ISC-T8311 E
and
ISC-T8411 E Transmitters

USER MANUAL

PN 9110.01156 Rev.D

Specifications subject to change without notice

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Rev D – Added label to 1.3 RF Hazards, Indicated 225 W rating w/o Isolator, Indicated complete range of nominal 28 VDC power supply.

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1 GENERAL

1.1 Manual Scope

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This manual provides information for the following transmitters:

- 200 (225 w/o Isolator)-watt, 150-MHz transmitter, model ISC-T8411E
- 125-watt, 150-MHz transmitter, model ISC-T8311E.

1.2 Applicable Documents

This manual is incomplete without additional manuals. See *Table 1-1, Applicable Documents,* for a listing and function of these manuals. Not all manuals listed are appropriate for a particular site, as transmitter controllers and power supplies differ. Also, new software revisions require new manuals which may not appear in the table.

Table 1-1 Applicable Documents

Document	Part Number	Note
ISC-T8xx1 transmitter system manual	9110.01156*	this manual
assembled ISC-T8411E manual	9100.01025	complete set of manuals for a transmitter
assembled ISC-T8311E manual	9100.01026	complete set of manuals for a transmitter
configuration, GL-C20x0 to ISC-T8x11E I20	9112.01042	describes equipment rackup and interconnections
DSP VDT manual	9110.00259*	describes DSP exciter software installed in exciter
DSP exciter user manual	9110.01021 *	describes DSP exciter hardware equipment in transmitter
GL-C2010 user manual	9110.00916	describes GL-C2010 controller hardware and software, v.3.0 UM
GL-C2000 user manual	9110.00949	describes GL-C2000 controller hardware and software, v. 3.0
ISC-T8411E/EC PA user manual	9110.00256*	describes 200-watt, 150-MHz PA with internal iso/cir
ISC-T8311E/EC PA user manual	9110.01006*	describes 125-watt, 150-MHz PA with internal iso/cir
power supply user manual	9130.00001	describes GL2835witching ac-to-dc power supply
dc-dc converter user manual	9110.00778	describes dc-dc converter
*part of assembled ISC-T8311E or ISC-T8411E transmitter manual		

1.3 Human Exposure to Radio Frequency Energy

In August 1996 the Federal Communications Commission (FCC) of the United States with its action in Report and Order FCC 96-326 adopted an updated safety standard for human exposure to radio frequency (RF) electromagnetic energy emitted by FCC regulated transmitters. Those guidelines are consistent with the safety standard previously set by both U.S. and international standards bodies. The design of this product complies with the FCC guidelines and these international standards.

This equipment is intended for use only in a permanent professionally installed licensed site. Licensing of that site may require that an Environmental Assessment be performed based upon human access, antenna type, antenna mounting height, ERP, operating frequency, duty factor, and any co-located transmitters that contribute to the overall Radio Frequency energy exposure level.

Compliance is ultimately the responsibility of the site licensee and a determination of compliance can only be made by evaluating the complex factors of the specific site.

1.4 Product Warranty Information

ISC Technologies warrants to the original purchaser that ISC Technologies products are free from defects in material or workmanship for a period of twenty-four months from the original invoice date, subject to the provisions herein. ISC Technologies will repair or replace at its option, FOB our factory, free of charge within one year from the date of shipment, any component, assembly or subassembly of our manufacture found to be defective under conditions of normal use. The unit, if repaired, will be returned to its original specifications. Failures caused by unauthorized modifications, *force majeure,* lightning, physical, environmental, or electrical damage including use with incompatible equipment are specifically excluded from this warranty. ISC Technologies disclaims any and all liability for loss or other damage whether direct, consequential or of any nature whatsoever, resulting from product failure.

This warranty is in lieu of all other warranties expressed or implied and covers only those items manufactured by ISC Technologies. Equipment supplied by, but not manufactured by ISC Technologies, is subject only to any warranty offered by the manufacturer of said equipment.

1.5 Service Warranty Information

Return of a defective item must be authorized by ISC Technologies prior to shipment. A Return Authorization number can be obtained from ISC Technologies Customer Service. When requesting a Return Authorization number, give the serial number of the unit. A description of the fault should accompany the unit on its return and the RA number must be shown on labels attached to the item(s). The cost of shipping to ISC Technologies is to be paid by the customer. Shipping from ISC Technologies will be prepaid by the customer, and shipped via surface mail. If express shipping is required, the unit will be shipped collect.

Any repair service performed by ISC Technologies under this limited warranty is warranted to be free from defects in material or workmanship for ninety days from the date

Transmitter specifications are subject to change without notice. See *Table 2-1, Specifications,* for various transmitter specifications. Listed specifications are applicable as of the manual printing date.

Also refer to the exciter, power supply, power amplifier, and other related manuals for more specifications. Test and measurement equipment is, where possible, calibrated in accordance with standards established by the National Institute of Standards and Technology (NIST).

Table 2-1 Specifications

	condition	specification
RF Characteristics		
RF output power	at RF OUT connector (W) ISC-T8411E ISC-T8311E	 100 to 200(225w w/o Isolator) 20 to 125
frequency range	In bands. (MHz) A major frequency change requires changing assemblies.	138-174
Physical Characteristics		
chassis dimensions overall	standard EIA cabinet	H x W x D inches: 5.25 x 19 x 16.5: (13.3 x 48.3 x 16.5 cm)
weight by transmitter model	PA chassis with exciter ISC-T8411 E ISC-T8311E	 40 lb (18.3 kg) 40 lb (18.3 kg)
Service Conditions		
elevation	continuous operation at rated power	to 10,000 ft (3050 m) (see temperature derating factor)
temperature	operating	-30 to +60 degrees C
	storage	-40 to +70 degrees C
temperature derating factor	above 5000 ft (1525 m)	2 degrees C per 1000 ft (305 m)
humidity	operating, noncondensing	0 to 95 percent
Voltage Requirements and Power Consumption		
dc input voltage	all models	28 Vdc Nominal (24-30VDC Operating range)
ripple on dc input	up to 120 Hz over 120 Hz	1.5Vp-p max 50 mVp-p max
tx power consumption at 28 Vdc	ISC-T8411E ISC-T8311E	600 W 450 W

Table 2-1 Specifications (continued)

	condition	specification
Performance Specifications		
spurious output by model	ISC-T8311E ISC-T8411E	-90 dBc -90 dBc
harmonic output by model	ISC-T8311E ISC-T8411E	-90 dBc -90 dBc
RF output stability	all models	0.5 dB over temperature range
Intermodulation of PA w/ circ.	all models	-40 dB
adjacent ch noise, 4-level FSK	all models (25-kHz spacing)	-70 dB
Alternate ch noise, 4-level FSK	25 kHz spacing ISC-T8311E ISC-T8411E	 -90 dBc -100 dBc
frequency stability	all models	0.005 parts per million
cabinet radiation	all models	0.25 uW (maximum)
FM hum and noise	all models	-40 dB in 15-kHz bandwidth
keyup / keydown time	all models	10 ms to +1.5 / -1.0 dB of rated power

3.1 Conceptual Description

The paging transmitter provides a modulated, high-level RF signal, which activates pagers within the coverage area of its associated antenna. The paging transmitter receives modulation and control information from the transmitter controller, which receives information from a control site. In a simulcasting environment, the control site may feed several paging sites at once. This transmitter is a computer-controlled device. All user-initiated setup and maintenance operations are accomplished using the video display terminal connected through the exciter.

3.2 Physical Description

Refer to *Figure 3-1, Transmitter Chassis Isometric Front View,* which shows a front view of the transmitter chassis which is used in all models in this transmitter series, and to, which shows a rear view of the transmitter. It is virtually impossible to identify the transmitter from the front view or rear view.

- Refer to *Figure 3-2, ISC-T8411 E PA Top View,* or *Figure 3-3, ISC-T8411 E PA Top View.* Positive identification can be done by removing the PA top cover since each transmitter has a unique PA compartment.
- A transmitter identification label is affixed to the bottom panel, behind the exciter.

3.2.1 Mounting Provisions

The transmitter chassis is mounted in the rack by screws which are inserted into the angle brackets on either side of the chassis. Access to the exciter and PA compartment is gained from the front; access to the metering board, fans, and I/O connections is gained from the rear.

3.2.1.1 PA and Exciter Assemblies

The transmitter chassis contains slide-out locations for the following:

- PA RF compartment (2 RU)
- exciter (1 RU)

Rear-mounted fans blow air across the PA heat sink and out the back. Fan speed is regulated by external temperature sensors located by the heat sink.

The PA RF compartment and exciter are mounted on slides which allow them to be accessed or removed by loosening the screws on either side of the assembly. Most exciter maintenance operations can be performed with the exciter mounted in the rack. Most PA maintenance can be performed with the PA RF compartment mounted in the rack.

3.2.1.2 Power Supply

The power supply is contained in a separate chassis which is mounted separately from the transmitter chassis. The power supply may be an ac power supply, which converts 50/60-Hz mains power to dc voltage for the transmitter, or it may be a dc-to-dc converter. Some sites provide 28 Vdc directly to the transmitter. Refer to the power supply manual for details.

