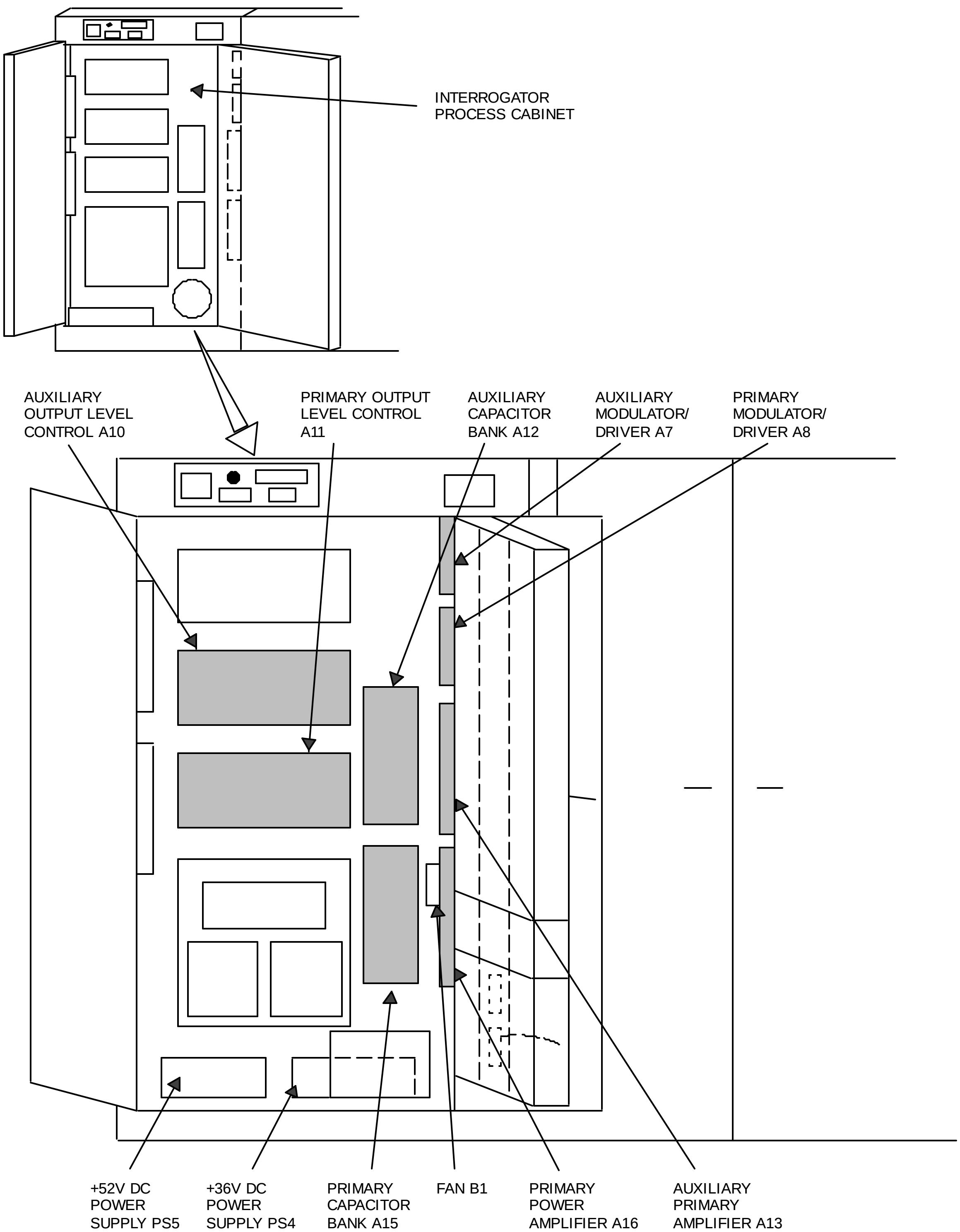


FIGURE 1–1. TRANSMITTER RELATIONSHIP OF UNITS

1.2.1 Auxiliary Modulator/Driver A7

The auxiliary modulator/driver A7 modulates and amplifies RF input signals. The modulator/driver sends the output signal to auxiliary power amplifier A13 at an amplitude of 220 **?** 60 watts peak. The input PAM modulation signal is provided by the signal processor. The RF input is provided by the receiver/RFTTG. The auxiliary modulator/driver is mounted inside the interrogator cabinet on the upper right wall above the primary modulator/driver. See figure 1–2. The physical configuration of the auxiliary modulator/driver A7 is the same as the primary modulator/driver A8.

1.2.2 Primary Modulator/Driver A8

The primary modulator/driver A8 modulates and amplifies RF input signals. The primary modulator/driver sends the output signal to primary power amplifier A16 at an amplitude of 220 **?** 60 watts peak. The input PAM and DPSK modulation signals to the modulator/driver are provided by the signal processor. The RF input is provided by the receiver/RFTTG. The primary modulator/driver is mounted inside the interrogator cabinet on the upper right wall below the auxiliary modulator/driver. The physical configuration of the primary modulator/driver A8 is the same as the auxiliary modulator/driver A7. See figure 1–2.

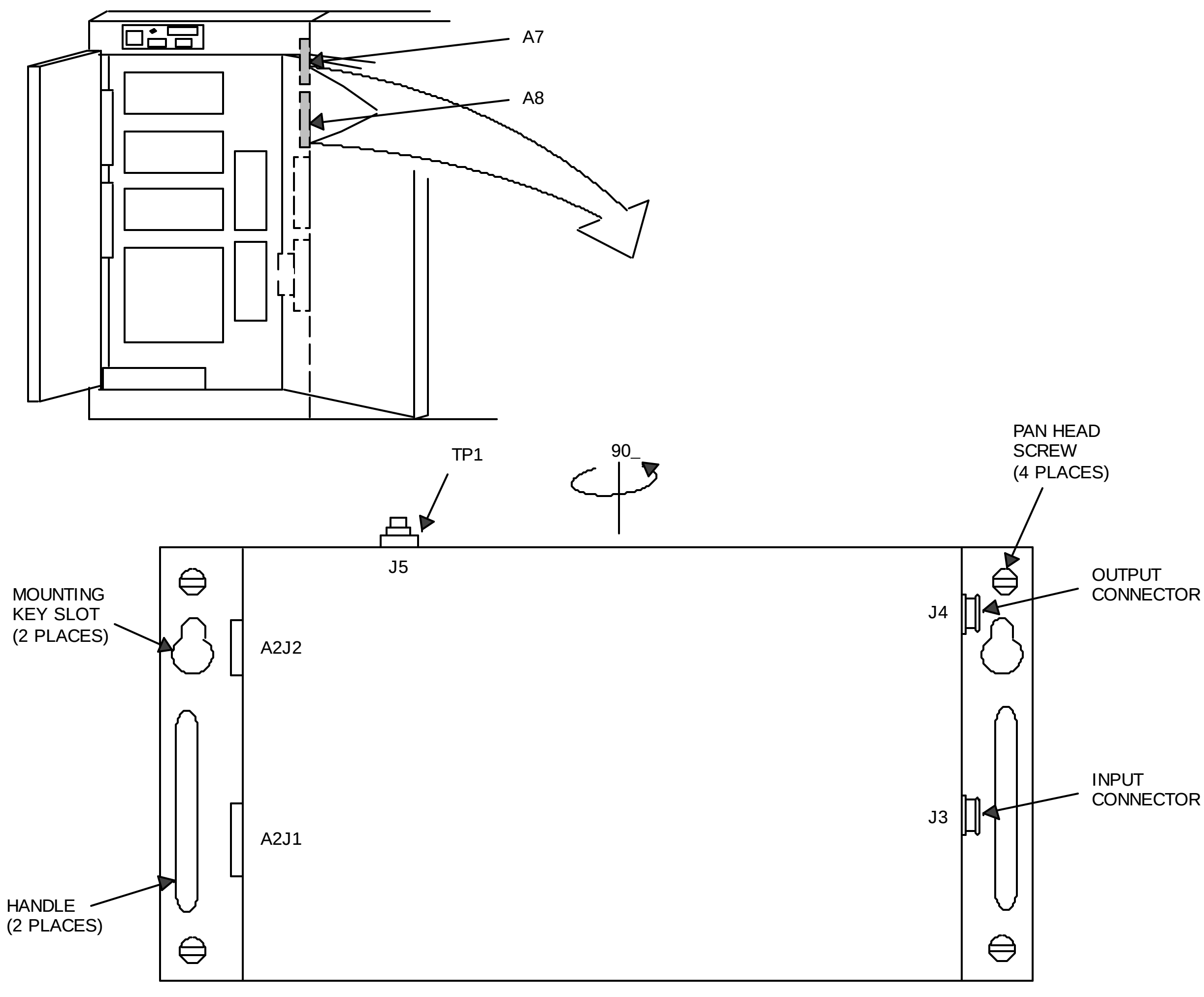


FIGURE 1–2. AUXILIARY MODULATOR/DRIVER A7 AND PRIMARY MODULATOR/DRIVER A8

WARNING

The auxiliary capacitor bank can maintain a charge buildup when disconnected. Make sure the output terminals are shorted together or covered when not in use. Use caution when handling the auxiliary capacitor bank to prevent injury or loss of life.

1.2.3 Auxiliary Capacitor Bank A12

The auxiliary capacitor bank A12 provides an electrical storage capacity of 65,000 microfarads for the auxiliary power amplifier. The capacitor bank consists of five 13,000-microfarad electrolytic capacitors connected in parallel. An external switch shorts the output terminals together whenever cabinet power is removed; however, there is no shorting provision when the capacitor bank is not connected. A shorting switch inside the capacitor bank shorts the output when the cover is removed. The auxiliary capacitor bank is mounted inside the interrogator cabinet on the upper right side of the back wall. See figure 1–3, Auxiliary Capacitor Bank A12 and Primary Capacitor Bank A15. The external physical configuration of the auxiliary capacitor bank is identical to that of the primary capacitor bank.

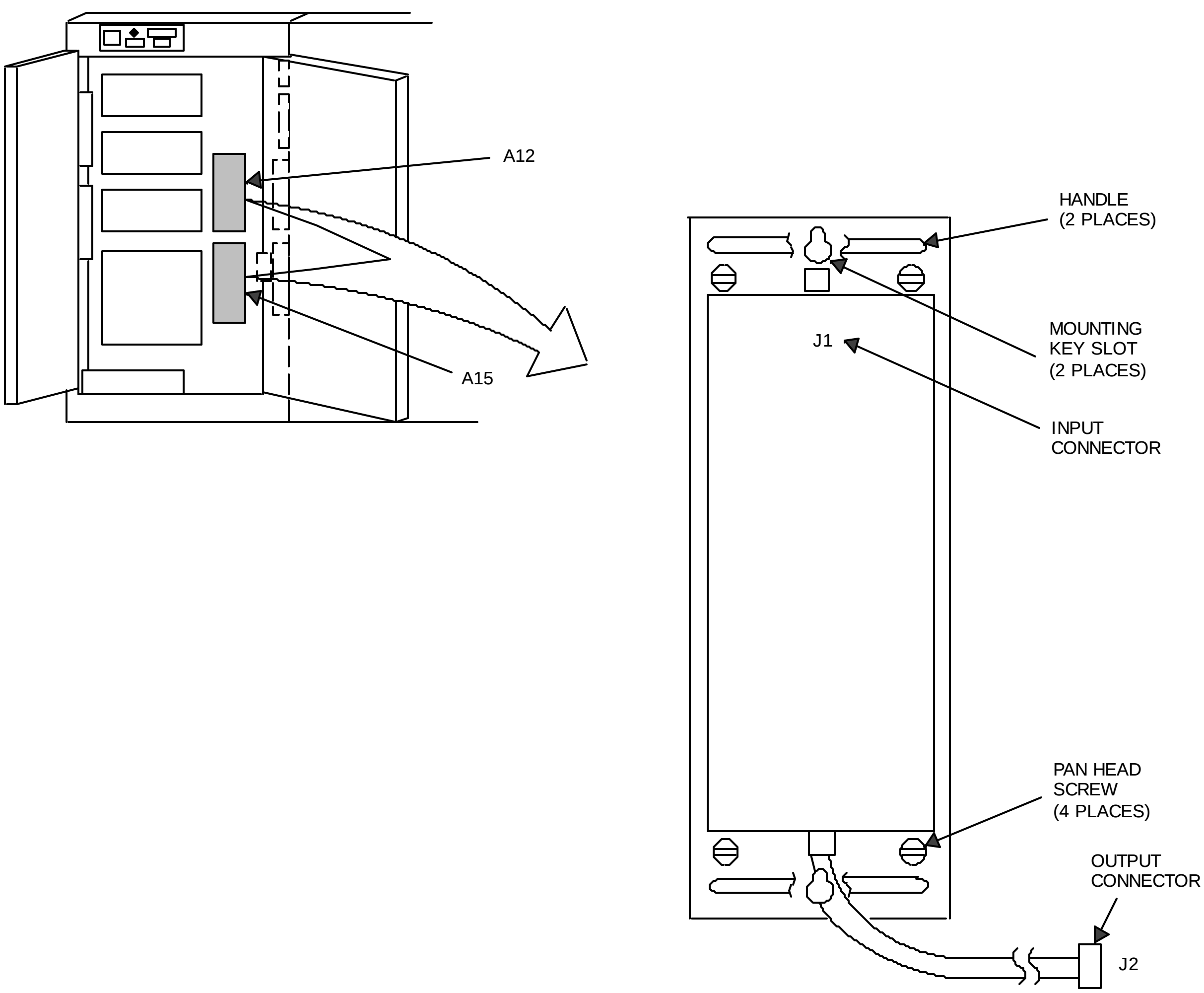


FIGURE 1–3. AUXILIARY CAPACITOR BANK A12 AND PRIMARY CAPACITOR BANK A15

1.2.4 Auxiliary Power Amplifier A13

The auxiliary power amplifier A13 provides final output power for the auxiliary channel of the transmitter. The auxiliary power amplifier produces an RF signal at an amplitude of 10,360 watts peak. The auxiliary power amplifier receives an RF signal of 220 ? 60 watts peak from auxiliary modulator/driver A7. Electrical storage capacity for the amplifier is provided by auxiliary capacitor bank A12. The output of the amplifier is sent to auxiliary output level control A10. Auxiliary power amplifier performance is monitored by a fault detect circuit within the amplifier. The auxiliary power amplifier is mounted inside the interrogator cabinet midway on the right wall just above the primary power amplifier. See figure 1–4, Auxiliary Power Amplifier A13 and Primary Power Amplifier A16, for the physical configuration of the auxiliary power amplifier.

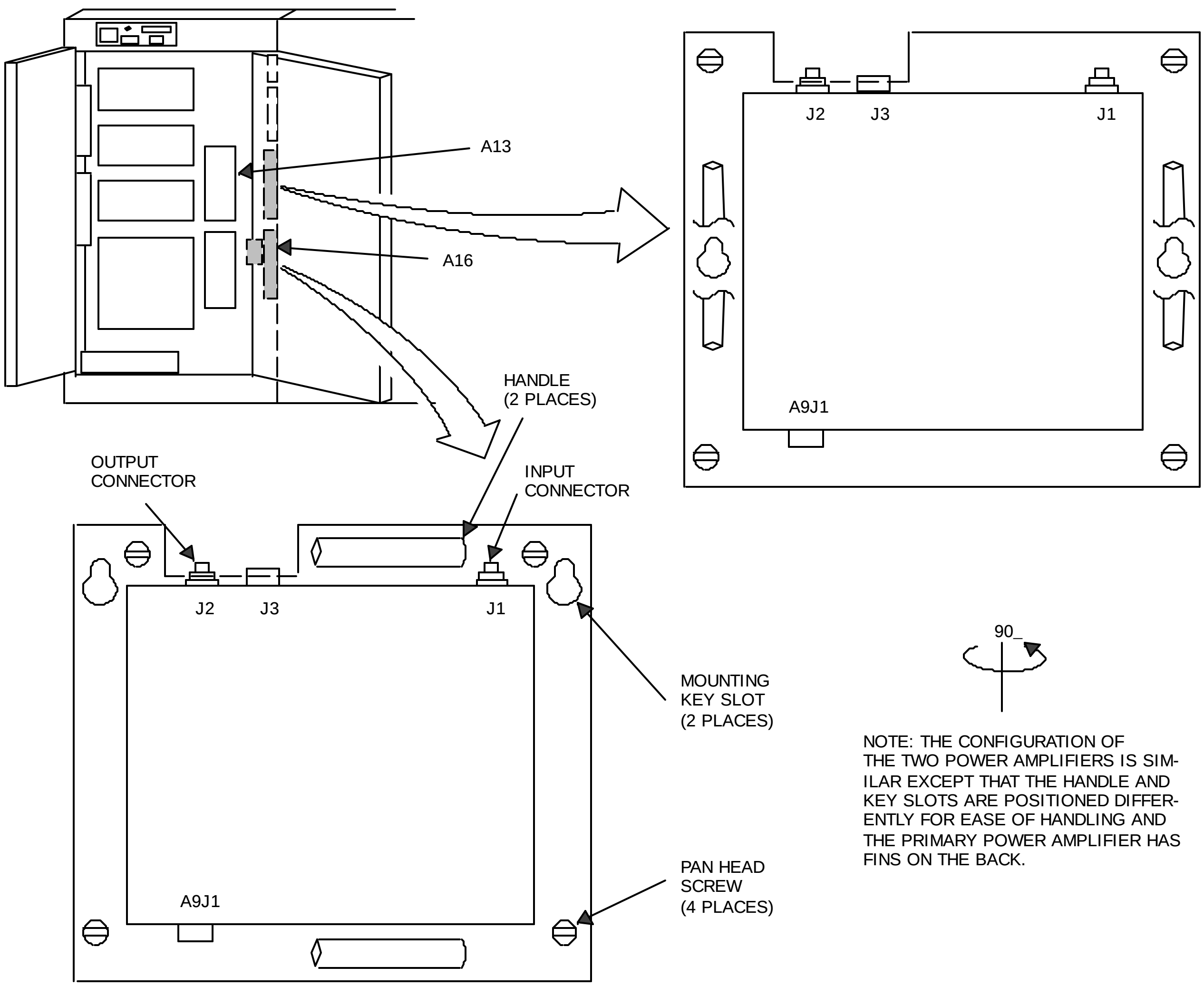


FIGURE 1–4. AUXILIARY POWER AMPLIFIER A13 AND PRIMARY POWER AMPLIFIER A16

WARNING

The primary capacitor bank can maintain a charge buildup when disconnected. Ensure the output pins are shorted together or covered when the unit is not connected. Use care whenever handling the primary capacitor bank to prevent injury or loss of life.

1.2.5 Primary Capacitor Bank A15

The primary capacitor bank provides an electrical storage capacity of 130,000 microfarads for the primary power amplifier. The capacitor bank consists of five 26,000-microfarad electrolytic capacitors connected in parallel. For safe handling when the capacitor bank is not connected, ensure the output pins are shorted together or covered. The primary capacitor bank is mounted inside the interrogator cabinet on the lower right side of the back wall. See figure 1–3. The external physical configuration of the primary capacitor bank is identical to that of the auxiliary capacitor bank.

1.2.6 Primary Power Amplifier A16

The primary power amplifier A16 provides final output power for the primary channel of the transmitter. The primary power amplifier produces an RF signal at an amplitude of 2700 watts peak. The primary power amplifier receives an RF signal of 220 **?** 60 watts peak from primary modulator/driver A8. Electrical storage capacity for the power amplifier is provided by primary capacitor bank A15. The output of the primary power amplifier is sent to primary output level control A11. Primary power amplifier performance is monitored by a fault detect circuit within the amplifier. The primary power amplifier is mounted inside the interrogator cabinet on the lower right wall. See figure 1–4, Auxiliary Power Amplifier A13 and Primary Power Amplifier A16, for the physical configuration of the primary power amplifier.

1.2.7 Auxiliary Output Level Control A10

The auxiliary output level control A10 is used to set the output amplitude of the auxiliary RF signal. The RF input to the auxiliary output level control is provided by the auxiliary power amplifier A13. Output signal amplitude is determined by one of three adjustable RF attenuators. Selection of an attenuator is controlled by the modulation control unit in the signal processor. The output signal is selected according to the type of transmission desired (Mode S low power, Mode S high power, or ATCRBS power). Each auxiliary output level control attenuator is adjusted to each Mode S site according to parameters specified on the variable site parameter card. The primary and auxiliary output level control attenuator ranges are listed in table 1–2, Output Level Control Attenuator Ranges. The output from the auxiliary output level control is sent to omni diplexer A6 in the receiver/RFTTG. The auxiliary output level control is mounted inside the interrogator cabinet on the upper back wall between primary output level control A11 and monopulse diplexer A19. See figure 1–5, Auxiliary Output Level Control A10 and Primary Output Level Control A11. The auxiliary output level control A10 is identical to the primary output level control A11.

TABLE 1–2. OUTPUT LEVEL CONTROL ATTENUATOR RANGES

Attenuator/Channel	Attenuation Range (dB)
AUX A10AT1/MODE S LOW POWER	0–20
AUX A10AT2/MODE S HIGH POWER	0–20
AUX A10AT3/ATCRBS	0–20
PRI A11AT1/MODE S LOW POWER	0–20
PRI A11AT2/MODE S HIGH POWER	0–20
PRI A11AT3/ATCRBS	0–20

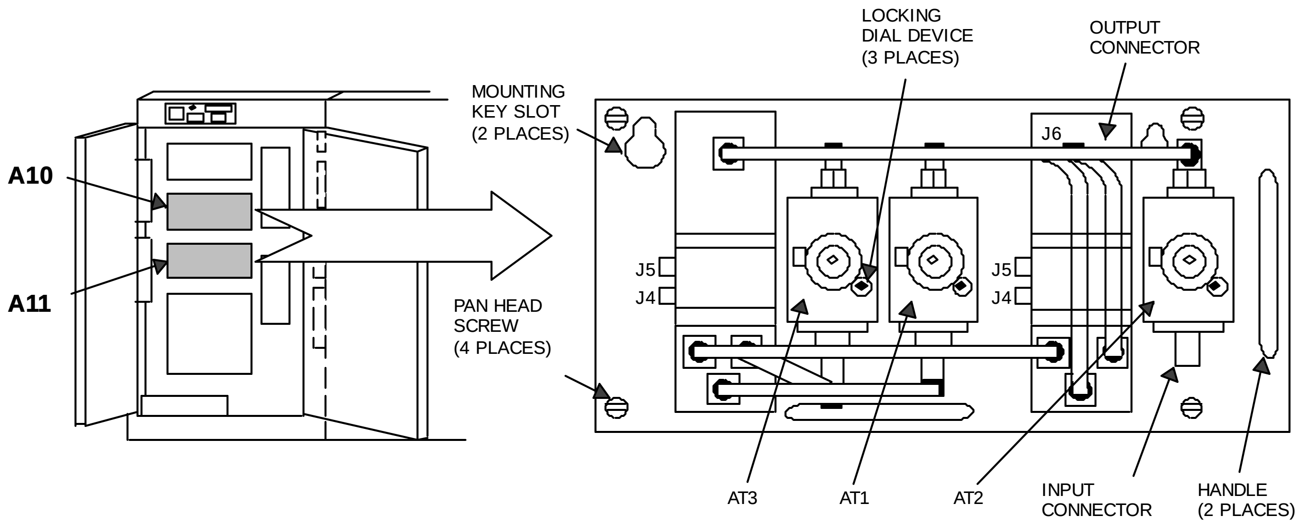


FIGURE 1–5. AUXILIARY OUTPUT LEVEL CONTROL A10 AND PRIMARY OUTPUT LEVEL CONTROL A11

1.2.8 Primary Output Level Control A11

The primary output level control A11 is used to set the output amplitude of the primary RF signal. The RF input to the primary output level control is provided by the primary power amplifier A16. Output signal amplitude is determined by one of three adjustable RF attenuators. Selection of an attenuator is controlled by the modulation control unit in the signal processor. The output signal is selected according to the type of transmission desired (Mode S low power, Mode S high power, or ATCRBS power). Each primary output level control attenuator is adjusted to each Mode S site according to parameters specified on the variable site parameter card. Primary output level control attenuator ranges are listed in table 1–2. The output of the primary output level control is sent to monopulse diplexer A19. The primary output level control is mounted inside the interrogator cabinet midway on the back wall just above RF test target generator A14. See figure 1–5, Auxiliary Output Level Control A10 and Primary Output Level Control A11. The primary output level control A11 is identical to the auxiliary output level control A10.

1.3 EQUIPMENT SPECIFICATION DATA

Table 1–3, Mode S Transmitter Equipment Specifications, lists the manufacturer name, model and type; FAA number; and the electrical/mechanical characteristics of the transmitter equipment.

TABLE 1–3. MODE S TRANSMITTER EQUIPMENT SPECIFICATIONS

Item	Description
Nameplate: Manufacturer	Westinghouse Electric Corporation Electronics Systems Group Baltimore, Maryland 21203
Nomenclature	Transmitter

TABLE 1–3. MODE S TRANSMITTER EQUIPMENT SPECIFICATIONS (Continued)

Item	Description
Manufacturer's Type	None
FAA Type	None
Functional Characteristics:	
Auxiliary power amplifier	
Frequency	1030 ? 0.010 MHz
Power input	220 ? 60 watts peak
Power output	10.36 kilowatts minimum
Pulsewidth	0.8 ? 05 ms maximum
Duty factor	0.46% for 6 ms 0.1% long term
Vcc	52 ? 2 volts
Peak current	840 amperes
Efficiency	22.5%
Power dissipated	33 watts long-term average
Auxiliary modulator/driver	
Local oscillator frequency	1030 ? 0.010 MHz
Pulse amplitude modulation	ATCRBS: P1 (IISLS), P2 Mode S: P5
Power input	5 to 12 ? 1 dBm CW
Power output	220 ? 60 watts peak
RF gain	47 dB
Primary power amplifier	
Frequency	1030 ? 0.010 MHz
Power input	220 ? 60 watts peak
Power output	2.7 kilowatts minimum
Pulsewidth	32 ? 1 ms maximum
Duty factor	64% for 1.6 ms 50% for 6 ms 7.6% for 40 ms 5.5% for 2 sec 4.5% long term
Vcc	36 volts
Peak current	195 amperes
Efficiency	33%
Power dissipated	210 watts long-term average
Primary modulator/driver	
Local oscillator frequency	1030 ? 0.010 MHz
Pulse amplitude modulation	ATCRBS: P1, P3, P4 Mode S: P1, P2, P6
DPSK	DF = 180 ? 5 degrees
Power input	5 to 12 ? 1 dBm CW
Power output	220 ? 60 watts peak
RF gain	47 dB

TABLE 1–3. MODE S TRANSMITTER EQUIPMENT SPECIFICATIONS (Continued)

Item	Description
External Power Requirements:	
AC voltage	None
DC voltage	+36V DC +52V DC
Environmental Characteristics:	
Cooling requirements	Forced air cooling (room air)
Operating temperature	- 10 to +50°C

1.4 EQUIPMENT AND ACCESSORIES REQUIRED (SUPPLIED)

Table 1–4, lists the equipment and accessories required for transmitter operation that are supplied with each system. The table lists all equipment that forms a part of the transmitter, and the dimensions and weights of the equipment.

1.5 EQUIPMENT AND ACCESSORIES REQUIRED (NOT SUPPLIED)

Not applicable.

TABLE 1–4. EQUIPMENT REQUIRED (SUPPLIED)

Quantity	Nomenclature	Dimensions (In.)	Weight (1b)
1	Primary Power Amplifier	23.9 x 20.9 x 1.8	37
1	Auxiliary Power Amplifier	23.9 x 20.9 x 1.8	37
2	Modulator/Driver	9.0 x 20.4 x 1.8	15
2	Output Level Control	12.1 x 30.0 x 9.5	24
1	Primary Capacitor Bank	23.5 x 5.8 x 6.5	15
1	Auxiliary Capacitor Bank	23.5 x 5.8 x 6.5	15

2.0 TECHNICAL DESCRIPTION

2.1 INTRODUCTION

This section contains the onsite theory of operation for the Mode S transmitter. The theory of operation is provided in two levels: simplified and detailed. Each level is divided into six elements: signal modulation, power amplification, output power level control, power distribution, performance monitoring, and fault detection/fault isolation testing. The simplified theory provides an overall functional description of the transmitter, transmitter interfaces with other equipment, and identifies the major functions performed by each unit. The detailed theory describes the functional signal flow between and within each of the units to ensure a complete understanding of transmitter operation for onsite maintenance. For offsite maintenance, the theory of operation for circuits within each unit is in TI 6365.9, Mode S Sensor, Depot Instruction Book.

2.2 SIMPLIFIED THEORY OF OPERATION

The transmitter modulates and amplifies RF signals from the receiver/RF test target generator (RFTTG) for transmission through the antenna. See figure 2–1, Transmitter Functional Block Diagram, in section 11. Modulation and control signals from the signal processor determine the mode and amplitude of transmission signals. The transmitter is made up of of two RF channels that perform the modulating and amplification. The channels are called the primary transmitter (sum transmit pattern) and the auxiliary transmitter (omni transmit pattern). Each channel consists of a modulator/driver, a power amplifier, a storage capacitor bank, and an output level control unit.

2.2.1 Signal Modulation

The primary and auxiliary modulator/drivers receive low power RF signals (PRITXLO and AUXTXLO) from local oscillator (LO) A9 (part of receiver/RFTTG). Modulation signals are received from signal processor A4 modulation control unit (MCU) A4A113. The primary modulator/driver A8 receives both pulse amplitude modulation (TE/PAMPR+/–) and differential phase shift keying (TE/DPSK+/–) modulation signals. The auxiliary modulator/driver A7 receives only the pulse amplitude modulation (TE/PAMAX+/–) signal. The modulation signals modulate the RF and send the result to the associated power amplifier. The pulse amplitude modulation signals gate the transmitter on and the differential phase shift keying signals provide the 0 or 180 degree phase shift of the RF signal.

2.2.1.1 Modulation Waveforms. The following paragraphs provide a brief description, with typical waveforms, of the modulation signals used during Air Traffic Control Radar Beacon System (ATCRBS) mode and Mode S low power or high power mode interrogations. See figure 2–2, Typical Interrogation Waveforms. Refer to the technical descriptions in TI 6365.4, Mode S Signal Processor Instruction Book, for more details about the various modes of operation.

2.2.1.1.1 ATCRBS Interrogations. See figure 2–2, detail A. An ATCRBS interrogation consists of three pulses: the challenge mode P1 and P3 pulses transmitted through the primary channel (main beam), and a side-lobe suppression (SLS) pulse P2 transmitted through the auxiliary channel (omnidirectional beam). The time between pulses P1 and P3 determines the mode of transmission.

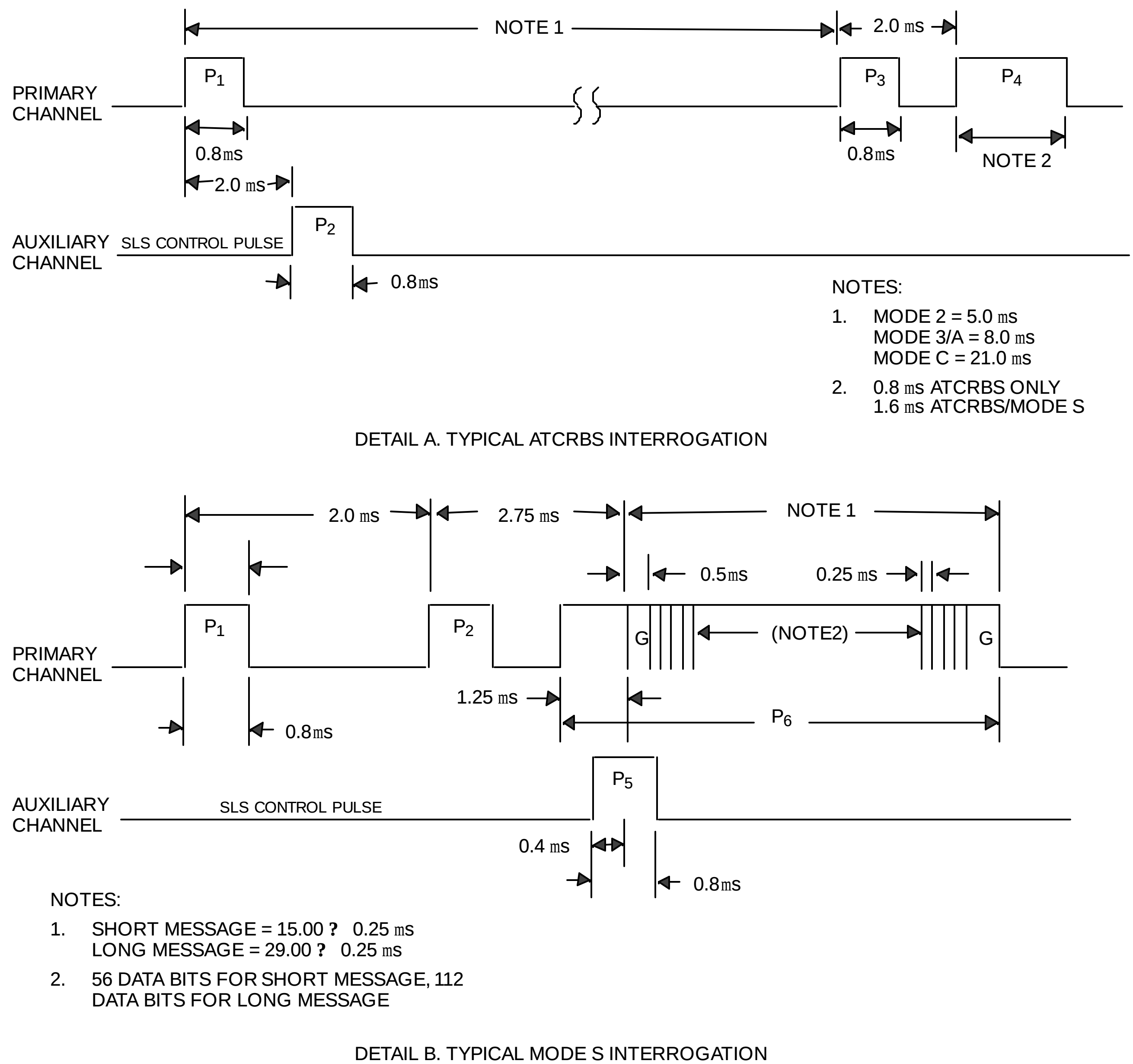


FIGURE 2–2. TYPICAL INTERROGATION WAVEFORMS

2.2.1.1.2 Mode S Interrogations. See figure 2–2, detail B. A Mode S interrogation consists of four pulses P1, P2, P5 and P6. Pulses P1 and P2, which form the preamble to P6, are transmitted through the primary channel (main beam). Pulses P1 and P2 are spaced 2 microseconds apart so that they appear as side-lobe suppression pulses to ATCRBS transponders; thereby inhibiting ATCRBS transponders from replying to Mode S interrogations. Pulse P6 contains data in the form of differential phase shift keying (DPSK+/–) modulation. The interrogation data block is formed by a sequence of phase reversals of the RF carrier in this pulse. The P5 pulse is a side-lobe suppression pulse which is transmitted through the auxiliary channel.

2.2.1.2 Modulator Outputs. See figure 7–1, Transmitter Signal Flow Diagram (Overall), in section 11. The modulated RF signals are amplified and sent to the associated power amplifier as primary RF signal PRI RF and auxiliary RF signal AUX RF. The auxiliary modulator/driver also provides a timing pulse (AUX TRIGGER +/–) to its power amplifier. The corresponding timing signal for the primary power amplifier (TE/XMTTST+/–) is provided directly from the signal processor. These timing signals clock the fault detection circuits (bite circuit A9) in the power amplifiers to synchronize operation with the RF signal. Two fault detection signals from each modulator/driver protection circuit [Primary Modulator Fault (ET/PRMDFT+/–), Primary Driver Fault (ET/PRDRFT+/–); and Auxiliary Modulator Fault (ET/AXMDFT+/–), Auxiliary Driver Fault (ET/AXDRFT+/–)] are sent to video processor monitor A3 for fault analysis processing. The signals detect various faults within the modulator/drivers.

2.2.2 Power Amplification

Each power amplifier (primary and auxiliary) receives a modulated RF signal (PRI RF and AUX RF) from its respective modulator/driver. An associated storage capacitor bank supplies each power amplifier with the necessary energy to boost the RF signal to required peak amplitudes. The power amplifiers also receive BITE timing signals (TE/XMTTST+/– for primary channel and AUX TRIGGER +/– for auxiliary channel). Each power amplifier contains a BITE [Fault Detection Circuit] circuit that sends fault signals Primary Power Amplifier Fault (ET/PRPAFT+/–) and Auxiliary Power Amplifier Fault (ET/AXPAFT+/–), respectively, to video processor monitor A3 for fault analysis processing. BITE circuit operation is synchronized to the modulation signal by the timing signal so that fault detection is enabled only when the RF signal is on. The amplified output [High Primary RF (HIGH PRI RF) and High Auxiliary RF (HIGH AUX RF)] is sent to the associated output level control to set the output power to the required final amplitude.

2.2.3 Output Power Control

Each output level control receives amplified RF signals (HIGH PRI RF and HIGH AUX RF) from their respective power amplifiers, and each receives mode control signals [Primary Control Data (PRI CONT DATA +/–) and Auxiliary Control Data (AUX CONT DATA +/–)] from signal processor A4. The control signals select the output amplitude of the transmitted RF for the selected mode: ATCRBS, Mode S high, or Mode S low output power. The output power for each mode is manually set for each site by attenuators. The attenuators are adjusted during site activation for the particular site location. The final output [Primary Transmission (PRITX) and Auxiliary Transmission (AUXTX)] is sent to monopulse diplexer A19 (primary) and omni diplexer A6 (auxiliary) for routing to the antenna.

2.2.4 Power Distribution

The power distribution circuits in the interrogator cabinet provide +52V DC, +36V DC, +/–15V DC, and +5V DC (part of POWER) to transmitter units. The primary power amplifier fan receives 115V, 60 Hz power (115V 60 HZ). The auxiliary capacitor bank is connected to the main power circuit breaker in control panel A1 through the interlock signal (INTLK). If power is shut off, the circuit breaker shorts the capacitor bank output to prevent charge buildup. For more details regarding power distribution, refer to the Interrogator Cabinet Power Distribution paragraph in Section 2 of TI 6365.5, Mode S Sensor, Interrogator Instruction Book.

2.2.5 Performance Monitoring

The performance monitoring circuits monitor primary and auxiliary transmitter operation to make sure each channel operates properly. Performance monitoring takes place within the transmitter and external to the transmitter. The following parameters are monitored within the transmitter:

- Low forward power within the modulator/drivers
- Excessive pulse width within the modulator/drivers
- Excessive pulse number in short time frame within the modulator/drivers

- Excessive duty cycle within the modulator/drivers
- Low +52V and +36V voltages within the modulator/drivers
- Low forward power within the power amplifiers.

The following parameters are monitored external to the transmitter at the diplexers.

- ATCRBS forward and reverse transmit power for primary and auxiliary transmitter
- Mode S low forward and reverse transmit power for primary and auxiliary transmitter
- Mode S high forward and reverse transmit power for primary and auxiliary transmitter
- Voltage standing wave ratio (VSWR) measurements for primary and auxiliary transmitter.

The signal processor accesses each of the above power levels (through the diplexers and the RFTTG power detector) and calculates the associated VSWR for each by determining the forward to reverse power ratio. The signal processor declares a fault if any forward power level is too low, if any reverse power level is too high, or if the forward/reverse power level is too low indicating a high VSWR.

2.2.6 Fault Detection/Fault Isolation Testing

Faults in transmitter operation are detected by tests run during the fault detection (FD) testing sequence described in TI 6365.5. Detected faults are isolated by the fault isolation test (FIT) routine. The FD and FIT routines consist of a series of tests run in a specific sequence. A test can be run in both FD and FIT, or only in one and not the other. The following paragraphs describe fault detection testing, fault isolation testing, and the tests in each.

2.2.6.1 Fault Detection Testing. Fault detection testing consists of power/VSWR tests that include transmitter power level measurements for each power mode (ATCRBS, Mode S high power, and Mode S low power), in each channel, and VSWR measurements for each channel. Fault detection tests are run during the fault detection cycle using the performance monitoring circuits to test the transmitter. The fault detection cycle requires eight scans, where one scan equals one rotation of the antenna. During each scan, power/VSWR tests are made, and the results are processed and stored by the signal processor. If targets need to be processed while performance tests are being run, the testing stops at the end of a test. During the next scan, power/VSWR tests are run and performance testing begins at the stopping point from the previous scan. All performance tests are completed by the end of the eight-scan cycle. Table 2–1, Transmitter Fault Detection Testing Schedule, shows the tests performed in each scan.

TABLE 2–1. TRANSMITTER FAULT DETECTION TESTING SCHEDULE

Scan	Power/VSWR Test Performed
1	Primary high Mode S power measured
2	Primary transmitter VSWR power measured
3	Primary transmitter low Mode S power measured
4	Auxiliary transmitter low Mode S power measured
5	Primary and auxiliary transmitter ATCRBS power measured
6	No power/VSWR measured
7	Auxiliary transmitter high Mode S power measured
8	Auxiliary transmitter VSWR power measured

2.2.6.1.1 Each test configures the system for the test, initiates the test, obtains the results of system operation, processes the data, compares the results with pass/fail criteria, and declares a fault when necessary. At the start of a scan, the interrogation mode (high Mode S power, low Mode S power, or ATCRBS power), sample interval, and transmitter (primary or auxiliary) are selected. At the proper time in a scan, the testing is initiated and test data generated.

2.2.6.1.2 The transmitter performance is monitored by collecting and analyzing power samples. Four power measurements are made for each interrogation mode: primary and auxiliary, forward and reverse. The VSWR check is made by calculating the forward to reverse power ratio and comparing this ratio to red and yellow pass/fail thresholds. If the power ratio falls below the yellow threshold, indicating a high VSWR, a status report with a yellow alarm condition is sent to the data processing system (DPS). If the power ratio falls below the red threshold, indicating a higher VSWR, a status report with a red alarm condition is sent to the data processing system (DPS). A red condition will cause the DPS to switch the standby channel to online, switch the online channel offline, and initiate fault isolation testing on the offline channel. Refer to Section 2 of TI 6365.5 for further details of fault detection operation. Refer to detailed theory in this book for details of transmitter tests run during fault detection testing.

2.2.6.2 Fault Isolation Testing. Fault isolation testing is run only on the offline channel when initiated by the DPS. FIT runs through a sequence of tests until the fault is isolated to a specific unit. Figure 7–2 shows the FIT tree (sequence) for the transmitter. The entire FIT tree is shown in Section 7 of TI 6365.5. The FIT routine runs each test individually, in sequence, until all tests have been run or a fault is detected. For each test, the interrogator is configured for testing by the FIT routine. Test targets are called up, amplitudes set, signals routed, and processing initiated. The test routine monitors and analyzes the results from the circuit under test and determines the test pass/fail status. If a test fails, fault isolation by the FIT routine is performed until a faulty unit is identified. A message is then sent to the DPS identifying the unit(s) to be replaced. If replacing the unit doesn't correct the fault, it must be resolved by manual techniques. Refer to Section 2 of TI 6365.5 for details of FIT operation, and paragraph 2.3 of this book for details of the transmitter FIT tests.