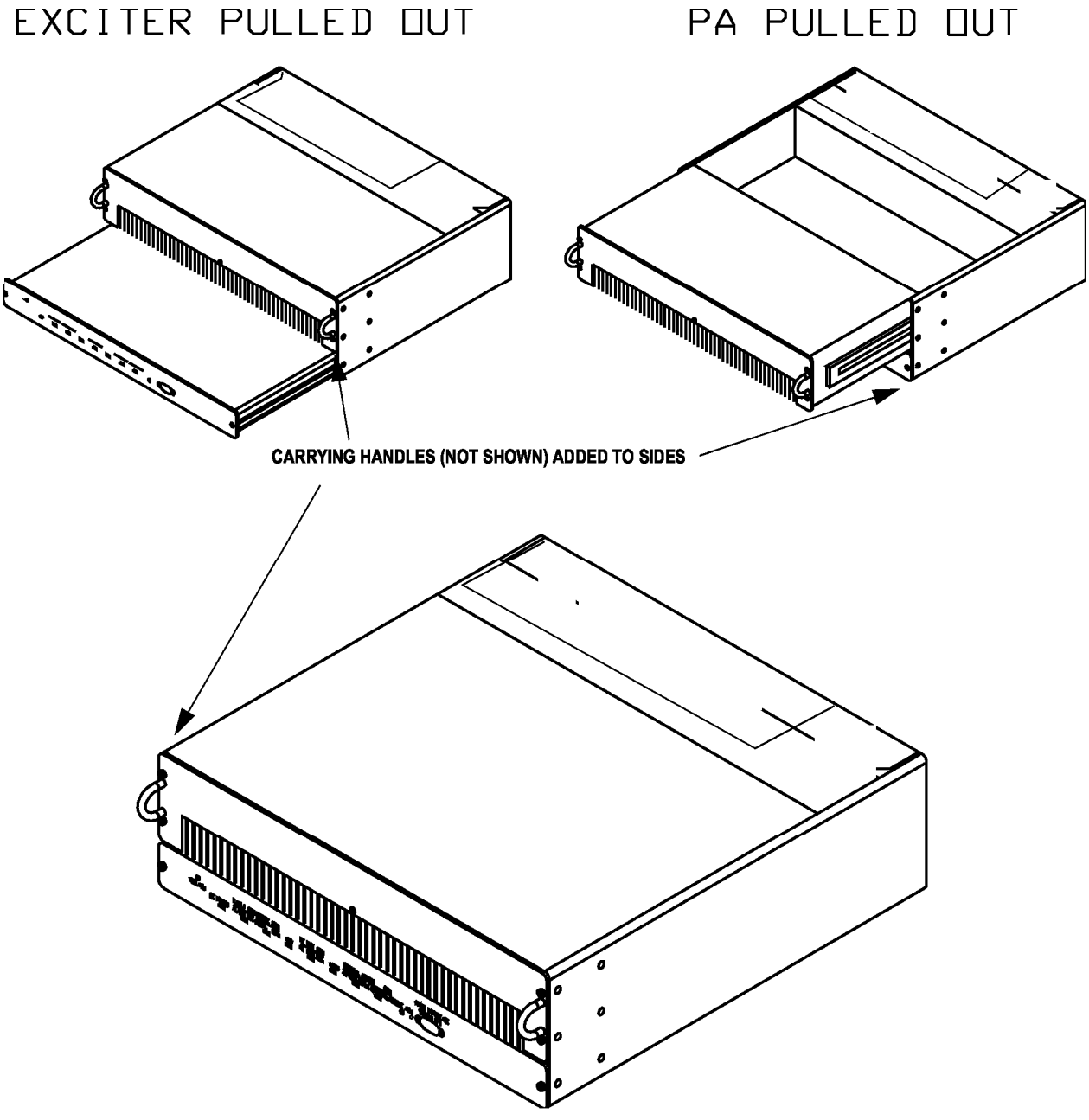

Figure 3-1 Transmitter Chassis Isometric Front View

3.2.1.3 Video Display Terminal

A video display terminal (VDT) is not part of the racked-up equipment; instead, it is a piece of test equipment which the user brings to the site when setup, maintenance, or troubleshooting is necessary; or it is used as a monitoring device. Refer to the VDT manual for details, including cable requirements.

3.3 Simplified Paging-Site Functional Description

3.3.1 Paging Site

The following paragraphs provide a block diagram-level functional description of a typical paging site.

Refer to *Figure 3-5, Transmitter Functional Diagram*. This figure shows basic signal flows between the various paging site equipment pieces. The communications device which the transmitter uses in order to communicate with the control site is not shown and may vary from application to application.

3.3.2 Communications Equipment and Transmitter Controller

A link receiver, satellite receiver, microwave drop, telephone link, or other similar device is used for communication between the transmitter controller and the control site. The particular device depends on the application.

The transmitter controller is typically a model GL-C2010 or GL-C2000. There are various ways of interfacing the transmitter controller to the I/O portions of the exciter. Refer to the transmitter controller manual and the exciter manual for details.

3.3.3 Paging Transmitter

The paging transmitter converts the signal from the transmitter controller into modulated and amplified RF. Depending on the type of transmitter controller-to-exciter interface which is used, the modulation information from the transmitter may be audio, modem signals (analog or digital), or a digitized representation of the original signal. In any case, all analog signals are ultimately converted to digital form at some point between the paging terminal and the DSP modulator in the exciter.

Operation is in response to commands from the transmitter controller via the DSP exciter. The transmitter monitors its functions and reports its status to the VDT via the exciter. The transmitter controller permits the transmitter to be controlled and monitored from a remote location. Local control and monitoring is performed through a VT-100 video display terminal (VDT).

3.3.3.1 DSP Exciter

The DSP exciter combines functions of an RF exciter and a PA controller. The exciter generates modulation using digital signal processing (DSP) to achieve accurate, stable modulation that does not vary with time or temperature. The PA-control section monitors

transmitter status signals in the form of fault logic and voltage samples. The microprocessor in the exciter reports PA status to the transmitter controller, VDT, and the exciter front panel. If a malfunction occurs, the transmitter enters a reduced operating condition, depending on the seriousness of the fault. PA control and status monitoring are performed by the microprocessor, which consolidates control logic from the transmitter controller or the locally operated VDT. Both the exciter and transmitter controller receive continuous status reports from the microprocessor. The exciter is the control and status-monitoring interface between the transmitter and the user.

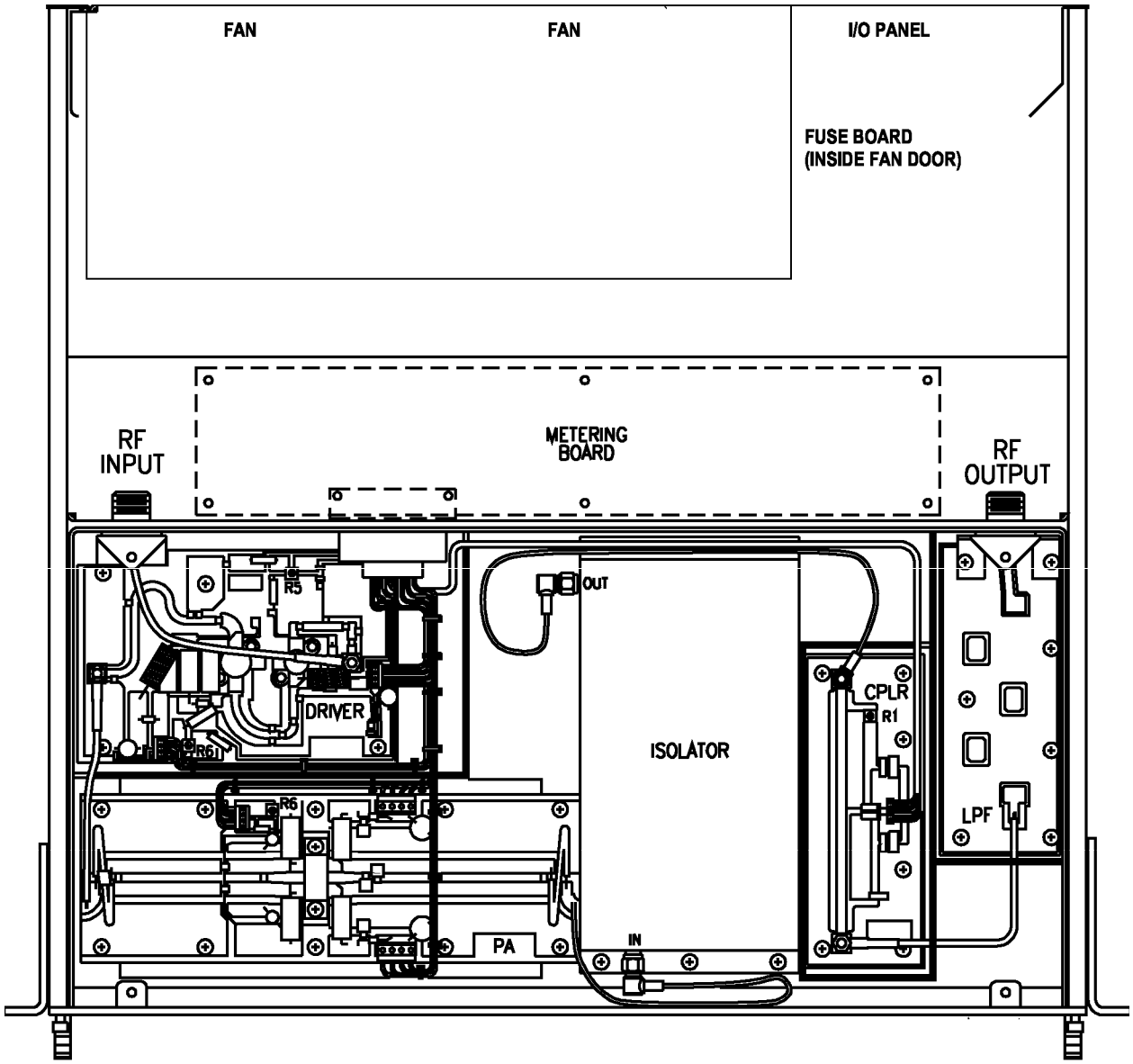

Figure 3-2 GL-T8411E PA Top View

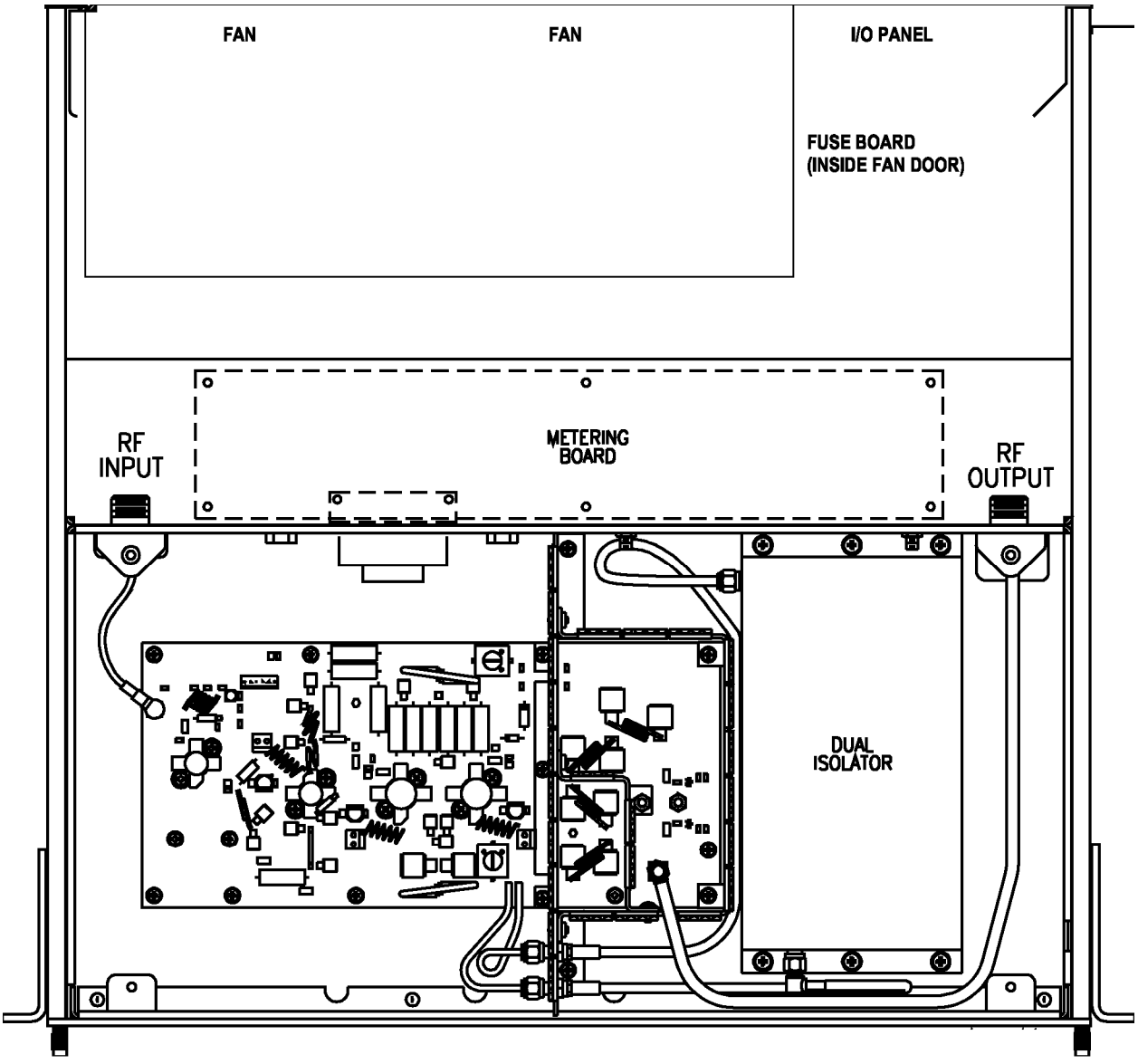

Figure 3-3 GL-T8311E PA Top View

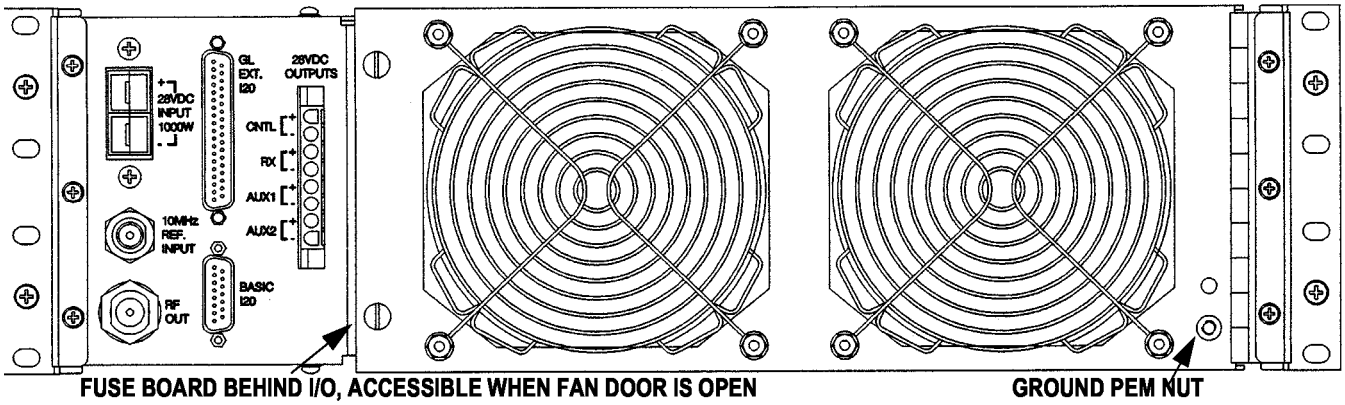

Figure 3-4 ISC-T8311E/T8411E Transmitter Rear View

The exciter provides up to 0.25 watt of RF drive to the PA. A power-reference signal from the PA is fed back to the exciter, via the metering board, to allow control and monitoring of output power.

3.3.3.2 Power Amplifier RF Compartment

The PA performs amplification of the RF signal generated by the exciter. The PA amplifies a nominal 0.25-watt signal to rated power for application to the antenna system. Monitoring circuitry is on the metering board in the rear compartment of the PA chassis.

3.3.3.3 Metering Board

The metering board provides a rectified dc sample of the PA output to the exciter; the exciter, in turn, generates a power-control voltage which maintains PA power at the desired level.

The metering board also returns operational parameters of the PA, which information can be read by the transmitter controller and the VDT.

The metering board also serves as a distribution point for dc power for other assemblies within the transmitter chassis. Refer to *Table 6-2, Exciter J6-to-Metering Board DB-1 5 J6 Pin Functions,* for a list of functional connections between the metering board and the PA RF compartment.

3.3.3.4 Power Supply

Because different power supplies can be used, refer to the appropriate power supply manual for details.

3.3.3.4.1 Ac-Powered Sites

The standard ac power supply takes ac input, converts it, rectifies and filters it, and supplies dc output to all racked equipment. Each dc circuit is individually fused on the front of the supply. (The standard transmitter rackup, however, does not use the power supply's indi-

vidual fuses. Instead, auxiliary equipment is powered and fused from the I/O board of the transmitter.) A circuit breaker on the front of the supply doubles as a transmitter power on/off switch.

3.3.3.4.2 Dc-Powered Sites

An external dc source should meet all pertinent specifications. A direct 28-volt feed should be fused at the current source. A racked dc-to-dc converter needs to have adequate cooling provisions so as not to overheat other racked equipment.

3.3.4 Video Display Terminal

The VDT, though not part of the transmitter, is required for setup, local control, and local monitoring of the transmitter. The VDT can be any laptop or desktop terminal with a VT-100 type program. The VDT interfaces the transmitter through the connector on the front of the exciter. The VDT software is menu-driven.

3.4 Site Signal Flows

All operational signal I/O connections are made at the rear of the transmitter chassis. VDT connection for setup, checkout, and maintenance is via a front-panel connector on the exciter.

3.4.1 Site RF-Signal Flow

Exciter RF signal

The on-frequency carrier is created by the VCO circuitry in the DSP exciter. It is then modulated with paging information, amplified, and sent to the PA via connector J3 on the back of the DSP exciter. Through coaxial cable, the carrier goes to the back of the PA RF compartment, where it is further amplified to a preset level under control of a microprocessor within the exciter. The amplified signal is cabled from the PA output to the RF OUT connector.

10-MHz reference

Most installations have a ten-MHz reference signal cabled from the transmitter controller to the 10MHZ REF. INPUT connector on the I/O panel, then to connector J8 on the back of the DSP exciter.

3.4.2 Site Modulating-Signal Flow

Modulation information arrives at the site either through a satellite receiver, a link receiver, or by wireline. The signal can be either analog or digital and is first routed through the transmitter controller, which checks for and responds to appropriate embedded commands. Paging information is normally supplied to the exciter via the GL EXT. I20 or BASIC I20 connector. The exciter modulates this signal using digital signal processing, then up-converts this modulated signal to final output frequency. This modulated RF from the exciter is supplied to the PA, which amplifies the signal to the RF output level. This modulated, amplified RF from the PA is supplied to the RF OUT connector for transmission.

3.4.3 Site Control-Signal Flow

Transmitter paging-site control is done two ways: remotely (normal operation), and locally. In either case, the paging transmitter is keyed when the transmitter controller commands it, via the I20 connector and DSP exciter, to key.

Control functions are shared by the transmitter controller and the DSP exciter. The DSP exciter also controls the power amplifier locally by responding to commands from the VDT.

Control signals enter and exit the paging site via the transmitter controller, which has overall control of the paging site. The transmitter controller is part of the larger paging control system even though it is racked with paging-site equipment. The transmitter controller has control functions which include these:

- transmitter-alarm gathering
- transmitter-alarm dispatching
- simulcast-parameter implementation
- remote-transmitter operation interface.

Remote control of the paging site is done through commands sent to the transmitter controller from the external paging control system. For a more extensive discussion of site control, refer to the configuration information. See *Table 1-1, Applicable Documents,* for the part number of the document.

Control commands originating from a remote site are supplied to the exciter through the controlling device. Control and setup commands may be applied to the exciter locally through the VDT. A microprocessor within the exciter interprets each command and responds by performing the appropriate function.

3.4.4 Status-Signal Flow

The exciter monitors transmitter status signal in the form of fault logic and voltage samples. The microprocessor within the exciter reports transmitter status to the controlling device, VDT, and the exciter front panel. If a transmitter malfunction occurs, a reduced operating condition is entered, depending on the seriousness of the fault.