2.3 DETAILED THEORY OF OPERATION

The transmitter modulates low power RF, amplifies the modulated RF, and adjusts the output power amplitude for transmission. The following paragraphs provide the detailed theory of operation for onsite transmitter operation. See figure 7–1, Transmitter Signal Flow Diagram, in section 11. The detailed theory provides a thorough description of the interface between the transmitter and the other units, and the major signal flow within the units to ensure a complete understanding of transmitter operation. Performance monitoring, fault detection testing, and fault isolation testing are also described.

2.3.1 Signal Modulation

Modulation of the RF signal is performed by the modulator/drivers. The auxiliary modulator/driver A7 and primary modulator/driver A8 provide a modulated and amplified RF signal to auxiliary power amplifier A13 and primary power amplifier A16, respectively. See figure 7–1, sheets 2 and 3 for primary modulator/driver A8, and sheets 8 and 9 for auxiliary modulator/driver A7. There are no differences between the auxiliary modulator/driver A7 and primary modulator/driver A8. Differences exist only in the signals received by each modulator/driver. The primary modulator/driver A8 (sheet 2) receives both pulse amplitude modulation primary (TE/PAMPR+/–) and differential phase shift keying (TE/DPSK+/–) modulation signals. Auxiliary modulator/driver A7 (sheet 8) receives only the pulse amplitude modulation auxiliary (TE/PAMAX+/–) signal. Signals TE/PAMPRI+/– and TE/PAMAX+/– gate the modulator drivers on, passing the RF energy. Signal TE/DPSK+/– provides the phase shift modulation changing the phase of the RF energy between 0 and 180 degrees. The primary modulator/driver A8 and auxiliary modulator/driver A7 receive a 1030 **?** 1 MH_Z, 9 to 11 dBm RF signal (PRITXLO and AUXTXLO, respectively) from local oscillator A9.

2.3.1.1 In each modulator/driver, the incoming RF signal is amplified through amplifier Q1. The amplified RF is applied to modulator S1, where signals TE/PAMPR+/– or TE/PAMAX+/– and TE/DPSK+/–, modulate the RF. The modulated RF signal is amplified by three-stage amplifier Q2, Q3, and Q4 and applied to isolator AT1. Isolator AT1 attenuates reflected energy from the next stage.

2.3.1.2 The RF from the isolator AT1 is amplified by three-stage amplifier Q5, Q6, and Q7, and through isolator AT2 and a 20 dB directional coupler (unattenuated) to the power amplifier. Primary signal PRI RF and auxiliary signal AUX RF, modulated 1030–MHz signals at 220 watts, are sent to their respective power amplifiers. Isolator AT2 prevents any reflected energy at the power amplifier from damaging the three-stage amplifier. The 20 dB directional coupler samples forward power at the output of the modulator/driver. The sample is applied to the level detector which develops the detected RF sample signal DET RF SAMPLE. This signal is used for performance monitoring.

2.3.2 Power Amplification

The modulated signal from each modulator/driver is amplified by its respective power amplifier. Capacitor banks store the energy required by the power amplifiers when they are gated on. See figure 7–1, sheets 4 and 5 for primary power amplifier A16, sheets 10 and 11 for auxiliary power amplifier A13, and sheet 6 for primary and auxiliary capacitor banks A15 and A12. The high power amplifiers are the same except for an additional predriver amplifier A12 in auxiliary power amplifier A13. In each power amplifier, the input RF signal is split and amplified twice before finally combining in the output combiner. Isolator AT2, located at the output of the combiner, prevents any reflections from loading the output of the combiner. A 20-dB directional coupler in the output signal path samples forward power at the output of the output combiner. The sample is applied to the level detector which develops the detected RF sample signal VIDEO OUT. This signal is applied to the BITE circuit where the signal is used for performance monitoring. The high power primary RF (HIGH PRI RF) and high power auxiliary RF (HIGH AUX RF) output signals are sent to their respective output level controls. The primary power amplifier provides an output of 2700 watts peak. The auxiliary power amplifier provides an output of 10,360 watts peak.

2.3.2.1 See figure 7–1, sheet 6. The primary capacitor bank consists of five 26,000-microfarad electrolytic capacitors connected in parallel that provide a storage capacity of 130,000 microfarads. The primary power amplifier circuits require high current +36V DC power during a transmit interval. The capacitors provide the current capability required during this interval.

2.3.2.2 The auxiliary capacitor bank consists of five 13,000-microfarad electrolytic capacitors connected in parallel that provide a storage capacity of 65,000 microfarads. The auxiliary power amplifier circuits require high current +52V DC power during the transmit interval. The capacitors provide the current capability required during this interval. If cabinet power is lost or turned off (A1CB1 opens), an interlock signal (INTLK) closes a discharge circuit discharging the capacitor bank.

2.3.3 Output Power Amplitude Control

See figure 7–1, sheets 7 and 12. The high power signals from the power amplifiers are adjusted for final amplitude in the output level controls. Each site requires a different output amplitude for the various modes of operation. The attenuators in each output level control are manually adjusted for local site requirements according to data on the variable site parameter cards. The modes of operation require three different power amplitudes: ATCRBS power, Low Mode S power, and High Mode S power, all controlled by the signal processor. Both primary output level control A11 and auxiliary output level control A10 are the same. The signal amplitude is varied through three manually adjustable attenuators, AT1, AT2, and AT3. As shown, AT2 is used for high Mode S power and local conditions, AT3 is used to adjust the power for the ATCRBS power amplitude, and AT1 is used for low Mode S power.

2.3.3.1 Primary output level control A11 and auxiliary output level control A10 receive high-power RF signals (HIGH PRI RF and HIGH AUX RF) from primary power amplifier A16 and auxiliary power amplifier A13, respectively. Switches S2 and S1 are operated together and select the RF path required for the desired mode of operation. If the mode of transmission is high Mode S power, the RF signal is routed from attenuator AT2 directly to the output. If low Mode S power is selected, the RF signal from attenuator AT2 is routed through AT3 to the output.

2.3.3.2 Selection of the RF path is determined by control signals from the signal processor as summarized in table 2–2, Output Power Selection. Each switch S1 and S2 contains three solid state switches which consist of a diode, an associated capacitor and a switch driver. In addition, the distance from the quarter wave point to each capacitor is 1/4 wavelength. This is a 1/4 wavelength stub. Therefore, when the diode is forward biased, grounding the capacitor, the quarter wavelength stub appears as an open circuit to the RF energy. As a result, RF energy does not pass. When the diode is reverse biased, the capacitor is not grounded and RF energy is passed to the output of the switch.

TABLE 2–2. OUTPUT POWER SELECTION

Mode	Control Signal	Control Signal Level	Attenuators In Signal Path
High Primary Mode S Power High Auxiliary Mode S Power	TE/HIPRB1/2 TE/HIPRA1/2	Logic 1 Logic 1	AT2 AT2
Primary Low Mode S Power Auxiliary Low Mode S Power	TE/LOPRB1/2 TE/LOPRA1/2	Logic 1 Logic 1	AT1, AT2 AT1, AT2
Primary ATCRBS Power Auxiliary ATCRBS Power	TE/ATPRB1/2 TE/ATPRA1/2	Logic 1 Logic 1	AT2, AT3 AT2, AT3

2.3.3.3 The bias on each diode is controlled by the associated switch driver and control signal (CONTROL A, CONTROL B or CONTROL C) from the signal processor. A control signal turns off an associated diode by causing the switch driver to apply –200V to the diode reverse biasing it. As a result, the associated capacitor is not connected to ground so that the 1/4 wave stub is not grounded. Therefore, RF energy sees an apparent completed circuit and is passed to the output of the switch. A control signal turns on an associated diode by causing the switch driver to remove –200 volts and apply a slight forward bias to the diode. As a result, the diode is forward biased connecting the capacitor to ground which shorts the 1/4 wave stub to ground. Therefore, the RF energy sees an apparent opened circuit and is not passed.

2.3.3.4 See figure 2–3, sheet 1. The outputs from the power level controls are applied to the antenna via diplexers and the RF transfer switch, unit 9. Output PRITX from the primary output level control A11 is applied through the monopulse diplexer A19 to the antenna and the output AUX TX from the auxiliary output level control A10 is applied through the omni diplexer A6 to the antenna. The diplexers contain directional couplers that provide RF samples used for performance monitoring.

2.3.4 Performance Monitoring Circuits

The performance monitoring circuits monitor transmitter status. These circuits monitor power levels, VSWR, pulse width, excessive pulse number, excessive duty cycle and low power supply voltage output. The outputs of the performance monitoring circuits are used for fault detection and fault isolation. Transmitter monitoring is performed within the transmitter via internal circuits and externally by other means. Within the transmitter, monitoring circuits are contained in the modulator/drivers and power amplifiers. External to the transmitter, monitoring circuits are contained in the receiver/RF test target generator.

2.3.4.1 Transmitter Internal Monitoring Circuits. The performance monitoring circuits contained in the modulator/drivers, and power amplifiers send fault detect bits to the transmitter/receiver status monitoring register U85 in video processor monitor A3. See figure 2–3, sheet 2, in section 11. The states of the bits is stored in register U85 bits 0 through 5. The bits, functions, signal names, and state meanings are listed in table 2–3, Transmitter Fault Status Register Bits. When signal TXREGEN– is generated by the signal processor in receiver video processor/monitor A3, the data in register U85 is placed on data bus PMDATA[00:07]. Then, the status (pass/fail) of the bits is read and processed by the signal processor. If status bits 0 through 5 are logic 0, then the transmitter status is normal. An abnormal condition exists if at least one of the status bits is a logic 1. If a pulse width, excessive pulse number, excessive duty cycle or low power supply voltage fault in a modulator/driver occurs, the modulator/driver will automatically shut down. When this occurs, the signal processor enables register address 02 (PV/ERA02), which is decoded by the write address decoder. The write address decoder then sends a reset signal (ET/TXRSTA+/−, primary; or ET/TXRSTB+/−, auxiliary) to clear the fault circuit and bring the modulator/driver back up to operational status.

TABLE 2−3. TRANSMITTER FAULT STATUS REGISTER BITS

Bit	Function	Signal Name	Meaning
0	Primary modulator fault	ET/PRMDFT+/−	1 = low forward power at primary modulator/driver output
1	Primary power amplifier fault	ET/PRPAFT+/−	1= low forward power at primary power amplifier output
2	Primary driver fault	ET/PRDRFT+/−	1 = excessive RF pulse width, excessive number of pulses, excessive duty cycle, low +52 volt power supply output or low +36 volt power supply output. Monitored at modulator/driver.
3	Auxiliary modulator fault	ET/AXMDFT+/−	1 = low forward power at auxiliary modulator/driver output
4	Auxiliary power amplifier fault	ET/AXPAFT+/−	1 = low forward power at auxiliary power amplifier output
5	Auxiliary driver fault	ET/AXDRFT+/−	1 = excessive RF pulse width, excessive number of pulses, excessive duty cycle, low +52 volt power supply output or low +36 volt power supply output. Monitored at modulator/driver.

2.3.4.2 Modulator Driver Monitoring Circuits. The modulator/driver performance monitoring circuits are shown in figure 7−1, sheets 2 and 3 for primary modulator/driver A8, and sheets 8 and 9 for auxiliary modulator/driver A7. The modulator/drivers are the same; therefore, the following discussion applies to both.

2.3.4.2.1 The fault protection circuit board A2 monitors the RF amplifier A1 output PRI RF for low forward power, excessive pulse width, excessive pulses in a given time frame and excessive duty cycle. The fault protection circuit board also monitors the outputs of the +52 and +36 volt power supplies for undervoltage conditions. Signal DET RF SAMPLE from the RF amplifier is applied to the fault protection board where the signal is used to detect low forward power, excessive pulse width, excessive pulses and excessive duty cycle. The level of signal DET RF SAMPLE is proportional to the RF pulse (RF PULSE) level and the duration of the signal is equal to length of the RF pulse. This signal is a detected sample of the RF amplifier forward power RF PULSE sampled by the 20dB directional coupler. The RF output of the directional coupler is applied to the level detector where the RF is detected producing the dc signal

DET RF SAMPLE. When a low forward power fault is detected, fault signal ET/PRMDFT+/– is generated and applied to the video processor/monitor A3. When an excessive pulse width, excessive pulses, excessive duty cycle, or low power supply output voltage fault is detected, fault signal ET/PRDRFT+/– is generated. This signal is applied to the video processor monitor A3 and signal OFF is applied to the shutdown circuit. The shutdown circuit responds by interrupting the REG22V from the voltage regulator, removing +22V from the RF amplifier, thus shutting down the transmitter. Resistors R39 and R40 form a feedback loop which develops signal ADJ which sets the regulation level for the voltage regulator. Resistor R40 is used to adjust the voltage regulator output REG22V to 22 volts.

2.3.4.2.2 For pulse width, pulse number, and excessive duty cycle detection, the DET RF SAMPLE signal is conditioned by the signal conditioning circuit. This circuit essentially produces a logic level signal from the analog signal DET RF SAMPLE for triggering the associated monitoring circuits. As a result, output signal SAMPLE is a well defined pulse with a pulse width equal to signal DET RF SAMPLE, but the amplitude is a logic level.

2.3.4.2.3 Low forward power monitoring is performed by the clock generator, sample and hold circuit, comparator, and latch circuit. See figure 2–4. When the RF amplifier A1 is gated on by signals PAM+/–, signal PAM from line receiver U6B is applied to the clock generator. The clock generator responds by generating 0.6 microsecond sample signal S+H CLOCK which is applied to the sample and hold circuit. At this time, the sample and hold circuit samples signal DET RF SAMPLE for 0.6 microseconds. Output signal POWER of the sample and hold circuit is applied to the comparator. This signal indicates the peak power level of the sampled RF pulse RF PULSE. When the level of signal POWER drops below the threshold (150 watts peak) set by potentiometer R22, indicating low forward peak power, the comparator output LOW POWER becomes logic 1. At the end of the 0.6 microsecond sample period, signal S+H CLOCK is removed from the sample and hold circuit which holds the voltage level sampled. In addition, at this time, the clock generator generates signal LATCH CLOCK which is applied to the latch. As a result, the logic 1 at the comparator output is clocked into the latch, and output DRFAULT of the latch becomes logic 0. Signal DRFAULT is applied to line driver U4B and sent to the video processor/monitor as signal ET/PRMDFT+/–. Due to wiring between the line driver and the line receiver in the video processor monitor, a logic 1 is applied to the monitoring circuits in the video processor monitor, indicating a fault. When the sampled RF pulse DET RF PULSE power increases above the power level threshold, the comparator output LOW POWER becomes logic 0 during the sample interval. Therefore, at the end of the sample interval, signal LATCH CLOCK clocks the logic 0 at the comparator output into the latch. As a result, output DRFAULT of the latch becomes logic 1, and a logic 0 is applied to the video processor monitor, indicating no fault.

2.3.4.2.4 Pulse width detection is performed by the pulse width detector, comparator U10A and the latch. See figure 2–5. When the leading edge of signal SAMPLE is applied to the pulse width detector, it begins an internal timeout interval. If the pulse width of signal SAMPLE exceeds the time of the timeout interval, the RF pulse (RF PULSE) width is too long. As a result, the pulse width detector generates signal PULSE WIDTH which is applied to the comparator. The comparator U10A output PROTECTION FAULT becomes logic 0. This signal is applied to the latch, presetting it. As a result, the FAULT output becomes logic 1 and the OFF output becomes logic 0. The FAULT output is applied to line driver U4C and sent to the video processor/monitor as signal ET/PRDRFT+/–. The OFF output is applied to the voltage regulator which shuts down, removing +22v from the RF amplifier, and thus shutting down the transmitter. The timeout interval is adjusted by potentiometer R9. For the primary channel, R9 is set for a timeout interval of 40 microseconds. For the auxiliary channel, a jumper across pins 5 and 9 of W17P7 bypasses R9, causing the timeout interval to be set to 2 microseconds. Therefore, the primary channel, pulse widths over 40 microseconds are excessive. When the signal RESET, originating at the video processor/monitor, is applied to the latch, it is reset with signal FAULT returning to a logic 0 and signal OFF returning to a logic 1. As a result, +22v is applied to the RF amplifier, and transmitter operation resumes.

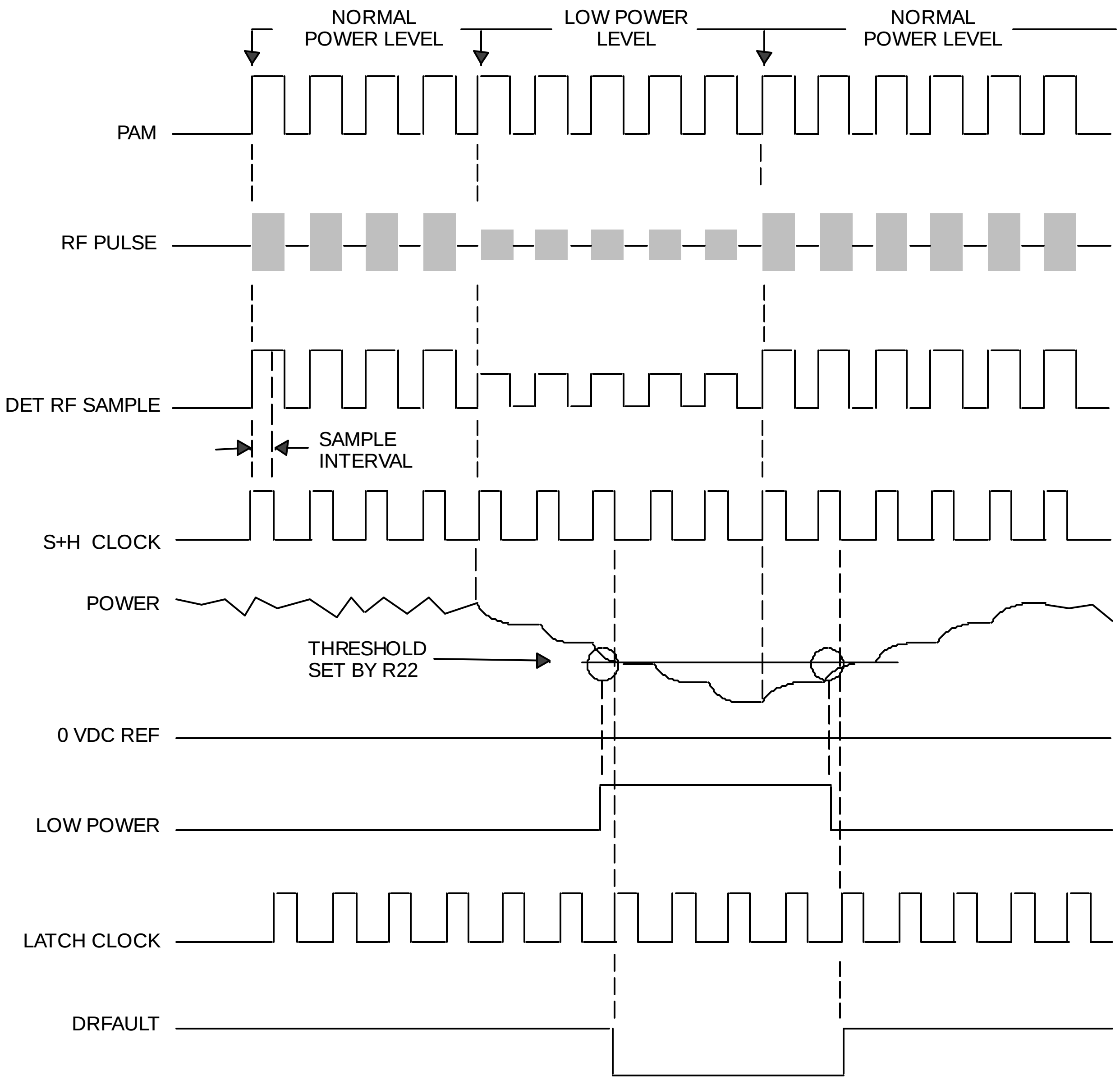


FIGURE 2–4. LOW FORWARD POWER DETECTION WAVEFORMS

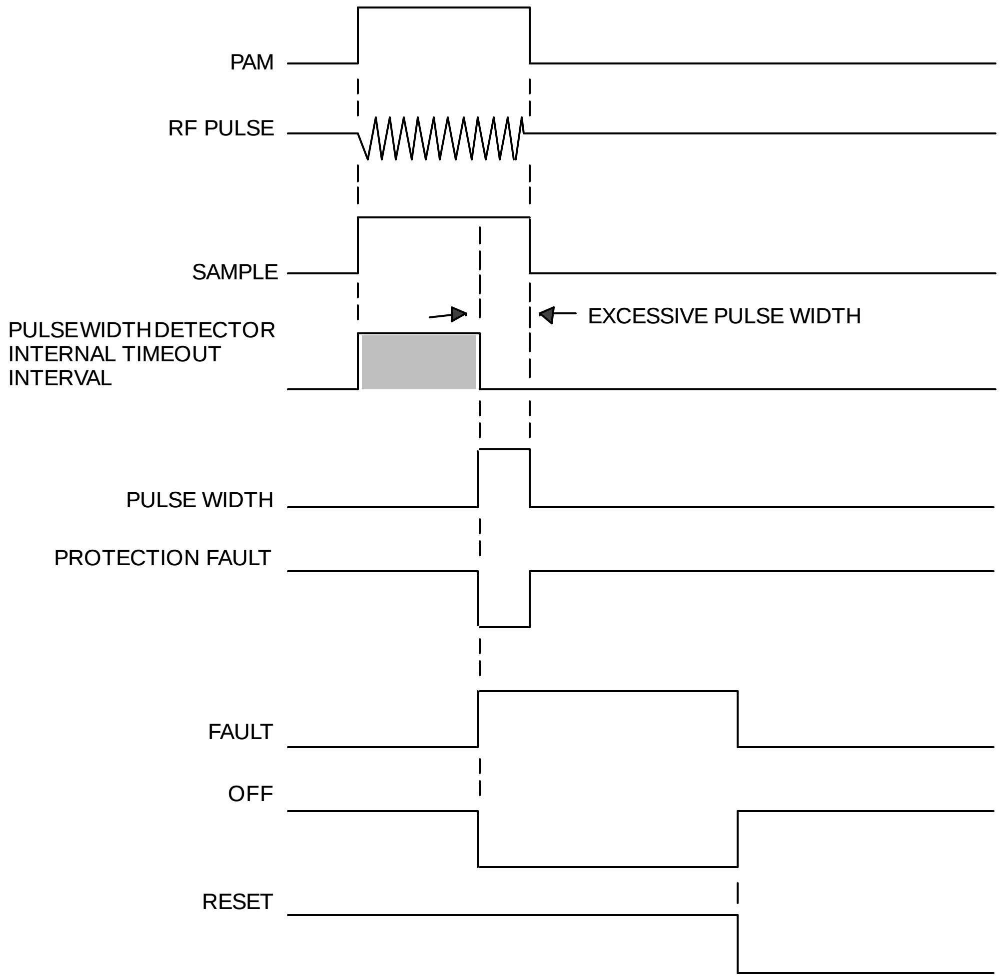


FIGURE 2–5. EXCESSIVE PULSE WIDTH DETECTION WAVEFORMS

2.3.4.2.5 Excessive pulse number detection is performed by the pulse number and duty cycle detector and comparator U10B. See figure 2–6. This circuit detects excessive average power caused by bursts of pulses that occur over a short period of time. Each time signal SAMPLE is applied to this circuit, it generates an output signal PULSES. The amplitude of signal PULSES is proportional to the number of RF pulses being transmitted in a given time frame. This signal is applied to comparator U10B. If the number of RF pulses being transmitted is greater than 110 in a 5.5 ms time interval, the amplitude of signal PULSES exceeds the threshold set by potentiometer R64. As a result, comparator U10B output PROTECTION FAULT becomes a logic 0. This signal is applied to the latch which functions as previously described.

2.3.4.2.6 Excessive duty cycle detection is performed by the pulse number and duty cycle detector and comparator U13A. This circuit detects excessive average power caused by pulses that occur over a long period of time. If the period of these pulses drops below 460 microseconds, a fault is detected. See figure 2–7. Each time signal SAMPLE is applied to this circuit, it generates an output signal DUTY CYCLE. The amplitude of signal DUTY CYCLE is proportional to the duty cycle of the RF pulses transmitted. This signal is applied to comparator U13A. If the duty cycle of the RF pulses being transmitted is excessive, the amplitude of signal DUTY CYCLE exceeds the threshold set by potentiometer R68. As a result, comparator U13A output PROTECTION FAULT becomes logic 0. This signal is applied to the latch which functions as previously described.

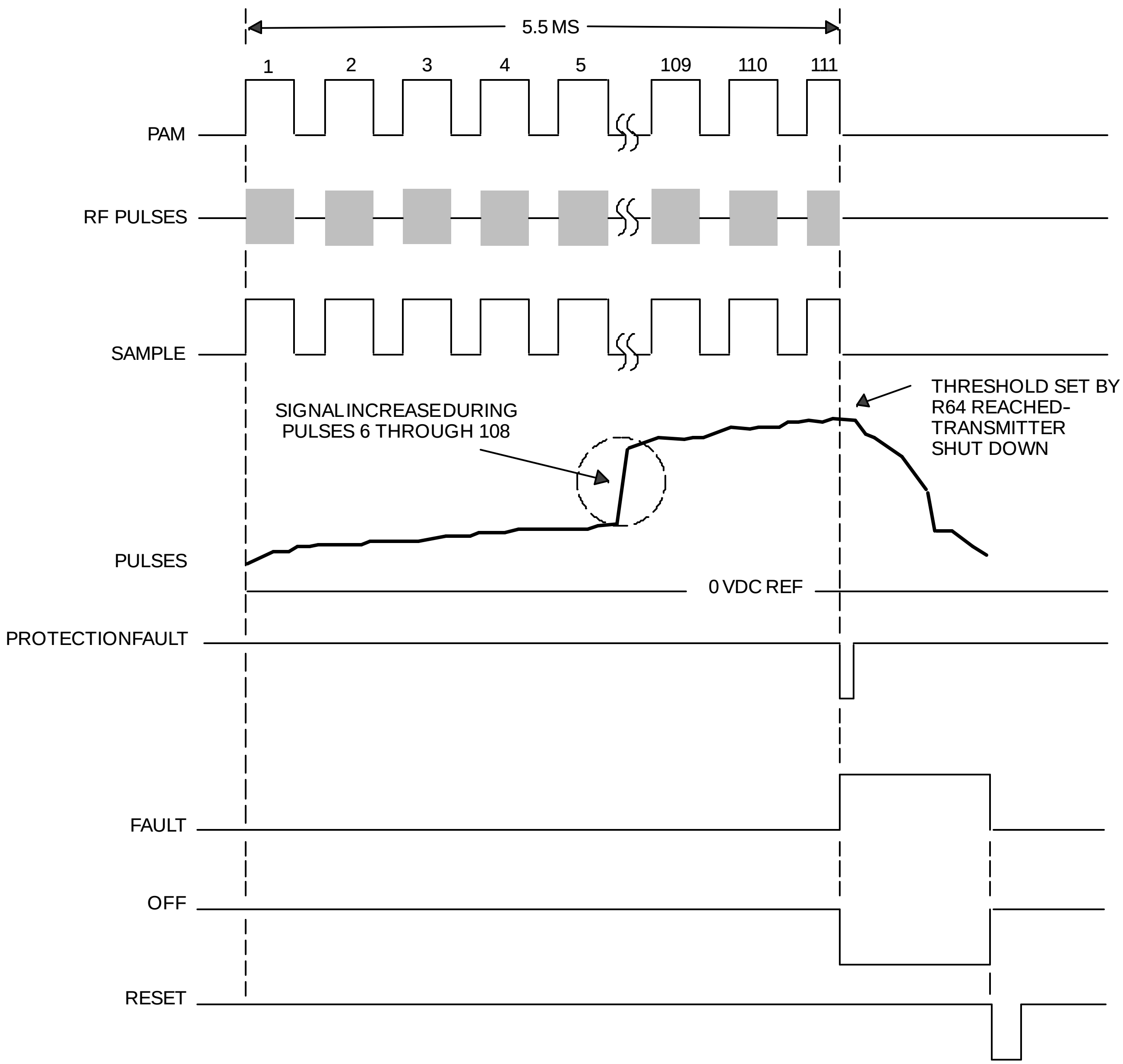


FIGURE 2–6. EXCESSIVE PULSE NUMBER DETECTION WAVEFORMS

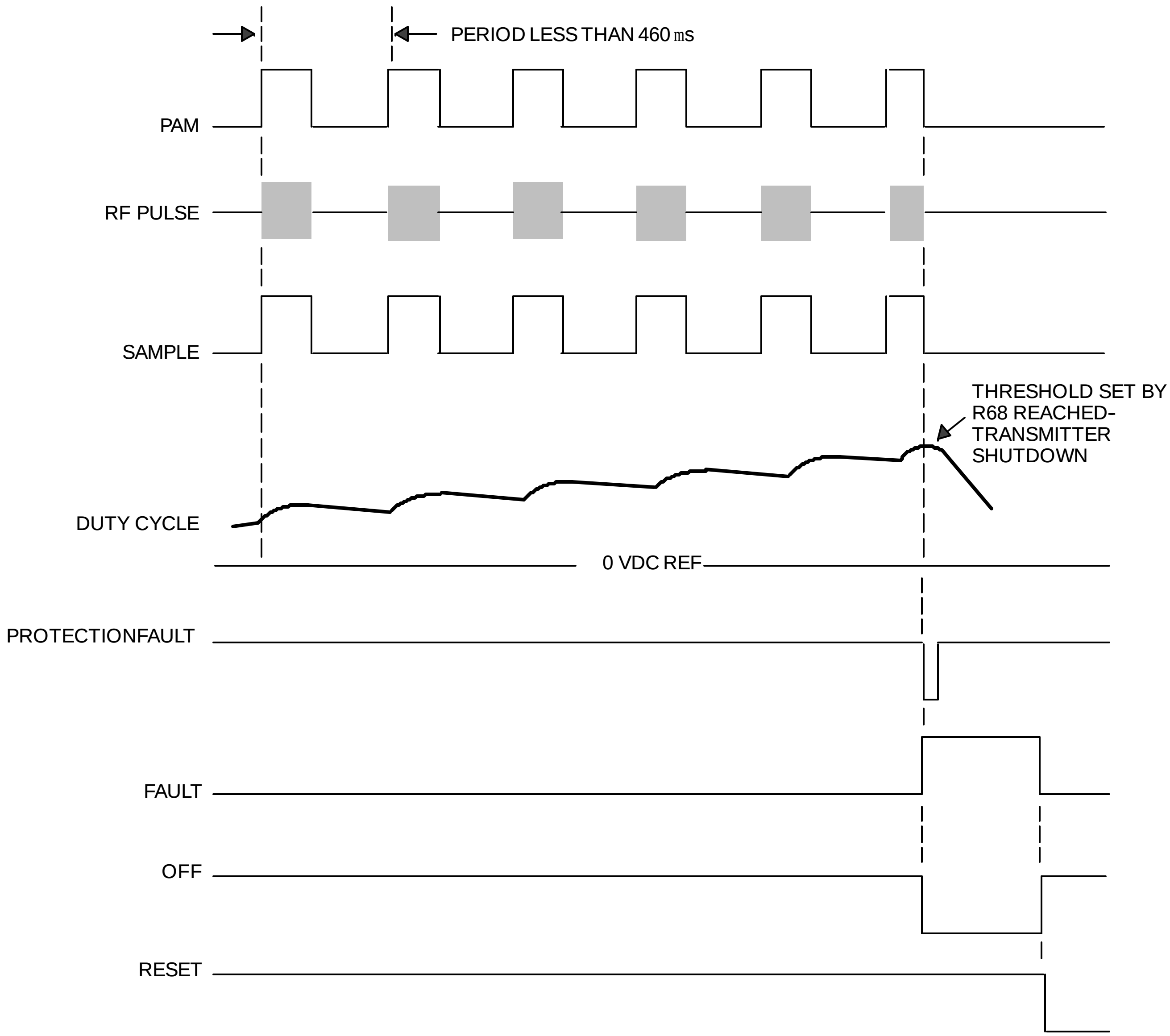


FIGURE 2–7. EXCESSIVE DUTY CYCLE DETECTION WAVEFORMS

2.3.4.2.7 The +52 volt and +36 volt undervoltage detection is performed by the undervoltage detector. A sample +52V of the output from the +52 volt power supply and a sample +36V of the output from the +36 volt power supply are applied through diodes CR2 and CR1 respectively to resistor R36 and the comparator U13B. The diodes isolate the two power supply outputs from one another. If either the +52V or the +36V power supply outputs drop below the required level, the voltage drop across R36 will fall below the 11.5 volt reference level. As a result, comparator U13B output PROTECTION FAULT becomes logic 0. This signal is applied to the latch which functions as previously described.

2.3.4.3 Power Amplifier Monitoring Circuit. The power amplifier BITE circuit board A9 detects low forward peak power POWER OUT at the output of the output combiner of the power amplifier. See figure 7–1, sheets 4 and 5 for primary power amplifier A16, and sheets 10 and 11 for auxiliary power amplifier A13. The BITE timing signal (TE/XMTTST+/– for the primary power amplifier and PA TRIG+/– for the auxiliary power amplifier) is applied through line receiver U7 to the clock generator as signal CLOCK TRIGGER. This initiates peak power detection when the RF pulses are present. At this time, signal VIDEO OUT is sampled by the sample and hold circuit and the resulting sample signal POWER is applied to the comparator. Signal VIDEO OUT is a detected sample of each RF pulse POWER OUT. The comparator compares sample signal POWER to the threshold set by potentiometer R6. This threshold is set for a peak power level of 2.03 kilowatts for primary power amplifier A16, and 8.14 kilowatts for auxiliary power amplifier A13. If a low power fault is detected, signal POWER falls below the threshold and the comparator output LOW POWER becomes logic 1. As a result, the output FAULT of the latch becomes logic 1 and is applied to the line driver U4. The output of the line driver is applied to the video processor monitor as signal ET/PRPAFT+/– for the primary channel and signal ET/AXPAFT+/– for the auxiliary channel. The detailed operation of the forward power monitoring circuit is the same as the operation of the forward power monitoring circuit in the modulator/driver which was previously described.

2.3.4.4 Transmitter External Monitoring Circuits. Forward and reverse (reflected) power for both the primary and auxiliary transmitters is sampled by the receiver/RFTTG diplexers. See figure 2–3, sheet 1. The primary transmitter output (PRI TX) is sampled in the monopulse diplexer A19 by directional coupler DC1, and the auxiliary transmitter output (AUX TX) is sampled in the omni diplexer A6 by the directional coupler DC1. Coupler A19DC1 provides a forward sample ER/SIGMFWD and a reverse sample ER/SIGMREV of the primary transmitter output pulses. Coupler A6DC1 provides a forward sample ER/OMEGFWD and a reverse sample ER/OMEGREV of the auxiliary transmitter output pulses.

2.3.4.4.1 The samples are sent to the RF test target generator A14 where they are processed in power detector A2. The power detector detects the amplitude and processes the samples when initiated by signal processor A4. The diodes detect the RF energy. The sigma/omega selector selects primary or auxiliary samples and applies them to transmitter/receiver selector. The primary transmitter samples are selected when signal sum select (PV/SUMSEL+/–) is logic 1. The transmitter/receiver selector selects either receiver/RFTTG video (ER/MNTRVID) or the transmitter samples for processing and applies the output to sample and hold circuits. The transmitter samples are selected when signal transmitter data select (PV/TXDSEL+/–) is logic 1.

2.3.4.4.2 The power samples are sampled and held in the forward sample and hold circuit and the reverse sample and hold circuit, and applied to forward/reverse selector U26. The forward/reverse selector selects either the forward or reverse sample and applies the output to the A/D converter. The forward sample is selected when signal PV/FWDSEL+/– is logic 1. The selected sample is then converted from analog to digital values, linearized in the linearization PROMs, and sent to the signal processor on the power detector bus (DATA BUS [00:12]). Refer to Section 2 of TI 6365.7, Mode S Sensor, Receiver Equipment Instruction Book for further details of RFTTG processing.

2.3.4.5 Performance Monitoring Routine. The interrogator regularly conducts performance monitoring tests to ensure the system is working properly. See figure 2–8, Transmitter Power/VSWR Testing Sequence. Power samples are obtained during the performance test cycle, which consists of eight scans. During a cycle, six power and two VSWR samples are obtained from the power detector and the VSWR monitor totaling eight samples per monitoring cycle. Each power and VSWR sample is identified by a scan number, and each scan is identified with a power mode (primary or auxiliary), or VSWR sample. The transmitter is made up of two channels, primary and auxiliary. Within each channel there are three modes of power: High Mode S Power, Low Mode S Power, and ATCRBS Power totaling six power levels and two VSWR. Tests are run using samples. There are four tests per sample, including 24 power level and 4 VSWR tests totaling 28 performance monitoring tests for the transmitter power/VSWR testing sequence. Tests are identified by test name and hexadecimal number.

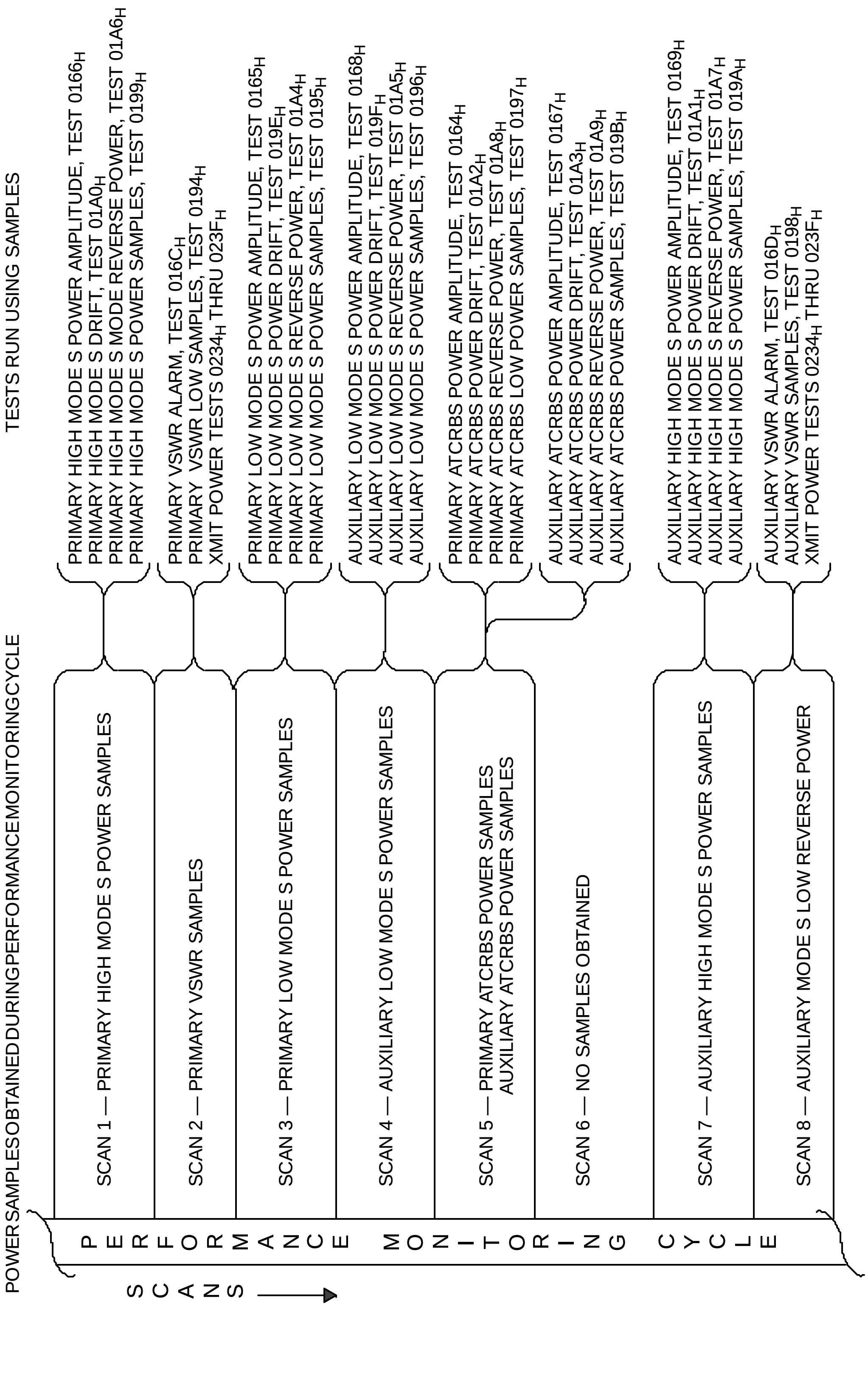


FIGURE 2–8. TRANSMITTER POWER/VSWR TESTING SEQUENCE

2.3.5 Fault Detection/Fault Isolation Testing

Faults in transmitter operation are detected by tests run during the fault detection testing sequence. Detected faults are isolated by the fault isolation test (FIT) routine. The fault detection and FIT routines consist of a series of tests run in a specific sequence. A test can be run in both fault detect and FIT, or only in one and not the other. Each test is identified by a hexadecimal test number that can be used to locate information within the instruction books. If replacement of the line replaceable unit (LRU) fails to resolve the fault, then manual fault analysis techniques are required. A local terminal connected to the DPS or a KCRT connected to an interrogator can be used to control the transmitter. With the KCRT, test signals can be generated and injected into the transmitter. In this way, troubleshooting, verification of onsite repairs or replacements can be performed, and adjustments can be made and verified.

2.3.5.1 Fault Detection Testing. Fault detection testing consists of a sequence of tests. If a fault is detected, testing stops, and a status report with red condition is sent to the DPS. A detected fault constitutes an automatic system failure. The DPS switches the standby channel to online, switches the suspect channel offline, and initiates FIT on the offline channel. The tests used during fault detection testing of the transmitter are listed in table 2–4, with test names and LRUs checked. A description of each test is provided in the following paragraphs in test number order.