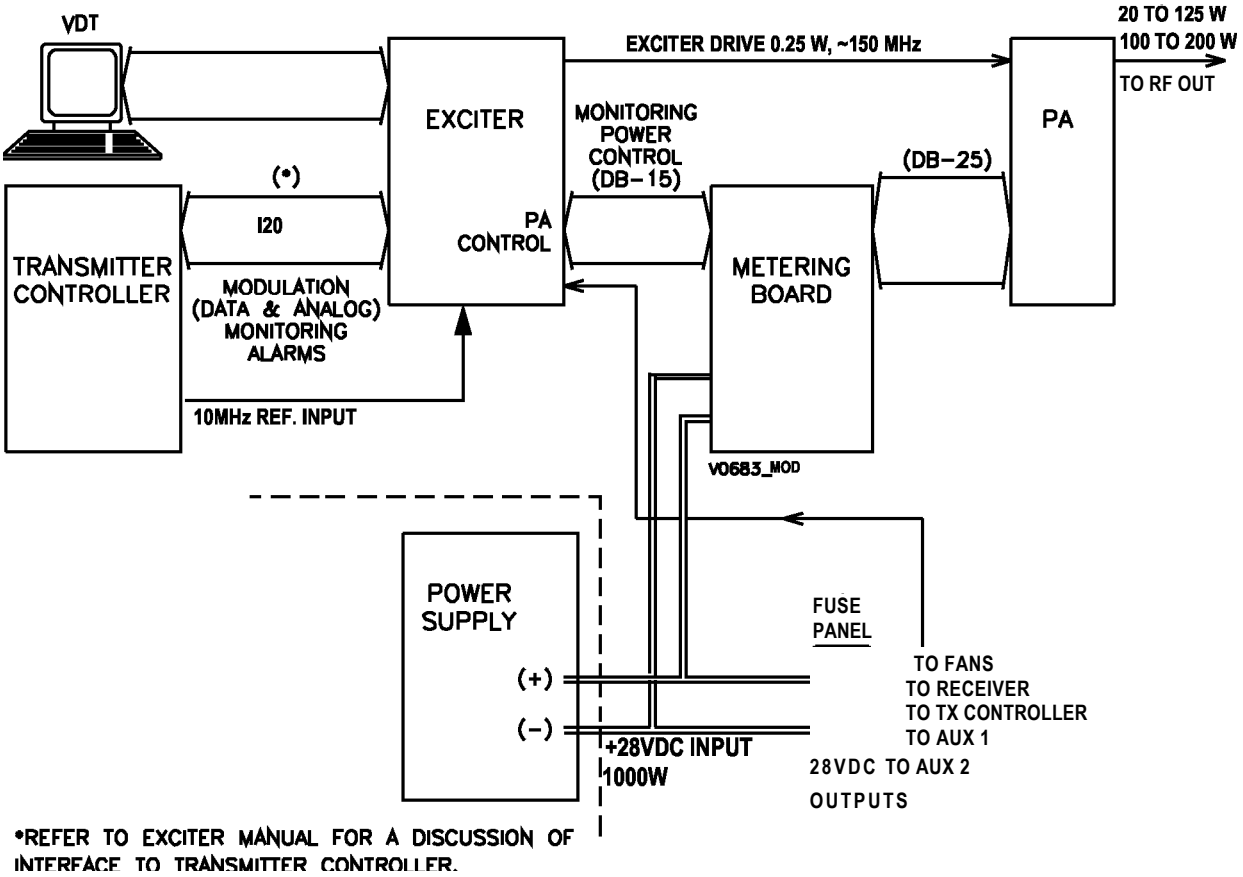

Figure 3-5 Transmitter Functional Diagram

4 INSTALLATION AND SETUP

4.1 Inspection

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Inspect the equipment to be certain that the equipment rack is complete. Compare items received to the packing list. Report shipping loss or damage to carrier within 15 days of receipt. Remove any packing material from the rack and check each assembly.Check assemblies closely and remove any foreign material in the chassis.

4.2 Installation

4.2.1 Tools and Equipment Required

Refer to *Table 4-1, Tools and Equipment.* Equipment listed by brand name may be substituted with equivalent. For installation, only common hand tools are necessary if at all, since installation is usually completed at the factory.

Table 4-1 Tools and Equipment

Device	Description	Device	Description
nut driver	5/16 in (7.9 mm)	dummy load	Bird model 8327 or equivalent
screwdriver	# 2 flat blade	barrel connector	type-N
screwdriver	# 2 Phillips	RF cable	type-N ends, 1m long max
RF power meter	Bird model 4421 or equivalent	voltmeter	Fluke 77 DVM or equivalent

4.2.2 Rack Positioning

ventilation Cooling and cabling restraints require that equipment pieces be racked so that there is adequate ventilation for exhaust air. The top and front of the rack should have at least ten inches (25 cm) of free space. The cabinet should be placed as close as possible to the transmitting antenna, and to the primary power source as a secondary consideration. To gain reasonable access to the back, 30 inches (76 cm) of free space should be allowed.

Caution

Never place rack where moisture, steam, condensation, or standing water can come in contact with it. The host room may need to be air conditioned or additionally ventilated to remove excess heat generated by this equipment.

4.2.3 Rack Grounding

The rack cabinet must be connected to a reliable earth ground. Connect the earth ground point to the ground stud provided on the right-rear corner of the transmitter chassis; use four-gauge (20 mm^2) or larger copper conductor.

4.2.4 Positioning within the Rack

When it is used in a normal, one-transmitter-per-cabinet rackup, the transmitter chassis should be placed directly above the power supply. The transmitter controller is directly above the transmitter.

The transmitter is often shipped already installed in a cabinet. To remove or reinstall the transmitter chassis, refer to Section 9.

4.2.5 Primary Power Requirements

The primary power source must be capable of delivering adequate power to the equipment. Racked power supplies operate with 50/60-Hz ac unless the power supply dc-only. Refer to Section 2 and to the power supply manual for current and voltage specifications. Electrical connections made to this equipment must be made in accordance with local electrical codes.

DANGER

Rotating fan blades are a hazard to maintenance personnel who access equipment from the rear.

Caution

The rear door must be closed and the fans must be operating before the PA is keyed to ensure that the PA receives adequate ventilation.

4.2.5.1 Special Considerations

The power supply causes a large inrush of current when first turned on. The ac mains breaker must be able to handle this brief surge.

4.2.6 Equipment Cabling

Refer to *Figure 6-4, Transmitter Rear View with Door Open and I/O Panel Removed,* and *Figure 6-1, Transmitter Chassis Schematic,* for details.

4.2.6.1 Ac Connections

Generally, all ac connections internal to the rack are made at the factory and should not need to be modified. Refer to the power supply manual for additional details.

4.2.6.2 Dc Connections

If cable is being originally installed or replaced, be sure connections are sufficiently tight. Refer to the power supply and related manuals for details.

4.2.6.3 Dc-Only Sites

Some installation do not use ac input power. If the transmitter is not racked and wired at the factory, be sure to connect as shown in the documentation supplied with the retrofit option.

Note

For locations operating from a direct 28-Vdc source or from an external power supply, the dc supply cable must not exceed three meters (3 m) in length. This restriction is critical to comply with the emission and immunity requirements

4.2.7 Transmitter I/O Connections

Refer to *Table 4-2, Transmitter Chassis I/O Connectors.* As viewed from the back, signal and power connections are on the left; the ground connection is on the right.

Table 4-2 Transmitter Chassis I/O Connectors

	Description /Function
10MHz REF. INPUT	female BNC, expects reference signal from transmitter controller
RF OUT	female type-N, connected to antenna network
+28VDC INPUT 1000W	power pole connections, + and ground return
28VDC OUTPUTS	mates with power distribution cable for external equipment
GL EXT. I20*	DB-37 for signals. Refer to exciter manual for pinout.
BASIC I20*	DB-15 for signals. Refer to exciter manual for pinout.
ground pemnut	stud on right side of transmitter (as viewed from rear), earth ground
*only one I20 connection per transmitter	

4.2.8 Transmitter Controller Requirement for I20 Control

GL-C2000 controllers (265-0090-002) manufactured prior to October, 1994, must have the universal exciter ASM board (265-0090-008) and v2.3 or later software installed. Units built after the October 1994 date support the I20 interface and have an assembly rev of A2 or greater (i.e. A2, B1, C1, etc.)

4.3 Setup

Refer to *Table 4-3* for jumper setups for various transmitters.

Table 4-3 Metering Board Jumper Table for Transmitter Setup

	metering bd P/N	JW1	JW2	JW3	JW4	JW5	JW6
ISC-T8311E	2000.00116	B	A	A	A	B	A
ISC-T8411E	2000.00513	B	B	A	A	B	B

4.4 Ultimate Disposition

Caution

This equipment may contain hazardous materials. Check with the local environmental authority before disposing of this equipment.

5 OPERATION

5.1 Controls and Indicators

These assemblies within the transmitter chassis have controls and indicators:

- PA compartment - see PA manual
- exciter - see exciter manual
- metering boards - *(Figure 5-1* and *Figure 6-5).* See *Table 4-3, Metering Board Jumper Table for Transmitter Setup,* to determine the correct part number for the model.

See *Table 5-1, Metering Board Fuses, Indicators, and Test Points,* and *Figure 6-5, Metering Board 2000. 00513/2000.00116 Functional Diagram,* for information about fuses and test points on the metering board. See *Table 5-2, Fuse Board Fuses,* for information about fuses on the I/O panel.

5.2 Operation

The transmitter normally operates within the paging system in an unattended manner. Local control is not intended for operation, but for setup, checkout, or maintenance. On the metering board, LED1 lights when 28 Vdc is applied to it. No operating controls are available.

5.2.1 Turn PA On and Off

The PA does not contain an on/off switch, but turns on and off whenever the primary power equipment is turned on and off. When the PA is on, it remains in a standby condition until keyed. Turning off primary power (ac or dc) always turns off the transmitter (PA and exciter).

5.2.2 Fan(s) Control

The fans do not contain an on/off switch, but turn on and off whenever the primary power equipment is turned on and off. The fan(s) run continuously whenever primary power is on.

DANGER

Rotating fan blades are a hazard to maintenance personnel who access equipment from the rear.

Caution

The rear door must be closed and the fans must be operating before the PA is keyed in order to ensure that the PA receives adequate ventilation.

Table 5-1 Metering Board Fuses, Indicators, and Test Points

	Function		Control/ Indicator	Function
F 1*	driver fuse	The function of fuses varies, depending on the PA used. To match a fuse with the affected PA function, refer to *Table 6-4.*	TP 1 (black)	**GROUND,** ground
F2*	PA1-A, PA1 fuse		TP2 (white)	**REF,** indication of reflected power
F3*	PA1-B, PA3 fuse		TP3 (blue)	+34 Vdc
F4*	PA2-A, PA2 fuse		TP4 (blue)	+5 Vdc
F5*	metering-board circuitry fuse		TP5 (yellow)	-15 Vdc
F6*	PA2-B fuse		TP6 (green)	+7.5 Vdc
			TP7 (red)	**FWD,** indication of forward power
LED 1 (green)	**POWER,** indicates +26-Vdc input power applied		TP8 (brown)	**AGC,** sample of AGC voltage to PA compartment (controlled by forward-power and AGC ref, subject to shutdown circuit)
*Replace fuses with fuses of the same current rating. F1 through F4 and F6 are 20 A; F5 is 1 A.				

Table 5-2 Fuse Board Fuses

	Function	Fuse	Function
CNTL 5A	transmitter controller	EXC 5A	exciter
RX 5A	external receiver	FAN1 3A	fan 1
AUX1 5A	auxiliary equipment 1	FAN2 3A	fan 2
AUX2 5A	auxiliary equipment 2		
I/O panel fuses are located inside the fan door on the rear of the transmitter.			

5.2.3 Key and Unkey PA

The PA does not contain a key switch, but is keyed and unkeyed by the exciter. The exciter must be keyed and unkeyed remotely through transmitter controller or locally through a video display terminal (VDT). Refer to the controller manual for remote key and unkey instructions or to the VDT manual for local key and unkey instructions.