TABLE 2–4. FAULT DETECTION TESTS

Test No.	Scan. No.	Test Name	LRUs Checked
0164_H	5	Primary ATCRBS Power Level	A8, A16, A11
0165_H	3	Primary Low Mode S Power Level	A16, A8, A11
0166_H	1	Primary High Mode S Power Level	A8, A16, A11
0167_H	4	Auxiliary ATCRBS Power Level	A13, A7, A10
0168_H	7	Auxiliary Low Mode S Power Level	A7, A13, A10
0169_H	4	Auxiliary High Mode S Power Level	A7, A13, A10
$016B_H$		Invalid Raw Forward Power Test	A14
$016C_H$	2	Primary VSWR Alarm Status	A8, A16, A11
$016D_H$	8	Auxiliary VSWR Alarm Status	A7, A13, A10
0194_H	2	Primary VSWR Low Samples	A8, A16, A11
0195_H	3	Primary Low Mode S Power Samples	A8, A16, A11
0196_H	4	Auxiliary Low Mode S Power Samples	A7, A13, A10
0197_H	5	Primary ATCRBS Low Power Samples	A8, A16, A11
0198_H	8	Auxiliary VSWR Low Samples	A4A113
0199_H	1	Primary High Mode S Power Samples	A8, A16, A11
$019A_H$	7	Auxiliary High Mode S Power Samples	A7, A13, A10
$019B_H$	7	Auxiliary ATCRBS Power Samples	A4A113
$019E_H$	3	Primary Low Mode S Power Drift	A8, A16, A11
$019F_H$	4	Auxiliary Low Mode S Power Drift	A7, A13, A10
$01A0_H$	1	Primary High Mode S Power Drift	A8, A16, A11
$01A1_H$	7	Auxiliary High Mode S Power Drift	A7, A13, A10

TABLE 2–4. FAULT DETECTION TESTS (Continued)

Test No.	Scan. No.	Test Name	LRUs Checked
01A2H	5	Primary ATCRBS Power Drift	A8, A16, A11
01A3H	5	Auxiliary ATCRBS Power Drift	A7, A13, 10
01A4H	3	Primary Mode S Low Low Reverse	A14, *
01A5H	4	Auxiliary Mode S Low Low Reverse	A14, *
01A6H	1	Primary Mode S High Low Reverse	A14, *
01A7H	7	Auxiliary Mode S High Low Reverse	A14, *
01A8H	5	Primary ATCRBS Low Reverse	A14, *
01A9H	5	Auxiliary ATCRBS Low Reverse	A14, *
0234H	2,8	Transmit ATCRBS Mode 3/A ATCRBS Power	Pri & Aux Tx
0235H	2,8	Transmit ATCRBS Mode C ATCRBS Power	Pri & Aux Tx
0236H	2,8	Transmit ATCRBS Mode 2 ATCRBS Power	Pri & Aux Tx
0237H	2,8	Transmit ATCRBS Mode 3/A Mode S All Call ATCRBS Pwr	Pri & Aux Tx
0238H	2,8	Transmit ATCRBS Mode C Mode S All Call ATCRBS Pwr	Pri & Aux Tx
0239H	2,8	Transmit ATCRBS Only All Call Mode 3/A ATCRBS Pwr	Pri & Aux Tx
023AH	2,8	Transmit ATCRBS Only All Call Mode C ATCRBS Pwr	Pri & Aux Tx
023BH	2,8	Transmit Mode S All Call (UF11) ATCRBS Power	Pri & Aux Tx
023CH	2,8	Transmit Mode S Short Roll Call Mode S Low Power	Pri & Aux Tx
023DH	2,8	Transmit Mode S Short Roll Call Mode S High Power	Pri & Aux Tx
023EH	2,8	Transmit Mode S Long Roll Call Mode S Low Power	Pri & Aux Tx
023FH	2,8	Transmit Mode S Long Roll Call Mode S High Power	Pri & Aux Tx

NOTE: Asterisk (*) indicates associated primary or auxiliary transmitter assemblies.

2.3.5.1.1 Test 0164H, Primary ATCRBS Power Level. The purpose of this test is to make sure the primary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and/or exceeds a stuck high threshold. Primary ATCRBS transmissions are monitored and sampled each scan 5 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.2 Test 0165H, Primary Low Mode S Power Level. The purpose of this test is to make sure the primary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and or exceeds a stuck high threshold. Primary Low Mode S power transmissions are monitored and sampled each scan 3 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.3 Test 0166H, Primary High Mode S Power Level. The purpose of this test is to make sure the primary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and or exceeds a stuck high threshold. Primary Mode S high power transmissions are monitored and sampled each scan 1 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.4 Test 0167H, Auxiliary ATCRBS Power Level. The purpose of this test is to make sure the auxiliary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and or exceeds a stuck high threshold. Auxiliary ATCRBS transmissions are monitored and sampled each scan 4 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.5 Test 0168H, Auxiliary Low Mode S Power Level. The purpose of this test is to make sure the auxiliary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and or exceeds a stuck high threshold. Auxiliary Low Mode S power transmissions are monitored and sampled each scan 7 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.6 Test 0169H, Auxiliary High Mode S Power Level. The purpose of this test is to make sure the auxiliary transmitter is working properly, and to generate a fault indication if the power level falls below a high or low threshold, and or exceeds a stuck high threshold. Auxiliary High Mode S power transmissions are monitored and sampled each scan 4 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A yellow condition is declared if the average is below the high threshold, or above the stuck high threshold. A fault is declared if the average is below the low threshold.

2.3.5.1.7 Test 016BH, Invalid Raw Forward Power Test. The invalid raw forward power test checks to ensure that the raw forward power value read for each transmission is a positive number. If the raw forward power value is not positive (indicating that either the transmitter or power detector has failed) a red condition is reported to the DPS.

2.3.5.1.8 Test 016CH, Primary VSWR Alarm Status. The purpose of this test is to make sure the primary (SUM) antenna rotary joint and cable connections are working properly, and to generate a fault indication if a VSWR status flag indicates an excessive VSWR reading. The VSWR monitor is initialized for VSWR measurements at the start of each scan 2 of the fault detection cycle. VSWR alarm status flags are monitored at the end of each scan 2 of the fault detection cycle. A fault is declared if either of the flags have been set during the scan.

2.3.5.1.9 Test 016DH, Auxiliary VSWR Alarm Status. The purpose of this test is to make sure the auxiliary (omni) antenna rotary joint and cable connections are working properly, and to generate a fault indication if a VSWR status flag indicates an excessive VSWR reading. The VSWR monitor is initialized for VSWR measurements at the start of each scan 8 of the fault detection cycle. VSWR alarm status flags are monitored at the end of each scan 8 of the fault detection cycle. A fault is declared if either of the flags have been set during the scan.

2.3.5.1.10 Test 0194H, Primary VSWR Low Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of VSWR. A fault indication is declared if the number of samples were insufficient. The VSWR monitor is initialized for VSWR measurements at the start of each scan 2 of the fault detection cycle. VSWR alarm status flags are monitored at the end of each scan 2 of the fault detection cycle. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.11 Test 0195H, Primary Low Mode S Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of primary low Mode S power. A fault indication is declared if the number of samples were insufficient. Primary low Mode S power transmissions are monitored and sampled each scan 3 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.12 Test 0196H, Auxiliary Low Mode S Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of auxiliary low Mode S power. A fault indication is declared if the number of samples were insufficient. Auxiliary low Mode S power transmissions are monitored and sampled each scan 4 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.13 Test 0197H, Primary ATCRBS Low Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of primary ATCRBS low power. A fault indication is declared if the number of samples were insufficient. Primary ATCRBS low power transmissions are monitored and sampled each scan 5 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.14 Test 0198H, Auxiliary VSWR Low Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of VSWR. A fault indication is declared if the number of samples were insufficient. The VSWR monitor is initialized for VSWR measurements at the start of each scan 8 of the fault detection cycle. VSWR alarm status flags are monitored at the end of each scan 8 of the fault detection cycle. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.15 Test 0199H, Primary High Mode S Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of primary Mode S high power. A fault indication is declared if the number of samples were insufficient. Primary high Mode S power transmissions are monitored and sampled each scan 1 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.16 Test 019AH, Auxiliary High Mode S Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of auxiliary Mode S high power. A fault indication is declared if the number of samples were insufficient. Auxiliary high Mode S power transmissions are monitored and sampled each scan 7 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.17 Test 019BH, Auxiliary ATCRBS Power Samples. The purpose of this test is to verify that a sufficient number of power samples were obtained for an accurate measure of auxiliary ATCRBS low power. A fault indication is declared if the number of samples were insufficient. Auxiliary ATCRBS low power transmissions are monitored and sampled each scan 7 of the fault detection cycle. Power levels are averaged over several samples, then compared to low, high, and stuck high thresholds. A fault is declared if an insufficient number of power samples were obtained during the scan.

2.3.5.1.18 Test 019EH, Primary Low Mode S Power Drift. The purpose of this test is to verify that the primary transmitter power amplitude for low Mode S power mode does not change with time. A fault indication is declared if a change in the primary low Mode S power amplitude exceeds a given amount. This amount varies with scan. Primary low Mode S power transmissions are sampled every scan 3 of the fault detection cycle. Refer to paragraph 2.3.4.4 for power sampling theory of operation. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. A primary low Mode S power drift fault is declared if the difference between the power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.19 Test 019FH, Auxiliary Low Mode S Power Drift. The purpose of this test is to verify that the auxiliary transmitter power amplitude for low Mode S power mode does not change with time. A fault indication is declared if a change in the auxiliary low Mode S power amplitude over a fixed amount exceeds a given amount. This amount varies with scan. Auxiliary low Mode S power transmissions are sampled every scan 4 of the fault detection cycle. Refer to paragraph 2.3.4.4 for forward power sampling. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. An auxiliary low Mode S power drift fault is declared if the difference between the power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.20 Test 01A0H, Primary High Mode S Power Drift. The purpose of this test is to verify that the primary transmitter power amplitude for high Mode S power mode does not change with time. A fault indication is declared if a change in the primary high Mode S power amplitude over a fixed amount exceeds a given amount. This amount varies with scan. Primary high Mode S power transmissions are sampled every scan 1 of the fault detection cycle. Refer to paragraph 2.3.4.4 for forward power sampling. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. A primary high Mode S power drift fault is declared if the difference between the power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.21 Test 01A0H, Auxiliary High Mode S Power Drift. The purpose of this test is to verify that the auxiliary transmitter power amplitude for high Mode S power mode does not change with time. A fault indication is declared if a change in the auxiliary high Mode S power amplitude exceeds a given amount. This amount varies with scan. Auxiliary high Mode S power transmissions are sampled each scan 7 of the fault detection cycle. Refer to paragraph 2.3.4.4 for forward power sampling. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. An auxiliary high Mode S power drift fault is declared if the difference between the current power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.22 Test 01A2H, Primary ATCRBS Power Drift. The purpose of this test is to verify that the primary transmitter power amplitude for ATCRBS mode does not change with time. A fault indication is declared if a change in the primary ATCRBS power amplitude exceeds a given amount. This amount varies with scan. Primary ATCRBS transmissions are sampled each scan 5 of the fault detection cycle. Refer to paragraph 2.3.4.4 for forward power sampling. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. A primary ATCRBS power drift fault is declared if the difference between the current power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.23 Test 01A3H, Auxiliary ATCRBS Power Drift. The purpose of this test is to verify that the auxiliary transmitter power amplitude for ATCRBS mode does not change with time. A fault indication is declared if a change in the auxiliary ATCRBS power amplitude exceeds a given amount. This amount varies with scan. Auxiliary ATCRBS transmissions are sampled each scan 5 of the fault detection cycle. Refer to paragraph 2.3.4.4 for forward power sampling. The forward power amplitude is compared to an average amplitude in the signal processor. The average amplitude is obtained by adding the latest sample amplitude to the previous average amplitude and dividing by the number of samples in the sum. An auxiliary ATCRBS power drift fault is declared if the difference between the current power amplitude and the running average is greater than 0.4 dB. A flag is set, and an alarm with a yellow condition is formed.

2.3.5.1.24 Test 01A4H, Primary Mode S Low Low Reverse Test. The primary Mode S low low reverse test is used to verify proper operation of the power detector in the RFTTG. The primary Mode S low power transmissions are monitored during scan 3 of each monitor cycle. This test reports a red condition if the primary reverse Mode S low power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.25 Test 01A5H, Auxiliary Mode S Low Low Reverse Test. The auxiliary mode S low low reverse test is used to verify proper operation of the power detector in the RFTTG. The auxiliary Mode S low power transmissions are monitored during scan 4 of each monitor cycle. This test reports a red condition if the auxiliary reverse mode S low power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.26 Test 01A6H, Primary Mode S High Low Reverse Test. The primary Mode S high low reverse test is used to verify proper operation of the power detector in the RFTTG. The primary Mode S high power transmissions are monitored during scan 1 of each monitor cycle. This test reports a red condition if the primary reverse Mode S high power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.27 Test 01A7H, Auxiliary Mode S High Low Reverse Test. The auxiliary Mode S high low reverse test is used to verify proper operation of the power detector in the RFTTG. The auxiliary mode S high power transmissions are monitored during scan 7 of each monitor cycle. This test reports a red condition if the auxiliary reverse Mode S high power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.28 Test 01A8H, Primary ATCRBS Low Reverse Test. The primary ATCRBS low reverse test is used to verify proper operation of the power detector in the RFTTG. The ATCRBS power transmissions are monitored during scan 5 of each monitor cycle. This test reports a red condition if the primary reverse ATCRBS power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.29 Test 01A9H, Auxiliary ATCRBS Low Reverse Test. The auxiliary ATCRBS low reverse test is used to verify proper operation of the power detector in the RFTTG. The ATCRBS power transmissions are monitored during scan 5 of each monitor cycle. This test reports a red condition if the auxiliary reverse ATCRBS power is below a fixed level (indicating that either no transmission took place or the power detector has failed).

2.3.5.1.30 Test 0234H, Transmit ATCRBS Mode 3/A ATCRBS Power. The transmit ATCRBS Mode 3/A ATCRBS power test is scheduled and executed by the standby interrogator during scans 2 and 8 of each monitor cycle, but its results are not monitored by software. The purpose of this test is to provide the technician with a means to command the interrogator to transmit in ATCRBS mode 3/A mode at the ATCRBS power level so that power level measurements can be taken using commercial test equipment. To use this test to take power measurements, command the interrogator to loop on the test using the Interrogator Diagnostics option on the Local Terminal RMS menu.

2.3.5.1.31 Test 0235H, Transmit ATCRBS Mode C ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS mode C transmission at the ATCRBS power level.

2.3.5.1.32 Test 0236H, Transmit ATCRBS Mode 2 ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS mode 2 transmission at the ATCRBS power level.

2.3.5.1.33 Test 0237H, Transmit ATCRBS Mode 3/A Mode S All Call ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS mode 3/A Mode S all call mode transmission at the ATCRBS power level.

2.3.5.1.34 Test 0238H, Transmit ATCRBS Mode C Mode S All Call ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS mode C Mode S all call mode transmission at the ATCRBS power level.

2.3.5.1.35 Test 0239H, Transmit ATCRBS Only All Call Mode 3/A ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS only all call mode 3/A transmission at the ATCRBS power level.

2.3.5.1.36 Test 023AH, Transmit ATCRBS Only All Call Mode C ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do an ATCRBS only all call mode C transmission at the ATCRBS power level.

2.3.5.1.37 Test 023BH, Transmit Mode S All Call (UF11) ATCRBS Power. Same as test 0234H except that the interrogator is commanded to do a Mode S all call transmission at the ATCRBS power level.

2.3.5.1.38 Test 023CH, Transmit Mode S Short Roll Call Mode S Low Power. Same as test 0234H except that the interrogator is commanded to do a Mode S short roll call transmission at the Mode S low power level.

2.3.5.1.39 Test 023DH, Transmit Mode S Short Roll Call Mode S High Power. Same as test 0234H except that the interrogator is commanded to do a Mode S short roll call transmission at the Mode S high power level.

2.3.5.1.40 Test 023EH, Transmit Mode S Long Roll Call Mode S Low Power. Same as test 0234H except that the interrogator is commanded to do a Mode S long roll call transmission at the Mode S low power level.

2.3.5.1.41 Test 023FH, Transmit Mode S Long Roll Call Mode S High Power. Same as test 0234H except that the interrogator is commanded to do a Mode S long roll call transmission at the Mode S high power level.

2.3.5.2 Fault Isolation Testing. The transmitter FIT routines run through a sequence of tests when attempting to isolate a fault that has been detected by a fault detection test. Each test is identified by a hexadecimal number. The FIT routine contains 14 successive tests that check transmitter status, power, and VSWR measurements. As each test is run, the pass/fail result leads to the next test, end of testing, or a replacement message. The replacement message is sent to the DPS for further processing. See figure 7–2, Interrogator FIT Tree, for the test sequence and units recommended for replacement. The following paragraphs describe each transmitter test and include input conditions, circuits tested, output conditions, and test results. Table 2–5, Fault Isolation Tests, lists each test in numerical order with name, test diagram/sheet and theory paragraph reference, and unit/circuit tested with signal name. Note that test 100_H, transmitter go/no go status, is run in both fault detection and FIT. Refer to paragraph 2.3.5.2.1 for the description of test 0100_H.

TABLE 2–5. FAULT ISOLATION TESTS

Test No.	Test Name	Fig., Sheet	Unit/Circuit Checked
0100_H	Transmitter Go/No Go Status	2–3, sh 2	All transmitter go/no go status bits
0101_H	Primary Modulator/Driver Fault Status	2–3, sh 2	Primary Modulator/Driver A8 Protection Circuit (ET/PRMDFT+/–)

TABLE 2–5. FAULT ISOLATION TESTS (Continued)

Test No.	Test Name	Fig., Sheet	Unit/Circuit Checked
0102_H	Primary Power Amplifier Fault Status	2–3, sh 2	Primary Power Amplifier A16 Protection Circuit (ET/PRPAFT+/–)
0103_H	Primary Driver Protection Fault Status	2–3, sh 2	Primary Modulator/Driver A8 Driver Fault Circuit (ET/PRDRFT+/–)
0104_H	Auxiliary Modulator/Driver Fault Status	2–3, sh 2	Auxiliary Modulator/Driver A7 Protection Circuit (ET/AXMDFT+/–)
0106_H	Auxiliary Driver Protection Fault Status	2–3, sh 2	Auxiliary Modulator/Driver A7 Driver Fault Circuit (ET/AXDRFT+/–)
0203_H	Primary ATCRBS Red Power Level	2–3, sh 1	Primary Output Level Control
0204_H	Primary Low Mode S Red Power Level	2–3, sh 1	Primary Output Level Control
0205_H	Primary High Mode S Red Power Level	2–3, sh 1	Primary Output Level Control
0206_H	Auxiliary ATCRBS Red Power Level	2–3, sh 1	Auxiliary Output Level Control
0207_H	Auxiliary Low Mode S Red Power Level	2–3, sh 1	Auxiliary Output Level Control
0208_H	Auxiliary High Mode S Red Power Level	2–3, sh 1	Auxiliary Output Level Control
0209_H	Primary High Mode S Red Reverse Power	2–3, sh 1	RFTTG A14, Monopulse diplexer A19
$020A_H$	Auxiliary High Mode S Red Reverse Power	2–3, sh 1	RFTTG A14, Omni diplexer A6

2.3.5.2.1 Test 0100H, Transmitter Go/No Go Status Sheet. This test monitors the go/no go status of the transmitter, and generates a fault indication if a fault exists. Status signals from the transmitter are stored in the transmitter status register U85 on test video processor monitor A3. See figure 2–3, sheet 2, in section 11. Transmitter status signals from the modulator/driver and high power amplifier in each channel (primary and auxiliary) are stored in transmitter/receiver status register U85, bits 0 through 5. Refer to table 2–3. To check the status of the register, the signal processor sets signal Transmitter Register Enable (TXREGEN–) to logic 0 to read word address 01. The content of register U85 is then placed on the data bus (PMDATA[00:07]), and sent to the signal processor, where it is examined for faults. Refer to paragraph 2.3.4.2 for more circuit details. If the values are not logic 0, the test has failed. Tests 0101_H through 0106_H are then performed, as required, to isolate the cause of the failure. The test is repeated until a fault is read again or three attempts are made. If the test fails a second time, then a status report with red condition is sent to the DPS. If a fault exists, the signal processor can attempt to reset the transmitter by writing logic 0 to word address 02 (write address decoder U69, U70), enabling the transmitter reset strobes (ER/TXRSTA, primary and ER/TXRSTB, auxiliary). Status register U85 is cleared and the test cycle is repeated.

2.3.5.2.2 Test 0101H, Primary Modulator/Driver Fault Status. This test monitors the status of primary modulator/driver fault detection signal ET/PRMDFT+/–. The fault detection signal (ET/PRMDFT+/–) is sent through transmitter status register U85 bit 00 in video processor monitor A3 to the signal processor. The content of the transmitter status register is read twice by the signal processor. If a failure (ET/PRMDFT+/– = logic 1) is read on either measurement, the test is repeated two more times or until a failure is read again, whichever comes first. A fault is declared if the status bit indicates a failure on two measurements.

2.3.5.2.3 Test 0102H, Primary Power Amplifier Fault Status. The purpose of this test is to monitor the status of the primary power amplifier fault detection signal ET/PRPAFT+/–. The fault detection signal (ET/PRPAFT+/–) is sent through transmitter status register U85 bit 01 in video processor monitor A3 to the signal processor. The content of the transmitter status register is read twice by the signal processor. If a failure (ET/PRPAFT+/– = logic 1) is read on either measurement, the test is repeated two more times or until a failure is read again, whichever comes first. A fault is declared if the status bit indicates a failure on two measurements.

2.3.5.2.4 Test 0103H, Primary Driver Protection Fault Status. The purpose of this test is to monitor the status of the driver protection circuit in the primary modulator/driver (fault detection signal ET/PRDRFT+/–). The fault detection signal is sent through transmitter status register U85 bit 02 in video processor monitor A3 to the signal processor. The content of the transmitter status register is read twice by the signal processor. If a failure (ET/PRDRFT+/– = logic 1) is read on either measurement, the test is repeated two more times or until a failure is read again, whichever comes first. A fault is declared if the status bit indicates a failure on two measurements.

2.3.5.2.5 Test 0104H, Auxiliary Modulator/Driver Fault Status. The purpose of this test is to monitor the status of the auxiliary modulator/driver fault detection signal ET/AXMDFT+/–. The fault detection signal is sent through transmitter status register U85 bit 03 in video processor/monitor A3 to the signal processor. The content of the transmitter status register is read twice by the signal processor. If a failure (ET/AXMDFT+/– = logic 1) is read on either measurement, the test is repeated two more times or until a failure is read again, whichever comes first. A fault is declared if the status bit indicates a failure on two measurements.

2.3.5.2.6 Test 0106H, Auxiliary Driver Protection Fault Status. The purpose of this test is to monitor the status of the driver protection circuit in the auxiliary modulator/driver (fault detection signal ET/AXDRFT+/–). The fault detection signal is sent through transmitter status register U85 bit 04 in video processor/monitor A3 to the signal processor. The content of the transmitter status register is read twice by the signal processor. If a failure (ET/AXDRFT+/– = logic 1) is read on either measurement, the test is repeated two more times or until a failure is read again, whichever comes first. A fault is declared if the status bit indicates a failure on two measurements.

2.3.5.2.7 Test 0203H, Primary ATCRBS Red Power Level. The purpose of this test is to verify proper primary power amplifier and output level control operation in ATCRBS mode. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter fault isolation (FI) condition array for primary ATCRBS is checked by the performance monitor. Primary ATCRBS forward power samples are made by RFTTG power detector A2 when commanded by the signal processor. The samples are compared to thresholds and a primary ATCRBS red level fault is declared if the measured value indicates a fault.

2.3.5.2.8 Test 0204H, Primary Low Mode S Red Power Level. The purpose of this test is to verify proper primary power amplifier and output level control operation in low power Mode S mode. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for primary low Mode S power is checked by the performance monitor. Primary low Mode S forward power samples are made by RFTTG power detector A2 when commanded by the signal processor. The samples are compared to thresholds and a primary low Mode S red level fault is declared if the measured value indicates a fault.

2.3.5.2.9 Test 0205H, Primary High Mode S Red Power Level. See figure 2–3, sheet 1. The purpose of this test is to verify proper primary power amplifier and output level control operation in high power Mode S operation. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for primary high Mode S power is checked by the performance monitor. Primary high Mode S forward power samples are made by RFTTG power detector A2 when commanded by the signal processor. The samples are compared to thresholds and a primary high Mode S red level fault is declared if the measured value indicates a fault.

2.3.5.2.10 Test 0206H, Auxiliary ATCRBS Red Power Level. The purpose of this test is to verify proper auxiliary power amplifier and output level control operation during ATCRBS mode. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for auxiliary ATCRBS power is checked by the performance monitor. Auxiliary ATCRBS forward power samples are made by RFTTG power detector A2 when commanded by the signal processor. The samples are compared to thresholds and an auxiliary ATCRBS red level fault is declared if the measured value indicates a fault.

2.3.5.2.11 Test 0207H, Auxiliary Low Mode S Red Power Level. The purpose of this test is to verify proper auxiliary power amplifier and output level control operation during low power Mode S mode. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for auxiliary low Mode S power is checked by the performance monitor. Auxiliary low Mode S forward power samples are made by RFTTG power detector A2 when commanded to do so by the signal processor. Samples are compared to thresholds and an auxiliary low Mode S red level fault is declared if the measured value indicates a fault.

2.3.5.2.12 Test 0208H, Auxiliary High Mode S Red Power Level. The purpose of this test is to verify proper auxiliary power amplifier and output level control operation during high power Mode S operation. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for auxiliary high Mode S power is checked by the performance monitor. Auxiliary high Mode S forward power samples are made by RFTTG power detector A2 when commanded to do so by the signal processor. Samples are compared to thresholds and an auxiliary high Mode S red level fault is declared if the measured value indicates a fault.

2.3.5.2.13 Test 0209H, Primary High Mode S Red Reverse Power Level. The purpose of this test is to verify proper RFTTG and monopulse diplexer A19 (primary channel) operation during high power Mode S operation. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for primary high Mode S reverse power is checked by the performance monitor. Primary high Mode S reverse power samples are made by RFTTG power detector A2 when commanded to do so by the signal processor. Samples are compared to thresholds and a primary high Mode S red level fault is declared if the measured value indicates a fault.

2.3.5.2.14 Test 020AH, Auxiliary High Mode S Red Reverse Power Level. The purpose of this test is to verify proper RFTTG and omni diplexer (auxiliary channel) operation during high power Mode S operation. A fault indication is declared if the transmitter power status indicates a red condition. The status of the transmitter FI condition array for auxiliary high Mode S power is checked by the performance monitor. Auxiliary high Mode S reverse power samples are made by RFTTG power detector A2 when commanded by the signal processor. Samples are compared to thresholds and an auxiliary high Mode S red level fault is declared if the measured value indicates a fault.

3.0 OPERATION

3.1 INTRODUCTION

The transmitter is operated as part of the interrogator. Refer to section 3 of TI 6365.5 for interrogator operating procedures.

4.0 STANDARDS AND TOLERANCES

4.1 INTRODUCTION

Standards and tolerances for the interrogator transmitter are listed as part of the interrogator standards and tolerances in section 4 of TI 6365.5.

5.0 PERIODIC MAINTENANCE

5.1 INTRODUCTION

All periodic maintenance requirements for the interrogator transmitter are provided in section 5 of TI 6365.5.

6.0 MAINTENANCE PROCEDURES

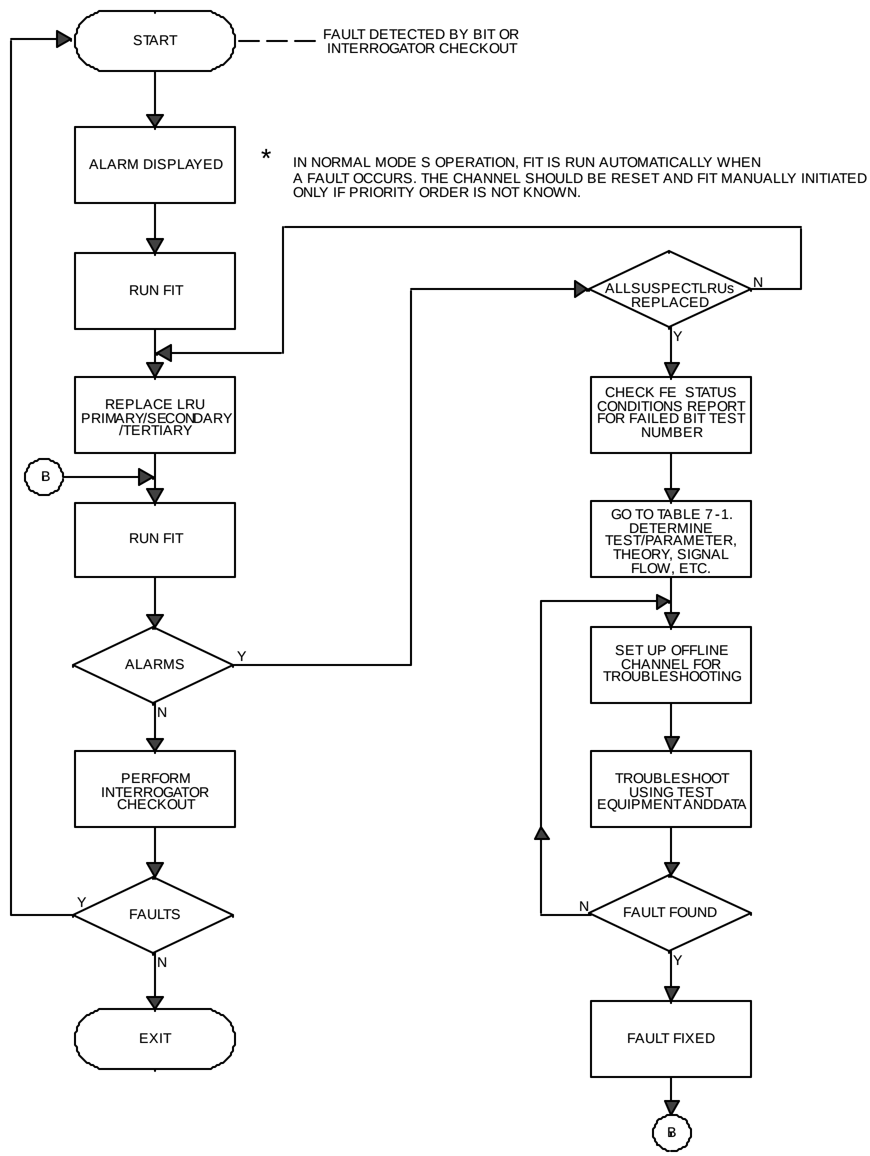
6.1 INTRODUCTION

All maintenance procedures for the interrogator transmitter are provided in section 6 of TI 6365.5.

7.0 CORRECTIVE MAINTENANCE

7.1 INTRODUCTION

This section contains the instructions for onsite analysis, isolation, and repair of faults in the Mode S transmitter equipment. Corrective maintenance instructions for the interrogator power distribution and environmental controls, receiver/RFTTG, and signal processor circuits are contained in their respective books. Interrogator corrective maintenance is performed when a fault is detected offsite through the RMMS or onsite during interrogator checkout. The corrective maintenance process differs slightly depending on whether the sensor is operating in the normal Mode S mode or in Independent ATCRBS mode. In either case, before any corrective maintenance is performed, onsite control of the Mode S sensor must be obtained. Also, the faulty interrogator channel must be configured to offline, if not done automatically by the sensor. The corrective maintenance concept is shown below and described in the following paragraphs.



7.1.1 Normal Mode S Corrective Maintenance

In the normal Mode S mode, if automatic controls have not been disabled, the DPS automatically switches channels and runs FIT when a red fault is detected by the fault detection routines. Suspect LRUs are identified in priority order (primary, secondary, and tertiary) by successive alarms sent to the RMMS. These messages can be displayed locally on the Local Terminal and remotely on an MDT. Corrective maintenance is then performed as follows. The primary LRU is replaced and FIT initiated (using the RMS menus) to check interrogator operation. If the same alarms are displayed again, the secondary LRU (if any) is replaced and FIT initiated. If the same alarms are displayed again, the tertiary LRU (if any) is replaced and FIT initiated.

7.1.1.1 If replacing any LRU(s) corrects the fault (no alarms displayed), the interrogator checkout procedure is performed. The interrogator checkout procedure checks for faults that may still exist in the interrogator. If no faults are found, the interrogator can be configured to standby and the maintenance action is complete. If faults are detected, during interrogator checkout, failing parameter(s) can be identified per table 7−1, Transmitter Fault Indicators, and manual troubleshooting can be initiated.

7.1.1.2 If alarms are displayed after replacing all the suspect LRUs, manual troubleshooting procedures are necessary to fix the fault. By matching the faulty LRU (primary) with the failed Built-In Test (BIT) (identified from the Interrogator FE Status Conditions Report), the circuit/parameter causing the failure can be identified in table 7−1. The offline channel is configured for troubleshooting per instructions referenced in table 7−1 and troubleshooting initiated. Troubleshooting is accomplished using the data referenced in table 7−1 and test equipment. After troubleshooting is complete, and the fault is corrected, FIT and checkout procedures are performed to check for faults. When no faults are found, the interrogator can be configured to standby and the maintenance action is complete.

7.1.2 IATCRBS Mode Corrective Maintenance

When operating in the Independent ATCRBS mode, the normal fault detection routines are not performed. Only key interrogator performance parameters including primary and auxiliary transmitter power levels, primary and auxiliary transmitter VSWR levels, and interrogator temperature sensors are monitored. The status of these parameters are displayed on the local and remote terminal status lines and can also be displayed on the KCRT. When a fault occurs, channels can be switched manually from the KCRT (connected to the standby interrogator). FIT can then be initiated and run at the KCRT (connected to the failed interrogator). The FIT program run from the KCRT is identical to the one run in the normal Mode S mode; but the FIT results display differs. Refer to Appendix B of TI 6365.5 for instructions on how to run FIT from the KCRT and for a description of the FIT display. Once FIT has completed, corrective maintenance is performed in the same manner as in the normal Mode S mode.

7.2 FAULT INDICATORS

This paragraph describes the fault indicators (data points or alarms) that may be displayed whenever a fault in transmitter operation is isolated by FIT. Table 7−1 lists the fault indicators, with troubleshooting information and references to fault isolation procedures (as applicable) that follow. The data points are listed in numerical order, with the other fault indicators (if any) following. Also listed with each fault indicator is the failing test number(s) in hexadecimal, the test description paragraph, a signal flow diagram reference, the circuit indicating a failure, fault analysis procedure reference, and any other pertinent information.

TABLE 7–1. TRANSMITTER FAULT INDICATORS

Alarm Display/ (LRU)	FI Test			FIT Tree Fig 7–2, SH	SFD Fig 7–1, SH	Comments
	Number (Hex)	Status	Para 2.3.5			
20 (*A7) –and– 36 (*A4A113) –and– 2A (*A3)	0100 –and– 0101 thru 0103 –and– 0106	Failed Passed Failed	.2.1 .2.2 thru .2.4 .2.6	55	8, 9	Test 0100_H detected a bit set in the transmitter go no/go status register. The primary modulator/driver and power amplifier tests (0101_H–0103_H) passed. Test 0106_H detected the auxiliary modulator/driver protection status bit set (ET/AXDRFT+/– = 1). If fault remains after replacing suspect LRUs, manually check auxiliary modulator/driver output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/AXDRFT+/– signal path between modulator/driver A7 and video processor/monitor A3.
20 (*A7) –and– 2A (*A3)	0100 –and– 0101 thru 0103 –and– 0106 –and– 0104	Failed Passed Passed Failed	.2.1 .2.2 thru .2.4 .2.6 .2.5	55	8, 9	Test 0100_H detected a bit set in the transmitter go no/go status register. The primary modulator/driver and power amplifier tests (0101_H–0103_H) passed. Test 0106_H passed indicating the auxiliary modulator/driver protection status bit is not set (ET/AXDRFT+/– = 0). Test 0104_H detected the auxiliary modulator/driver power output status bit set (ET/AXMDFT+/– = 1). If fault remains after replacing suspect LRUs, manually check auxiliary modulator/driver output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/AXMDFT+/– signal path between modulator/driver A7 and video processor/monitor A3.
21 (*A8) –and– 36 (*A4A113) –and– 2A (*A3)	0100 0103	Failed Failed	.2.1 .2.4	55	2, 3	Test 0100_H detected a bit set in the transmitter go no/go status register. Test 0103_H detected the primary modulator/driver protection status bit set (ET/PRDRFT+/– = 1). If fault remains after replacing suspect LRUs, manually check primary modulator output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/PRDRFT+/– signal path between modulator/driver A8 and video processor/monitor A3.

TABLE 7–1. TRANSMITTER FAULT INDICATORS (Continued)

Alarm Display/ (LRU)	FI Test			FIT Tree Fig 7–2, SH	SFD Fig 7–1, SH	Comments
	Number (Hex)	Status	Para 2.3.5			
21 (*A8) –and– 2A (*A3)	0100 0103 0101	Failed Passed Failed	.2.1 .2.4 .2.2	55	2, 3	Test 0100_H detected a bit set in the transmitter go no/go status register. Test 0103_H passed indicating the primary modulator/driver protection status bit is not set (ET/PRDRFT+/– = 0). Test 0101_H detected the primary modulator/driver power output status bit set (ET/PRMDFT+/– = 1). If fault remains after replacing suspect LRUs, manually check primary modulator output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/PRMDFT+/– signal path between modulator/driver A8 and video processor/monitor A3.
22 (*A16) –and– 2A (*A3)	0100 0103 0101 0102	Failed Passed Passed Failed	.2.1 .2.4 .2.2 .2.3	55	4, 5, 6	Test 0100_H detected a bit set in the transmitter go no/go status register. Tests 0101_H and 0103_H passed indicating there are no faults in primary modulator/driver. Test 0102_H detected a primary power amplifier status bit set (ET/PRPAFT+/– = 1). If fault remains after replacing suspect LRUs, manually check primary power amplifier output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/PRPAFT+/– signal path between power amplifier A16 and video processor/monitor A3.
23 (*A13) –and– 2A (*A3)	0100 –and– 0101 thru 0104 –and– 0106	Failed Passed Passed	.2.1 .2.2 thru .2.5 .2.6	55	6, 10, 11	Test 0100_H detected a bit set in the transmitter go no/go status register. The primary modulator/driver and power amplifier tests (0101_H–0103_H) passed. Test 0104_H and 0106_H passed indicating there are no faults in auxiliary modulator/driver, therefore the auxiliary power amplifier status bit must be set (ET/AXPAFT+/– = 1). If fault remains after replacing suspect LRUs, manually check auxiliary power amplifier output power and waveform per paragraph 7.3.5. If output power and waveform are correct, check ET/AXPAFT+/– signal path between power amplifier A13 and video processor/monitor A3.

TABLE 7–1. TRANSMITTER FAULT INDICATORS (Continued)

Alarm Display/ (LRU)	FI Test			FIT Tree Fig 7–2, SH	SFD Fig 7–1, SH	Comments
	Number (Hex)	Status	Para 2.3.5			
24 (*A10) –and– 35 (*A4A111)	0100 –and– 0203 thru 0205 –and– 0209 –and– 0206 –or– 0207 –or– 0208	Passed Passed Passed Failed Failed Failed	.2.1 .2.7 thru .2.9 .2.13 .2.10 .2.11 .2.12	55, 56, 57	12	At least one, but not all three, of the auxiliary transmitter power level tests failed. Test 0100_H passed indicating that no failures were detected in the auxiliary modulator/ driver or power amplifier. Because at least one auxiliary power level test passed, the monitoring path through the omni diplexer and RFTTG is assumed good. The fault is assumed to be in the output level control or the control signals going to it. If fault remains after replacing suspect LRUs, check the following signal paths between timing and expansion board A4A111 and auxiliary output level control A10: TE/ATPRA1+/– TE/ATPRA2+/– TE/LOPRA1+/– TE/LOPRA2+/– TE/HIPRA1+/– TE/HIPRA2+/–
25 (*A11) –and– 35 (*A4A111)	0100 –and– 0203 –or– 0204 –or– 0205	Passed Failed Failed Failed	.2.1 .2.7 .2.8 .2.9	55, 56	7	At least one, but not all three, of the primary transmitter power level tests failed. Test 0100_H passed indicating that no failures were detected in the primary modulator/ driver or power amplifier. Because at least one primary power level test passed, the monitoring path through the monopulse diplexer and RFTTG is assumed good. The fault is assumed to be in the output level control or the control signals going to it.

TABLE 7–1. TRANSMITTER FAULT INDICATORS (Continued)

Alarm Display/ (LRU)	FI Test			FIT Tree Fig 7–2, SH	SFD Fig 7–1, SH	Comments
	Number (Hex)	Status	Para 2.3.5			
25 (*A11) –and– 35 (*A4A111) Continued						If fault remains after replacing suspect LRUs, check the following signal paths between timing and expansion board A4A111 and primary output level control A11: TE/ATPRP1+/– TE/ATPRP2+/– TE/LOPRP1+/– TE/LOPRP2+/– TE/HIPRP1+/– TE/HIPRP2+/–
2B (*A14) –and– 41 (*A19) –and– 25 (*A11)	0100 0203 0204 0205	Passed Failed Failed Failed	.2.1 .2.7 .2.8 .2.9	55, 56	2, thru 7	The transmitter status test 0100_H passed but the primary transmitter output power falls below the RED alarm threshold for all three power levels (ATCRBS, Mode S high, and Mode S low). If fault remains after replacing suspect LRUs, perform power detector calibration per paragraph 7.5.7 in TI 6365.7. If unable to obtain the expected primary transmitter ATCRBS power level, manually check primary transmitter per paragraph 7.3.5.
2B (*A14) –and– 40 (*A6) –and– 24 (*A10)	0100 0203 thru 0205 0209 0206 0207 0208	Passed Passed Passed Failed Failed Failed	.2.1 .2.7 thru .2.9 .2.13 .2.10 .2.11 .2.12	55, 56, 57	6, 8 thru 12	The transmitter status test 0100_H passed but the auxiliary transmitter output power falls below the RED alarm threshold for all three power levels (ATCRBS, Mode S high, and Mode S low). If fault remains after replacing suspect LRUs, perform power detector calibration per paragraph 7.5.7 in TI 6365.7. If unable to obtain the expected auxiliary transmitter ATCRBS power level, manually check auxiliary transmitter per paragraph 7.3.5.

TABLE 7–1. TRANSMITTER FAULT INDICATORS (Continued)

Alarm Display/ (LRU)	FI Test Number (Hex)	FI Test Status	FI Test Para 2.3.5	FIT Tree Fig 7–2, SH	SFD Fig 7–1, SH	Comments
2B (*A14) –and– 41 (*A19)	0209	Failed	.2.13	56	—	NOTE Refer to TI 6365.7, Fig. 7–1, sh 2, 13, 14. High primary reverse power level. If fault remains after replacing both LRUs, possible RF cable, rotary joint, or antenna problem. Perform sigma and delta RF phase alignment per paragraph 7.5.2 in TI 6365.7. If unable to obtain the expected results, refer to paragraph 7.3.6 in TI 6365.7 for troubleshooting instructions.
2B (*A14) –and– 40 (*A6)	020A	Failed	.2.14	57	—	NOTE Refer to TI 6365.7, Fig. 7–1, sh 2, 13, 14. High auxiliary reverse power level. If fault remains after replacing both LRUs, possible RF cable, rotary joint, or antenna problem. Perform sigma and delta RF phase alignment per paragraph 7.5.2 in TI 6365.7. If unable to obtain the expected results, refer to paragraph 7.3.6 in TI 6365.7 for troubleshooting instructions.