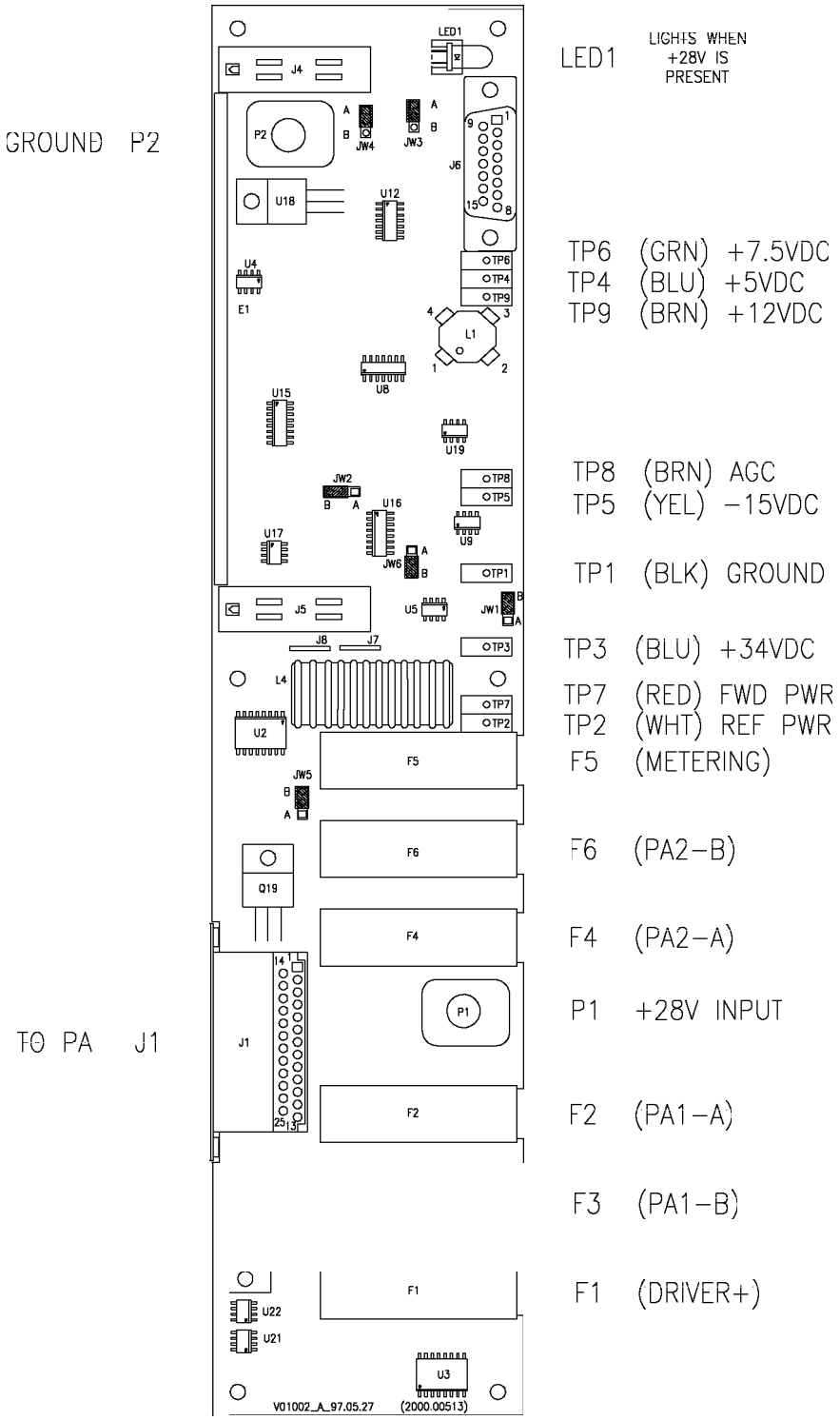

Figure 5-1 Metering Board Assembly 2000.00513/2000. 00116

6 THEORY OF OPERATION

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6.1 Transmitter Chassis Signal Flow

The I20 interface signals to and from the exciter are routed directly to the I/O panel through a cable. Either the GL EXT. I20 or the BASIC I20 DB connector is used. Likewise, the 10MHz REF. INPUT is passed directly to the exciter. The signals from both connectors are routed to or from the transmitter controller, typically a GL-C2010 or GL-C2000.

6.2 Transmitter Chassis Power Distribution

6.2.1 I/O Panel and Fuse Board

Refer to *Figure 6-2, I/O Panel,* and *Figure 6-3, Fuse Board,*. The transmitter receives 28 volts dc from an external source at the +28VDC INPUT 1000W connection on the I/O panel on the rear of the transmitter.

Fuses on the fuse board protect seven devices, including the exciter and fans. Power for external devices leaves the fuse board and is routed to a cable which is connected to the 28VDC OUTPUTS. The fuse board is accessible by opening the fan door on the rear of the transmitter.

The bulk of the current is passed through the metering board, which has its own fuses. Refer to *Paragraph 6.2.3* for a discussion of the metering board.

6.2.2 Fuse Board (Dc Distribution Board)

Refer to *Figure 6-1* for detailed circuit information. The fuse board is accessible by opening the rear fan door. The following connections terminate at the fuse board:

- dc power to rear-mounted fans
- dc power to exciter
- dc power to external equipment which is delivered through 28VDC OUTPUTS connector.

6.2.3 Metering Board

Refer to *Figure 6-5* for detailed circuit information.

6.2.3.1 Dc-Power Distribution

The +lug on the metering board is the main distribution point for dc power to the PA RF compartment. The following connections terminate at the +lug:

- dc power from main power supply
- dc power to PA compartment (through pc traces on board).

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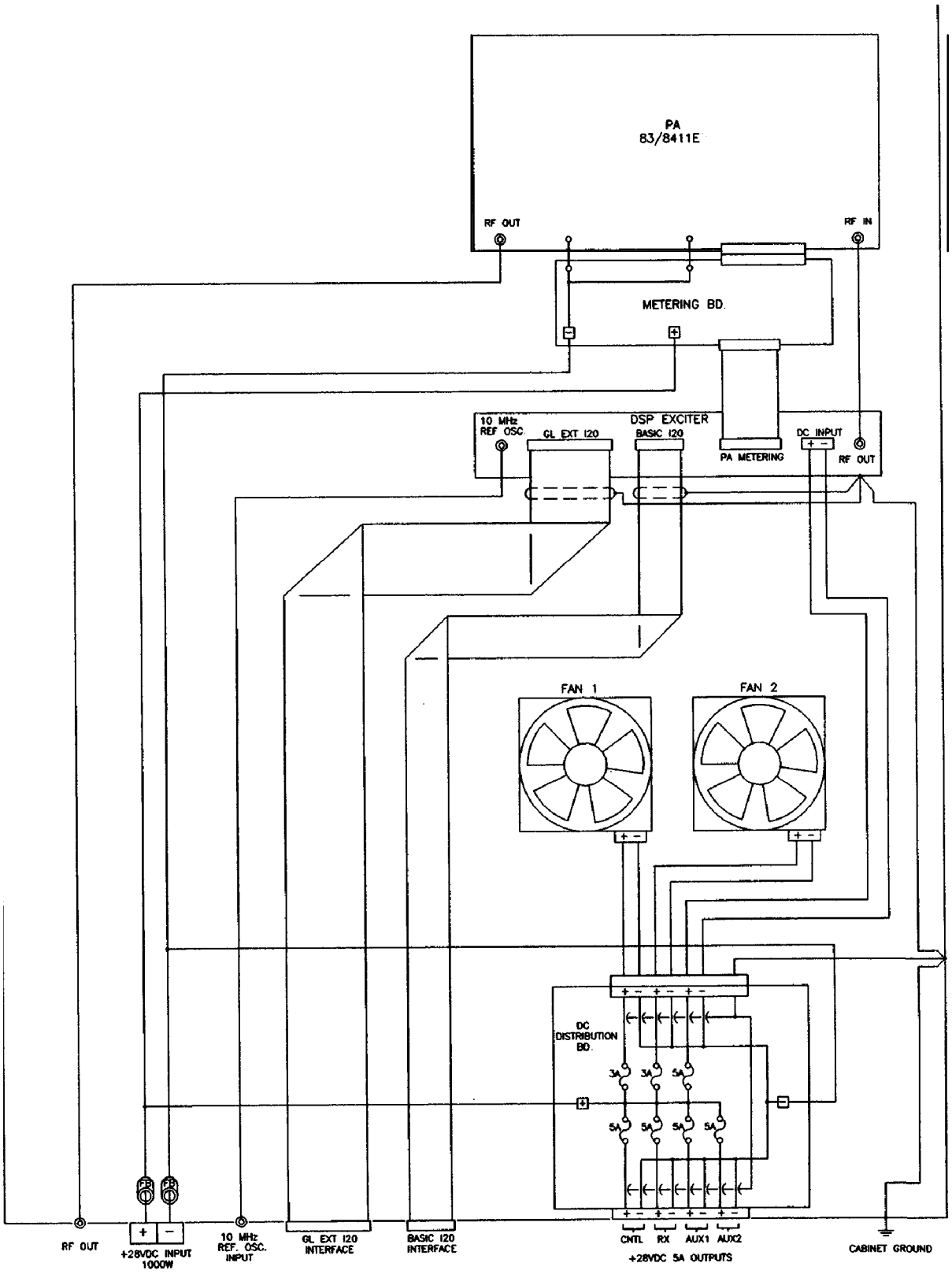

Figure 6-1 Transmitter Chassis Schematic

There are several current sources for stages within the PA RF compartment. Each separate circuit contains a fuse, metering resistor, and associated circuitry for measuring and reporting circuit currents. *Table 5-1, Metering Board Fuses, Indicators, and Test Points,* shows the circuits which are protected by the various fuses. Note that some transmitters do not use every fused circuit. *Table 6-4, Detail of J1 Connections (DB-25) between Metering Board and PA RF Compartment,* shows the functions of the connections between the metering board and the PA compartment. *Table 6-2, Exciter J6-to-Metering Board DB-15 J6 Pin Functions,* shows detail of the connections between the metering board and the exciter.

6.2.3.2 Control-Signal Distribution

6.2.3.2.1 Transmitter Keying

The transmitter may be keyed remotely by the transmitter controller or locally by the VDT. The exciter receives the key signal and activates internal circuitry which causes its RF output to become active. The exciter also sends a key signal to the PA RF compartment. The exciter signal is wired to metering-board J6-7. Metering-board circuitry relays the signal to the PA RF compartment and the IPA second amplifier stage via J1-7. The AGC reference signal from the exciter is passed to metering-board circuitry when the key signal is active.

6.2.3.2.2 Power-Output Control

A reference signal from the exciter determines the nominal output power. Depending on the exciter interface, the level may be remotely adjustable. The REF PWR dc reference signal (J1-5 and J6-8) is also routed to the exciter for use in determining acceptable output power and for generating alarms.

The metering board compares the AGC REF signal (J6-3) from the exciter and the FWD PWR dc reference signal (J1-6) from the PA RF compartment. The metering board attempts to hold power constant by using these signals to generate the AGC voltage (J1-19) which it sends to the PA RF compartment. All stages, except the first IPA stage, are under the influence of the AGC signal.

6.2.3.2.3 Signal Measurement and Alarm Gathering

Refer to *Table 6-4, Detail of J1 Connections (DB-25) between Metering Board and PA RF Compartment.* Each PA board and IPA board have separate, fused supplies, whose currents are measured by A/D converters which are multiplexed to the A/D1 line (J6-1) and A/D2 line (J6-9) to the exciter. The exciter has three input-select lines which determine the circuit to be measured. Refer to *Table 6-3, Input-Select Metering Lines from Exciter.*

Several metering points may not be used depending on the metering board assembly and the transmitter it is in. The labels of the measured parameters appear on the VDT screen when it is used to measure operating parameters. Refer to the VDT manual for details.

6.2.3.2.4 PA Fault

On nearly all versions of the metering board, no hardware circuit for PA-fault detection is installed, and PA faults are determined by software, as power supply voltage, PA currents, and RF power output can be read by the software.

On a few versions of the metering board, there is a hardware fault-detection circuit. If any of the PAs experiences a fuse-blowing fault, the PA FAULT line (J6-11) becomes active (HI).

6.2.3.3 Metering Board Connections

Refer to *Table 6-1, Metering Board Connectors* and *Figure 6-4, Transmitter Rear View with Door Open and I/O Panel Removed.* As viewed from the back, the + dc lug is on the right; the - dc lug is on the left; the control/ IO connector is in the middle.

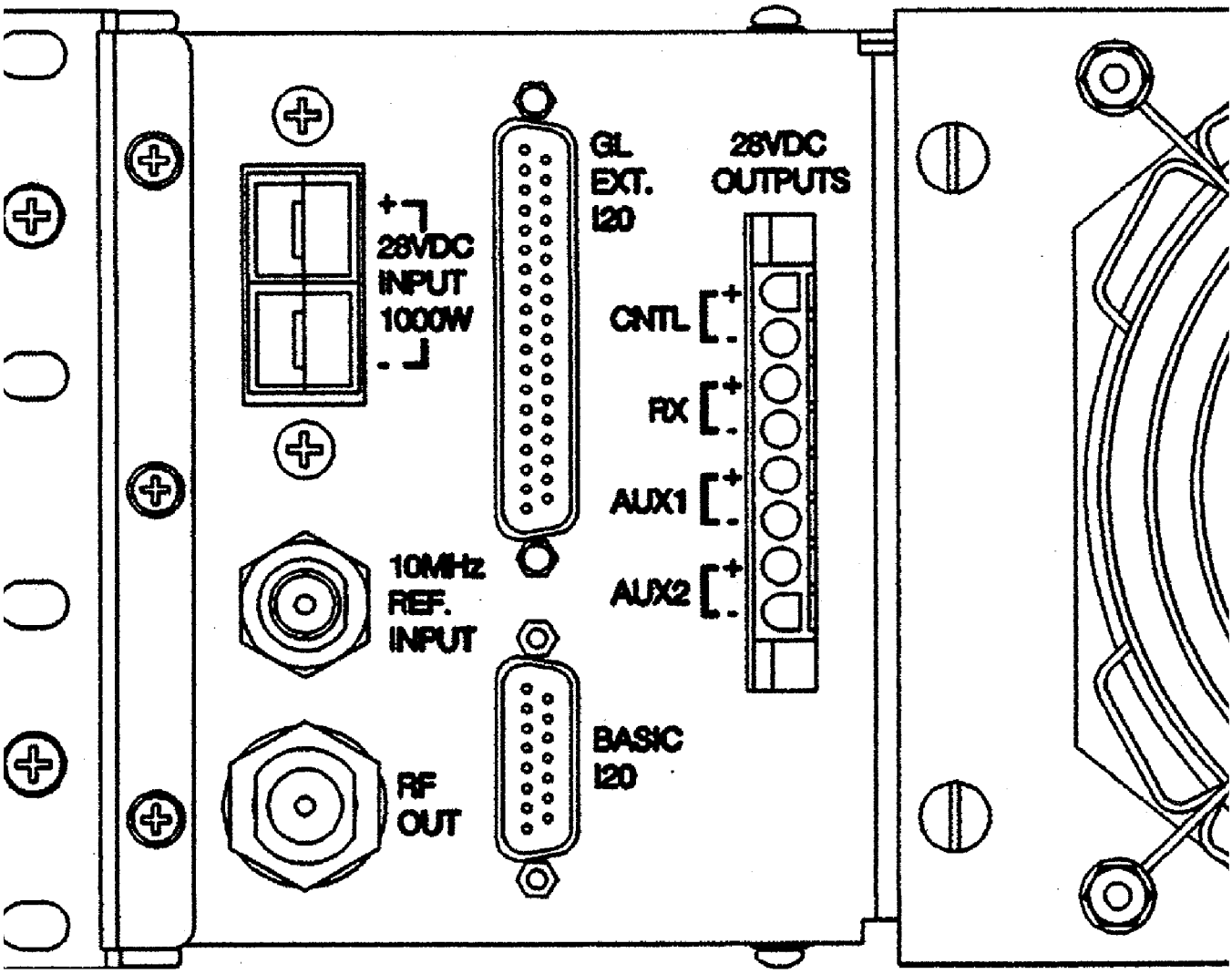

Figure 6-2 I/O Panel

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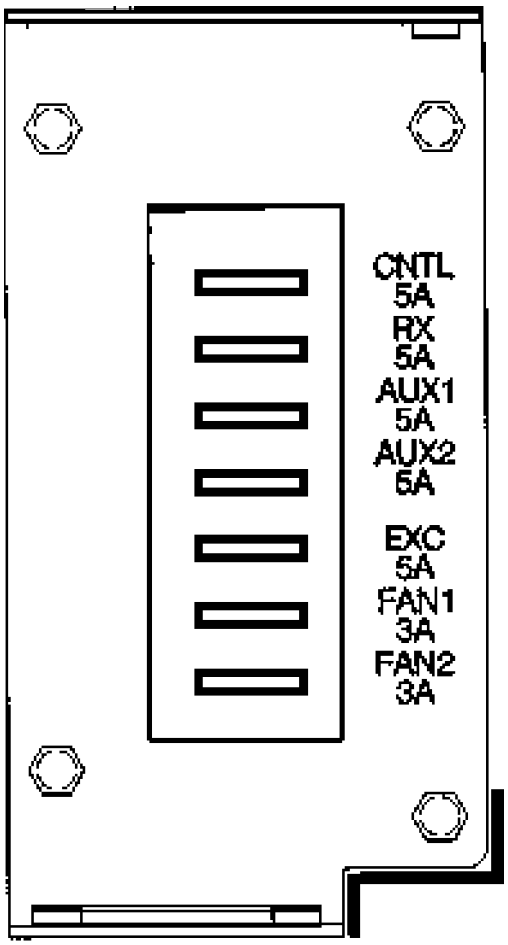

Figure 6-3 Fuse Board

Table 6-1 Metering Board Connectors

	Description /Function
+ dc lug	1/4 -20 post, part of metering bd assembly, from I/O panel
- dc lug	1/4 -20 post, part of metering bd assembly, from I/O panel
control/IO J2	DB-15, part of metering bd assembly/ control and IO

Table 6-2, Exciter J6-to -Metering Board DB-1 5 J6 Pin Functions, shows the functional pinout of the connection between the metering board and the DSP exciter.*Table 6-4, Detail of J1 Connections (DB-25) between Metering Board and PA RF Compartment,* shows the functional pinout of the connection between the metering board and the PA compartment. Note that the connection is made whenever the PA compartment is positioned normally within the transmitter compartment, as the connector on the metering board becomes effectively, part of the chassis.

Table 6-2 Exciter J6-to-Metering Board DB-1 5 J6 Pin Functions

	Exciter Function	Metering Board J6-	Metering Board Function
1	multiplex analog input from PA No. 1 multiplexer	1	A/D1
2	multiplex analog input from PA No. 3 multiplexer	2	A/D3, fixed LO
3	AGC reference voltage output to PA, 1-12 Vdc	3	AGC ref
4	no connection	4	ground
5	no connection	5	ground
6	1 of 4 select outputs to PA multiplexers, LO=2^1	6	input sel 2
7	one of four select outputs to PA multiplexers, not used	7	PA key input, enables AGC and preamplifier stage
		8	ref sample
9	multiplex analog input from PA No. 2 multiplexer	9	A/D2
10	multiplexed analog input from PA No. 4 multiplexer	10	A/D4, fixed LO
11	PA fault input, LO=fault		fixed LO (active logic in some versions)
12	no connection		ground
13	one of four select outputs to PA multiplexers, LO=2^0 digit enabled for mux input decoder	13	input sel 1
14	one of four select outputs to PA multiplexers, LO=2^2 digit enabled for mux input decoder	14	input sel 3
15	latch-enable output to PA multiplexers, LO=mux input decoder reads the three select inputs	15	spare