* Prefix LRU designation with 2, 3, or 8 for interrogator A, B or C, respectively.

7.3 FAULT ANALYSIS PROCEDURES

Fault analysis of transmitter faults requires the monitoring of signals while the equipment is operating. Procedures are included to configure system operation for troubleshooting. Signal analysis and monitoring is performed using test equipment, the signal flow diagram (figure 7–1, in section 11), the FIT tree (figure 7–2), and wiring data. If desired, various parameters can be monitored using the local terminal. The following paragraphs describe information available for use during transmitter fault analysis and provide procedures for analyzing transmitter faults.

7.3.1 Signal Flow Diagram

The transmitter signal flow diagram (overall) is shown in figure 7–1 (in section 11) and consists of 12 sheets as follows:

Sheet 1 is an overall block diagram of the transmitter and includes the sheet number or instruction book reference for detailed information

Sheets 2 and 3 show primary modulator/driver A8 circuits

Sheets 4 and 5 show primary power amplifier A16 circuits

Sheet 6 shows primary A15 and auxiliary A12 capacitor bank circuits

Sheet 7 shows primary output level control A11 circuits

Sheets 8 and 9 show auxiliary modulator/driver A7 circuits

Sheets 10 and 11 show auxiliary power amplifier A13 circuits

Sheet 12 shows auxiliary output level control A10 circuits.

7.3.2 Interrogator FIT Tree

Figure 7–2 shows the transmitter portion of the interrogator FIT tree. The FIT tree shows all tests performed by the FIT program in the order the tests are performed. Tests are identified by hexadecimal numbers that can be used to locate descriptive information in the instruction book. The tests used for the transmitter start on sheet 55. The complete FIT tree is in Section 7 of TI 6365.5, Mode S Sensor, Interrogator Equipment Instruction Book. All tests listed prior to the start of the transmitter FIT must pass before transmitter FIT can begin. By following the FIT tree, the analysis performed by FIT to isolate a fault can be understood.

7.3.3 Wiring Data

Wiring data is used to locate accessible monitoring points for signal tracing, and to locate and correct wiring faults. Various connector pins that carry signals of interest are not accessible at the LRU. The signal flow diagram and wiring data is used to locate an accessible point. The wiring data is described in paragraph 7.5.

7.3.4 Parameter Monitoring

The fault detect tests use various pass/fail thresholds to check equipment operation. These parameters are called interrogator conditions parameters and can be monitored at the local terminal. The transmitter part of the interrogator conditions parameters display contains thresholds used while the fault detection routine is testing transmitter operation. The proper threshold values can be determined from the installation and checkout documents for the site.

NOTE: ALL PREVIOUS TESTS HAVE PASSED. THIS PORTION OF THE FIT TREE IS FOR THE TRANSMITTER ONLY. FOR THE COMPLETE FIT TREE, SEE SECTION 7 OF TI 6365.5.

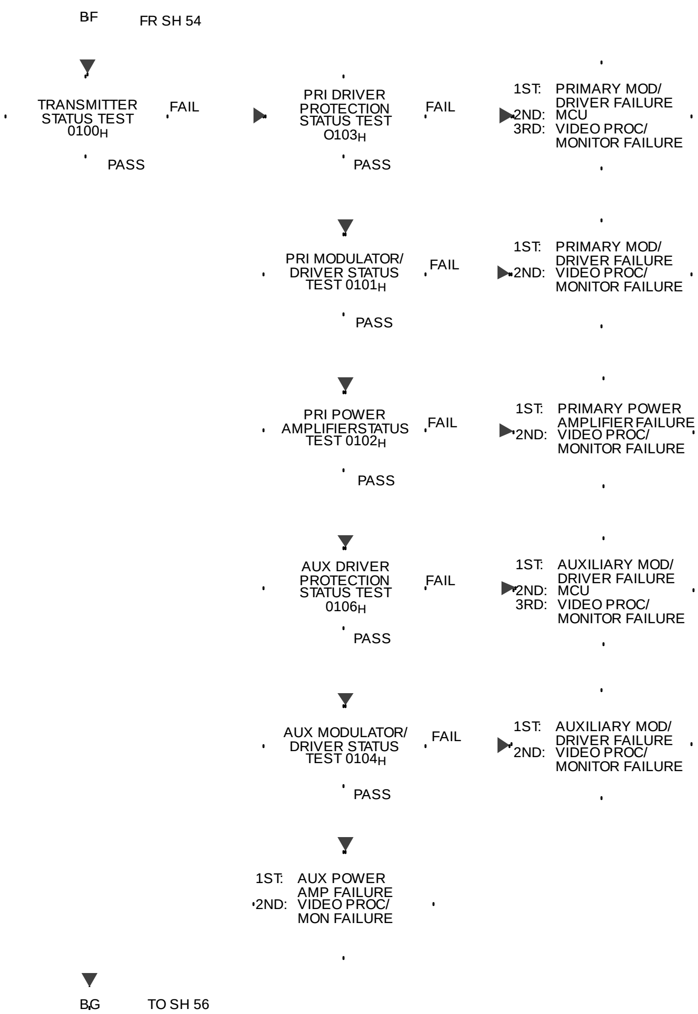


FIGURE 7–2. INTERROGATOR FIT TREE (SHEET 55)

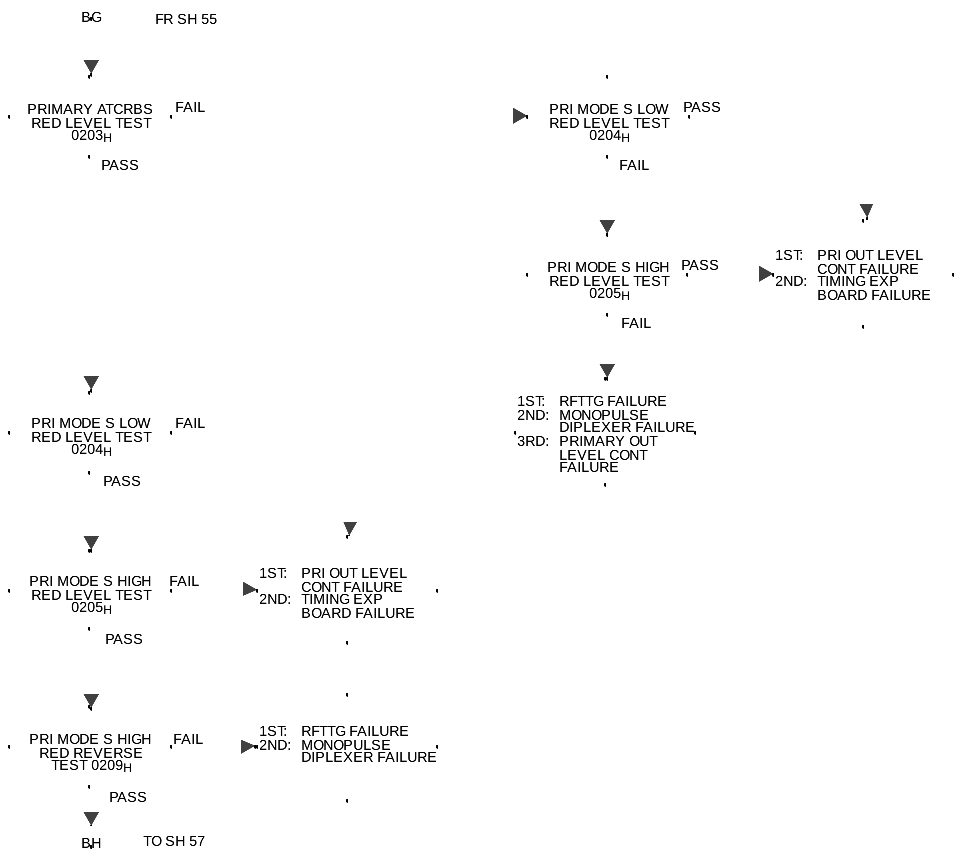


FIGURE 7–2. INTERROGATOR FIT TREE (SHEET 56)

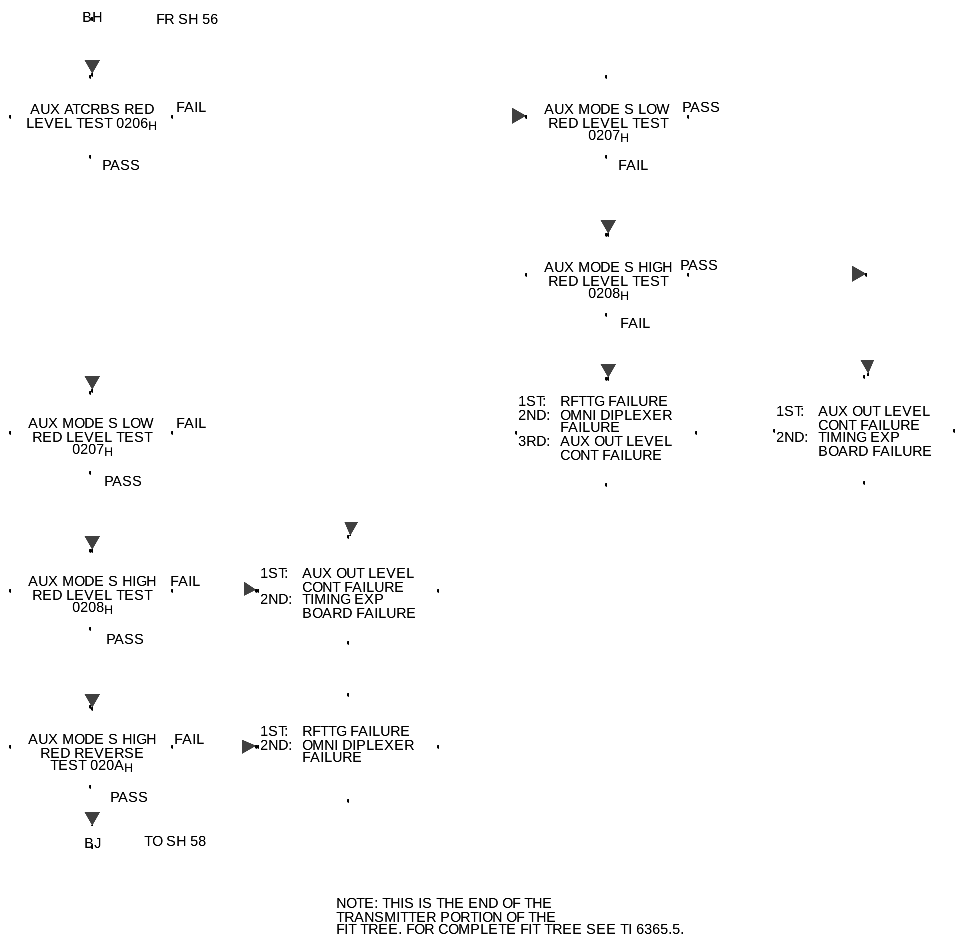


FIGURE 7–2. INTERROGATOR FIT TREE (SHEET 57)

7.3.5 Primary/Auxiliary Transmitter Manual Fault Detection Procedure

This procedure is used to manually check the output of each stage of the primary or auxiliary transmitter chain to help isolate faults that were not isolated by FIT. If FIT has not been able to isolate a fault, the fault probably exists in control signal lines, B+ voltage lines, or RF power coaxial cables. This procedure detects the transmitter stage that is failing, then references table 7–1A which provides instructions to isolate the fault to the failed item.

Prerequisite Procedures

None.

Tools and Test Equipment Required

KCRT Terminal, (dumb terminal or equivalent)
RS232 Signal Cable
Oscilloscope (Tektronix 2440)
Peak Power Meter (Wavetek 8501)
Digital Multimeter (DMM) (HP 3478)
Directional coupler, 30-dB (NARDA 3002–30)
Attenuator, 30-dB (High power) (Weinschel Model 49–30–33)
Attenuator, 20-dB (Low power) (HP 8491A020)
Crystal Detector (HP 423B)
SMA connector wrench, 5/16-inch (Omni-Spectra P/N–2098–5065–54)
SC/N connector wrench, 13/16-inch (Omni-Spectra P/N–2598–5026–54)
Test Cable, of known loss — (approximately 10 ft. long) with RG 214 coaxial cable with straight N male connector at one end and right angle N male connector at other end.
Adapter, straight, N male to male (Amphenol 82–100)
Adapter, N female to female (Amphenol 82–65)
Adapter, N female to SMA female (Amphenol 901–B2501–316)
Adapter, N female to SMA male (Amphenol 901–B2501–317)
Adapter, N female to SC male (Omni-Spectra 3082–5012–02)
Adapter, N female to SC female (Omni Spectra 3082–5007–00)
Adapter, T BNC, female-male-female (Amphenol 31–8))
Adapter, SMA female to male, right angle (Model 219)

Procedure

See figure 7–3, Auxiliary and Primary Modulator/Driver Output Power Test Setup.

WARNING

The transmitter generates high power RF. Use extreme care when making power measurements or when hooking up test equipment to prevent injury or loss of life.

CAUTION

To prevent interfering with online operations, obtain approval from the central maintenance facility before performing maintenance.

CAUTION

Do not overtighten connector hold down screws.

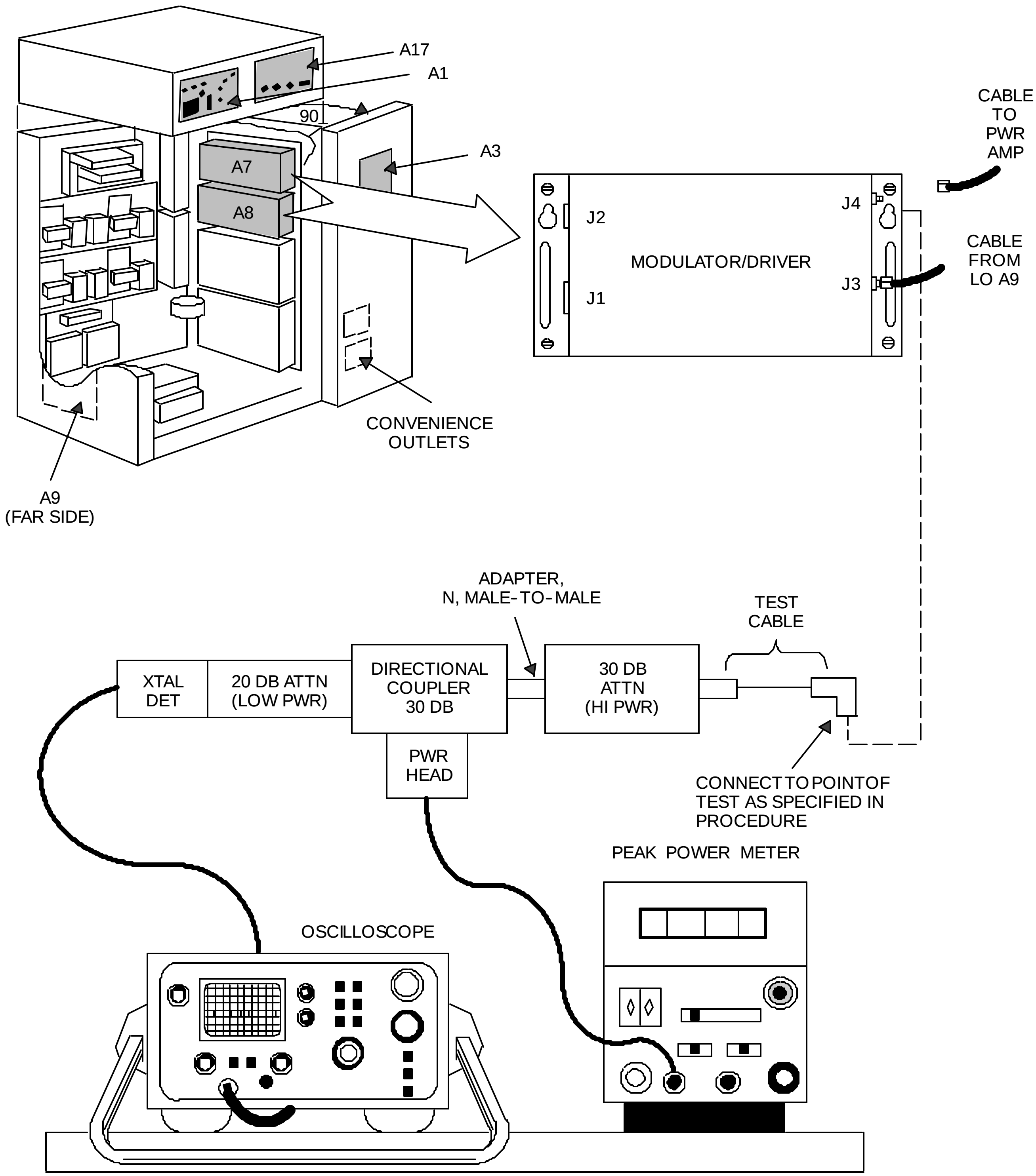


FIGURE 7–3. AUXILIARY AND PRIMARY MODULATOR/DRIVER OUTPUT POWER TEST SETUP

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION

Step	Procedure	Action	
		Yes	No
1	Are modulator/driver output power level and waveform correct?	Go to step 7.	Go to step 2.
2	Using N-female to SMA-female adapter, check modulator/driver cw RF input power level at cable connected to input J3 of modulator/driver. See figure 7–10 for test setup. Signal level should be +5.0 to +12.0 dBm.		
	S Is modulator/driver input power level correct?	Go to step 4.	Go to step 3.
3	Using N-female to SMA-male adapter and an SMA-right angle adapter, check level of cw RF signal at output of local oscillator (A9J5 for primary, A9J4 for auxiliary). Signal level should be +9.0 to +11.0 dBm.		
	S Is local oscillator output power level correct?	Replace cable W35 (pri) or W36 (aux)	Replace local oscillator.
4	Check PAM gating signal at output of signal processor as follows: a. Disable local oscillator by disconnecting connector P3 from A9A1J7. b. Disconnect oscilloscope from crystal detector. c. Disconnect W17P1 from A4J116 on back of signal processor. d. At KCRT (main menu), type: 7 <CR> to turn on standby ATC–BI transmissions. e. Using oscilloscope, check signal TM/–PAMPR+/– at A4J116–33/34 or check signal TE/–PAMAX+/– at A4J116–39/40. Pin 33 (or 39) should be negative going pulses, 0.8 microseconds wide. Pin 34 (or 40) should be positive pulses, 0.8 microseconds wide.		
	S Are PAM gating signals correct?	Go to step 5.	Replace timing and expansion board A4A111.

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action	
		Yes	No
5	Check modulator/driving gating signals as follows: a. Reconnect W17P1 to A4J116. b. Disconnect connector W17P6 from A8J2 for A8 or disconnect connector W17P7 from A7J2 for A7. c. Using oscilloscope, check signal TE/–PAMPR+/– at W17P6–6,2 for A8 or check signal TE–/PAMAX+/– at W17P7–6,2 for A7. Pin 6 should be a negative going pulse, 0.8 microseconds wide. Pin 2 should be a positive pulse, 0.8 microseconds wide. S Are PAM gating signals correct?	Go to step 6.	Wiring fault in cable W17.
6	Check modulator/driving DC input as follows: a. At KCRT, press <ESC> to turn off standby ATC–BI transmissions. b. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF. c. Reconnect connector W17P6 to A8J2 for A8 or reconnect connector W17P7 to A7J2 for A7. d. Disconnect connector P5 from A8J1 for A8 or disconnect connector P7 from A7J1 for A7. e. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to ON. f. Using DMM, check power supply voltages at connectors P5 (or P7) as follows: Voltage — P5/P7 Pins — Voltage Level +5V — 10 to 11(RTN) — +5V (4.75V to 5.25V) +15V — 07 to 22(RTN) — +15V (14.25V to 15.75V) +36V — 25 to 24(RTN) — +36V (34.2V to 37.8V) +52V — 09 to 20(RTN) — +52V (49.4V to 54.6V) –15V — 13 to 21(RTN) — –15V (–14.25V to –15.75V) S Are DC inputs correct?	Replace modulator/ driver.	Check associated power supplies and wiring.

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action	
		Yes	No
7	Are power amplifier output power level and waveform correct?	Go to step 12.	Go to step 8.
8	Check power amplifier input power level as follows: a. At right angle end of 10-foot test cable, connect an N-female to SMA-female adapter. See figure 7–11. CAUTION The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur. b. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. c. On power amplifier, disconnect P1 from J1 and connect free end of test cable to P1 using N-female to SMA-female adapter. d. At KCRT, type: 7 <CR> to turn on standby ATC–BI transmissions. e. Observe power level on peak power meter. Power level should be 51.8 to 54.3 dBm (151 to 269 watts) minimum. S Was input power level correct?	Go to step 9.	Replace cable W44 (pri) or W46 (aux).
9	Check DC power supply inputs to power amplifier as follows: a. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF. b. Disconnect test cable from P1 and reconnect P1 to J1 on power amplifier. Tighten to preset value of connector torque wrench. c. Disable local oscillator by disconnecting connector P3 from A9A1J7 on local oscillator A9.		

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action: Yes	Action: No
9 cont.	d. At A16, disconnect P4 from A9J1 or at A13 disconnect P6 from A9J1. e. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to ON. f. Using DMM, check power supply voltages at connectors P4 or P6 as follows: <u>Voltage</u> — <u>Pins</u> — <u>Voltage Level</u> +5V — 04 to 13(RTN) — +5V (4.75V to 5.25V) +15V — 03 to 12(RTN) — +15V (14.25V to 15.75V) –15V — 02 to 05(RTN) — –15V (–14.25V to –15.75V) S Are DC inputs correct?	Go to step 10.	Check associated power supply and wiring.
10	Check capacitor bank outputs as follows: a. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF. b. At A16, reconnect P4 to A9J1 or at A13 connect P6 from A9J1. c. At A16, disconnect A15J2 from J3 or at A13 disconnect A12J2 from J3. d. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to ON. WARNING The +36V and +52V power supplies are high current supplies. Use extreme care when making voltage measurements to prevent personal injury. e. Using DMM, check voltages at following pins on A15J2 or A12J2. Voltage should be 35.3V to 36.7V for A15J2 and 50.0V to 54.0V for A12J2.		

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action	
		Yes	No
10 cont.	P2 Pins 01 to 12 (RTN) 03 to 14 (RTN) 02 to 13 (RTN) 04 to 15 (RTN) S Are capacitor bank outputs correct?	Replace power amplifier.	Go to step 11.
11	Check capacitor bank inputs as follows: a. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF. b. At A16, reconnect A15J2 to J3 or at A13 reconnect A12J2 to J3. c. At capacitor bank A15, disconnect P14 from J1 or at A12 disconnect P13 from J1. d. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to ON. e. Using DMM, check voltages at following pins on P14 or P13. Voltage should be 34.2V to 37.8V for P14 and 49.4V to 54.6V for P13. P13 Pins P14 Pins 01 to 06 (RTN) 01 to 06 (RTN) 02 to 07 (RTN) 02 to 07 (RTN) 03 to 08 (RTN) 04 to 09 (RTN) S Are capacitor bank inputs correct?	Replace capacitor bank.	Check associated power supply and wiring.
12	Are output level control output power level and waveform correct?	Go to step 16.	Go to step 13.

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

<table>
<tr><th rowspan="2">Step</th><th rowspan="2">Procedure</th><th colspan="2">Action</th></tr>
<tr><th>Yes</th><th>No</th></tr>
<tr><td>13</td><td>Check output level control input power as follows:

a. At right angle end of 10-foot test cable, connect an N-female to SC-female adapter. See figure 7–12.

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

b. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter.

CAUTION

In following steps, to prevent changes in electrical characteristics, do not bend semi-rigid coaxial cable. Loosen connector at opposite end of cable from end being removed. Then, loosen and remove other end by rotating cable slightly.

c. On output level control, disconnect P1 from AT2J1 and connect free end of test cable to P1 using an N-female to SC-female adapter. Torque connector at each end of cable to 13 to 15 inch-pounds.

d. At KCRT, type: 7 <CR> to turn on standby ATC–BI transmissions.

e. Observe power level on peak power meter. Power level should be 62.8 (1.91 kilowatts) minimum for primary channel or 68.9 dBm (7.76 kilowatts) minimum for auxiliary channel.

S Was input power level correct?</td><td>

Go to step 14.</td><td>

Replace cable W43 (pri) or W45 (aux).</td></tr>
</table>

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

<table>
<tr><th rowspan="2">Step</th><th rowspan="2">Procedure</th><th colspan="2">Action</th></tr>
<tr><th>Yes</th><th>No</th></tr>
<tr><td>14</td><td>See figure 7–13. Check DC power supply inputs to output level control as follows:

a. At KCRT, press <ESC> to turn off standby ATC–BI transmissions.

b. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.

CAUTION

In following steps, to prevent changes in electrical characteristics, do not bend semi-rigid coaxial cable. On semi-rigid coaxial cable, loosen connector at opposite end of cable test cable connection. Then, remove test cable from P1.

c. At output level control, disconnect test cable from P1 and reconnect P1 to AT2J1. Using 13/16 inch torque wrench, torque P1 to 13 to 15 inch-pounds. Torque connector at other end of cable to 13 to 15 inch-pounds.

d. On local oscillator A9, disconnect connector P3 from A9A1J7 to disable local oscillator output.

e. At output level control, disconnect connectors P8 from S1J4 and P9 from S2J4 (primary) or connectors P10 from S1J4 and P11 from S2J4 for A10 (auxiliary).

f. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to ON.

g. Using DMM, check power supply voltages at connector P8 (P10) and P9 (P11) as follows:

<table><tr><th>Voltage</th><th>Pins</th><th>Voltage Level</th></tr><tr><td>+5V</td><td>01 to 07(RTN)</td><td>+5V (4.75V to 5.25V)</td></tr><tr><td>+15V</td><td>02 to 06(RTN)</td><td>+15V (14.25V to 15.75V)</td></tr></table>
S Are DC inputs correct?</td><td>Go to step 15.</td><td>Check associated power supply and wiring.</td></tr>
</table>

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action	
		Yes	No
15	Check power level control signal path to output level control as follows: a. At cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF. b. On local oscillator A9, reconnect connector P3 to A9A1J7. c. At output level control, reconnect connectors P8 to S1J4 and P9 to S2J4 for A11 or reconnect connectors P10 to S1J4 and P11 to S2J4 for A10. d. Disconnect connectors P2 from S1J5 and P3 from S2J5 for A11 or disconnect connectors P4 from S1J5 and P5 from S2J5 for A10. e. Remove eight screws securing cover to signal processor back plane. f. See figure 7–13.1. Using DMM, at P2 and P3 or P4 and P5, check continuity from connectors back to timing and expansion board A4A111 at backplane as follows: From P2 / To XA111 / From P3 / To XA111 1 / A81 / 1 / B80 3 / A75 / 3 / A76 4 / A79 / 4 / C74 6 / B81 / 6 / C80 8 / B75 / 8 / B76 9 / B79 / 9 / C75 From P4 / To XA111 / From P5 / To XA111 1 / C76 / 1 / C78 3 / A73 / 3 / A74 4 / A77 / 4 / A78 6 / C77 / 6 / C79 8 / B73 / 8 / B74 9 / B77 / 9 / B78		

TABLE 7–1A. TRANSMITTER MANUAL FAULT ISOLATION (Continued)

Step	Procedure	Action	
		Yes	No
15 cont.	S Are all signal paths correct?	Replace output level control.	Repair wiring.
16	Transmitter chain is operational. If a transmitter output power level fault is still being reported by BIT/FIT, check transmit path for excessive power loss per paragraph 7.3.6.	N/A	N/A

1. Put failed interrogator into standby, disable automatic testing and prepare cabinet for maintenance as follows:

    a. At Local Terminal, ensure alternate channel is ACTIVE.

    b. At Local Terminal, disable automatic channel controls.

    c. Connect KCRT to failed interrogator per section 3 of TI 6365.5. Note that KCRT Main menu will not be displayed until the following two steps are performed.

    d. At Local Terminal, initialize failed channel.

    e. As soon as Main Menu appears on KCRT, type 7 <CR> to disable automatic testing.

    f. Open interrogator cabinet doors and swingout rack. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)

2. Turn on and set up test equipment as follows:

    a. Connect peak power meter to convenience outlet. Turn on power meter and allow to warm up.

    b. Connect oscilloscope to convenience outlet. Turn on the oscilloscope and allow to warm up. Set channel 1 input at 50 ohms. Set scope to sync on channel 2 input.

    c. On the interrogator cabinet signal monitor panel A17, connect a 50-ohm BNC T connector to TEST TRIG (J1) jack. Then connect a 50-ohm coaxial cable from one end of the T connector to trigger input on power meter. Connect a second 50-ohm coaxial cable from the other end of T connector to channel 2 input of oscilloscope.

    d. At power meter, perform the following:

        (1) Calibrate meter

        (2) Zero meter

        (3) Set trigger mode to external

        (4) Enter an offset equal to: calibrated coupler loss + 30 dB attenuator loss + calibrated test cable loss.

        (5) On power meter, set frequency at 1.030 GHz.

(6) Set trigger delay at 5.3 ms for primary transmitter or 7.3 ms for auxiliary transmitter.

3. Assemble transmitter power and waveform monitoring probe as follows:

   a. Connect straight end of 10-ft. calibrated test cable to 30-dB high power attenuator input port.

   b. Using an N male to male adapter, connect 30-dB directional coupler input port to 30-dB high power attenuator output port.

   c. Connect 20-dB low power attenuator to 30-dB directional coupler straight through output port.

   d. Connect crystal detector to 20-dB low power attenuator.

   e. Using a 50-ohm coaxial cable, connect oscilloscope channel 1 input to crystal detector.

   f. Connect power meter power head to 30-dB output port of the 30-dB directional coupler.

4. See figure 7–4, KCRT Standby ATC–BI Transmit Menus. Ensure KCRT control of standby ATC–BI transmissions as follows:

   a. At KCRT (starting with main menu displayed), type the following:

      6 <CR> to call up Mode S Calibration Menu

      7 <CR> to turn on standby ATC–BI transmissions

   b. On oscilloscope, display both channel 1 and channel 2 inputs. Observe that a 38 microsecond (approximate) test trigger is present on channel 2.

   c. At KCRT, press <ESC> to turn off ATC–BI transmissions.

   d. On oscilloscope, observe that the test trigger is no longer present indicating that standby ATC–BI transmissions have been turn off.

5. To check modulator/driver output power/waveform, perform the following:

   a. See figure 7–3. At right angle end of 10-foot test cable, connect an N female to SMA male adapter followed by an SMA male to female, right angle adapter.

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

   b. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. If the trigger is present, repeat step 4.

   c. On modulator/driver, disconnect plug P2 from J4 and connect free end of test cable to J4.

   d. At KCRT (starting with Calibration Submenu displayed), type: 7 <CR> to turn on standby ATC–BI transmissions.

```
                         MODE S MAIN MENU
'$' to abort, <esc> to redisplay menu. *** AUTO TESTING SUSPENDED ***
1.  GENERATE ATCRBS DIGITAL TARGET(S)
2.  GENERATE MODE S DIGITAL TARGET(S)
3.  GENERATE ATCRBS RF/IF TARGET(S)
4.  GENERATE MODE S RF/IF TARGET(S)
5.  TTG MEMORY TEST
6.  CALIBRATION SUB MENU
7.  TOGGLE AUTOMATIC TESTING ON/OFF
8.  TOGGLE TERSE MENU ON/OFF
9.  LRU'S SUB MENU
SELECT ITEM NO ?
```

```
                      MODE S CALIBRATION MENU
'$' to abort, <esc> to redisplay menu. *** AUTO TESTING SUSPENDED ***
1.  GENERATE CONT. WAVE BORESIGHT
2.  GENERATE CONT. WAVE CROSSOVER
3.  COMPUTE PROBABILITY OF DETECTION FOR ATCRBS
4.  COMPUTE PROBABILITY OF DETECTION FOR AUX
5.  COMPUTE PROBABILITY OF DETECTION FOR MODE S
6.  PHASE DETECTOR ALIGNMENT (MONOPULSE VALUES)
7.  STANDBY ATC-BI TRANSMIT

SELECT ITEM NO ?
TRANSMITTING VIA INDEPENDENT ATCRBS BOARD . . .
PRESS <ESC> TO END, $ TO ABORT ?
```

FIGURE 7–4. KCRT STANDBY ATC–BI TRANSMIT MENUS

e. On peak power meter, observe modulator/driver peak RF output power. Peak power should be 52.0 to 54.5 dBm (220 **?** 61 watts).

f. On oscilloscope, observe detected pulse waveform. Waveform should appear as shown in figure 7–5, Modulator/Driver Detected RF Waveform.

OSCILLOSCOPE CONTROL SETTINGS:
HORIZONTAL — 100 NS
VERTICAL — 10 MV/DIV

WAVEFORM CHARACTERISTICS:
PULSE WIDTH = 800 **?** 50 NS
PULSE RISE TIME = 100 NS
PULSE AMPLITUDE = 30 **?** 10 MV

NOTE
PULSE SHAPE IS OF PRIMARY CONCERN.
PULSE AMPLITUDE IS NOT CRITICAL.

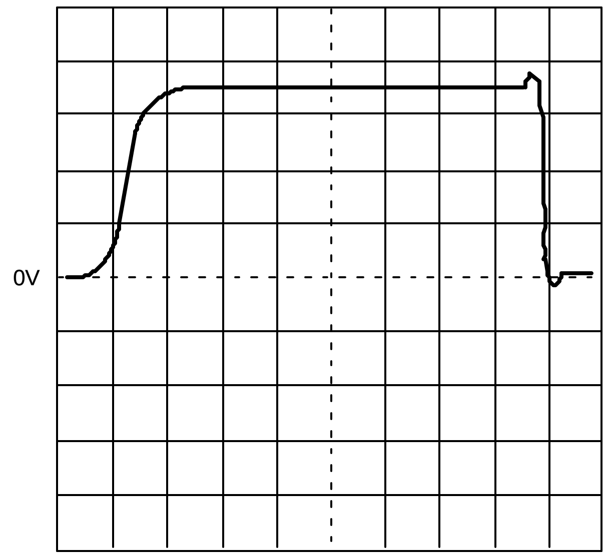


FIGURE 7–5. MODULATOR/DRIVER DETECTED RF WAVEFORM

g. At KCRT, press <ESC> to turn off ATC–BI transmissions.

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

h. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. If trigger is present, repeat step g.

i. At modulator/driver, disconnect test cable from J4. Connect P2 to J4 and using 5/16 inch torque wrench, torque from 7 to 9 inch-pounds.

j. If modulator/driver power level and waveform are correct, modulator/driver operation is good. Proceed to step 6 to check power amplifier output (if desired). If modulator/driver power level or waveform is bad, isolate failure per table 7–1A.

6. See figure 7–6, Auxiliary and Primary Power Amplifier Test Setup 1. To check power amplifier output power and waveform, perform the following:

a. At free end of 10-foot test cable, remove all adapters.

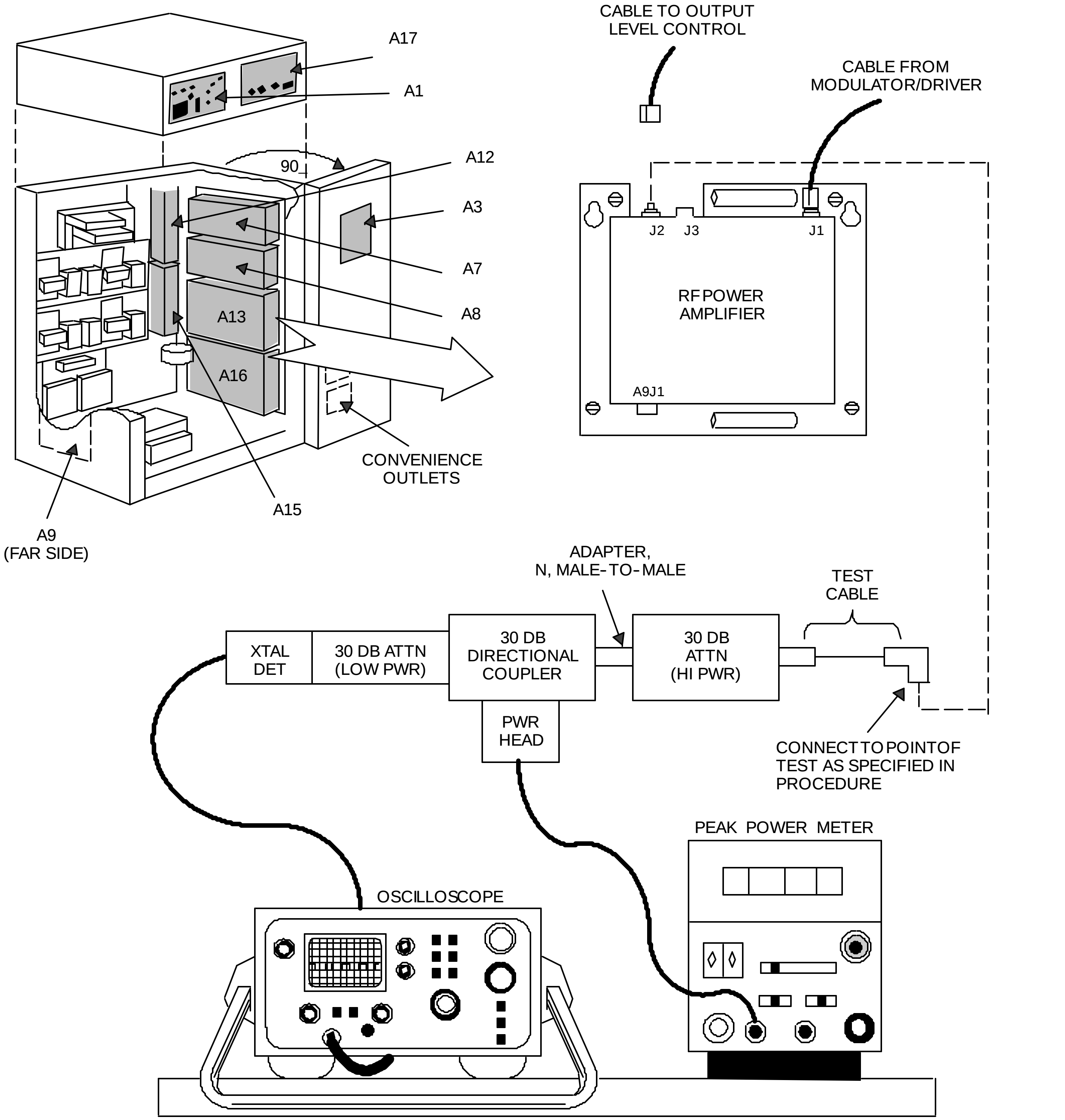


FIGURE 7–6. AUXILIARY AND PRIMARY POWER AMPLIFIER TEST SETUP 1

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

b. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. If the trigger is present, repeat step 5g.

CAUTION

In following steps, to prevent changes in electrical characteristics, do not bend semi-rigid coaxial cable. Loosen connector at opposite end of cable from end being removed. Then, loosen and remove other end by rotating cable slightly.

c. At power amplifier, disconnect plug P2 from J2 and connect an N female to SC male adapter to J2. Connect free end of test cable to the N female to SC male adapter. Torque connector to 13 to 15 inch-pounds.

d. At KCRT (with Calibration Submenu displayed), type: 7 <CR> to turn on standby ATC–BI transmissions.

e. On peak power meter, observe power amplifier RF peak power. For primary power amplifier, peak power should be 63.0 dBm (2.03 kilowatts) minimum. For auxiliary power amplifier, peak power should be 69.1 dBm (8.14 kilowatts) minimum.

f. On oscilloscope, observe detected pulse waveform. Waveform should appear as shown in figure 7–7, Power Amplifier Output Waveforms.

g. At KCRT, press <ESC> to turn off standby ATC–BI transmissions.

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

h. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. If trigger is present, repeat step g.

i. At power amplifier, disconnect test cable from adapter. Disconnect adapter from J2. Connect connector P2 to J2 and using 13/16 inch torque wrench, torque to 13 to 15 inch-pounds. Torque connector at other end of cable to 13 to 15 inch-pounds.

j. If power amplifier output power level and waveform are correct, power amplifier operation is good. Proceed to step 7 to check output level control (if desired). If power amplifier power level or waveform is bad, isolate fault per table 7–1A.

7. See figure 7–8, Auxiliary and Primary Output Level Control Test Setup 1. To check output level control output power and waveform, perform the following:

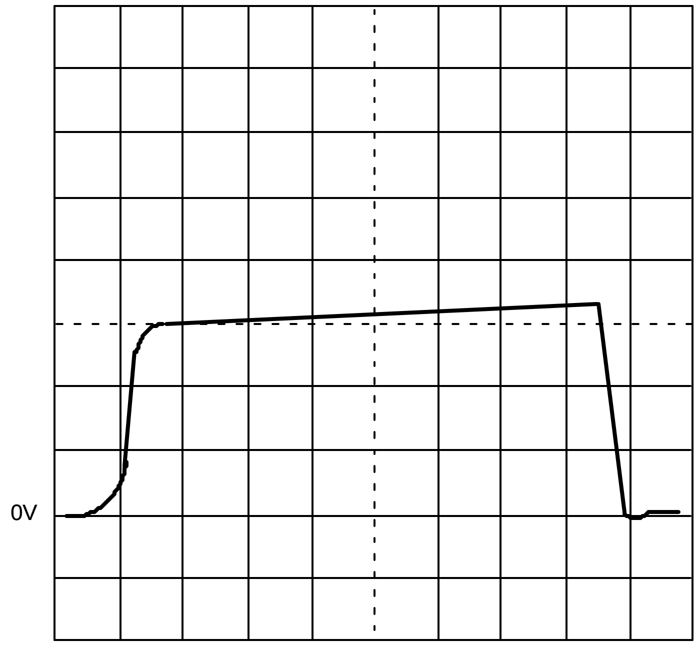
a. At free end of test cable, connect N female to SC male adapter.

OSCILLOSCOPE CONTROL SETTINGS:
HORIZONTAL — 100 NS
VERTICAL — 50 MV/CM

WAVEFORM CHARACTERISTICS:
PULSE WIDTH = 800 **?** 50 NS
PULSE RISE TIME = 100 NS
PULSE AMPLITUDE = 150 **?** 40 MV

NOTE

PULSE SHAPE IS OF PRIMARY CONCERN.
PULSE AMPLITUDE IS NOT CRITICAL.