Table 6-3 Input-Select Metering Lines from Exciter

	J6-x pin
1	13
2	6
3	14

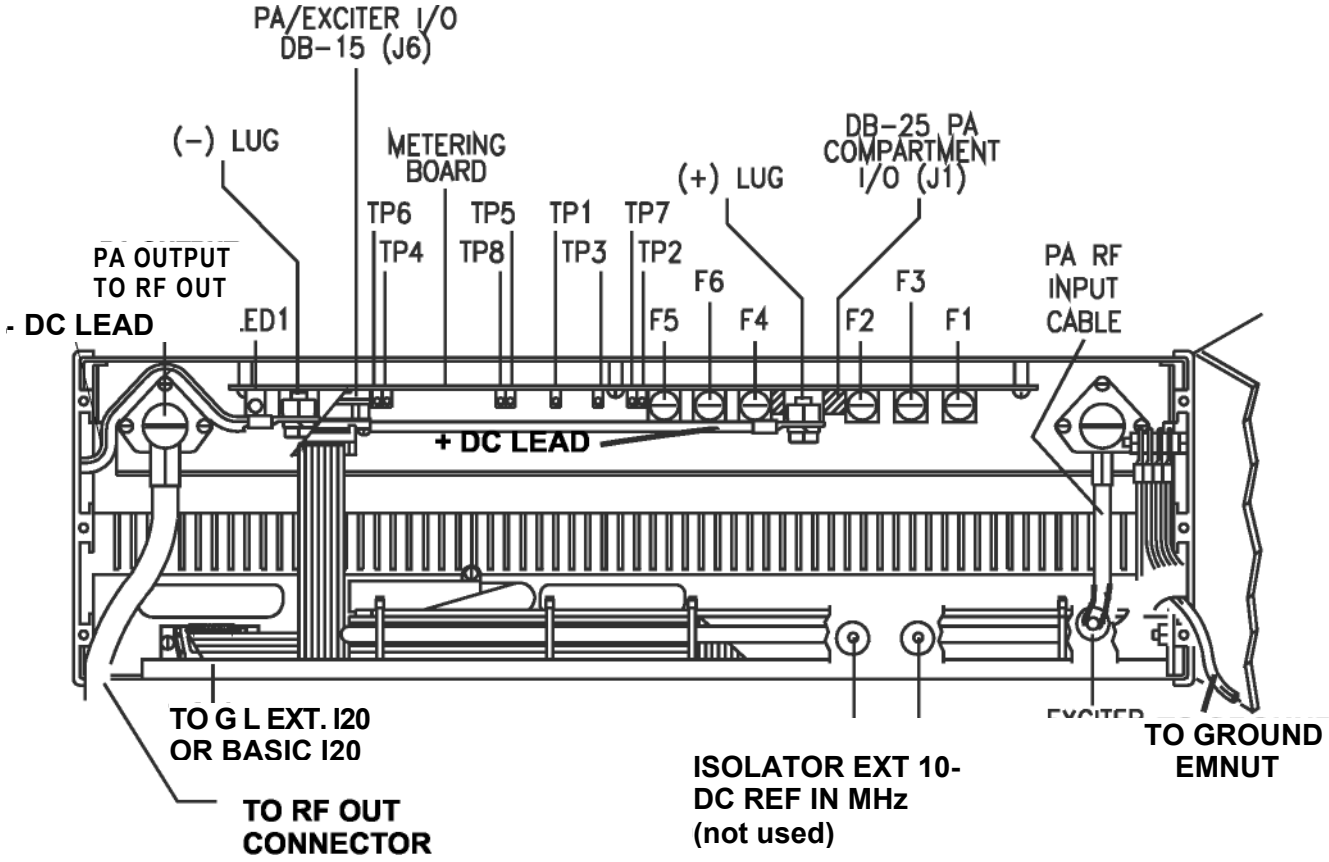

Figure 6-4 Transmitter Rear View with Door Open and I/O Panel Removed

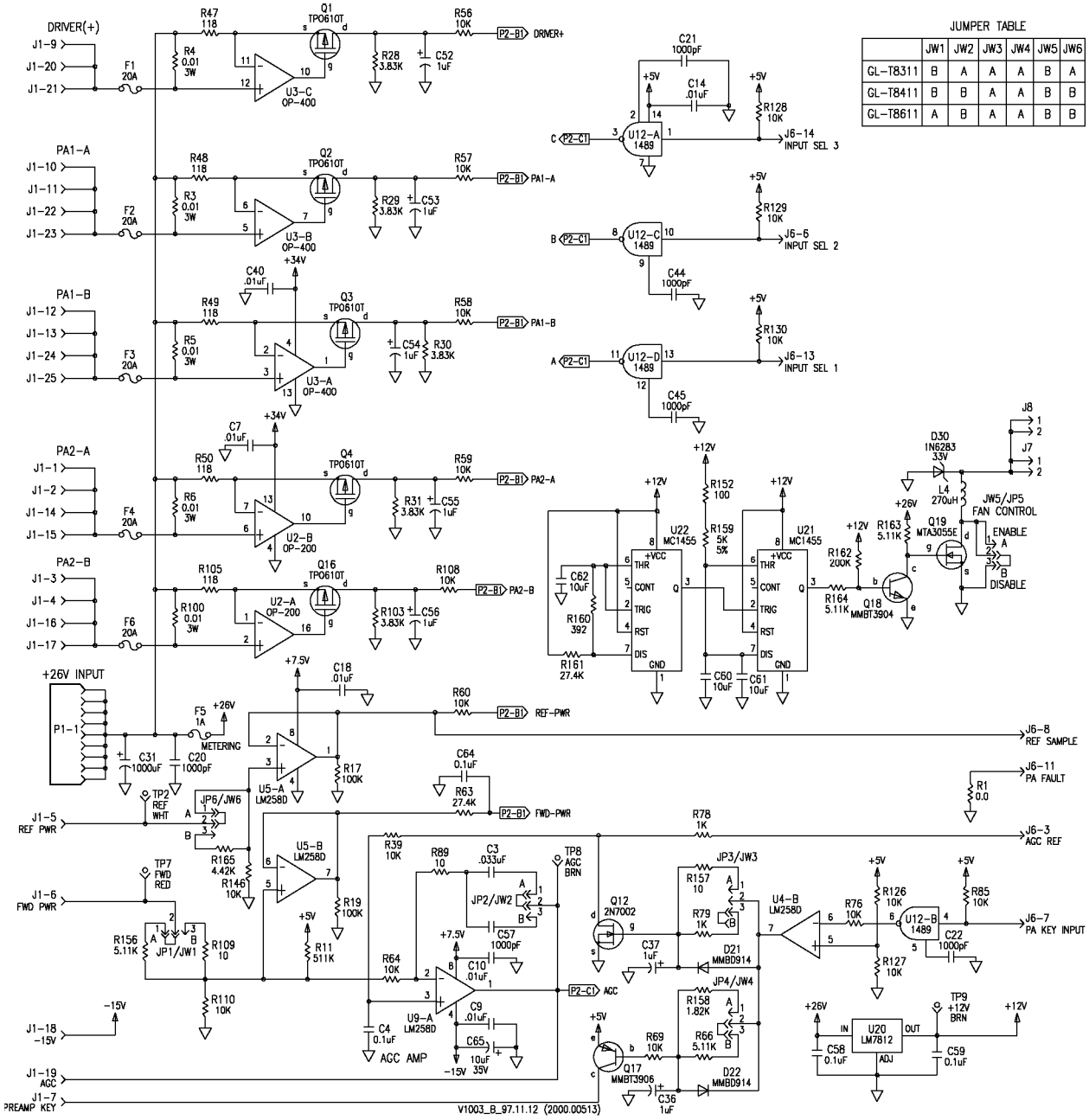

Figure 6-5 Metering Board 2000.00513/2000.00116 Functional Diagram

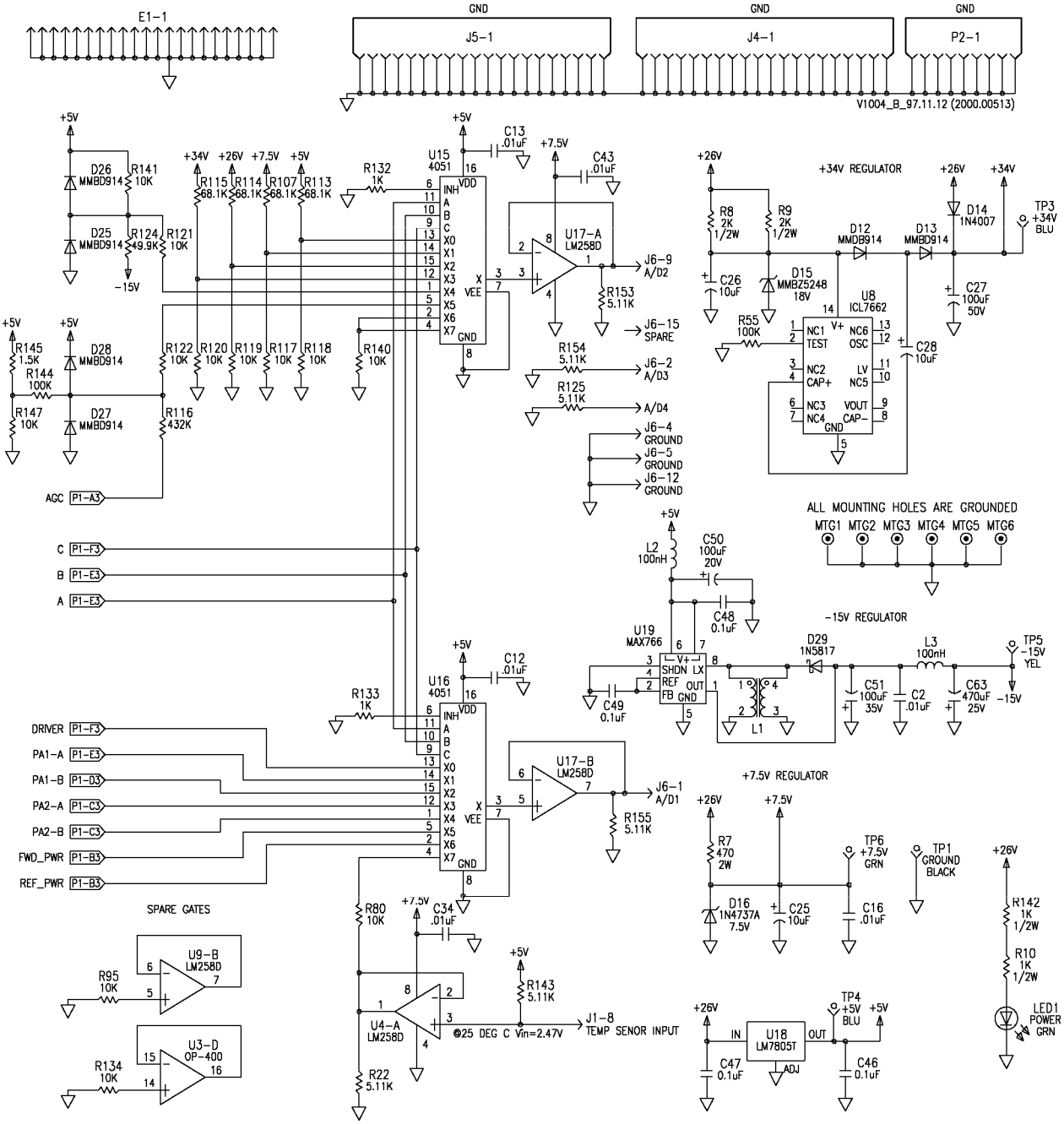

Figure 6-5, Metering Board 2000.00513/2000.00116 Functional Diagram (continued)

Table 6-4 Detail of J1 Connections (DB-25) between Metering Board and PA RF Compartment

	J1-X	metering board fuse	8311 E/ 8411 E PA RF compartment function
PA2-A, PA2, PA	1	F4	
PA2-A, PA2, PA	2	F4	
PA2-B	3	F6	
PA2-B	4	F6	
REF PWR, dc sample of reflected power	5		P6-1, reflected power sample from directional coupler board (red wire)
FWD PWR, dc sample of forward power	6		P6-4, forward power sample from directional coupler (black wire)
PREAMP KEY	7		P1-1, preamp key bus
TEMP SENSOR	8		P1-4, temp sensor on driver board
DRIVER+	9	F1	P1-3, +supply to driver
PA1-A, PA1	10	F2	P4-1, +supply to PA board
PA1-A, PA1	11	F2	P4-2, +supply to PA board
PA1-B, PA3	12	F3	P5-8, +supply to PA board
PA1-B, PA3	13	F3	P5-2, +supply to PA board
PA2-A, PA2	14	F4	
PA2-A, PA2	15	F4	
PA2-B	16	F6	
PA2-B	17	F6	
-15V	18		P3-1, -15 Vdc to PA board (daisy-chained to P2-4 on driver board)
AGC	19		P3-4, AGC to PA board
DRIVER+	20	F1	PRE KEY BUS
DRIVER+	21	F1	PREAMP
PA1-A, PA1	22	F2	P4-3, +supply to PA board
PA1-A, PA1	23	F2	P4-4, +supply to PA board
PA1-B, PA3	24	F3	P5-3, +supply to PA board
PA1-B, PA3	25	F3	P5-4, +supply to PA board

7 MAINTENANCE

7.1 General

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Little or no maintenance is required on a regular schedule. The following, however, are important to ensure long-term trouble-free operation.