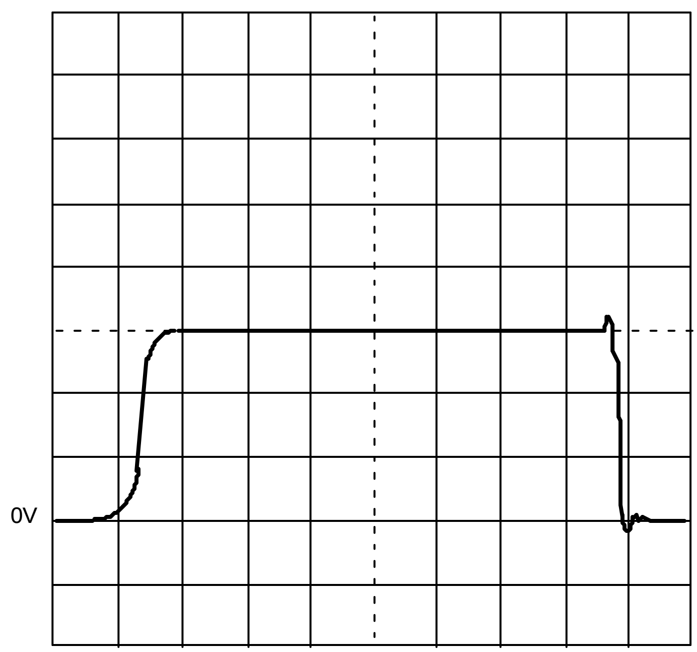
DETAIL A. PRIMARY POWER AMPLIFIER OUTPUT WAVEFORM

OSCILLOSCOPE CONTROL SETTINGS:
HORIZONTAL — 100 NS
VERTICAL — 100 MV/CM

WAVEFORM CHARACTERISTICS:
PULSE WIDTH = 800 **?** 50 NS
PULSE RISE TIME = 100 NS
PULSE AMPLITUDE = 300 **?** 50 MV

NOTE

PULSE SHAPE IS OF PRIMARY CONCERN.
PULSE AMPLITUDE IS NOT CRITICAL.



DETAIL B. AUXILIARY POWER AMPLIFIER OUTPUT WAVEFORM

FIGURE 7–7. POWER AMPLIFIER OUTPUT WAVEFORMS

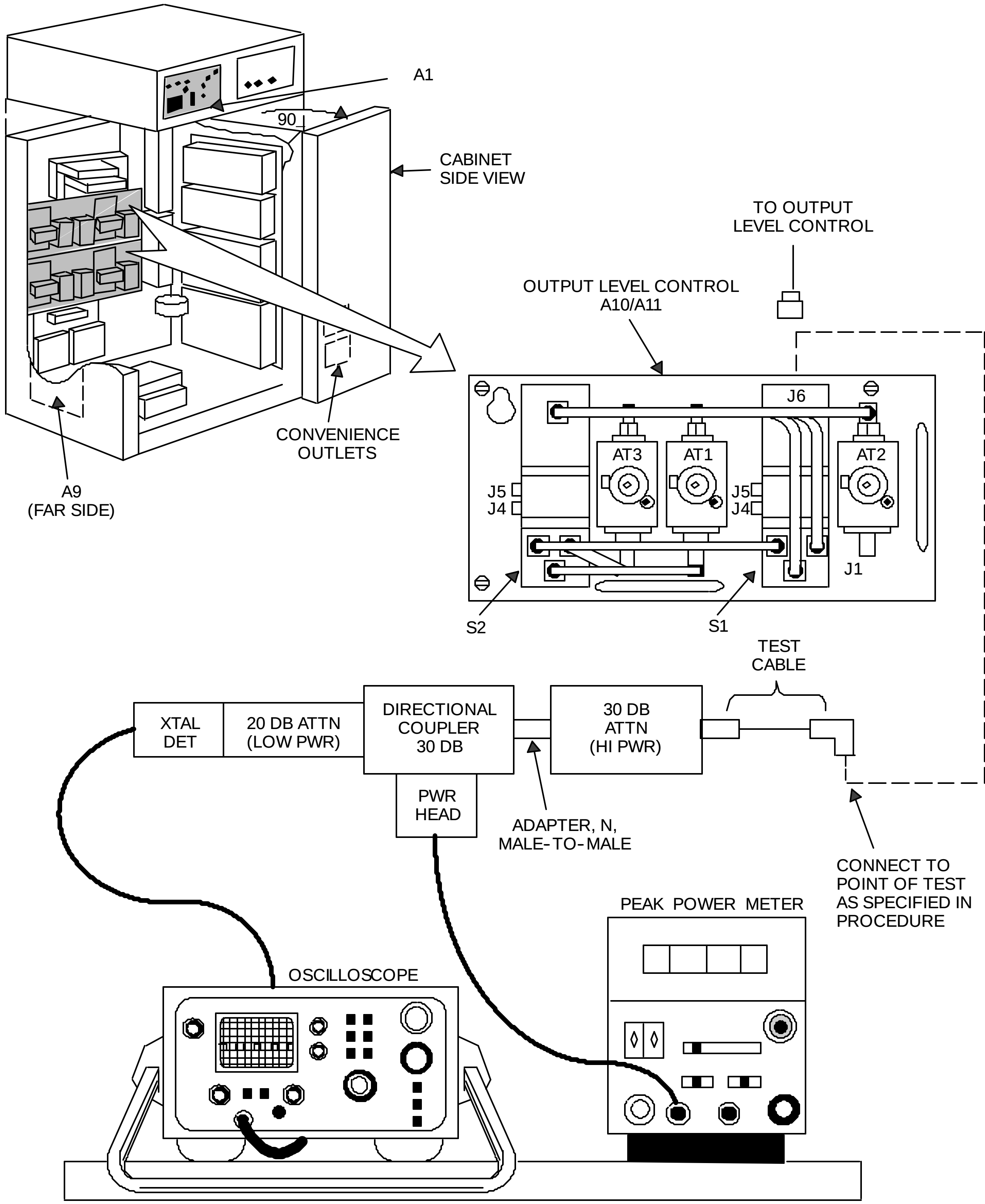


FIGURE 7–8. AUXILIARY AND PRIMARY OUTPUT LEVEL CONTROL TEST SETUP 1

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

b. On oscilloscope, observe that there is no test trigger to ensure that no gating signals are applied to the transmitter. If the trigger is present, repeat step 6g.

CAUTION

In following steps, to prevent changes in electrical characteristics, do not bend semi-rigid coaxial cable. Loosen connector at opposite end of cable from end being removed. Then, loosen and remove other end by rotating cable slightly.

c. At output level control, disconnect plug P2 from S1J6 and connect free end of test cable to S1J6. Torque connector to 13 to 15 inch-pounds.

d. At KCRT (with Calibration Submenu displayed), type: 7 <CR> to turn on standby ATC–BI transmissions.

e. On peak power meter, observe RF peak power at output of output level control. For primary output level control, output peak power should be a minimum of 61.3 dBm minus xx dBm where xx = the settings of AT2 and AT3 on the output level control. For auxiliary output level control, output peak power should be a minimum of 67.4 dBm minus xx dBm where xx = the settings of AT2 and AT3 on the output level control.

f. On oscilloscope, observe detected RF pulse. Waveform should appear as shown in figure 7–9, Output Level Control Output Waveforms.

g. At KCRT, press <ESC> to turn off standby ATC–BI transmissions.

WARNING

The following step must be performed to ensure that there is no RF energy applied to the transmitter before disconnecting RF cables. If RF cables are disconnected with RF energy applied, possible personal injury or damage to equipment may occur.

h. On oscilloscope, observe that there is no test trigger to ensure that no test targets are applied to the transmitter. If the trigger is present, repeat step g.

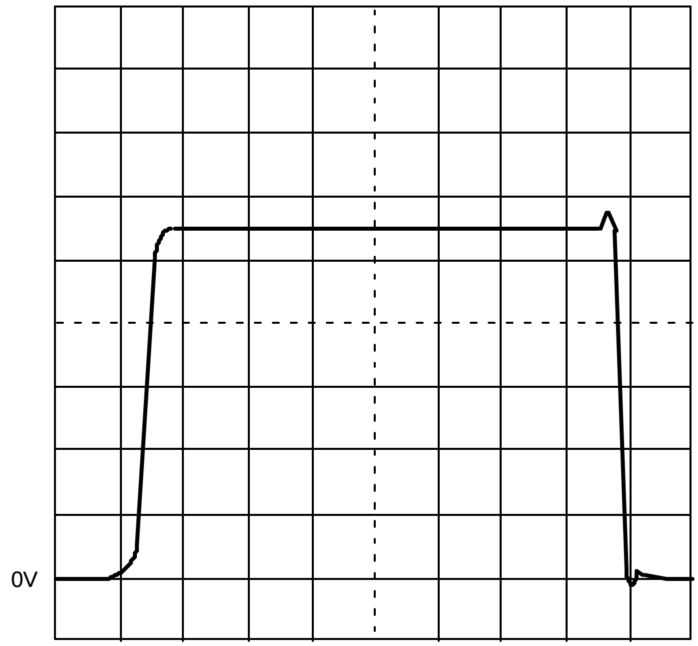
i. At output level control, disconnect test cable from S1J6 and reconnect plug P2 to S1J6. Using 13/16 inch torque wrench, torque P2 to 13 to 15 inch-pounds. Torque connector at other end of cable.

j. If power level and waveform are correct, modulator/driver, power amplifier, and output level control operation for the ATCRBS power level are good. If automatic testing still reports a transmitter power level failure, troubleshoot the transmit path per paragraph 7.3.6. If output level control power level or waveform is bad, isolate fault per table 7–1A.

OSCILLOSCOPE CONTROL SETTINGS:
HORIZONTAL — 100 NS
VERTICAL — 20 MV/CM

WAVEFORM CHARACTERISTICS:
PULSE WIDTH = 800 **?** 50 NS
PULSE RISE TIME = 100 NS
PULSE AMPLITUDE = 80 **?** 25 MV

NOTE
PULSE SHAPE IS OF PRIMARY CONCERN.
PULSE AMPLITUDE IS NOT CRITICAL.

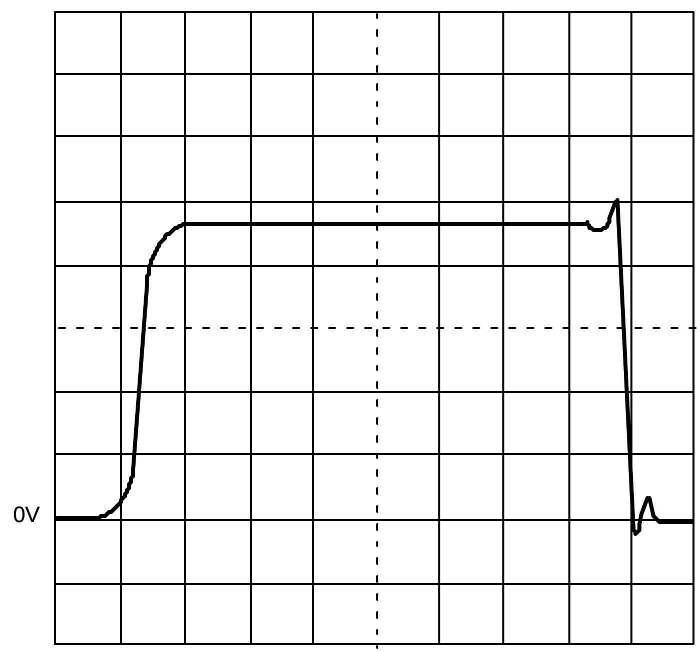


DETAIL A. PRIMARY OUTPUT LEVEL CONTROL INPUT WAVEFORM

OSCILLOSCOPE CONTROL SETTINGS:
HORIZONTAL — 100 NS
VERTICAL — 50 MV/CM

WAVEFORM CHARACTERISTICS:
PULSE WIDTH = 800 **?** 50 NS
PULSE RISE TIME = 100 NS
PULSE AMPLITUDE = 175 **?** 50 MV

NOTE
PULSE SHAPE IS OF PRIMARY CONCERN.
PULSE AMPLITUDE IS NOT CRITICAL.



DETAIL B. AUXILIARY OUTPUT LEVEL CONTROL INPUT WAVEFORM

FIGURE 7–9. OUTPUT LEVEL CONTROL OUTPUT WAVEFORMS

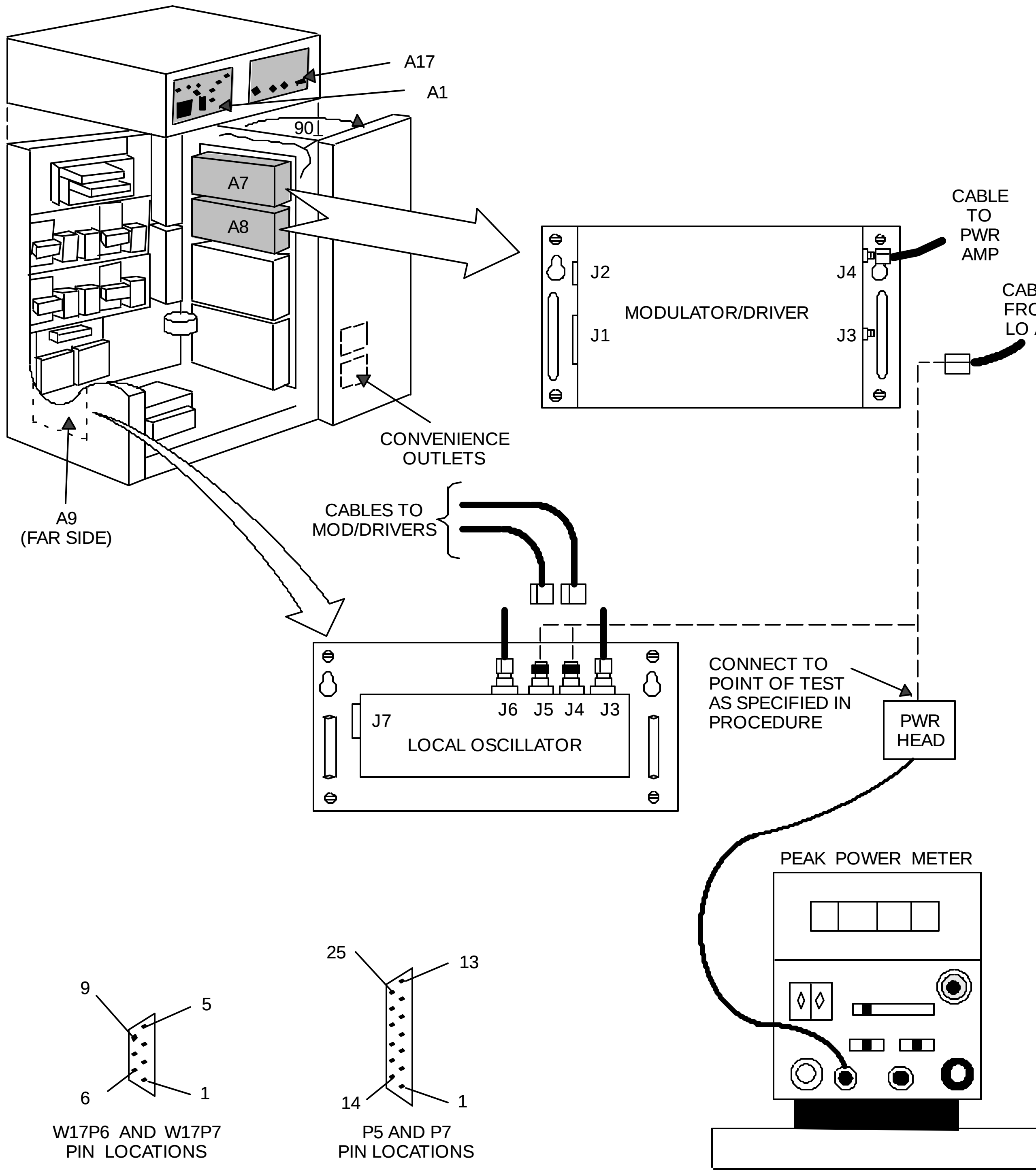


FIGURE 7–10. AUXILIARY AND PRIMARY MODULATOR/DRIVER INPUT POWER TEST SETUP

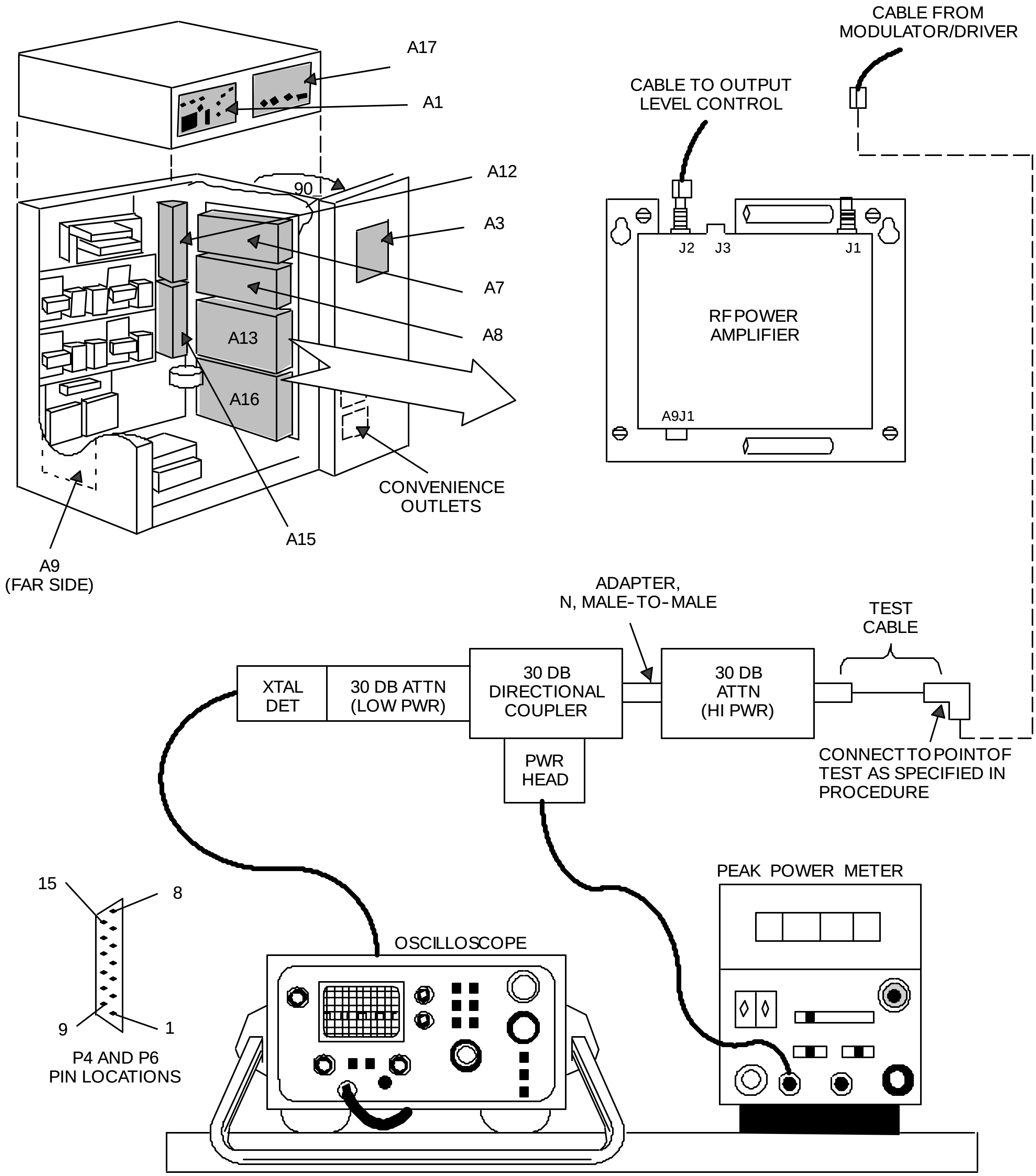


FIGURE 7–11. AUXILIARY AND PRIMARY POWER AMPLIFIER TEST SETUP 2

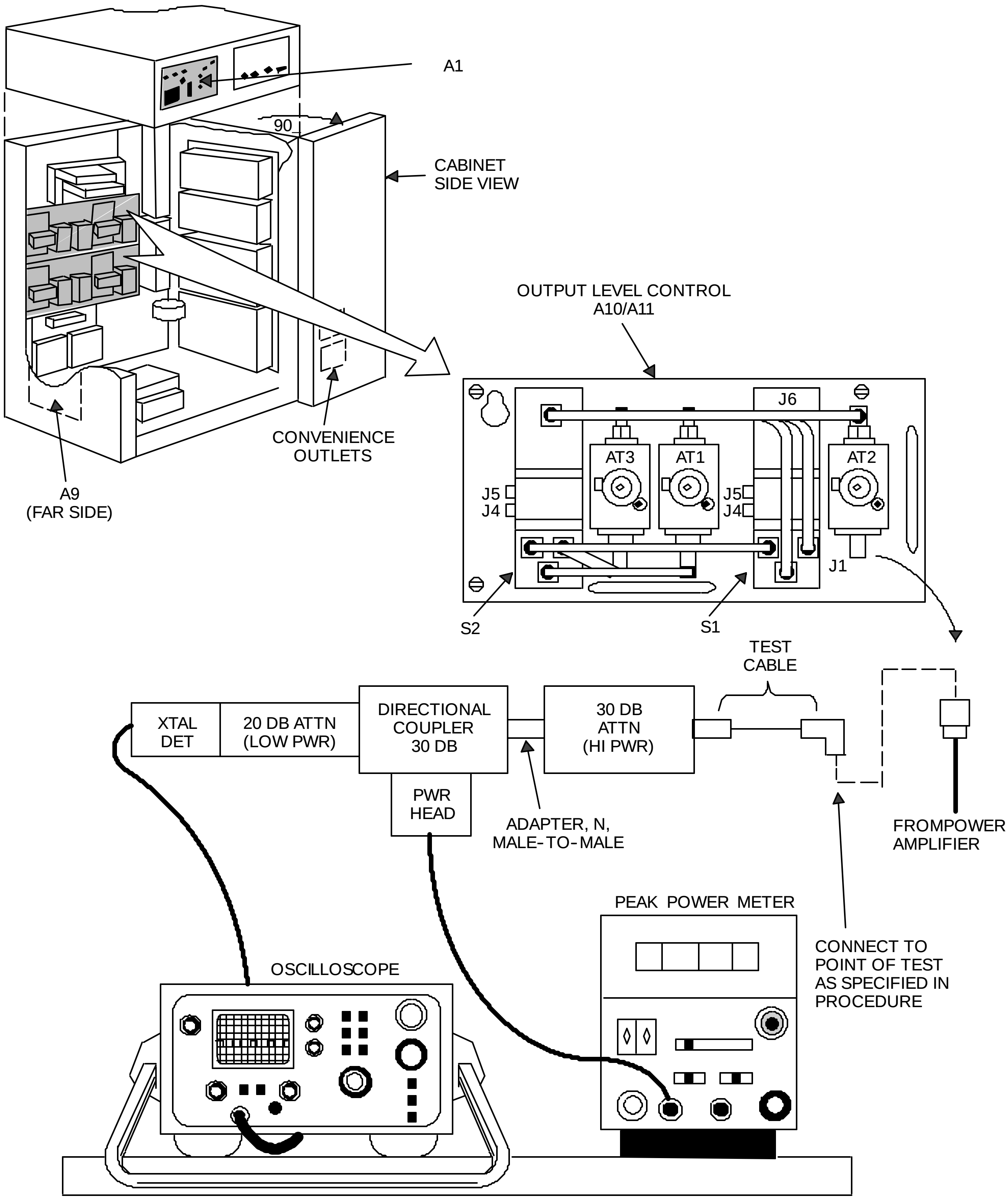


FIGURE 7–12. AUXILIARY AND PRIMARY OUTPUT LEVEL CONTROL TEST SETUP 1

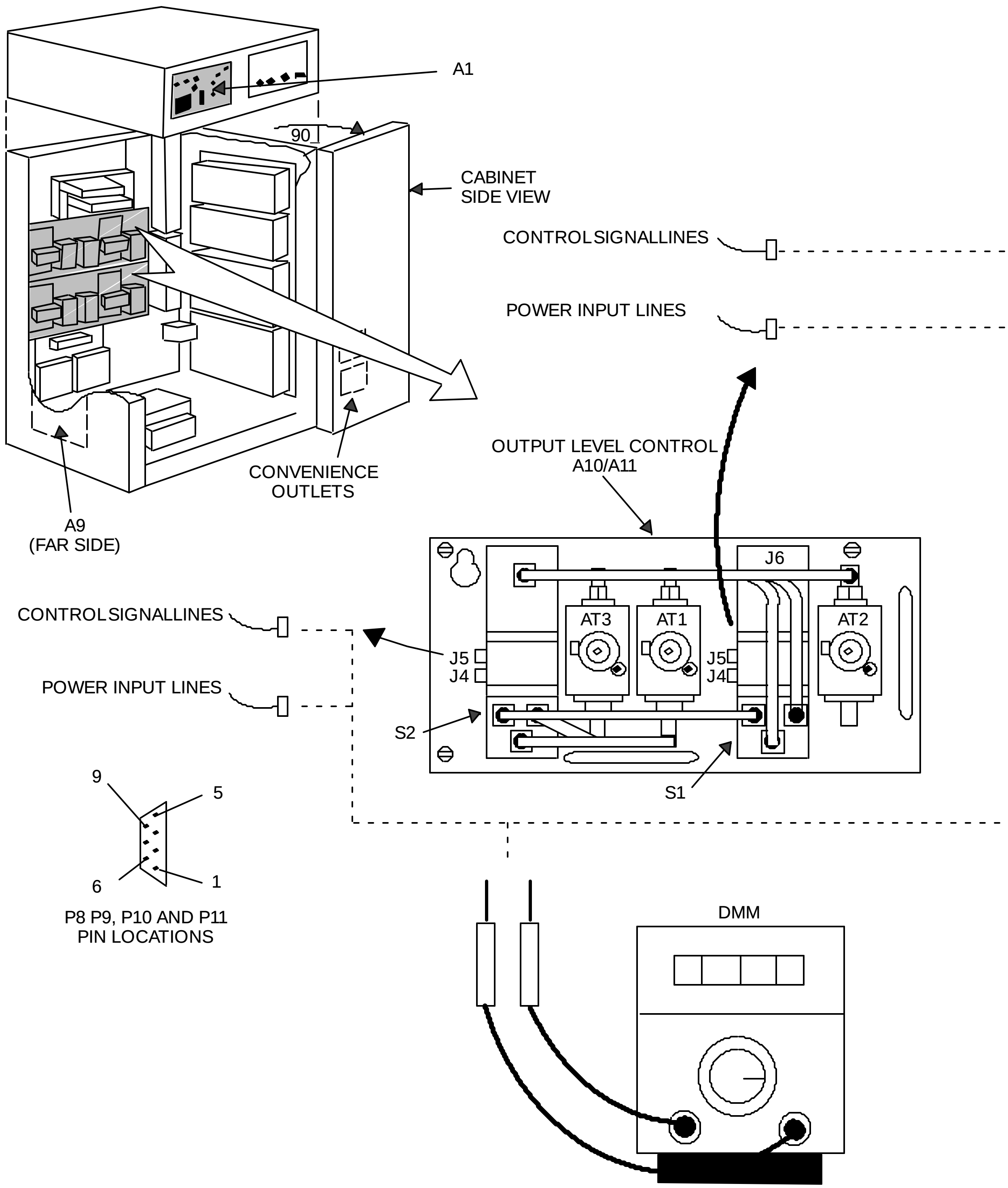


FIGURE 7–13. AUXILIARY AND PRIMARY OUTPUT LEVEL CONTROL TEST SETUP 2

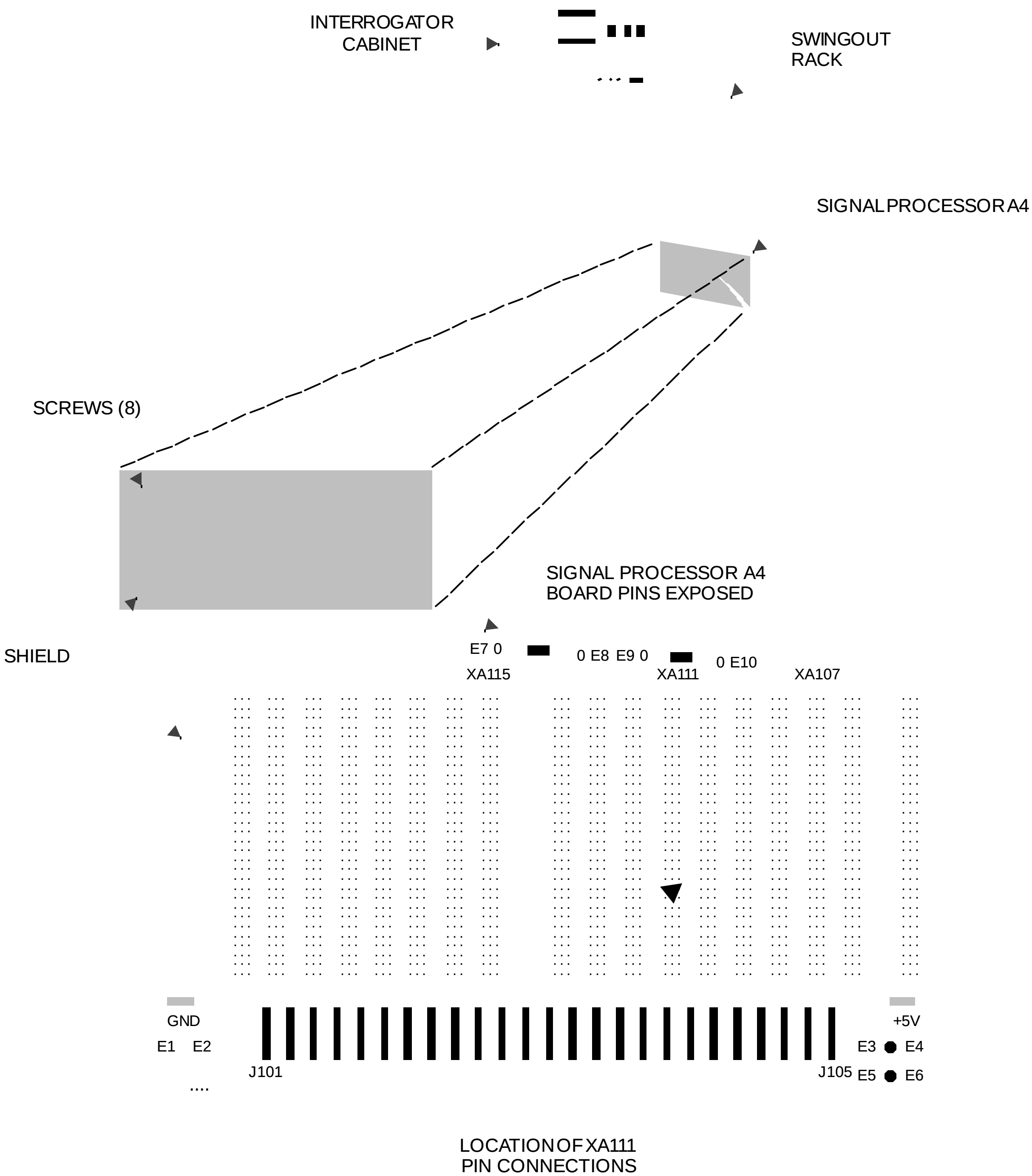


FIGURE 7–13.1. SIGNAL PROCESSOR BACKPLANE ACCESS DIAGRAM

8. After troubleshooting is complete, perform the following:

   a. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 and BRKR ALARM circuit breaker CB2 to OFF.

   b. If removed, replace signal processor backplane shield using 8 screws.

   c. Turn off, disconnect, and stow all test equipment.

   d. Ensure all operational cables have been reconnected.

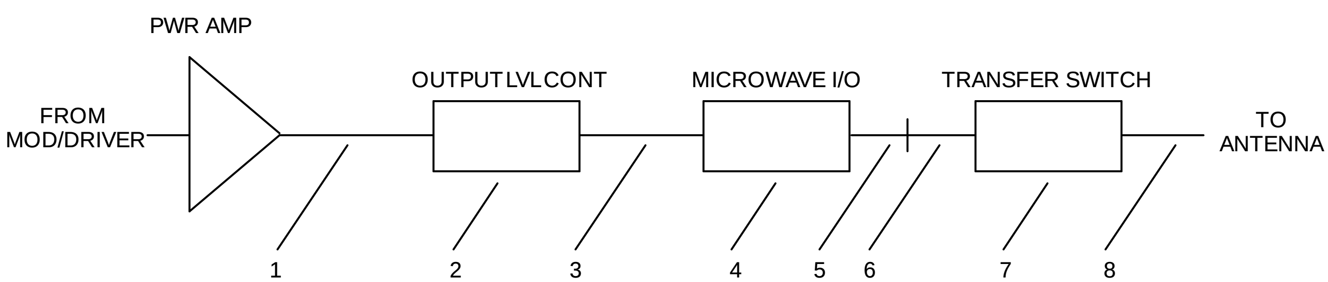
   e. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)

   f. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 and BRKR ALARM circuit breaker CB2 to ON.

   g. Perform interrogator channel checkout per section 6 of TI 6365.5.

7.3.6 Transmit Path Manual Troubleshooting Data

See figure 7–13.2. The following data provides RF insertion loss information for the inactive components in the transmit path from the power amplifier output to the output end of the 100 foot cable. This information is to be used to manually isolate faults to these various components. The figure provides an overview of the transmit path components with the insertion losses for components in the primary and auxiliary transmit paths. This is supplemental information to be used as necessary to troubleshoot the RF transmit path.



INDEX NO	COMPONENT/MAXIMUM INSERTION LOSS
1	CABLE W43 (PRIMARY CHANNEL): -0.21 DB CABLE W45 (AUXILIARY CHANNEL): -0.20 DB
2	OUTPUT LEVEL CONTROL A11 (PRIMARY CHANNEL): -1.5 DB OUTPUT LEVEL CONTROL A10 (AUXILIARY CHANNEL): -1.5 DB
3	CABLE W28 (PRIMARY CHANNEL): -0.23.DB CABLE W29 (AUXILIARY CHANNEL): -0.21 DB
4	MICROWAVE I/O A19 (PRIMARY CHANNEL): -0.8 DB MICROWAVE I/O A6 (AUXILIARY CHANNEL): -1.05 DB
5	CABLE W23 (PRIMARY CHANNEL): -0.22.DB CABLE W57 (AUXILIARY CHANNEL): -0.20 DB
6	CABLE W64 (PRIMARY CHANNEL): -0.26.DB CABLE W57 (AUXILIARY CHANNEL): -0.20 DB
7	TRANSFER SWITCH 9S3 (PRIMARY CHANNEL): -0.25.DB TRANSFER SWITCH 9S1 (AUXILIARY CHANNEL): -0.25 DB
8	100 FOOT CABLE (PRIMARY CHANNEL): -1.7.DB 100 FOOT CABLE (AUXILIARY CHANNEL): -1.7 DB

NOTES

1. TOTAL MAXIMUM LOSS IN PRIMARY CHANNEL, FROM POWER AMPLIFIER OUTPUT TO OUTPUT OF 100 FT CABLE IS 4.57 DB.
2. TOTAL MAXIMUM LOSS IN AUXILIARY CHANNEL, FROM POWER AMPLIFIER OUTPUT TO OUTPUT OF 100 FT CABLE IS 4.75 DB.
3. OUTPUT LEVEL CONTROL INSERTION LOSS MEASURED WITH ATTENUATORS AT1 THROUGH AT3 SET AT 0 DB.

FIGURE 7–13.2. TRANSMIT PATH OVERVIEW

7.4 REMOVAL AND INSTALLATION PROCEDURES

The following paragraphs provide the removal and installation procedures for the transmitter LRUs in reference designator order. Each removal procedure is followed by the installation procedure for each LRU. Equivalent tools and test equipment can be substituted for those identified in each procedure.

CAUTION

Do not overtighten hold down screws on connectors.

7.4.1 Auxiliary Modulator/Driver A7 and Primary Modulator/Driver A8 Removal

Use this procedure for both auxiliary modulator/driver A7 and primary modulator/driver A8.

Prerequisite Procedures

Obtain local control of Mode S sensor per section 3 of TI 6365.5.

Tools and Test Equipment Required

Screwdriver, flat tip, heavy-duty
Screwdriver, flat tip, light-duty, short
Wrench, open-end 5/16-inch

Removal Procedure

See figure 7–13.3, Auxiliary Modulator/Driver A7 and Primary Modulator/Driver A8 Removal and Installation Diagram.

WARNING

The modulator/driver weighs approximately 15 pounds. To prevent injury, use care when lifting unit into or out of the interrogator cabinet.

1. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.
2. At interrogator cabinet control panel A1, set BRKR ALARM circuit breaker CB2 to OFF to silence alarm.
3. Open doors to interrogator cabinet. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)
4. Swing out equipment rack to gain access to transmitter units.
5. Loosen two hold-down screws on electrical connector J1 (4); then, disconnect plug from connector J1 (4).
6. Disconnect RF cables from connectors J4 (2) and J3 (3).
7. At each corner of modulator/driver, loosen captive screws (5).

CAUTION

Connector J2 (1) remains connected to driver. Be careful when removing unit to avoid overstretching wires of connector J2.

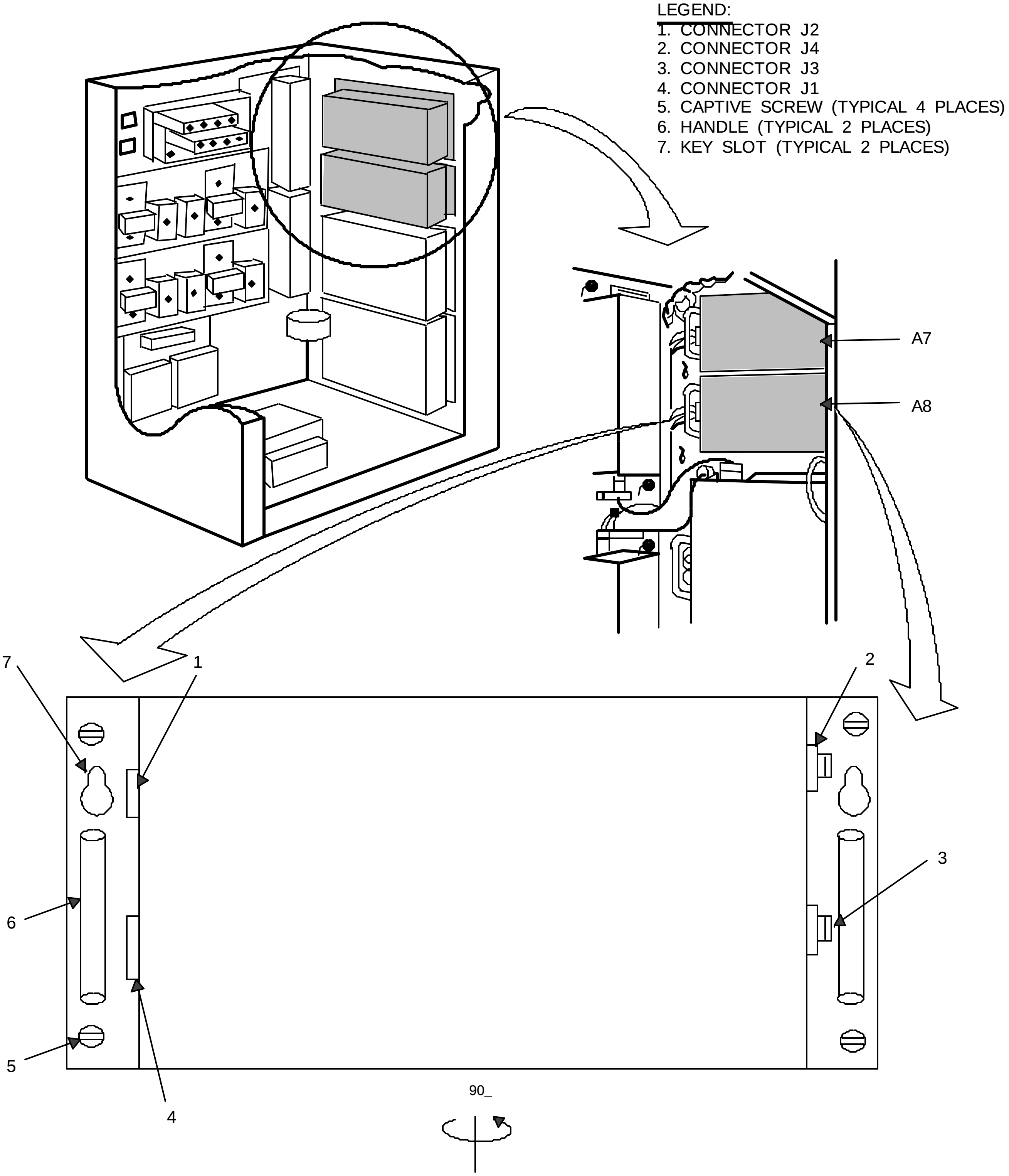


FIGURE 7–13.3. AUXILIARY MODULATOR/DRIVER A7 AND PRIMARY MODULATOR/DRIVER A8 REMOVAL AND INSTALLATION DIAGRAM

8. Grasp handles (6) and slide modulator/driver up until large holes in key slots (7) line up with mounting pins on cabinet wall.

9. Carefully pull modulator/driver away from mounting pins just far enough to allow access to connector J2 (1).

10. Hold unit in position so that connector J2 (1) can be disconnected without stretching attaching wires. Loosen two hold-down screws and disconnect connector J2 (1) from modulator/driver.

11. Remove modulator/driver.

12. Pack auxiliary modulator/driver A7 or primary modulator/driver A8 for shipping per paragraph 7.6.2.

7.4.2 Auxiliary Modulator/Driver A7 and Primary Modulator/Driver A8 Installation

Use the following procedure for both auxiliary modulator/driver A7 and primary modulator/driver A8.

Prerequisite Procedures

Unpack modulator/driver per paragraph 7.6.1.

Tools and Test Equipment Required

Screwdriver, flat tip, heavy-duty
Screwdriver, flat tip, light-duty, short
Wrench, open-end 5/16-inch
Wrench, torque, SMA connector, 5/16-inch

Installation Procedure

See figure 7-13.3, Auxiliary Modulator/Driver A7 and Primary Modulator/Driver A8 Removal and Installation Diagram.

WARNING

The modulator/driver weighs approximately 15 pounds. To prevent injury, use care when lifting unit in or out of the interrogator cabinet.

1. Make sure power to interrogator cabinet is still off.

2. Hold modulator driver in position and connect loose connectors J1 (4) and J2 (1) to their respective receptacles on unit. (Be careful to avoid overstretching wires of connectors J1 and J2.)

3. Grasp handles (6) and position modulator/driver so large holes in key slots (7) line up with mounting pins on cabinet wall. Place unit over mounting pins and lower onto pins.

4. At each corner of modulator/driver, tighten four captive screws (5).

5. Connect two loose RF cables to connectors J3 (3) and J4 (2). Using SMA connector torque wrench, tighten connectors to preset value of torque wrench (8 inch-pounds).

6. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)

7. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to ON. Audible alarm makes a loud sound.

8. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 to ON. Audible alarm turns off.

9. Perform Interrogator Channel Checkout Procedure in section 6 of TI 6365.5.

7.4.3 Auxiliary Capacitor Bank A12 and Primary Capacitor Bank A15 Removal

Use the following procedure for both auxiliary capacitor bank A12 and primary capacitor bank A15.

Prerequisite Procedures

Obtain local control of Mode S sensor per section 3 of TI 6365.5.

Tools and Test Equipment Required

Screwdriver, flat tip, heavy-duty
Screwdriver, flat tip, light-duty (short shank or offset screwdriver)

Procedure

See figure 7–14, Auxiliary Capacitor Bank A12 and Primary Capacitor Bank A15 Removal and Installation Diagram.

WARNING

The capacitor bank weighs approximately 15 pounds. To prevent injury, use care when lifting unit in or out of the interrogator cabinet.

The capacitor bank stores high voltage. To prevent injury or loss of life, when removing the auxiliary capacitor bank, ensure the MAIN POWER circuit breaker CB1 on the interrogator control panel is in the OFF position.

1. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.

2. At interrogator cabinet control panel A1, set BRKR ALARM circuit breaker CB2 to OFF to silence alarm.

3. Open doors to interrogator cabinet. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)

4. Open swingout rack to gain access to transmitter units.

5. Disconnect cable plug P13 (auxiliary capacitor bank A12) or cable plug P14 (primary capacitor bank A15) from connector J1 (1).

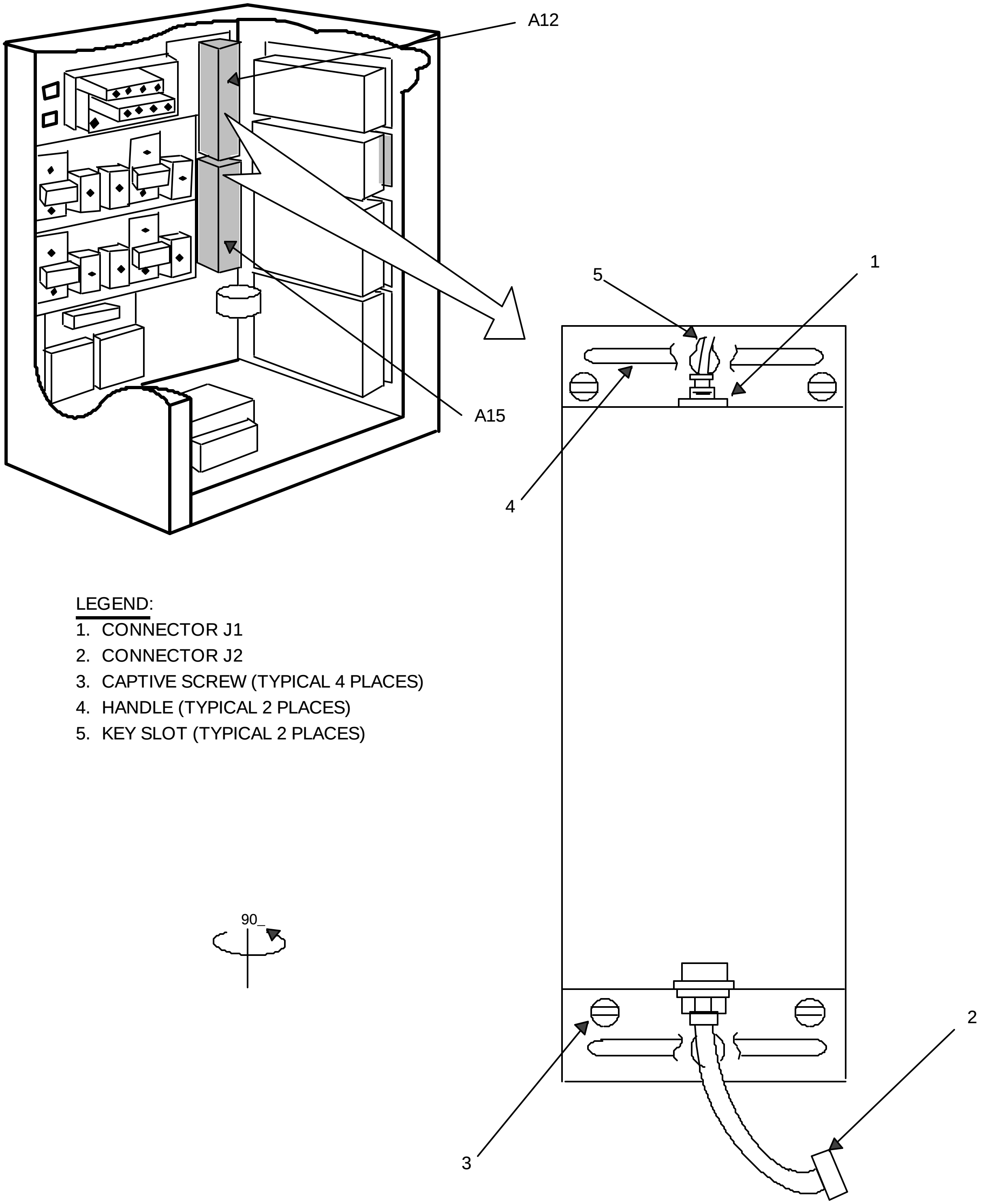
6. Disconnect connector J2 (2) from connector J3 at power amplifier (A13 or A16).

7. At each corner of capacitor bank, loosen captive screws (3).

8. Grasp handles (4) and slide capacitor bank up until large holes in key slots (5) line up with mounting pins on cabinet wall.

9. Pull unit away from mounting pins, and remove from interrogator cabinet.

10. Pack auxiliary capacitor bank A12 or primary capacitor bank A15 for shipping per paragraph 7.6.2.



LEGEND:
1. CONNECTOR J1
2. CONNECTOR J2
3. CAPTIVE SCREW (TYPICAL 4 PLACES)
4. HANDLE (TYPICAL 2 PLACES)
5. KEY SLOT (TYPICAL 2 PLACES)

FIGURE 7–14. AUXILIARY CAPACITOR BANK A12 AND PRIMARY CAPACITOR BANK A15 REMOVAL AND INSTALLATION DIAGRAM

7.4.4 Auxiliary Capacitor Bank A12 and Primary Capacitor Bank A15 Installation

Use the following procedure for both auxiliary capacitor bank A12 and primary capacitor bank A15.

Prerequisite Procedures

Unpack capacitor bank per paragraph 7.6.1.

Tools and Test Equipment Required

Screwdriver, flat-tip, heavy-duty
Screwdriver, flat-tip, light-duty (short shank or offset screwdriver)

Installation Procedure

See figure 7–14, Auxiliary Capacitor Bank A12 and Primary Capacitor Bank A15 Removal and Installation Diagram.

WARNING

> The capacitor bank weighs approximately 15 pounds. To prevent injury, use care when lifting unit in or out of the interrogator cabinet.

1. Make sure power to interrogator cabinet is still off.
2. Grasp handles (4) and position capacitor bank so large holes in key slots (5) line up with mounting pins on cabinet wall.
3. Place unit over mounting pins and lower onto pins.
4. At each corner of capacitor bank, tighten captive screws (3).
5. At power amplifier (A13 or A16) J3, connect loose connector J2 (2) to connector J3.
6. At capacitor bank connector J1 (1), connect loose cable plug P13 (or P14).
7. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)
8. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to ON. Audible alarm makes a loud sound.
9. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 to ON. Audible alarm turns off.
10. Perform Interrogator Channel Checkout Procedure in section 6 of TI 6365.5.

7.4.5 Auxiliary Power Amplifier A13 Removal

Use this procedure to remove the auxiliary power amplifier A13.

Prerequisite Procedures

Obtain local control of Mode S sensor per section 3 of TI 6365.5.

Tools and Equipment Required

Screwdriver, flat-tip, heavy-duty
Screwdriver, flat-tip, light-duty (short shank or offset screwdriver)
Wrench, open-end, 5/16-inch
Wrench, open-end, 13/16-inch

Removal Procedure

See figure 7–15, Auxiliary Power Amplifier A13 Removal and Installation Diagram.

WARNING

The auxiliary power amplifier weighs approximately 30 pounds. To prevent injury, use care when lifting unit into or out of the interrogator cabinet.

1. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.
2. At interrogator cabinet control panel A1, set BRKR ALARM circuit breaker CB2 to OFF to silence alarm.
3. Open doors to interrogator cabinet. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)
4. Open swingout rack to gain access to transmitter units.
5. Disconnect electrical plug from connector J3 (2) on top of power amplifier.
6. Disconnect electrical plug from connector A9J1 (4) on bottom of power amplifier.
7. Disconnect RF cable from connector J1 (3) on top of power amplifier.
8. Loosen and disconnect rigid cable W45 coupling nut from connector J2 (1).
9. Loosen coupling nut at other end of cable W45 at connector J1 on AT2 of output level control A10. Being careful not to bend cable, rotate cable W45 out of the way.
10. At each corner of unit, loosen captive screws (5).
11. Grasp handles (6) and slide auxiliary power amplifier up until large holes in key slots (7) line up with mounting pins on cabinet wall.
12. Pull unit away from mounting pins, moving right side away first. Remove unit from interrogator cabinet.
13. Pack auxiliary power amplifier A13 for shipping per paragraph 7.6.2.

7.4.6 Auxiliary Power Amplifier A13 Installation

Use this procedure to install auxiliary power amplifier A13.

Prerequisite Procedures

Unpack auxiliary power amplifier A13 per paragraph 7.6.1.

Tools and Test Equipment Required

Screwdriver, flat-tip, heavy-duty
Screwdriver, flat-tip, light-duty (short shank or offset screwdriver)
Wrench, torque, N-connector, 13/16-inch
Wrench, torque, SMA connector, 5/16-inch

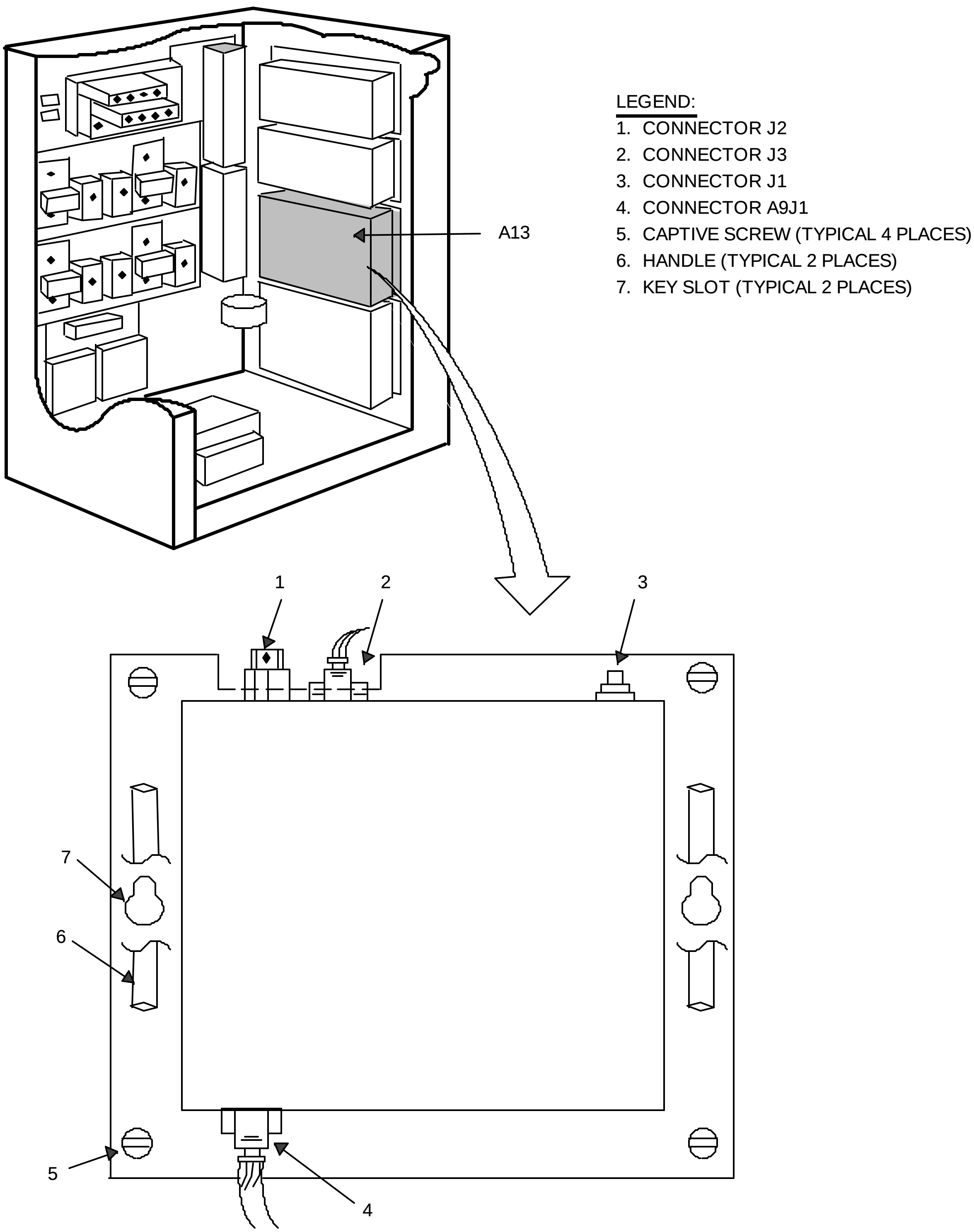


FIGURE 7–15. AUXILIARY POWER AMPLIFIER A13 REMOVAL AND INSTALLATION DIAGRAM

Installation Procedure

See figure 7–15, Auxiliary Power Amplifier A13 Removal and Installation Diagram.

WARNING

The auxiliary power amplifier A13 weighs approximately 30 pounds. To prevent injury, use care when lifting unit in and out of the interrogator cabinet.

1. Make sure power to interrogator cabinet is still off.
2. Grasp handles (6). Angle auxiliary power amplifier slightly left; position so large holes in key slots (7) line up with mounting pins on cabinet wall. Place unit over mounting pins and lower onto pins.
3. At each corner, tighten captive screws (5).
4. Connect one end of rigid RF cable W45 to connect J2 (1) on power amplifier.
5. Tighten other end of rigid RF cable W45 at connector J1 of AT2 on output level control A10.
6. Using N-connector torque wrench, tighten coupling nuts at both ends of RF cable W45 to preset value of wrench (14 inch-pounds).
7. Connect loose end of flexible RF cable to connector J1 (3).
8. Using SMA connector torque wrench, tighten coupling nut of flexible RF cable to preset value of wrench (8 inch-pounds).
9. Connect loose electrical plugs to connectors J3 (2) and A9J1 (4).
10. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)
11. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to ON. Audible alarm makes a loud sound.
12. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 to ON. Audible alarm turns off.
13. Perform Interrogator Channel Checkout Procedure in section 6 of TI 6365.5.

7.4.7 Primary Power Amplifier A16 Removal

Use the following procedure to remove primary power amplifier A16.

Prerequisite Procedures

Obtain local control of Mode S sensor per section 3 of TI 6365.5.

Tools and Equipment Required

Screwdriver, flat-tip, heavy-duty
Screwdriver, flat-tip, light-duty, short
Wrench, open-end, 5/16-inch
Wrench, open-end, 13/16-inch

Removal Procedure

See figure 7–16, Primary Power Amplifier A16 Removal and Installation Diagram.

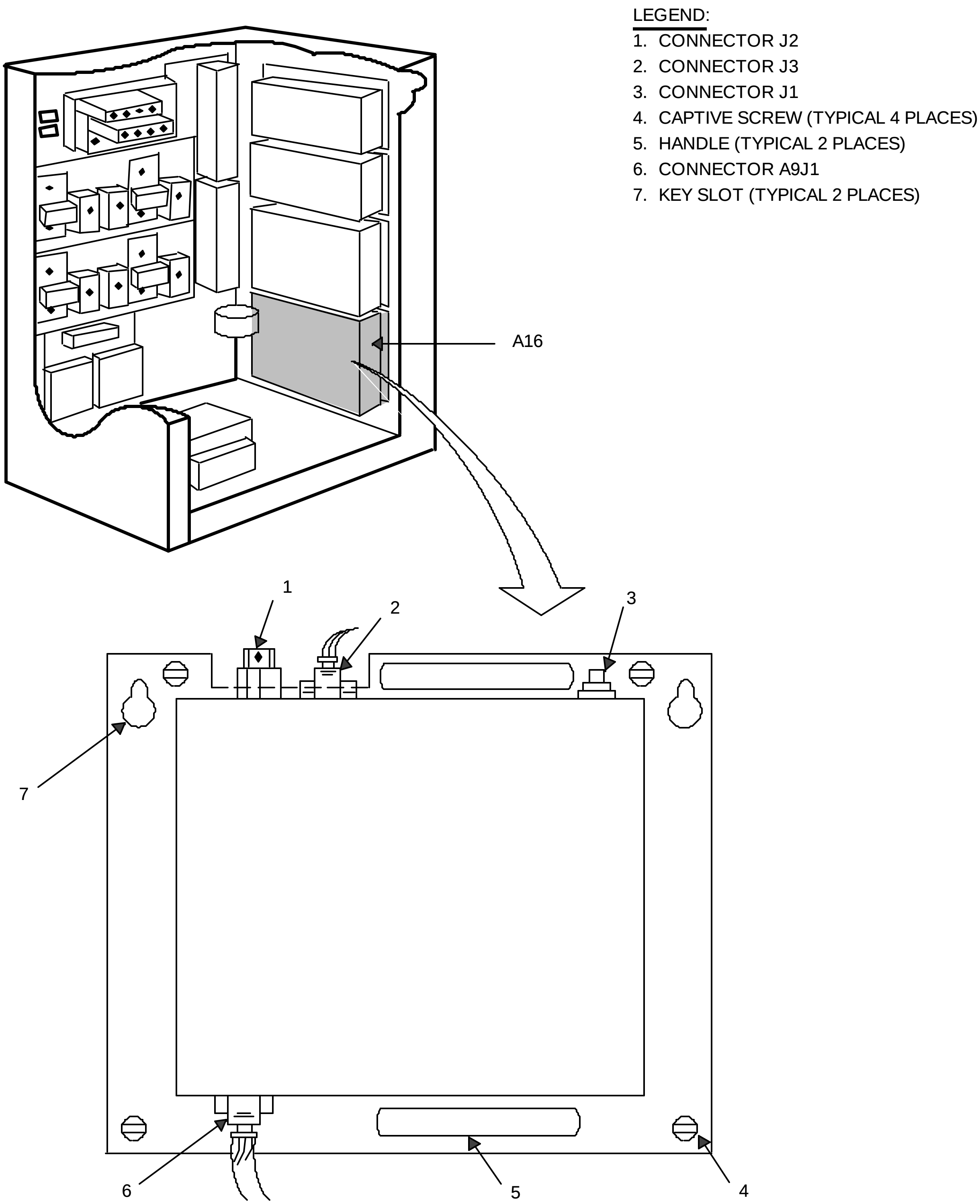


FIGURE 7–16. PRIMARY POWER AMPLIFIER A16 REMOVAL AND INSTALLATION DIAGRAM

WARNING

The primary power amplifier A16 weighs approximately 30 pounds. To prevent injury, use care when lifting unit in or out of the interrogator cabinet.

1. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.
2. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to OFF to silence alarm.
3. Open doors to interrogator cabinet. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)
4. Open swingout rack to gain access to transmitter units.
5. Disconnect electrical cables from connectors J3 (2) and A9J1 (6).
6. Disconnect RF cable from connector J1 (3).
7. Loosen and disconnect coupling nut of RF cable W43 from connector J2 (1).
8. Loosen and disconnect coupling nut at other end of cable W43 from connector J1 of AT2 on output level control A11. Remove cable W43 from cabinet.
9. At each corner of unit, completely loosen captive screws (4).
10. Grasp handles (5) and slide primary power amplifier up until large holes in key slots (7) line up with mounting pins on cabinet wall.
11. Move amplifier away from cabinet wall, moving right side away first. Angle amplifier away from wall and to the right. Remove unit from interrogator cabinet.
12. Pack primary power amplifier A16 for shipping per paragraph 7.6.2.

7.4.8 Primary Power Amplifier A16 Installation

Use the following procedure to install primary power amplifier A16.

Prerequisite Procedures

Unpack primary power amplifier per paragraph 7.6.1.

Tools and Equipment Required

Screwdriver, flat tip, heavy-duty
Screwdriver, flat tip, light-duty, short
Wrench, open-end, 5/16-inch
Wrench, open-end, 13/16-inch
Wrench, torque, SMA-connector, 5/16-inch
Wrench, torque, N-connector, 13/16-inch

Installation Procedure

See figure 7–16, Primary Power Amplifier A16 Removal and Installation Diagram.

WARNING

The primary power amplifier A16 weighs approximately 30 pounds. To prevent personal injury, use care when lifting unit in or out of the interrogator cabinet.

1. Make sure power to the interrogator cabinet is still off.

2. Grasp handles (5) of power amplifier. As amplifier is inserted into cabinet, angle amplifier toward cabinet wall and to the left. Position large holes in key slots (7) to line up with mounting pins on cabinet wall. Place unit over mounting pins and lower onto pins.

3. At each corner of unit, tighten captive screws (4).

4. Connect coupling nut of cable W43 to connector J2 (1) on power amplifier.

5. Connect coupling nut on other end of cable W43 to connector J1 of AT2 on output level control A11.

6. Using N-connector torque wrench, tighten coupling nuts of cable W43 to preset value of torque wrench (14 inch-pounds).

7. Connect loose RF cable to connector J1 (3). Using SMA connector torque wrench, tighten RF cable to preset value of torque wrench (7 to 9 inch-pounds).

8. Connect electrical cables to connectors J3 (2) and J2 (1).

9. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)

10. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to ON. Audible alarm makes a loud sound.

11. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 to ON. Audible alarm turns off.

12. Perform Interrogator Channel Checkout Procedure in section 6 of TI 6365.5.

7.4.9 Auxiliary Output Level Control A10 and Primary Output Level Control A11 Removal

The removal procedure is the same for both auxiliary output level control A10 and primary output level control A11. To remove either unit, proceed as follows:

Prerequisite Procedures

Obtain local control of Mode S sensor per section 3 of TI 6365.5.

Tools and Test Equipment Required

Screwdriver, flat-tip, heavy-duty
Screwdriver, flat-tip, light-duty, short
Wrench, open-end 13/16-inch

Removal Procedure

See figure 7–17, Auxiliary Output Level Control A10 and Primary Output Level Control A11 Removal and Installation Diagram.

WARNING

The output level control assembly weighs approximately 24 pounds. To prevent injury, use care when lifting unit in or out of the interrogator cabinet.

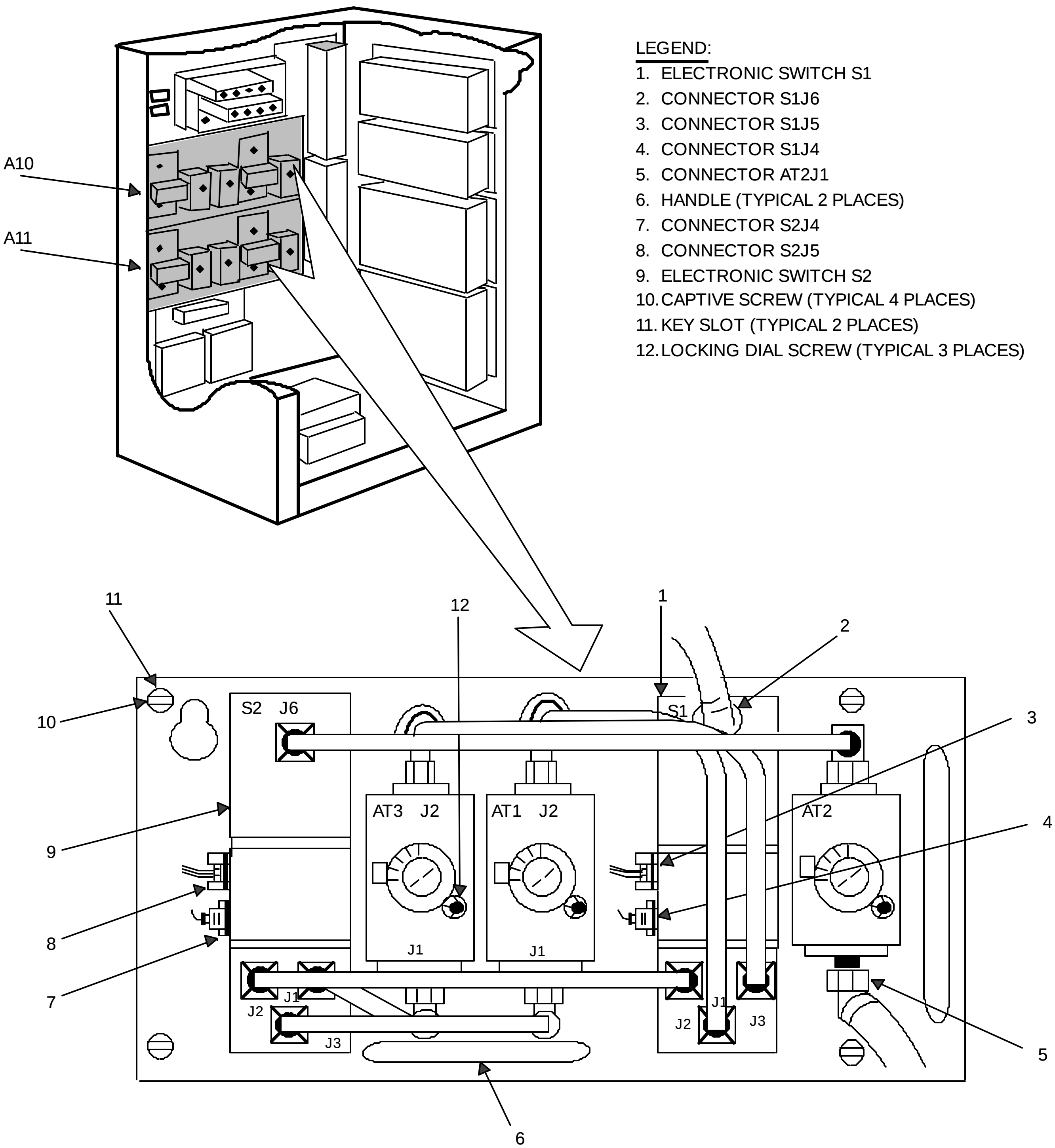


FIGURE 7−17. AUXILIARY OUTPUT LEVEL CONTROL A10 AND PRIMARY OUTPUT LEVEL CONTROL A11 REMOVAL AND INSTALLATION DIAGRAM

NOTE

When removing the semi-rigid cable from connectors, make sure both ends of the cable have been loosened before attempting to remove from the LRU.

1. At interrogator cabinet control panel A1, set MAIN POWER circuit breaker CB1 to OFF.
2. At interrogator cabinet control panel A1, set BRKR ALARM circuit breaker CB2 to OFF to silence alarm.
3. Open doors to interrogator cabinet. (If necessary, refer to TI 6365.5, section 7, Preparation of Interrogator Cabinet Prior to Maintenance.)
4. Open swingout rack to gain access to transmitter units.
5. Disconnect one end of RF cable from connector AT2J1 (5) on output level control.
6. Loosen coupling nut on other end of RF cable at connector J2 on primary power amplifier A16 (or auxiliary power amplifier A13). Being careful not to bend cable, rotate cable out of the way.

NOTE

If removing auxiliary output level control A10, do steps 7 and 8; then, skip to step 11. If removing primary output level control A11, skip to step 9.

7. Disconnect one end of RF cable W29 from connector J6 (2) of electronic switch S1 (1).
8. Disconnect other end of RF cable W29 from connector FL1J3 of omni diplexer A6. Remove cable W29 from cabinet.
9. Disconnect one end of RF cable W28 from connector J6 (2) of electronic switch S1 (1).
10. Disconnect other end of RF cable W28 from connector FL1J3 of monopulse diplexer A19. Remove cable W28 from cabinet.
11. Loosen hold-down screws and disconnect connectors J4 (4) and J5 (3) of electronic switch S1 (1).
12. Loosen hold-down screws and disconnect connectors J4 (7) and J5 (8) of electronic switch S2 (9).
13. At each corner of output level control, completely loosen captive screws (10).

CAUTION

When removing the auxiliary output level control A10, use care not to damage cables W26 and W28.

14. Grasp handles (6) and slide output level control up until large holes in key slots (11) line up with mounting pins on cabinet wall.
15. Pull unit away from mounting pins, and remove from interrogator cabinet.
16. Pack output level control for shipping per paragraph 7.6.2.

7.4.10 Auxiliary Output Level Control A10 and Primary Output Level Control A11 Installation

Use the following procedure for both auxiliary output level control A10 and primary output level control A11.

Prerequisite Procedures

Unpack auxiliary output level control per paragraph 7.6.1.

Tools and Equipment Required

Screwdriver, flat-tip, light-duty, short
Screwdriver, flat-tip, heavy-duty
Wrench, open end 13/16-inch
Wrench, torque, SC/N connector, 13/16-inch

CAUTION

When installing the output level control, ensure the bend angles of semi-rigid cables do not change. Otherwise, maintenance faults, such as insertion loss differences, will be induced.

When installing semi-rigid cable connectors onto connector plugs, ensure connectors are flatly seated before tightening connector nut.

Installation Procedure

See figure 7–17, Auxiliary Output Level Control A10 and Primary Output Level Control A11 Removal and Installation Diagram.

1. Make sure power to interrogator cabinet is still off.

CAUTION

When installing the auxiliary output level control A10, use care not to damage cables W26 or W28.

2. Grasp handles (6) of output level control. Position output level control so large holes in key slots (11) line up with mounting pins on cabinet wall. Place unit over mounting pins and lower onto pins.

3. At each corner of output level control, tighten captive screws (10).

4. Connect loose cables to connectors J4 (7) and J5 (8) of electronic switch S2 (9).

5. Connect loose cables to connectors J4 (4) and J5 (3) of electronic switch S1 (1).

NOTE

If installing auxiliary output level control A10, do steps 6 and 7; then, skip to step 10.

If installing primary output level control A11, skip to step 8.

6. Connect one end of RF cable W29 to connector J6 (2) of electronic switch S1 (1).

7. Connect other end of RF cable W29 to FL1J3 of omni diplexer A6.

8. Connect one end of RF cable W28 to J6 (2) of electronic switch S1 (1).

9. Connect other end of RF cable W28 to connector FL1J3 of monopulse diplexer A19.

10. Connect one end of RF cable to connector AT2J1 (5). Tighten other end of RF cable at connector J2 on power amplifier A16 (or A13).

11. Using N-connector torque wrench, tighten all coax cables to preset value of torque wrench (14 inch-pounds).

12. Set following attenuators to parameter values listed on variable site parameter card, and lock attenuator dial by tightening locking dial screw (12):

Attenuator	Parameter
AT1	Low Mode S
AT2	High Mode S
AT3	ATCRBS

13. Close swingout rack and cabinet doors. (If necessary, refer to TI 6365.5, section 7, Securing Interrogator Cabinet After Maintenance.)

14. At interrogator control panel A1, set BRKR ALARM circuit breaker CB2 to ON. Audible alarm makes a loud sound.

15. At interrogator control panel A1, set MAIN POWER circuit breaker CB1 to ON. Audible alarm turns off.

16. Perform Interrogator Channel Checkout Procedure in section 6 of TI 6365.5.

7.5 WIRING DATA

Interconnecting coaxial, semi-rigid coaxial, and low-voltage cabinet wiring data is provided for the transmitter.

7.5.1 Transmitter Wiring Diagram

See figure 7–18, Transmitter Wiring Diagram, in section 11. Sheet 1 of the wiring diagram shows the connections between each transmitter LRU, and the interconnections with other equipment. The remaining sheets provide detailed information for each cable. Included in the wiring diagram are cable reference designator, connector number (both cable plug and mating LRU jack), pin numbers, and signal names.

7.5.2 Transmitter Electrical Parts List

A parts list with part numbers for each LRU that makes up the transmitter, is provided in section 8.

7.5.3 Transmitter Signal List

Table 7–2, Transmitter Signal List, lists the input and output signal names for the transmitter. The signal name is the entry into table 7–2; signal mnemonics are listed in alphabetical order. Mnemonics are used with the signal flow diagrams. The Meaning column deciphers the signal mnemonic into the actual name. The Function column describes the signal function. The figure and sheet number of the signal flow diagram where the signal can be located are referenced in the last column.

TABLE 7–2. TRANSMITTER SIGNAL LIST

Signal Name	Meaning	Function	Functional Diagram Fig/Sheet
AUXTXLO	Auxiliary transmitter local (LO) RF input signal	The auxiliary modulator/driver receives an LO RF input signal from RF receiver A9 for amplification and modulation.	7–1/8
AUX RF	Auxiliary RF	Amplified RF from the auxiliary modulator/driver is sent to the auxiliary power amplifier for further amplification.	7–1/8, 10
HIGH AUX RF	Auxiliary high power RF	The auxiliary power amplifier amplifies the RF to transmitter peak power amplitude, and sends the output to the output level control.	7–1/11, 12
AUXTX	Auxiliary transmit	The auxiliary transmit signal is selected by the output level control and sent to omni diplexer A6 in the receiver/RFTTG.	7–1/12
AUX TRIGGER+/–	Auxiliary power amplifier trigger	Initiates RF power level fault monitoring only when RF pulses are present.	7–1/9, 11
ER/SIGMREV	Sigma reverse	The VSWR monitor accesses reflected power samples (sigma reverse) from the primary channel for use in transmitter VSWR fault detection testing.	2–3/1
ER/SIGMFWD	Sigma forward	The VSWR monitor accesses forward power samples (sigma forward) from the primary channel for use in transmitter VSWR fault detection testing.	2–3/1
ER/OMEGREV	Omega reverse	The VSWR monitor accesses reflected power samples (omega reverse) from the auxiliary channel for use in transmitter VSWR fault detection testing.	2–3/1
ER/OMEGFWD	Omega forward	The VSWR monitor accesses forward power samples (omega forward) from the auxiliary channel for use in transmitter VSWR fault detection testing.	2–3/1

TABLE 7–2. TRANSMITTER SIGNAL LIST (Continued)

Signal Name	Meaning	Function	Functional Diagram Fig/Sheet
ER/TXRSTA+/–	Transmitter reset channel A	Whenever the primary modulator/driver protection circuits detect a fault, the fault is latched, and the modulator/driver shuts down. A clock pulse from the CPU resets the latch and restores the power to the modulator/driver.	7–1/2 2–3/2
ER/TXRSTB+/–	Transmitter reset channel B	Whenever the auxiliary modulator/driver protection circuits detect a fault, the fault is latched, and the modulator/driver shuts down. A clock pulse from the CPU resets the latch and restores the power to the modulator/driver.	7–1/8 2–3/2
ET/AXMDFT+/–	Auxiliary modulator/driver fault protection	An auxiliary modulator/driver fault is detected whenever the driver RF output signal level drops below the specified peak amplitude.	7–1/9 2–3/2
ET/AXDRFT+/–	Auxiliary modulator/driver fault protection	Fault signal that shuts down transmitter when a high pulse width, high pulse number, high duty cycle, low +36V power or +52V power occurs.	7–1/9 2–3/2
ET/AXPAFT+/–	Auxiliary power amplifier fault	An auxiliary power amplifier fault is detected whenever the RF output signal level drops below the specified peak amplitude.	7–1/11 2–3/2
ET/PRMDFT+/–	Primary modulator/driver fault protection	A primary modulator/driver fault is detected whenever the driver RF output signal level drops below the specified peak amplitude.	7–1/3 2–3/2
ET/PRDRFT+/–	Primary modulator/driver fault protection	Fault signal that shuts down transmitter when a high pulse width, high pulse number, high duty cycle, low +36V power or +52V power occurs.	7–1/3 2–3/2
ET/PRPAFT+/–	Primary power amplifier fault	A primary power amplifier fault is detected whenever the RF output signal drops below the specified peak amplitude.	7–1/5 2–3/2

TABLE 7–2. TRANSMITTER SIGNAL LIST (Continued)

Signal Name	Meaning	Function	Functional Diagram Fig/Sheet
PRITXLO	Primary transmitter local oscillator (LO) RF input signal	This low level RF signal from the local oscillator is applied to the modulator/driver for amplitude modulation, DPSK modulation, and amplification.	7–1/2 2–3/1
PRI RF	Primary RF	The amplified RF from the modulator/driver is sent to the primary power amplifier for further amplification.	7–1/2,4 2–3/1
HIGH PRI RF	Primary high power RF	The primary power amplifier amplifies the RF to transmitter peak power amplitude and sends the output to the output level control.	7–1/5,7 2–3/1
PRI TX	Primary transmit signal	The primary transmit signal is selected by the output level control and sent to monopulse diplexer A19 in the receiver/RFTTG.	7–1/7 2–3/1
PRI TRIGGER+/–	Primary power amplifier trigger	NOT USED	7–1/3
SUM RF	Main beam transmission	Primary transmitter output from the diplexer FL1 to the antenna.	2–3/1
OMNI RF	Unidirectional beam	Auxiliary transmitter output from the diplexer FL1 to the omni antenna.	2–3/1
TE/PAMAX+/–	Auxiliary pulse amplitude modulation (PAM)	Auxiliary pulse amplitude modulation (PAM) modulates the RF and initiates fault monitor circuit operation.	7–1/8
TE/PAMPR+/–	Primary pulse amplitude modulation (PAM)	Primary pulse amplitude modulation (PAM) modulates the RF and initiates fault monitor circuit operation.	7–1/2
PV/SUMSEL+/–	Sum select	When sum select line is enabled, the desired channel (primary or auxiliary) is selected for power level monitoring.	2–3/1
PV/TXDSEL+/–	Transmitter/receiver selector	When transmitter/receiver selector is enabled the desired power level (forward or reverse) is sampled.	2–3/1

TABLE 7–2. TRANSMITTER SIGNAL LIST (Continued)

Signal Name	Meaning	Function	Functional Diagram Fig/Sheet
TE/DPSK+/–	Differential phase shift keying	This signal provides DPSK modulation (0 or 180 degrees phase shift) during the P6 pulse.	7–1/2
TE/ATPRA1+/–	Auxiliary ATCRBS power switch 1	Provides ATCRBS power control to the auxiliary output level control electronic switch 1.	7–1/12
TE/HIPRA1+/–	Auxiliary high Mode S power switch 1	Provides high Mode S power to the auxiliary output level control electronic switch 1.	7–1/12
TE/LOPRA1+/–	Auxiliary low Mode S power switch 1	Provides low Mode S power to the auxiliary output level control electronic switch 1.	7–1/12
TE/ATPRA2+/–	Auxiliary ATCRBS power switch 2	Provides ATCRBS power control to the auxiliary output level control electronic switch 2.	7–1/12
TE/HIPRA2+/–	Auxiliary high Mode S power switch 2	Provides high Mode S power to the auxiliary output level control electronic switch 2.	7–1/12
TE/LOPRA2+/–	Auxiliary low Mode S power switch 2	Provides low Mode S power to the auxiliary output level control electronic switch 2.	7–1/12
TE/HIPRP1+/–	Primary high Mode S power switch 1	Provides high Mode S power to the primary output level control electronic switch 1.	7–1/7
TE/LOPRP1+/–	Primary low Mode S power switch 1	Provides low Mode S power to the primary output level control electronic switch 1.	7–1/7
TE/ATPRP2+/–	Primary ATCRBS power switch 2	Provides ATCRBS power to the primary output level control electronic switch 2.	7–1/7
TE/HIPRP2+/–	Primary high Mode S power switch 2	Provides high Mode S power to the primary output level control electronic switch 2.	7–1/7

TABLE 7–2. TRANSMITTER SIGNAL LIST (Continued)

Signal Name	Meaning	Function	Functional Diagram Fig/Sheet
TE/LOPRP2+/–	Primary low Mode S power switch 2	Provides low Mode S power to the primary output level control electronic switch 2.	7–1/7
TE/ATPRP1+/–	Primary ATCRBS power switch 1	Provides ATCRBS power to the primary output level control electronic switch 1.	7–1/7

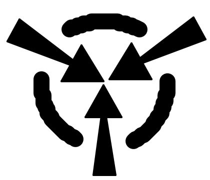
7.6 PACKING INSTRUCTIONS

The following procedures provide the unpacking and packing instructions for transmitter LRUs in preparation for installation and shipment.

7.6.1 Unpacking Instructions

The following procedure is used to unpack the transmitter LRUs for use or repair.

CAUTION



This equipment contains parts and assemblies sensitive to electrostatic discharge (ESD). To prevent damage, use ESD precautionary procedures when touching. removing, or inserting components. Refer to T.O. 00–25–234, General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment.

Special Handling Precautions

When not being worked on or when being transported outside of protected areas within a facility, items shall be enclosed in ESD protective packaging or contain shunting devices that short all pins to case for protection from triboelectric charging, direct contact with charged objects, and electrostatic fields.

Materials Required

None.

Tools Required

Scissors
Knife

Unpacking Instructions

See figure 7–19, LRU Packing Special Marking Locations.

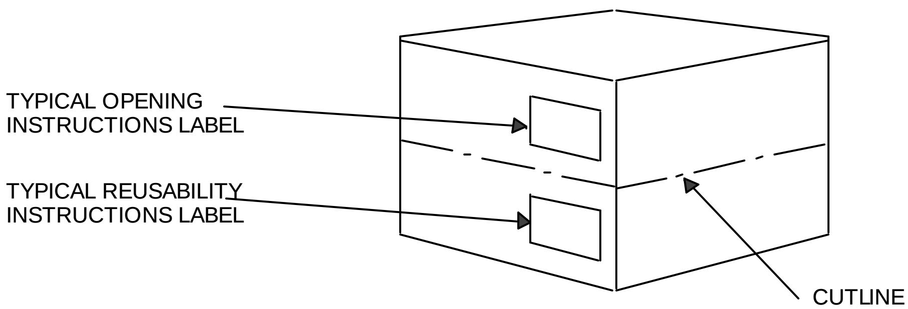


FIGURE 7–19. LRU PACKING SPECIAL MARKING LOCATIONS

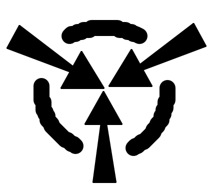
1. Place package to be opened on suitable work surface.

CAUTION

The LRU is packaged in a reusable container. Refer to opening instructions placarded on side of container before attempting to open container. Failure to follow instructions could result in damage to the container or the LRU inside.

2. Use knife to carefully cut along cut line on reusable container. See figure 7–19 for instructions.
3. Lift top off container. Set cover aside for later reuse.
4. Lift and remove packing material covering LRU. Set aside for later reuse.
5. Carefully lift LRU out of container and place on suitable work surface.
6. Place packing material back in container and set top in place. Set container aside for later reuse.
7. Using knife or scissors, carefully open plastic bag.

CAUTION



This equipment contains parts and assemblies sensitive to electrostatic discharge (ESD). To prevent damage, use ESD precautionary procedures when touching, removing, or inserting components. Refer to T.O. 00–25–234, General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment.

8. Remove LRU from electrostatic-protective plastic bag and place on suitable work surface. Save desiccant bag for later use.
9. Remove all dust caps from LRU connectors. Save dust caps for later use.

7.6.2 Packing Instructions

The following procedure is used to pack transmitter LRUs for shipment.

Special Handling Precautions

When not being worked on or when being transported outside of protected areas within a facility, items shall be enclosed in ESD protective packaging or contain shunting devices that short all pins to case for protection from triboelectric charging, direct contact with charged objects, and electrostatic fields.

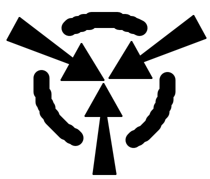
Materials Required

2-inch wide tape

Tools Required

Scissors
Knife

CAUTION



This equipment contains parts and assemblies sensitive to electrostatic discharge (ESD). To prevent damage, use ESD precautionary procedures when touching, removing, or inserting components. Refer to T.O. 00–25–234, General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment.

Packing Instructions

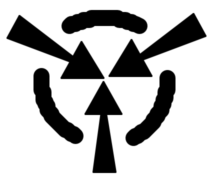
1. Prepare the LRU for shipment by placing dust caps saved during unpacking on all exposed electrical connectors.
2. Pack the LRU in protective bag as follows:
   a. Insert LRU in electrostatic-protective plastic bag saved during unpacking.
   b. Place desiccant packet saved during unpacking inside plastic bag with LRU.
   c. Fold and tape seams, any overlaps, and folds to conform plastic bag to the contours of the LRU.
   d. Tape a protective sleeve horizontally around the LRU so it contours to the LRU as closely as possible, this will protect the LRU during cutting operations in unpacking.
3. Insert wrapped LRU in the container so that the LRU fits into the same place as the LRU removed during unpacking.
4. Insert top packing material over LRU. Ensure the material fits over and conforms to the LRU. The packing material should be even with the top of the container when properly installed.
5. Place cover on top of container. Secure cover to top with tape.

8.0 PARTS LIST

8.1 INTRODUCTION

This section provides the onsite parts list for the transmitter equipment. The onsite parts list for the interrogator power distribution and environmental control equipment, receiver/RFTTG, and signal processor are contained in their respective instruction books. The parts list for each LRU is located in the depot book, TI 6365.9. The transmitter contains integrated circuits (IC) that are sensitive to electrostatic discharge (ESD). Refer to the USAF technical manual T.O. 00–25–234, General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment, for procedures and practices required for the repair of ESD sensitive equipment.

CAUTION



This equipment contains parts and assemblies sensitive to electrostatic discharge (ESD). To prevent damage, use ESD precautionary procedures when touching, removing, or inserting components. Refer to T.O. 00–25–234, General Shop Practice Requirements for the Repair, Maintenance, and Test of Electronic Equipment.

8.2 PARTS LIST

The electrical parts that are subject to replacement are listed in table 8–1 in a special format, which is described in the following paragraphs.

8.2.1

Column one of the parts list lists the reference designation of a part per ANSI Y32.16. To permit orderly development of the list, using electronic data processing equipment, certain listing conventions are necessary. The conventions used are explained in the following paragraphs.

8.2.1.1 Reference designations are generally in accordance with the actual equipment markings, with some exceptions. When an electrical assembly has not been assigned a reference designation, a letter N reference designation is assigned for parts listing purposes. Letter N reference designations are also assigned to electromechanical assemblies that have not been assigned reference designations. Electrical piece parts that have not been assigned reference designations are assigned ZZ reference designations in the parts list; and MP reference designations are used for electromechanical piece parts not having reference designations.

8.2.1.2 To minimize the occurrence of extremely long reference designations, the repeating portion of a reference designation appears only once at the start of a sequence, and once thereafter at the start of each new page, as applicable. Reference designations are in computer list sequence, not in numerical sequence. Thus, parts A1R1, A1R2, A1R3. . .A1R10, A1R11, are computer listed as A1R1, A1R10, A1R11. . .A1R2, A1R3.

8.2.2

Column two of the parts list shows the top-down breakdown by means of indenture (IN) letters. That is, the letter A indicates the highest level of assembly, the letter B indicates a first-level subordinate assembly, the letter C indicates an assembly subordinate to a second-level assembly, and so on.

8.2.3

Column three of the parts list contains the name and description of each part. If an identical part has already been listed at an earlier point within the same indenture, a SAME AS reference is given; and columns four, five, and six are left blank.

8.2.4

Column four of the parts list lists a five-digit manufacturer's code taken from Federal Cataloging Handbook H4–1. Table 8–2 (refer to paragraph 2.4 in the handbook) translates the code.

8.2.5

Column five of the parts list lists the Joint Army-Navy (JAN) or military (MIL) standard part number type designation of each part, when such information is applicable. If JAN or MIL type designations are not applicable, the manufacturer's part identification number is listed.

8.2.6

Column six of the parts list is reserved for any notes.

8.2.7

Table 8–2 lists, in numerical order, the manufacturers' supply codes that appear in the parts list. Opposite each code is the manufacturer's name and current address.

TABLE 8–1. PARTS LIST

Reference Designator	IN	Name of Part/Description	MFR Code No.	JAN/MIL MFR Part Number	Notes
2/3/8 Ref.	A	Interrogator Cabinet	97942	612J422G01	
2/3/8A7 Fig. 7–13.3	B	Auxiliary Modulator/Drivers	97942	1D21546G01	
2/3/8A8 Fig. 7–13.3	B	Primary Modulator/Driver	97942	1D21546G01	
2/3/8A10 Fig. 7–17	B	Auxiliary Output Level Control	97942	3D59053G01	
2/3/8A11 Fig. 7–17	B	Primary Output Level Control	97942	3D59053G01	
2/3/8A12 Fig. 7–14	B	Auxiliary Capacitor Bank	97942	1D23489G01	
2/3/8A13 Fig. 7–15	B	Auxiliary Power Amplifier	97942	1D28200G01	

TABLE 8–1. PARTS LIST (Continued)

Reference Designator	IN	Name of Part/Description	MFR Code No.	JAN/MIL MFR Part Number	Notes
2/3/8A15 Fig. 7–14	B	Primary Capacitor Bank	97942	1D23488G01	
2/3/8A16 Fig. 7–16	B	Primary Power Amplifier	97942	1D28201G01	

TABLE 8–2. MANUFACTURERS' CODES

Code	Name and Address	Code	Name and Address
97942	Westinghouse Electric Corp. Electronic Systems Group Baltimore-Washington International Airport P.O. Box 1897, MS–984 Baltimore, MD 21203		

9.0 INSTALLATION, INTEGRATION AND CHECKOUT

9.1 INTRODUCTION

The installation, integration, and checkout instructions for the interrogator are contained in separate documents referenced in section 9 of Mode S system equipment instruction book, TI 6365.2.

10.0 COMPUTER SOFTWARE

10.1 INTRODUCTION

This section contains references to documentation that describes the software of the Mode S interrogator. Paragraph 10.2 references the software top level design documents (STLDD), the software detailed design documents (SDDD), and the software user's manual and gives a brief overview of the program hierarchy. Paragraph 10.3 references the software maintenance manual and gives an overview of software maintenance.

10.2 PROGRAM HIERARCHY, DESCRIPTION AND LISTINGS

The computer software for the Mode S interrogator is controlled by two computer program configuration items (CPCIs). CPCIs are the highest level of functional grouping of software. The two CPCIs for the interrogator are the reply-to-reply processor (RRP) CPCI and the interrogator performance monitor (IPM) CPCI. The RRP CPCI combines the ATCRBS replies into one report per aircraft, and sends the report to the surveillance processor in the DPS. The IPM CPCI is the automatic BIT/FIT testing for the interrogator. Faults are reported to the performance monitor in the DPS. The program hierarchy, functional description, and listings for the two interrogator CPCIs are provided in the following software design documents:

TM–PA–0018/29/xx	Software Top Level Design Document for Interrogator Performance Monitor
TM–PA–0018/30/xx	Software Top Level Design Document for Reply-Reply Processor
TM–PA–0018/46/xx	Software Detailed Design Document for Interrogator Performance Monitor
TM–PA–0018/47/xx	Software Detailed Design Document for Reply-Reply Processor

Instructions for using the software are contained in document TM–PA–0028/311/xx, Software Users and Diagnostic Manual for Mode S Beacon System Sensor. This manual identifies the available controls and gives instructions on entering parameters using the local terminal and KCRT. The contents of the software user's manual includes the scope of the manual, applicable reference documentation, functional requirements (limited to operator interfaces), functional use instructions, and operating instructions. The operating instructions include step-by-step operating procedures, remote and local program loading, maintenance of system operation, and stopping and restarting procedures. A complete description of operator inputs is also given.

10.3 SOFTWARE MAINTENANCE

Maintenance instructions for the Mode S interrogator software are contained in document TM–PA–0018/122/xx, Software Maintenance Manual for Mode S Beacon System Sensor. The contents of this manual include the scope of the manual; input/output descriptions; and program assembling, loading, and maintenance procedures.

11.0 TROUBLESHOOTING SUPPORT DATA

11.1 INTRODUCTION

This section contains data referenced from other sections of this book. Figures are presented in order by section. Figure 2-1 supports the simplified theory of operation in section 2; figure 2-3 supports performance monitoring and fault detection isolation/testing in sections 2 and 7; figure 7-1 supports the detailed theory of operation in section 2 and corrective maintenance in section 7. The remaining figure 7-18, Transmitter Wiring Diagram, supports corrective maintenance in section 7.

TABLE 11-1. SUPPORT DATA FIGURES

Figure	Title	From Section	Page Number
2-1	Transmitter Functional Block Diagram	2	11-3
2-3, Sheets 1, 2	Transmitter Performance Monitoring Signal Flow Diagram	2	11-5
7-1, Sheet 1	Transmitter Signal Flow Diagram (Overall)	7	11-9
7-1, Sheets 2, 3	Transmitter Signal Flow Diagram (Primary Modulator/Driver A8)	7	11-11
7-1, Sheets 4, 5	Transmitter Signal Flow Diagram (Primary Power Amplifier A16)	7	11-15
7-1, Sheet 6	Transmitter Signal Flow Diagram (Primary A15 and Auxiliary A12 Capacitor Banks)	7	11-19
7-1, Sheet 7	Transmitter Signal Flow Diagram (Primary Output Level Control A11)	7	11-21
7-1, Sheets 8, 9	Transmitter Signal Flow Diagram (Auxiliary Modulator/Driver A7)	7	11-23
7-1, Sheets 10, 11	Transmitter Signal Flow Diagram (Auxiliary Power Amplifier A13)	7	11-27
7-1, Sheet 12	Transmitter Signal Flow Diagram (Auxiliary Output Level Control A10)	7	11-31

7-18, Sheets 1, 2, 3	Transmitter Wiring Diagram	7	11-33

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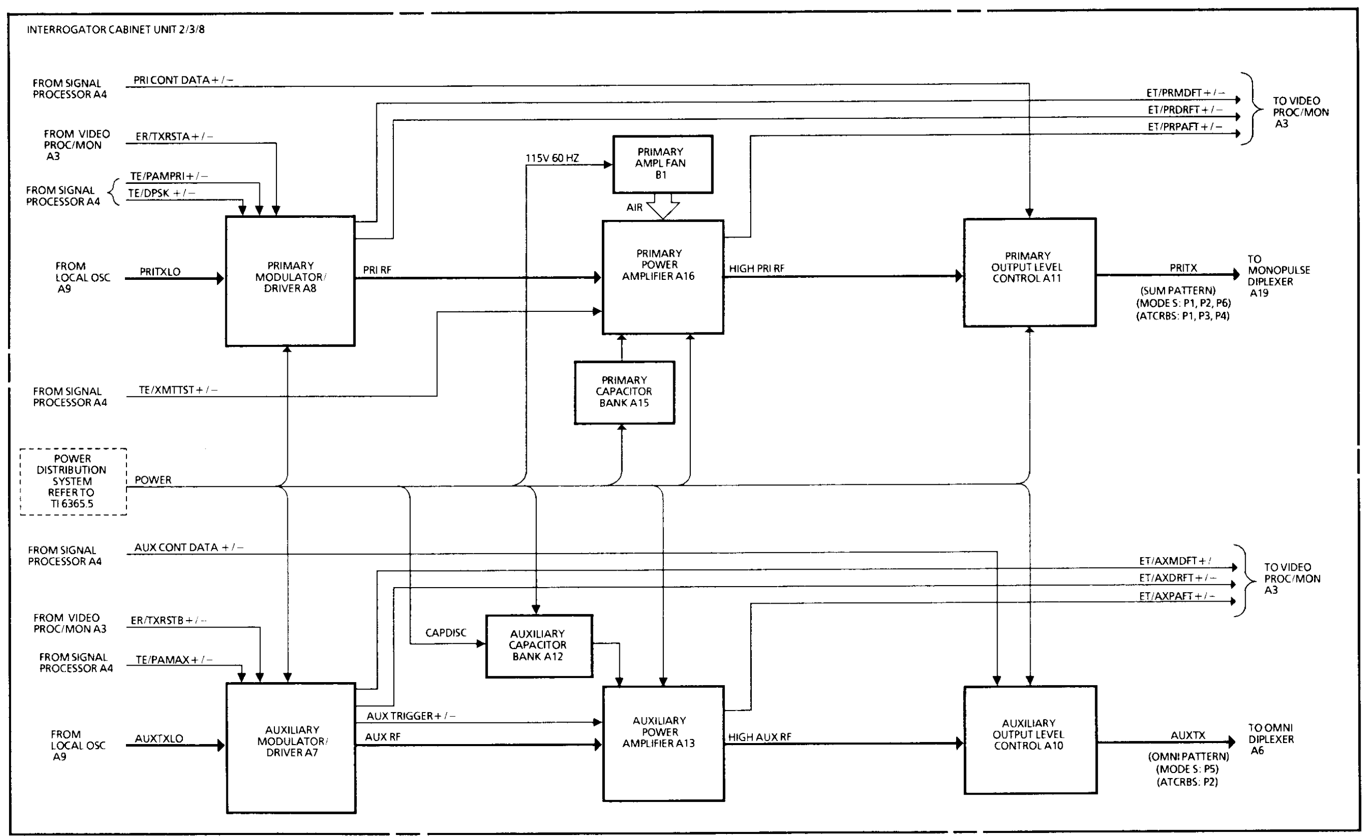

FIGURE 2-1. TRANSMITTER FUNCTIONAL BLOCK DIAGRAM

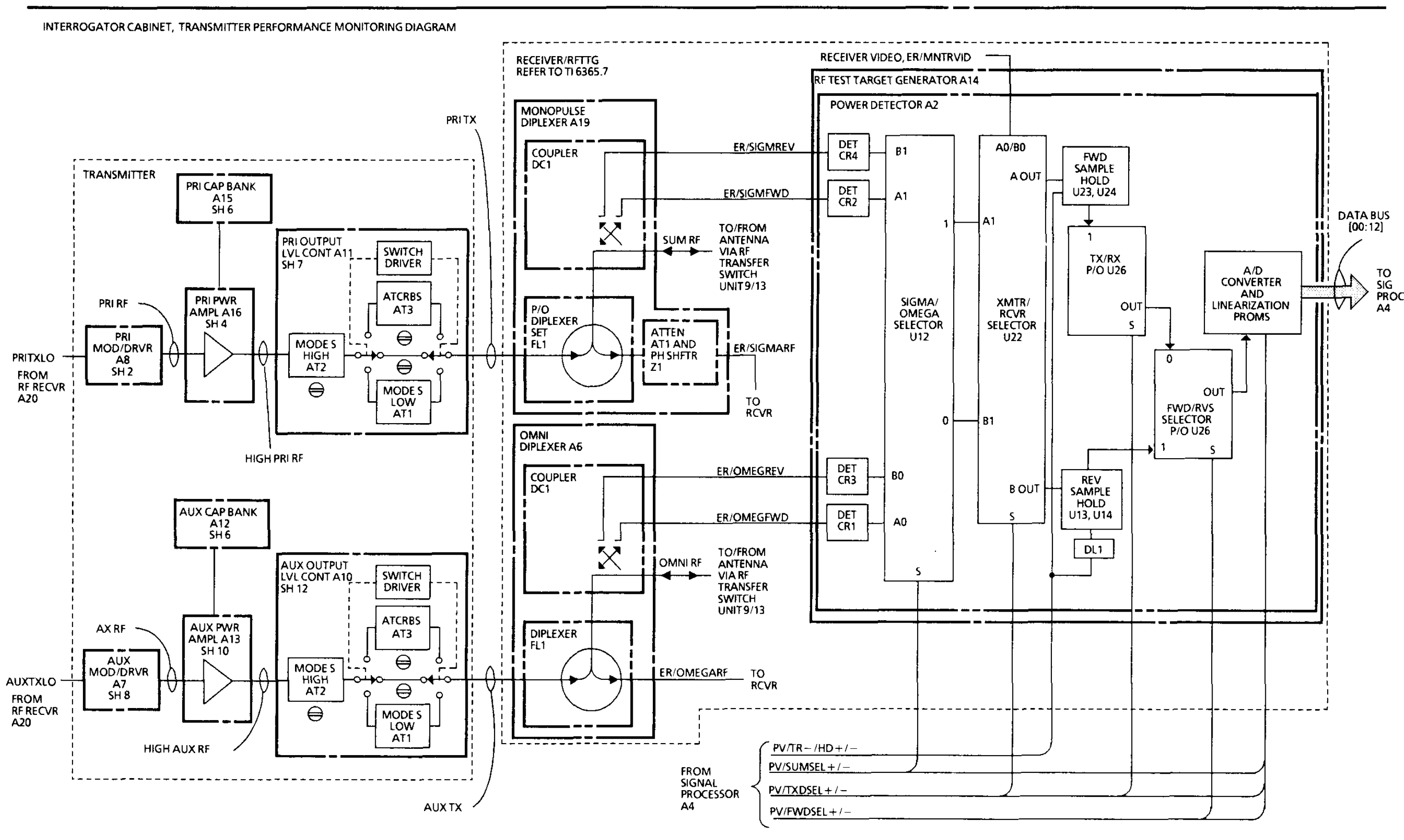

FIGURE 2-3. TRANSMITTER PERFORMANCE MONITORING SIGNAL FLOW DIAGRAM (SHEET 1)

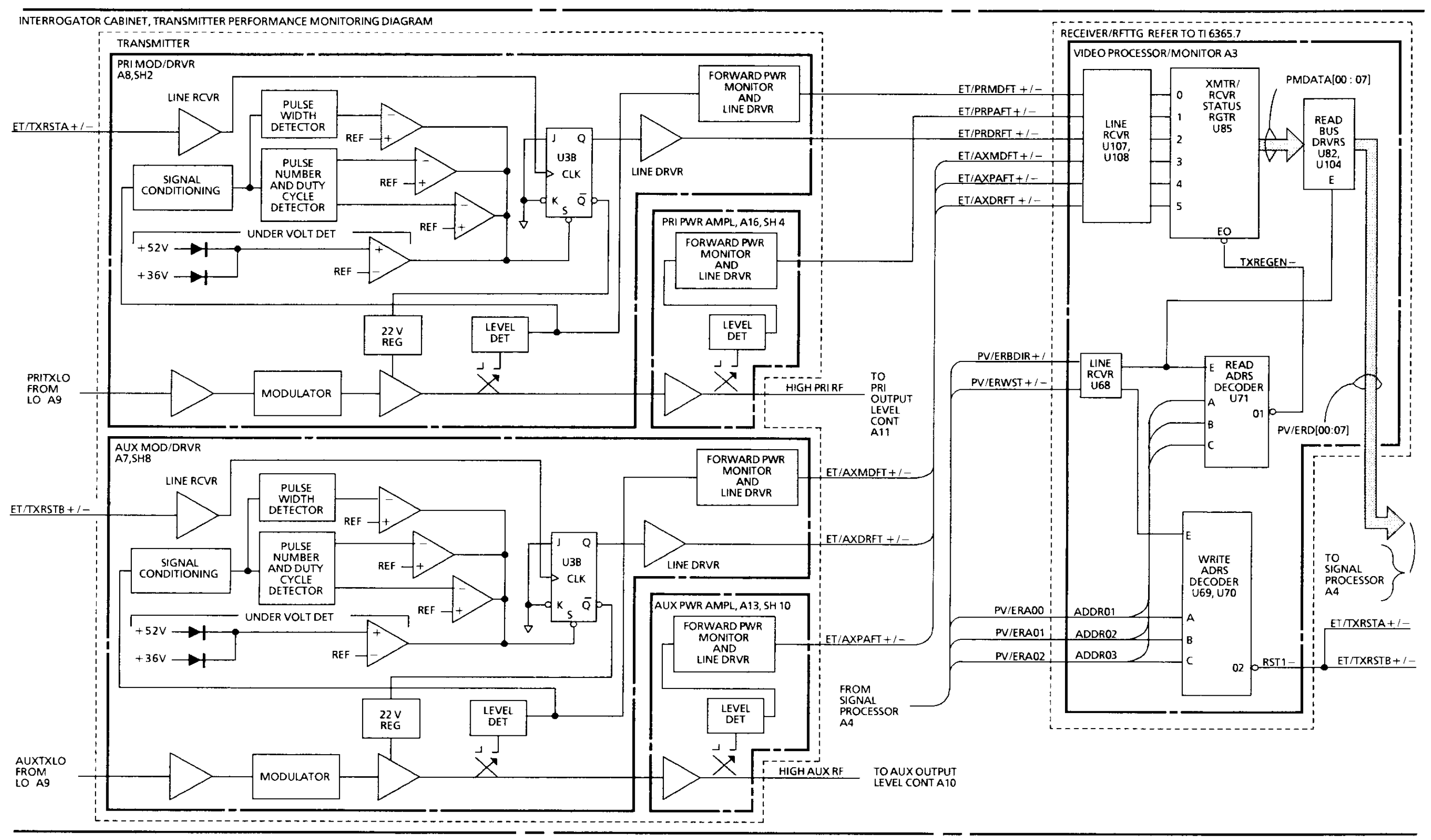

FIGURE 2-3. TRANSMITTER PERFORMANCE MONITORING SIGNAL FLOW DIAGRAM (SHEET 2 — END)

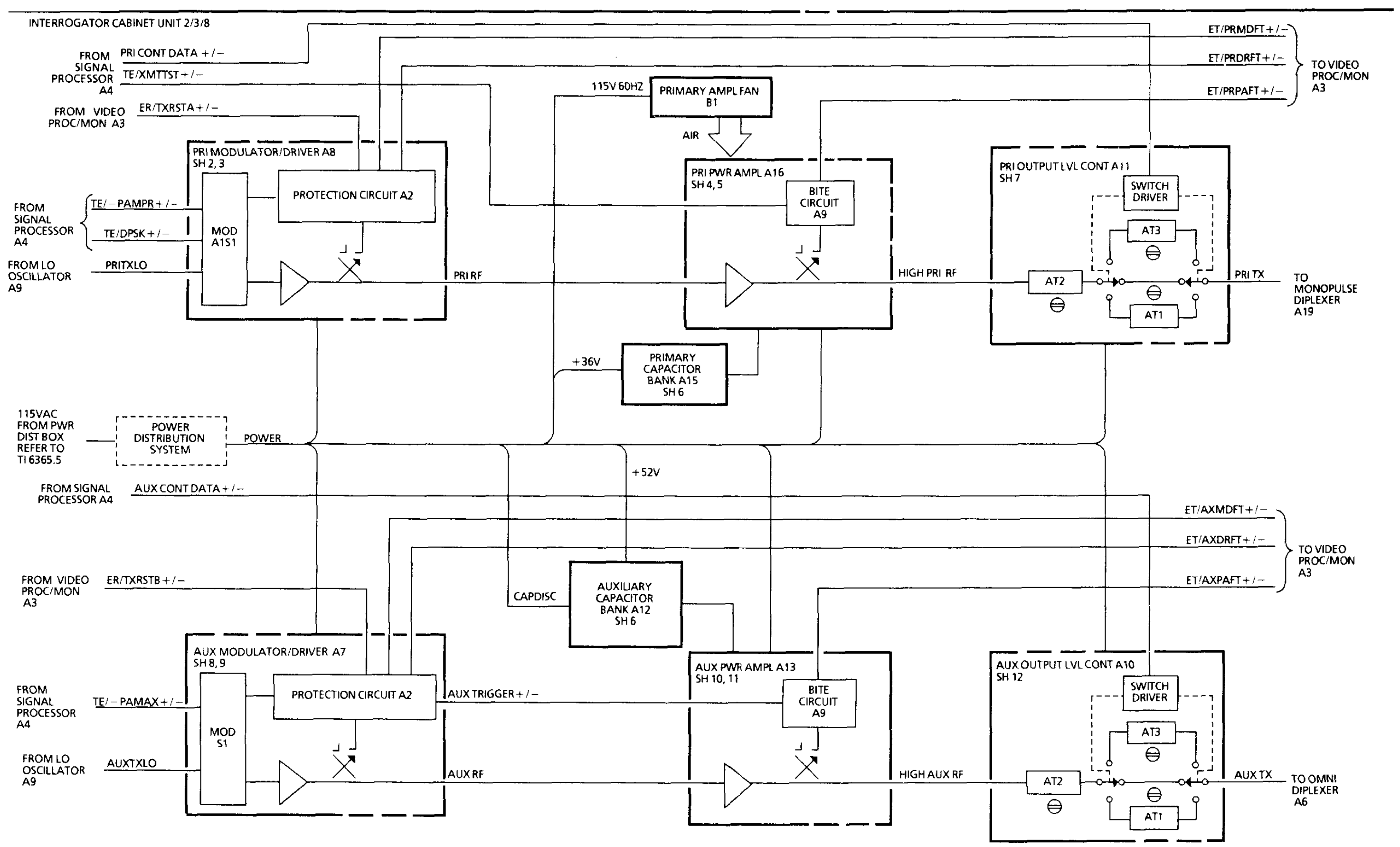

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (OVERALL) (SHEET 1)

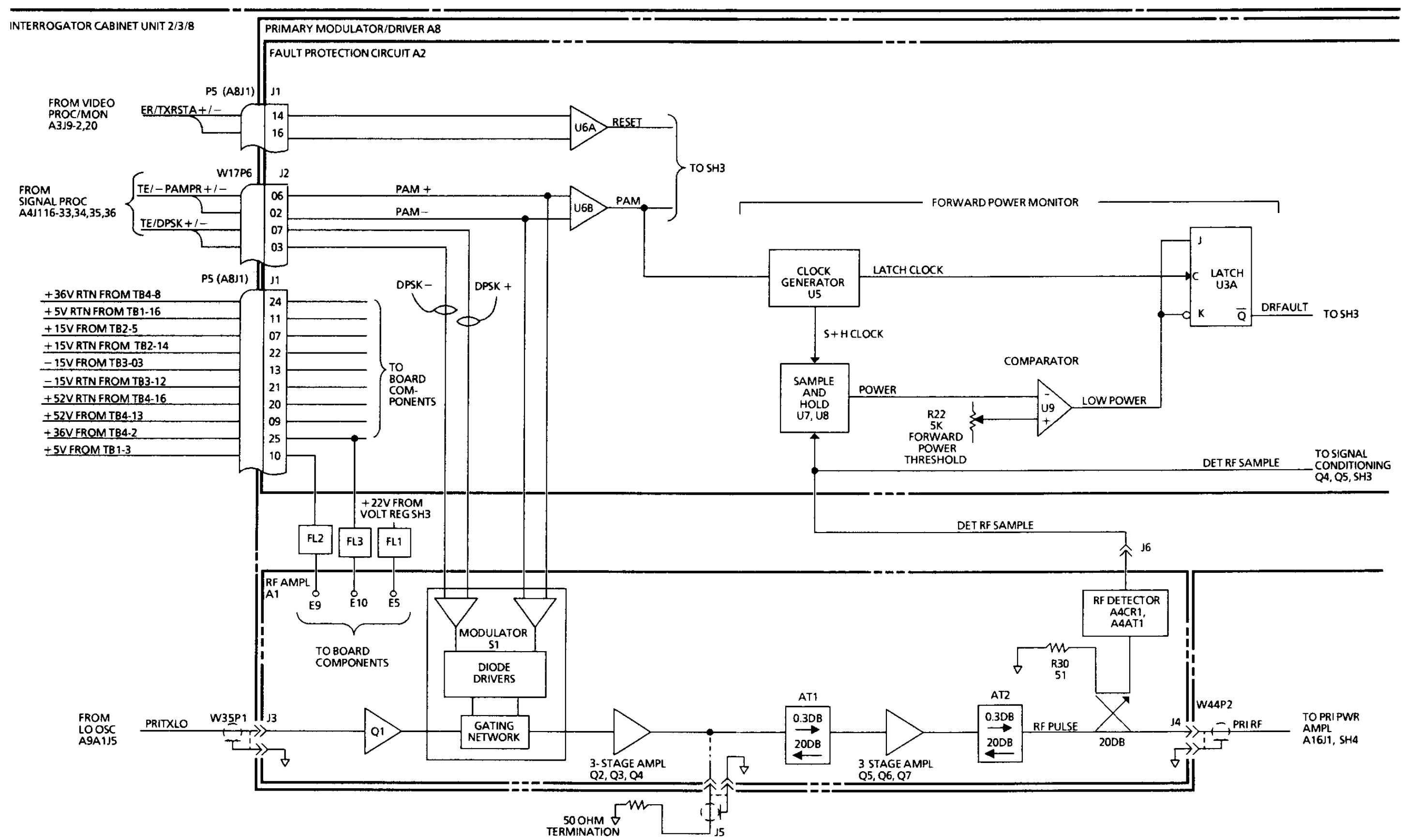

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY MODULATOR/DRIVER A8) (SHEET 2)

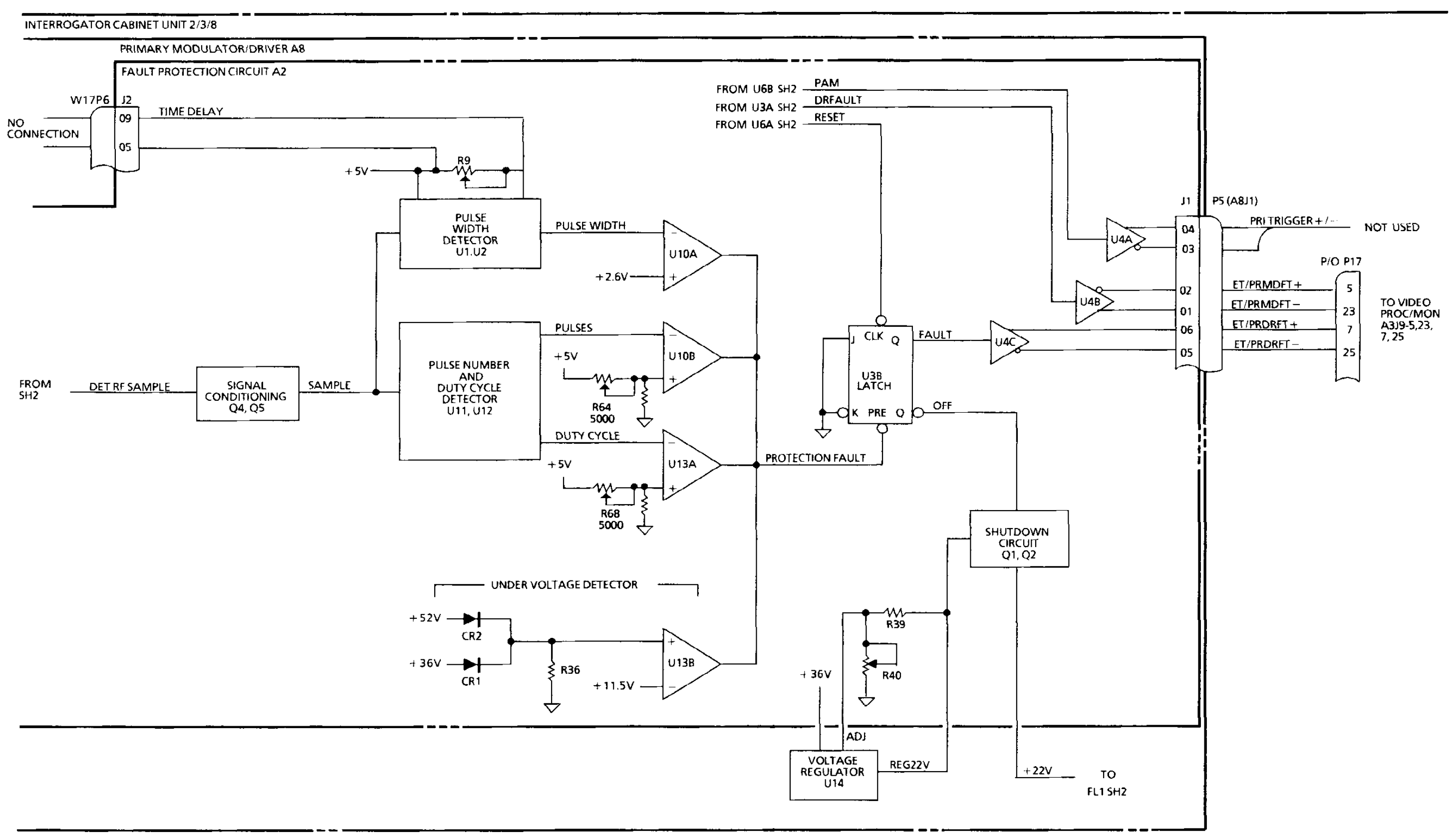

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY MODULATOR/DRIVER A8) (SHEET 3)

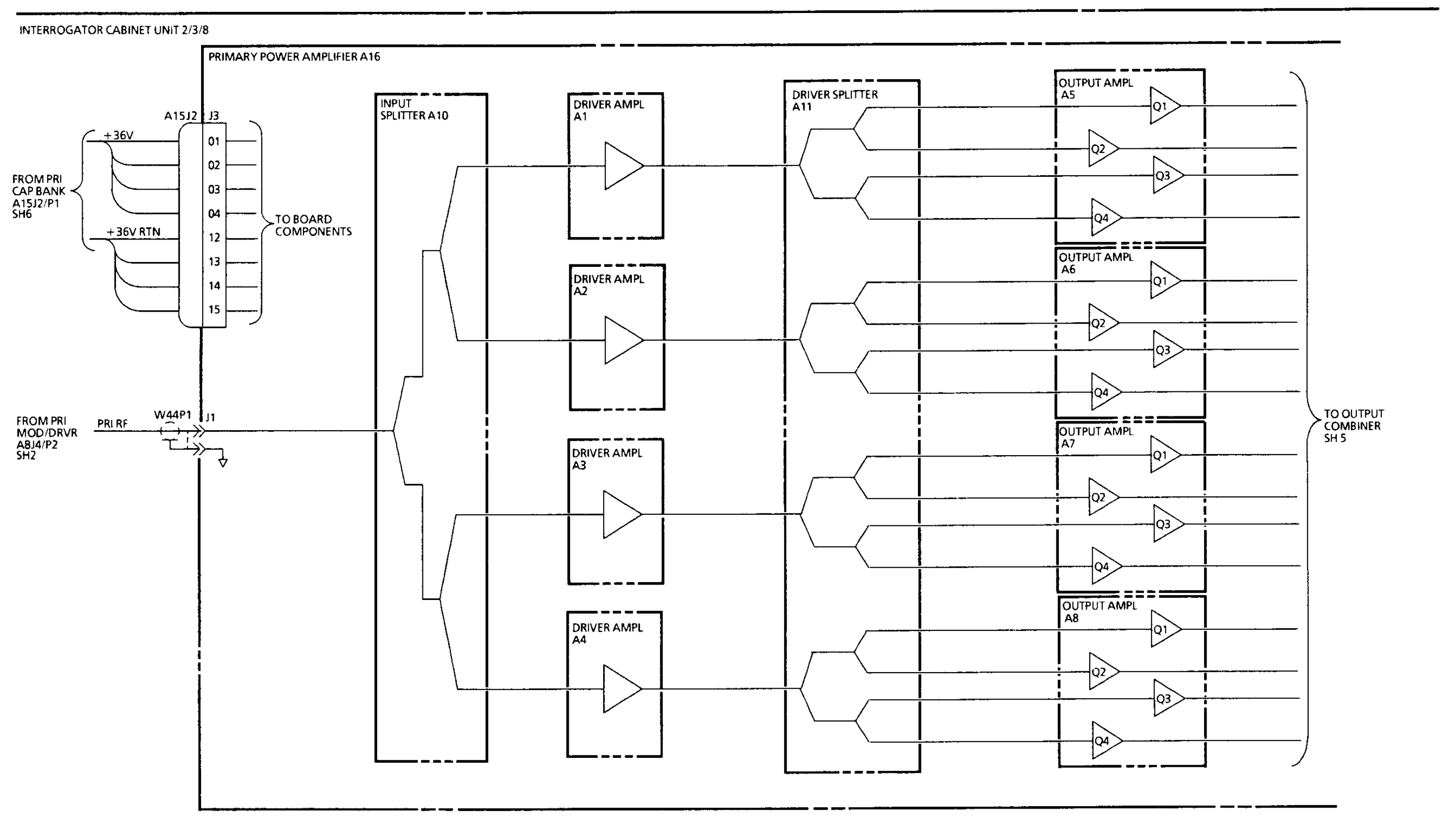

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY POWER AMPLIFIER A16) (SHEET 4)

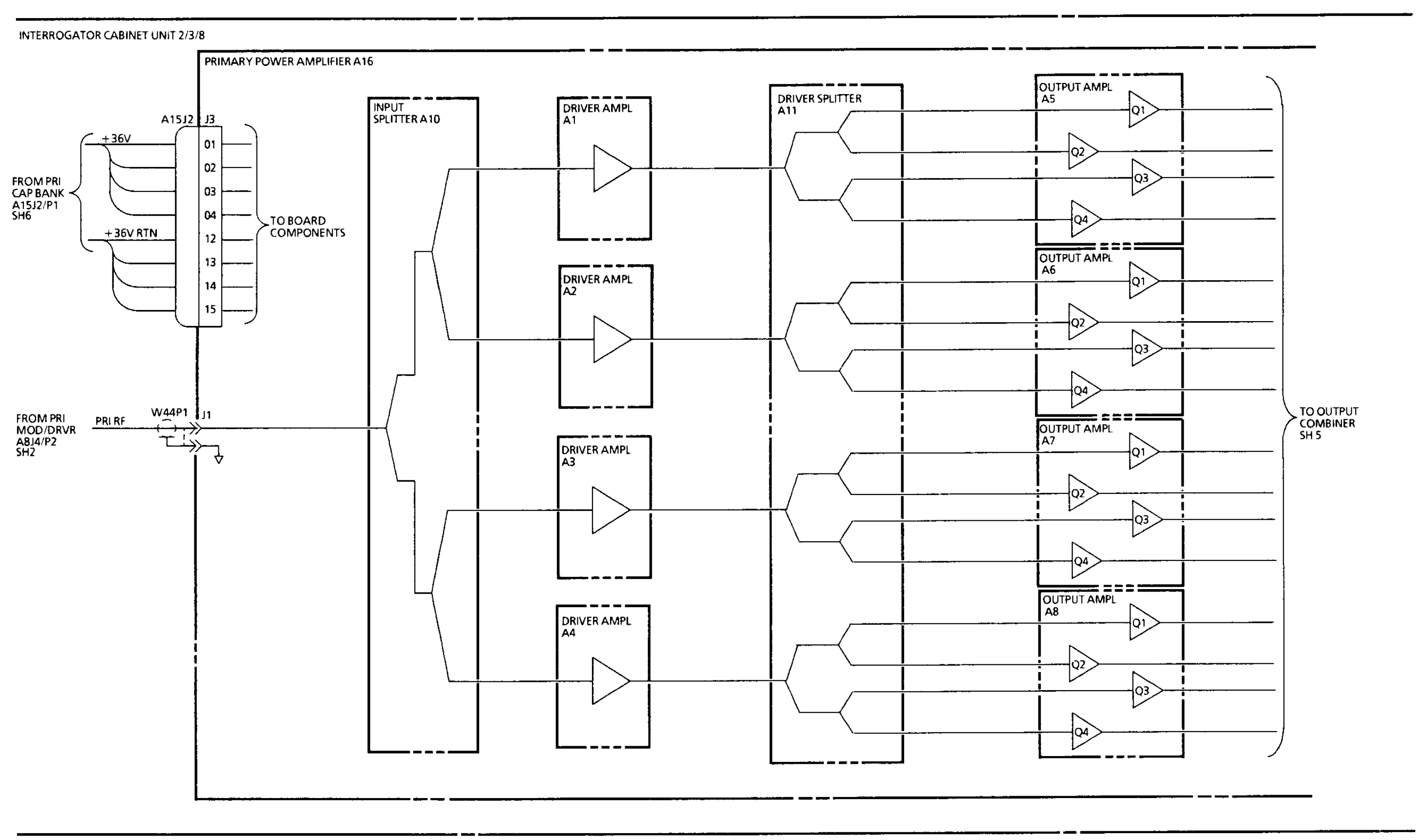

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY POWER AMPLIFIER A16) (SHEET 5)

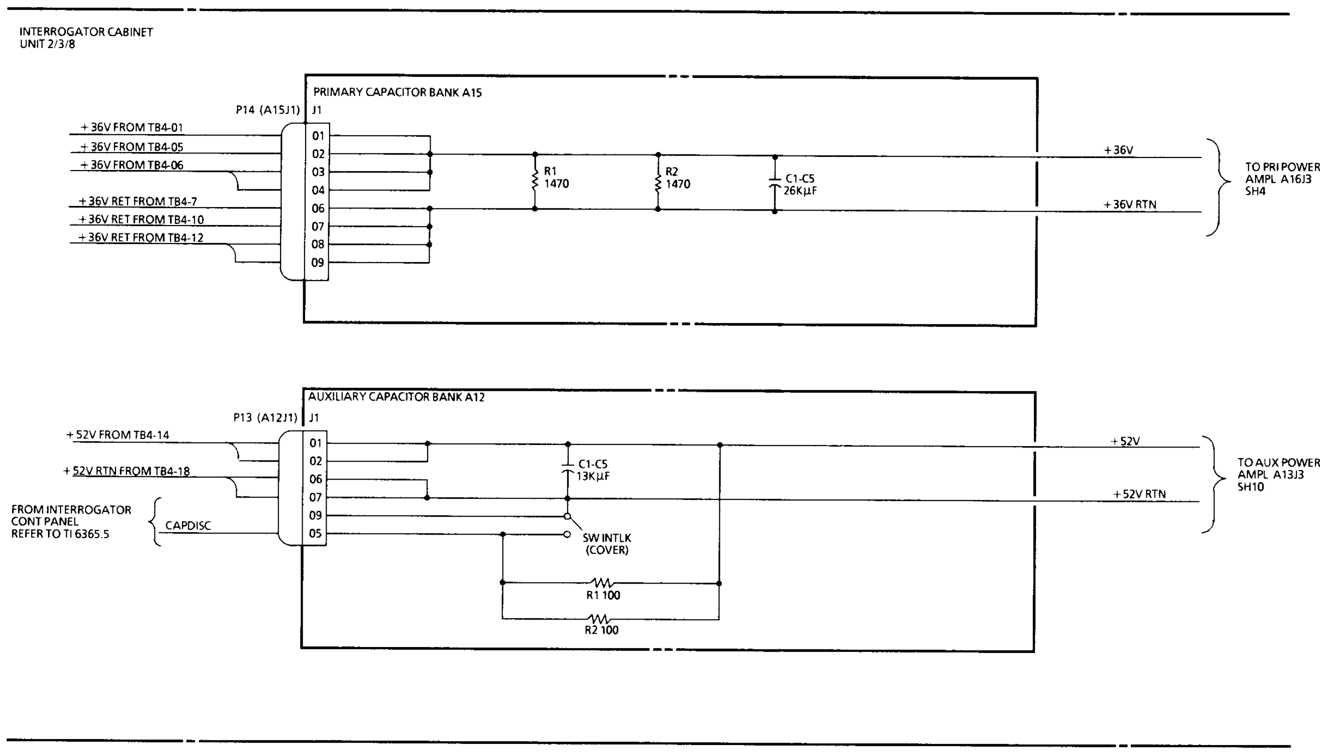

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY A15 AND AUXILIARY A12 CAPACITOR BANKS) (SHEET 6)

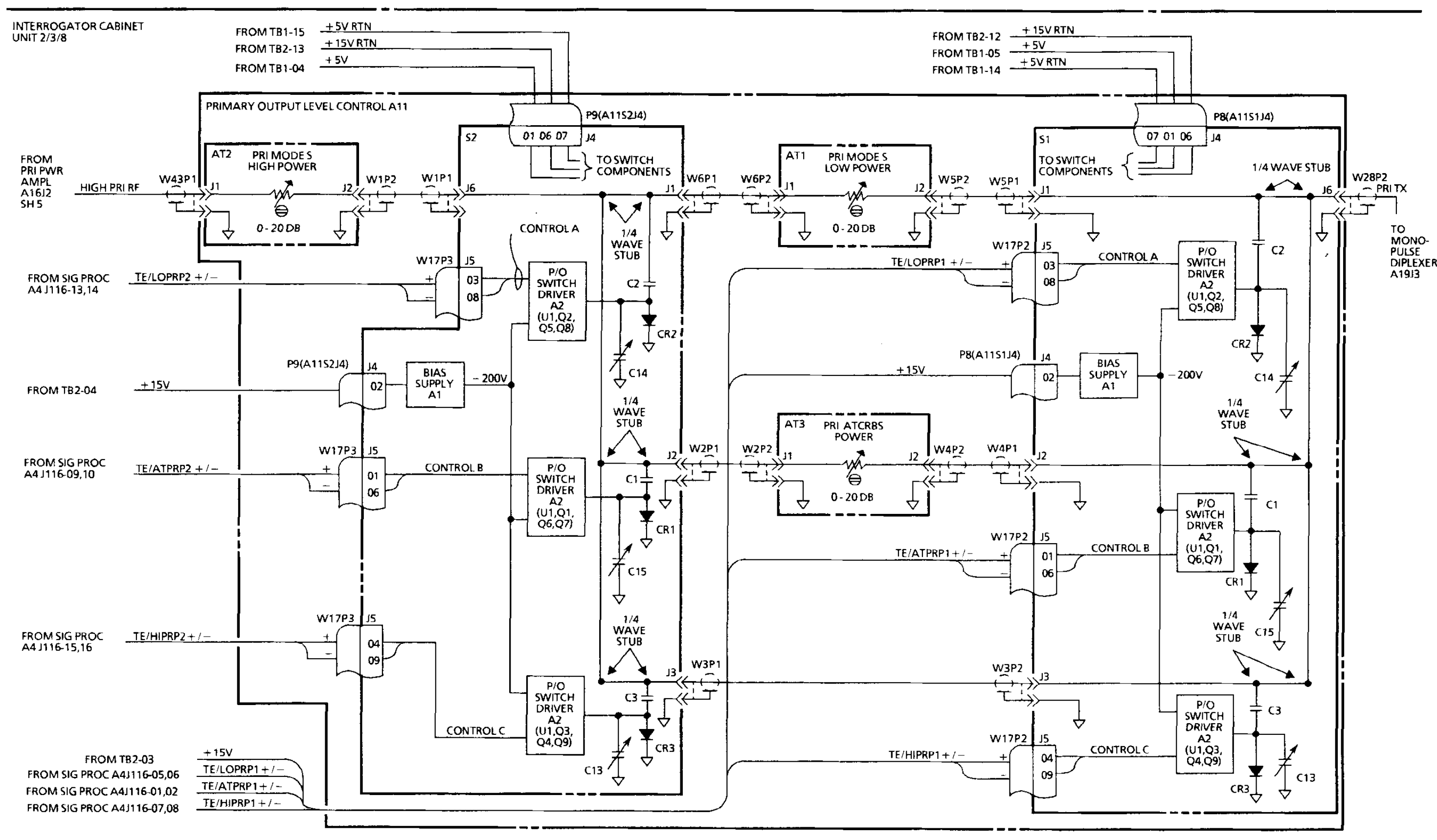

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (PRIMARY OUTPUT LEVEL CONTROL A11)
(SHEET 7)

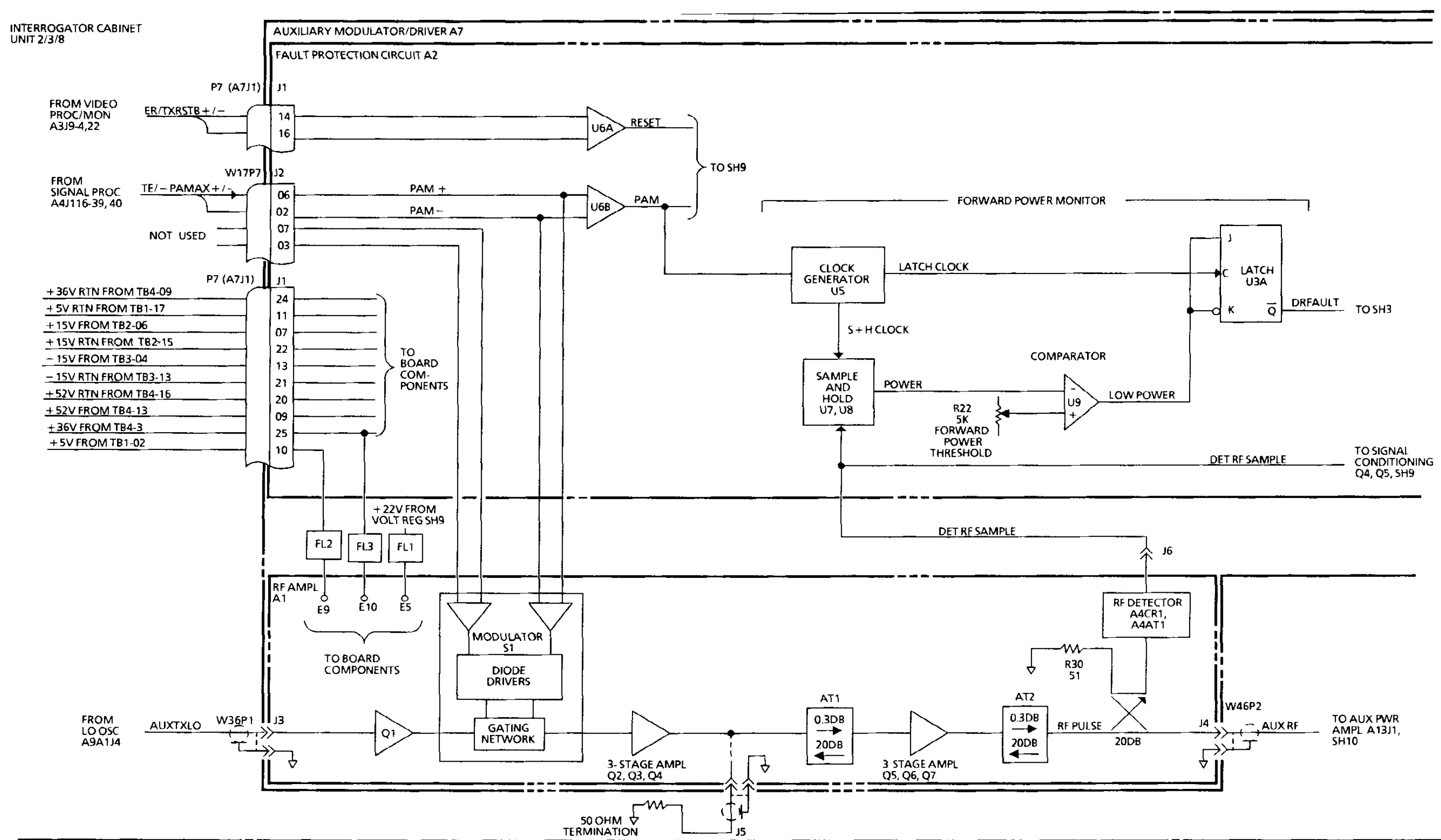

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (AUXILIARY MODULATOR/DRIVER A7) (SHEET 8)

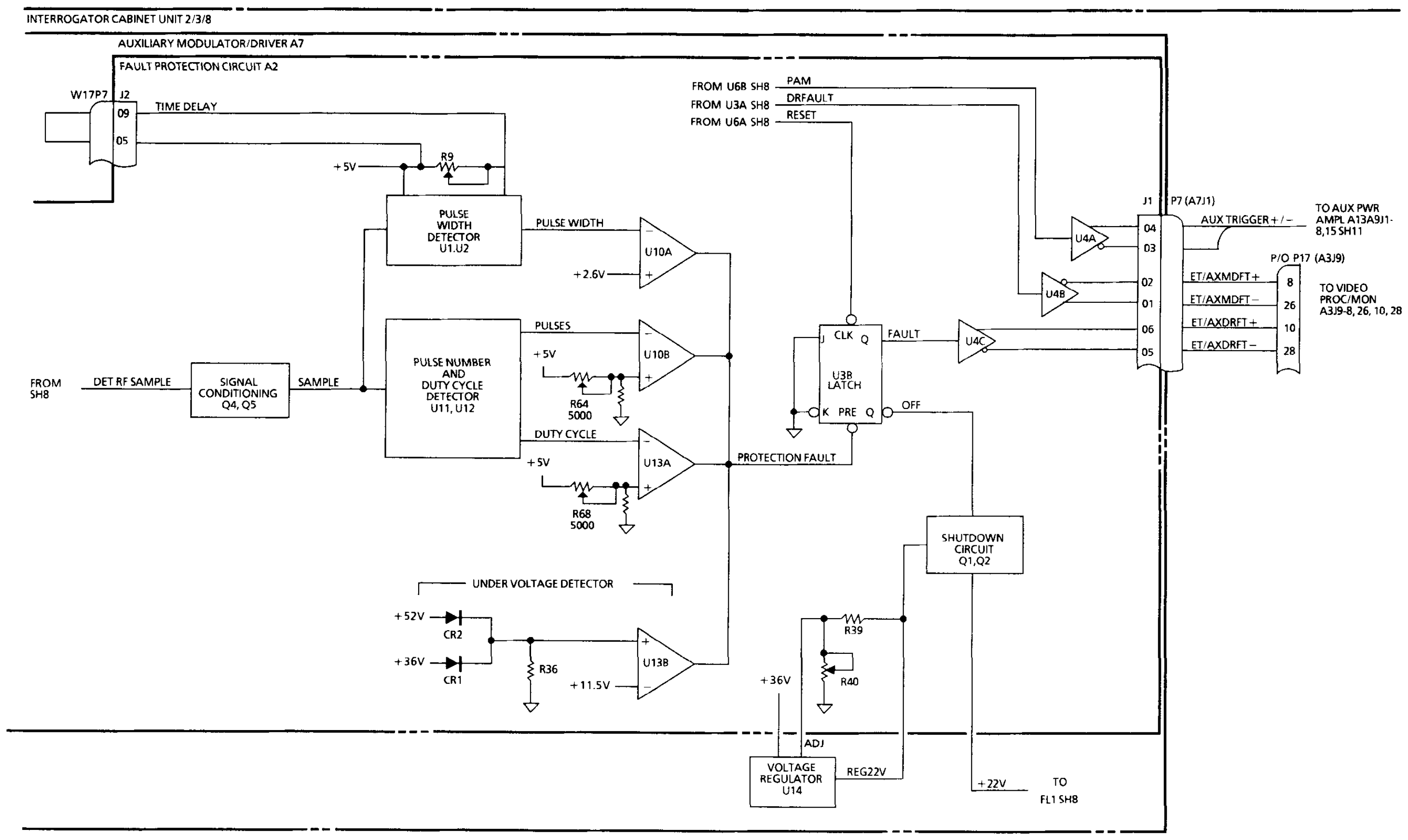

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (AUXILIARY MODULATOR/DRIVER A7) (SHEET 9)

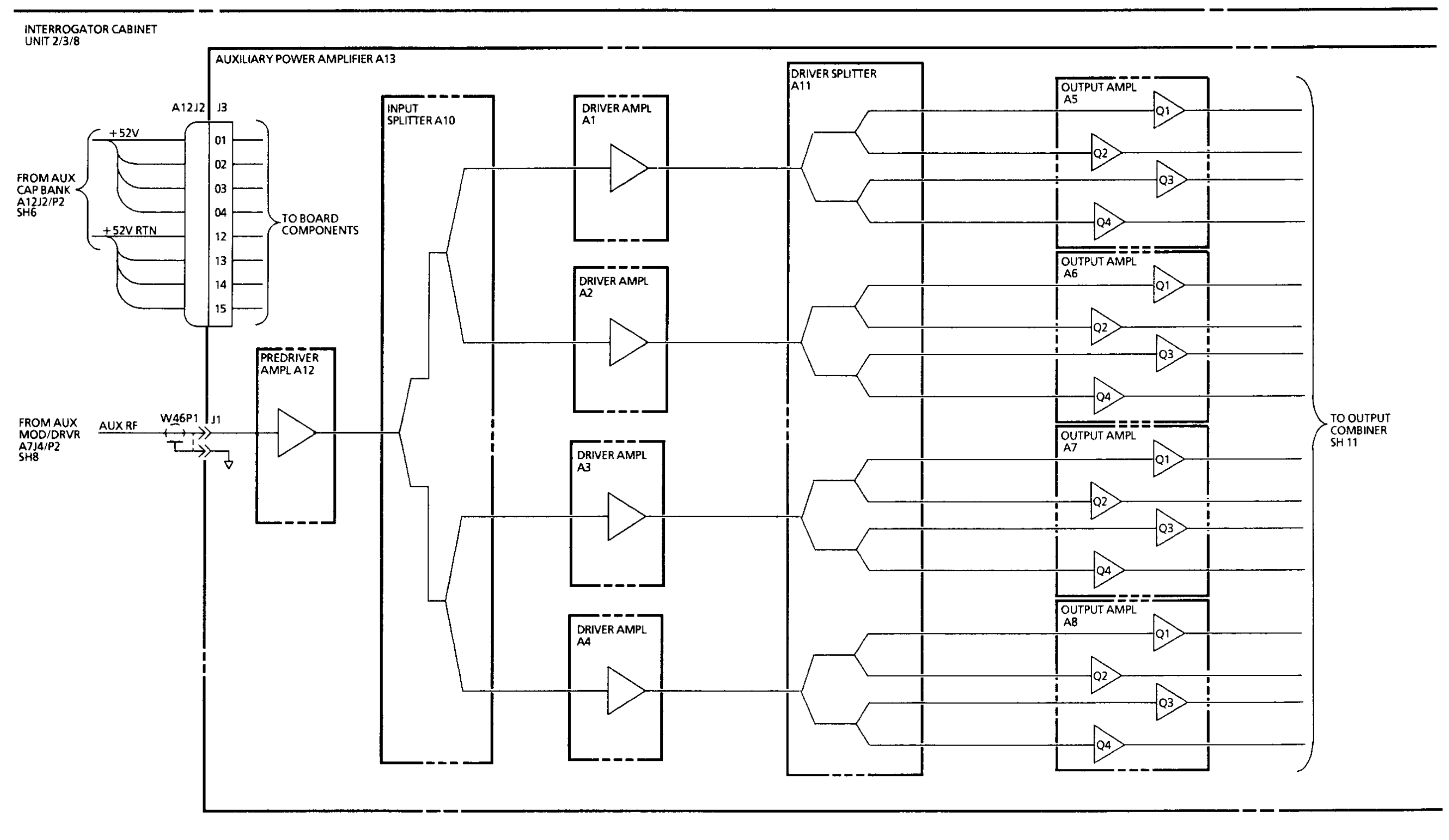

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (AUXILIARY POWER AMPLIFIER A13) (SHEET 10)

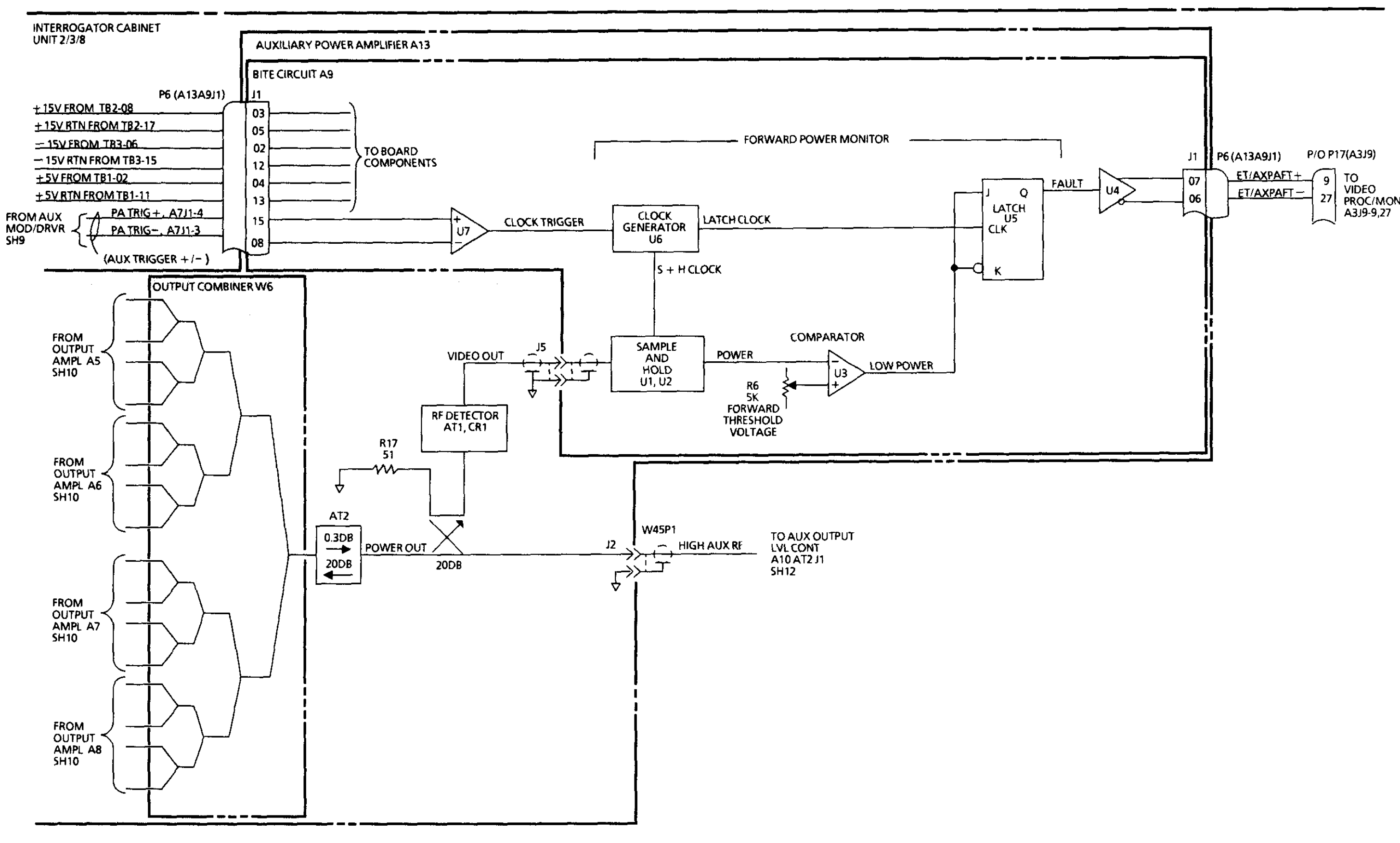

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (AUXILIARY POWER AMPLIFIER A13) (SHEET 11)

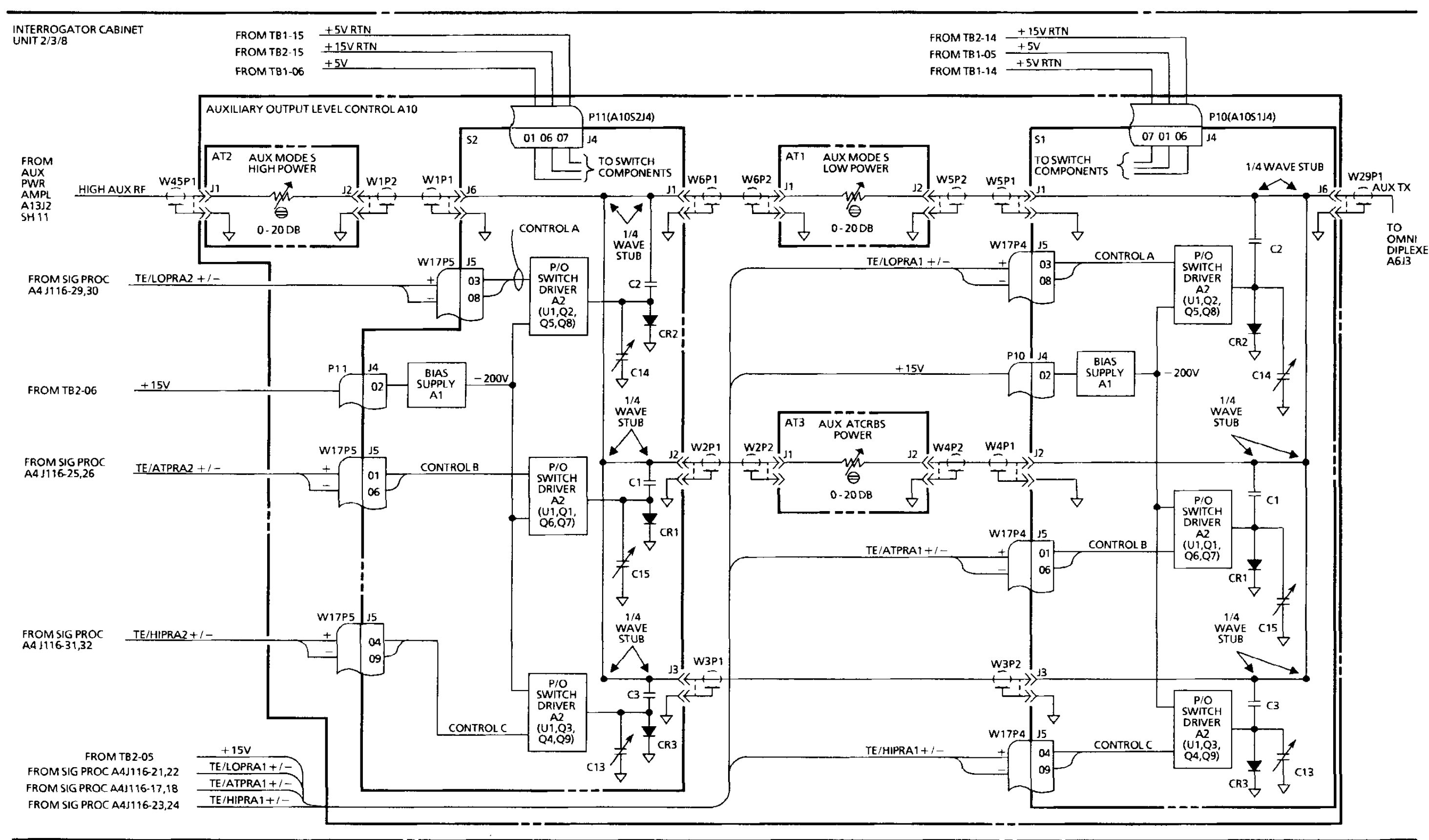

FIGURE 7-1. TRANSMITTER SIGNAL FLOW DIAGRAM (AUXILIARY OUTPUT LEVEL CONTROL A10)
(SHEET 12 — END)

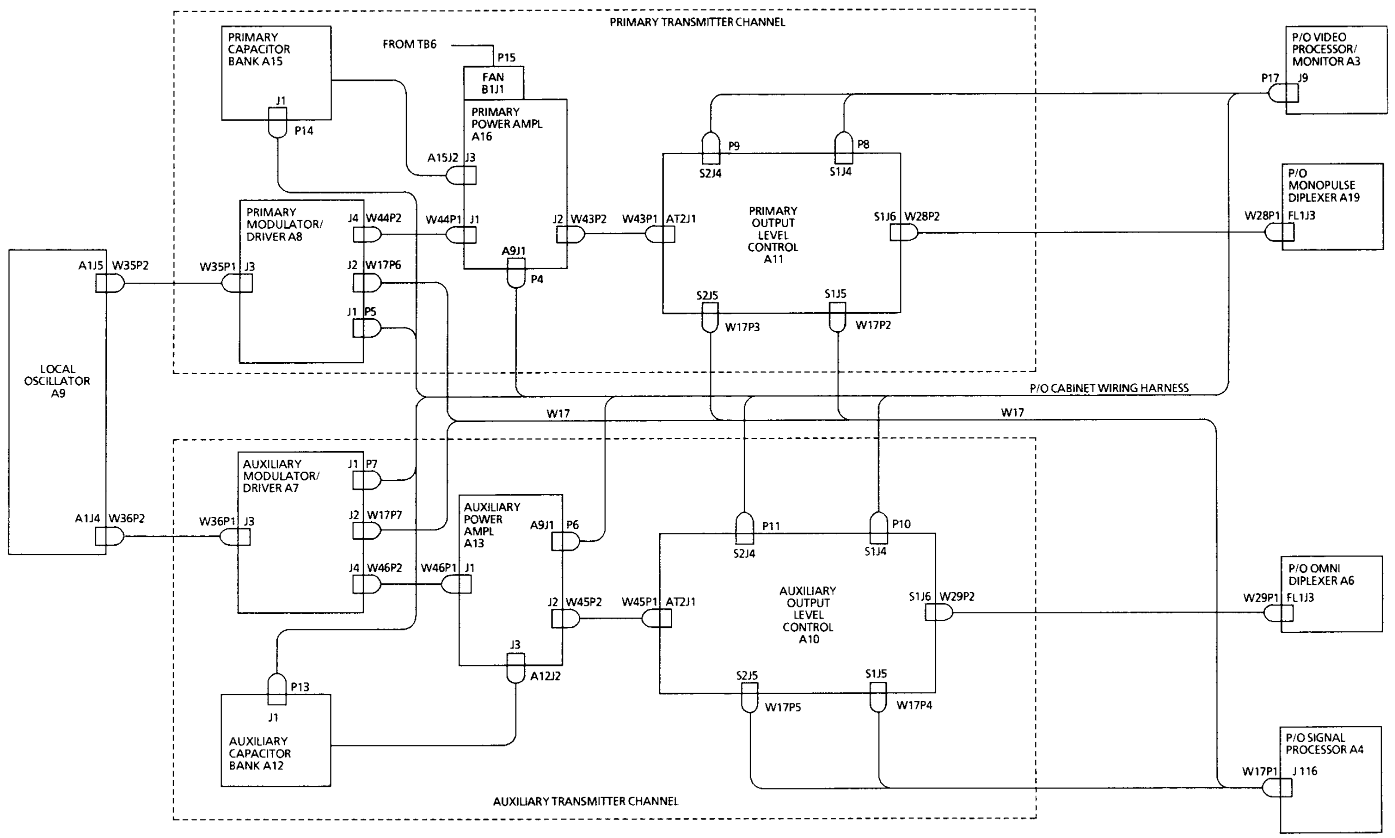

FIGURE 7-18. TRANSMITTER WIRING DIAGRAM (SHEET 1)

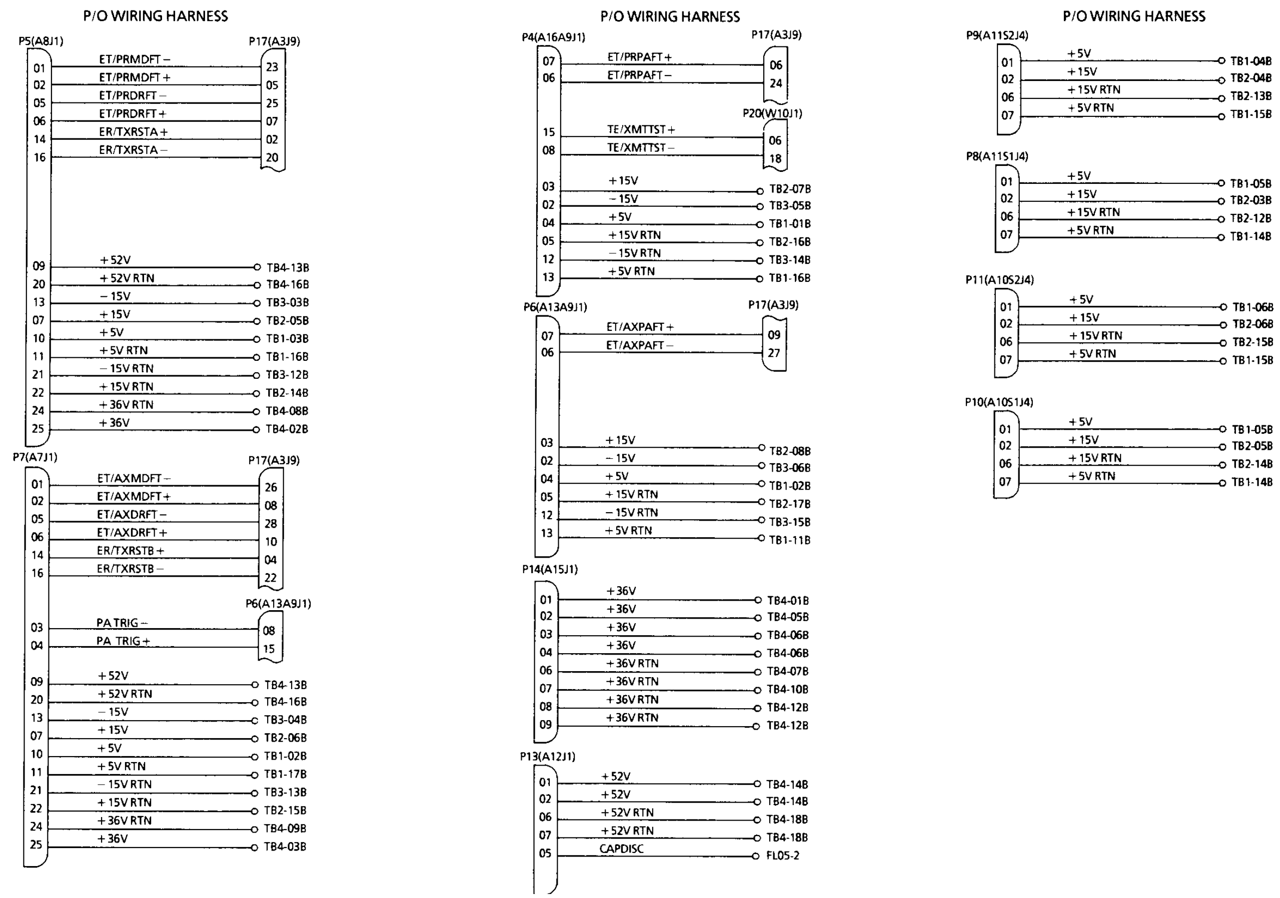

FIGURE 7-18. TRANSMITTER WIRING DIAGRAM (SHEET 2)

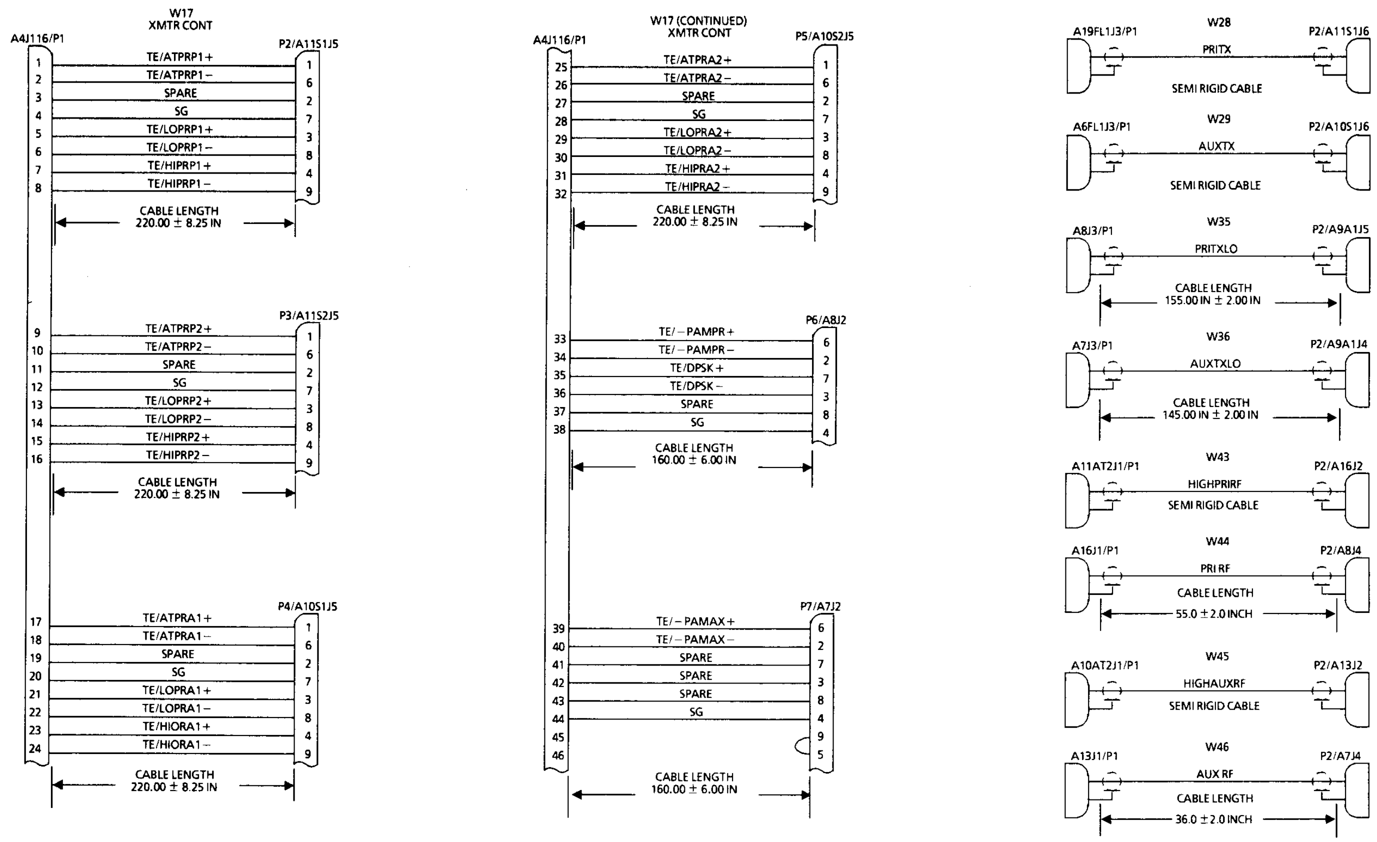

FIGURE 7-18. TRANSMITTER WIRING DIAGRAM
(SHEET 3 — END)

Appendix A

GLOSSARY

This glossary provides standard definitions for commonly used acronyms and abbreviations in this Mode S book.

Abbreviation	Definition
ABBREV	abbreviation
AC	alternating current
ACK	acknowledge
ACP	azimuth change pulse
ACT	activity
A/D	analog-to-digital
ADCOM	Air Defense Communications
ADJ	adjust
ADRS	address
ALM	alarm
ALU	arithmetic and logic unit
AM	amplitude modulation
AMPL	amplifier
APG	azimuth pulse generator
ARIES	Aircraft Reply and Interference Environment Simulator
ARP	azimuth reference pulse
ARSR	air route surveillance radar
ARTCC	air route traffic control center
ASR	airborne surveillance radar
ATC	air traffic control
ATCRBS	Air Traffic Control Radar Beacon System
ATE	automatic test equipment
ATTEN	attenuator; attenuation
AUX	auxiliary
AZ	azimuth
BCD	binary coded decimal
BIR	block input ready
BIT	built-in-test
BOT	beginning of test
BRKR	breaker
BRKT	bracket
C	clear (reset)
CD	common digitizer
CFE	contractor-furnished equipment
CHKB	check bit

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
CKT	circuit
CLK	clock
CLR	clear
CMD	command
CMPTR	computer
CNTR	counter
COMBR	combiner
COMJB	communications junction box
COMM	communication
COMPTR	comparator
CONFIG	configuration
CONT	control
CONV	converter
CORR	correct; correction
CPCI	computer program configuration item
CPME	Calibration Performance Monitoring Equipment
CPRSN	compression
CPU	central processing unit
CRT	cathode-ray tube
CSDIR	computer subsystem direction
CSS	computer subsystem
CW	continuous wave
D/A	digital-to-analog
dB	decibels
DB	distribution box
DC	direct current
DCDR	decoder
DEC	decimal
DEG	degree
DET	detector
DGTL	digital
DIAG	diagram
DMM	digital multimeter
DOPPA	delayed otherpulse
DPS	Data Processing System
DPSK	differential phase-shift keying
DPSS	digital processor subsystem
DRVR	driver
DSAK	data size acknowledge
DSR	data shift register
EDAC	error detection and correction
EEPROM	electrically erasable programmable read-only memory

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
EIB	equipment instruction book
ELM	extended length message
EMI	electromagnetic interference
ENBL	enable
EOT	end of test
EPROM	erasable programmable read-only memory
ERR	error
ESC	escape
ESD	electrostatic discharge
ESR	error syndrome register
FAA	Federal Aviation Administration
FD	fault detect
FE	front end
FET	field-effect transistor
FF	flip-flop
FI	fault isolate
FIFO	first-in-first-out
FIT	fault isolation test
FLT	fault
FR REF	frame of reference
FWD	forward
GEN	generator
GND	ground
GPI/O	general purpose input/output
GRAM	global random access memory
hr	hour
Hz	Hertz (symbol for cycles per second)
IATCRBS	independent air traffic control radar beacon system
IC	integrated circuit
ID	identification
IF	intermediate frequency
IFF	identification friend or foe
IISLS	improved interrogator side-lobe suppression
IN	indenture
I/O	input/output
INTERR	interrogator
INTFC	interface
INTRF	interference
INTRPT	interrupt
IOP	input/output processor
IPM	interrogator performance monitor

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
IR	input ready
IRIG–B	interrange instrumentation group B
ISLS	interrogator side-lobe suppression
JB	junction box
KCRT	keyboard cathode ray tube (panel placarding for terminal connection on signal monitor panel)
LA	line adapter
lb	pound
LCH	latch
LE	leading edge
LED	light-emitting diode
LO	local oscillator
LOG	logarithm
LOS	line-of-sight; line of sight
LRC	lowest replaceable component
LRU	lowest replaceable unit or line replaceable unit
LSB	least significant bit
LU	logical unit
LVL	level
Mbps	megabits per second
MCU	modulation control unit
MDT	maintenance data terminal
MEM	memory
MFP	multifunction peripheral
MHz	megahertz
MICRPS	microprocessor
min	minute
MK	mark
ML	message length
MNPLS	monopulse
Mode S	Mode Select Beacon Sensor System
MON	monitor
MPS	Maintenance Processor Subsystem
MPTH	multipath
ms	millisecond
MSB	most significant bit
MSG	message
MSJB	Mode S junction box
MSMI	Mode S major interface
MTD	moving target detector
MULTR	multiplier

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
MUX	multiplex, multiplexer
mW	milliwatt
ms	microseconds
NEG	negative
NADIN	National Airspace Data Interchange Network
nmi	nautical miles
NMTOY	North mark time of year
ns	nanosecond
NVMEM	nonvolatile memory
OSC	oscillator; oscillate
PA	planar array
PAL	programmable array logic
PAM	pulse amplitude modulation
PARA	paragraph
PCB	printed circuit board
PIN	position indicator
PMS	Performance Monitor(ing) System
PN	part number
POS	positive
POSN	position (see also PIN)
p-p	peak-to-peak
PPM	pulse position modulation
PRCSS	(DPS) processor subsystem
PRI	primary
PRL	parallel
PROC	processor
PROM	programmable read-only memory
PRPHL	peripheral
PRT	pulse repetition time
PS	power supply
PSF	program support facility
PW	pulse width
PWA	printed wiring assembly
PWR	power
RAM	random access memory
RCV	receive
RCVR	receiver
RECOG	recognition
RED	redundant
REF DES	reference designation
RF	radio frequency

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
RFTTG	radio frequency test target generator
RGTR	register (see also shift register)
RMS	remote maintenance subsystem
RMMS	remote maintenance monitoring system
RO	range zero
RRP	reply-to-reply processor
RW	read-write
s	second
SEC	second
SEL	select
SER	serial
SFD	signal flow diagram
SH	sheet
SIG PROC	signal processor
SLS	side-lobe suppression
SMPL	sample
SNR	signal-to-noise ratio
SNSR	sensor
SPI	special position identification
SPLY	supply
SR	shift register
SRAP	Sensor Receiver and Processor
STAT	status
STC	sensitivity-time control
SYNC	synchronize, synchronizer
SW	switch
TACP	test azimuth change pulse
TARP	test azimuth reference pulse
TCAS	Traffic Alert and Collision Avoidance System
TE	trailing edge
TEMP	temperature
TGT	target
TMG	timing
TOD	time of day
TOY	time of year
TTL	transistor transistor logic
TTG	test target generator
USART	universal synchronous/asynchronous receiver-transmitter
V	volts
V AC	volts alternating current
V DC	volts direct current

Appendix A

GLOSSARY (CONTINUED)

Abbreviation	Definition
VDD	version description document
VID	video
VPP	valid pulse position
VSP	variable site parameter
VSWR	voltage standing-wave ratio
XCVR	transceiver
XFR	transfer
XMT	transmit
XMTR	transmitter