Maintenance procedures in this section are listed below:

- PA-current check
- Dc-ripple check.

7.2 PA-Current Check

Occasionally, the power amplifier device currents should be compared to the levels listed on the data sheet that accompanied the transmitter. Be sure that the operating RF output is the same as listed on the data sheet. The labelling of PA currents on the VDT's screen may be confusing. To relate the VDT indication to a particular pc assembly in the PA RF compartment, refer to the 'metering board function' column of *Table 6-4, Detail of J1 Connections (DB-25) between Metering Board and PA RF Compartment.* Also refer to the PA manual for the model of transmitter you are using.

1. Put transmitter in local mode.
2. Key transmitter.
3. Monitor power amplifier currents on VDT.
4. Make comparison between data sheet and monitor.

Monitored currents should not vary more than ten percent from data sheet levels. An exception is when original components or modules have been replaced or modified; in this case, record a new benchmark for future reference after you perform the maintenance.

7.3 Dc-Ripple Check

This procedure assumes that an ac power supply is part of the configuration. Occasionally the ac supply should be checked for excessive ripple. Maximum permissible ripple is given in section two of this manual. The supply should be under normal operating load for this procedure.

1. Put transmitter in local mode.
2. Key transmitter.
3. Connect oscilloscope between ground and supply output.
4. Set oscilloscope to read ripple.

The observed ripple level should be less than the ripple specification given in *Table 2-1, Specifications.*

8 CHECKOUT

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8.1 General

Checkout procedures can be performed at any time to verify that the transmitter and related paging site equipment is functioning properly. After checkout procedures are successfully completed, the site can be returned to normal service. Refer to the VDT user manual for details on checkout procedures.

8.2 Checkout Procedures

8.2.1 Dc-Voltage Verification

Once powered, verify that the equipment is powered and refer to list below.

1. On GL exciter front panel, the DC POWER indicator is on.
2. On the transmitter controller, the POWER indicator is on.
3. On receiver, the POWER indicator is on.

8.2.2 VDT Power-up Verification

Once powered, verify that the VDT is powered; continue with the checklist below.

1. The VDT should have a cursor displayed and blinking; or,
2. the VDT should have an instructional prompt displayed; or,
3. the VDT should have an auto-loaded program running.

8.2.3 Cooling-Fans Check

Once the transmitter is powered, verify that the fans are operating; they should operate whenever the transmitter is powered.

9 REMOVAL AND REINSTALLATION

The following paragraphs discuss removing and reinstalling the various assemblies which make up the transmitter.

Caution

Remove all input power to the cabinet before performing a removal or reinstallation procedure.

9.1 Entire Transmitter Chassis

Note

The user may choose to remove the PA RF compartment and exciter before removing the transmitter chassis in order to lighten the transmitter chassis for handling.

The transmitter chassis is held in the equipment rack by screws which are accessible from the front.

Removal

1. Remove red and black power pole dc power connector.
2. Remove other connectors and mark for reconnecting: RF output, I20 (basic or extended), 10-MHz reference, 28VDC OUTPUTS.
3. Remove screws from front of rack and pull out transmitter chassis.

Reinstallation

The software and hardware in the replacement exciter must be matched with the site requirement. Before reinstalling the transmitter, heed the discussion on programming the exciter in *Paragraph 9.3*.

1. Replace transmitter chassis in rack; secure with same hardware that was removed during removal.
2. If required, carefully reinsert exciter *(Paragraph 9.3)* and PA RF compartment *(Paragraph 9.2)* in chassis.
3. Reconnect coax, power connectors, and I/O as before.
4. Return transmitter to service.

9.2 PA RF Compartment

Note

Before removing the PA RF compartment as part of troubleshooting, be certain that the fault is on an assembly within it. The exciter, metering board, and interconnecting wiring are essential to proper operation of the power amplifier.

Removal

1. From front of chassis, turn screws ccw so that front panel is loose, and pull PA RF compartment forward and out of transmitter chassis.

Reinstallation

The PA RF compartment contains an isolator/circulator, which is a frequency-specific part. Before installing a new PA, make certain that it is for the correct range. Refer to the PA RF Compartment manual. See *Table 1-1, Applicable Documents,* for the part number of the appropriate manual.

1. Slide replacement PA RF compartment into location in top of transmitter chassis. Note that connectors slide into receptacles in rear of transmitter chassis.
2. Refasten front-panel screws. Refer to the VDT

manual tocheck out the replacement PA.

9.3 Exciter

The exciter is installed on slides in the lower third of the chassis. Most controls can be adjusted while the unit is mounted in the rack.

Removal

1. Refer to*Paragraph 9.2.* Remove PA RF compartment.
2. On exciter chassis front, turn thumb fasteners ccw approximately one quarter turn to loosen; pull exciter chassis forward as far as possible in order to access connections on exciter rear.
3. From rear of exciter chassis, label and remove signal connectors on rear of exciter. Note that there is an unused BNC connector (isolator) on the rear of the exciter. Note that some DB-style connectors require loosening screws which hold mating receptacles in contact with one another.
4. Unfasten BNC RF output plug on right side of chassis.
5. Unfasten BNC 10-MHz reference oscillator plug.
6. Label and remove any other connections to exciter (ground, power).
7. Using needlenose pliers, remove hardware which holds cable arm onto exciter.
8. When all connections are removed, pull exciter out of transmitter chassis.
9. Retain all hardware for reinstallation.

Reinstallation

When replacing the exciter, be certain that all variable subassemblies in the replacement exciter are correct for system requirements. Subassemblies which must be matched include those included in the list below.

- VCO/RF amplifier (must be for the correct frequency band)
- firmware chips (must be of the correct revision and type)
- controller interface (must be of the proper type and revision for interfacing with transmitter controller).

Site information is also programmed into the exciter and must be the same for the replacement exciter. In most cases, it is convenient to keep the same exciter in the site. If it is necessary to replace the exciter, refer to the VDT manual for programming information. You can enter the information from the exciter's front-mounted VT-100 receptacle or else program the exciter from the transmitter controller. Refer to the exciter manual for additional information.

When a new exciter is installed in the site, it may be necessary to readjust the VCO, VSWR sensitivity, and reference frequency. Refer to the exciter manual for additional information.

The PA RF compartment must be removed before reinstalling the exciter. Ensure that the transmitter chassis bottom panel is installed before performing the following procedure.

1. Slide replacement exciter into location in lower third of transmitter chassis.
2. Reattach and resecure connectors removed during removal process.
3. Refasten front-panel thumb fasteners.
4. If necessary, reinstall PA RF compartment

Refer to exciter manual and VDT manual to check out and realign replacement exciter.

9.4 Metering Board

Refer to *Figure 6-4.* The fuses on the metering board can be replaced without the need to remove the pc board from the chassis. It is possible to replace fuses by opening the rear door of the transmitter. In the event that replacing the metering board becomes necessary, use the following procedures. It is best to remove the transmitter from the cabinet *(Paragraph 9.1)* before performing the following procedures.

Caution
Use static-handling precautions on metering board.

Removal

1. Refer to *Paragraph 9. 6.* Remove transmitter bottom panel.
2. Remove PA RF compartment *(Paragraph 9.2).*
3. Mark and remove red wire between +lug and I/O panel.

4. Mark and remove black wire between -lug and I/O panel.
5. Disconnect DB-15 ribbon cable from exciter.
6. Mounting hardware must be removed from pc board. Use L-shaped Phillips screwdriver or stubby screwdriver to gain access to screw heads. Remove all screws holding metering board to top of transmitter chassis.
7. Once screws are removed, remove metering board from chassis by carefully pulling it toward rear, carefully removing DB-25 connection from chassis; then pull metering board out of transmitter chassis.

Reinstallation

Note that there are at least two models of metering board. Be certain that the metering board is the correct one for the transmitter. Refer to *Table 4-3, Metering Board Jumper Table for Transmitter Setup,* to determine that the metering board is the correct one and that it is jumpered correctly.

The following procedure assumes that the PA RF compartment, exciter, and transmitter bottom panel are removed.

1. Refer to *Figure 6-4.* Position replacement metering-board into transmitter chassis.
2. Reinstall screws removed during removal process. Do not tighten yet.
3. Once all screws are installed, tighten screws.
4. As a test, push PA RF compartment shelf in out to verify that PA RF compartment DB-25 chassis receptacle and RF connections easily dock with metering board and transmitter chassis.
5. Reconnect DB-15 ribbon cable from exciter.
6. Reconnect power wires to +lug and -lug.
7. Refer to *Paragraph 9. 6.* Reinstall transmitter bottom panel.
8. Refer to *Paragraph 9.3.* Reinstall exciter.
9. Refer to *Paragraph 9.2.* Reinstall PA RF compartment. The

replacement metering board should not require realignment.

9.5 Fuse Board

The I/O panel has a fuse board located behind the main I/O panel. It is best to remove the transmitter from the cabinet *(Paragraph 9.1)* before performing the following procedures.

Removal

1. Refer to *Paragraph 9. 6.* Remove exciter, transmitter bottom panel, and PA RF compartment.
2. Remove connections from fuse board.
3. Remove main + wire (red) and - wire (black), which are connected to metering board.
4. Remove 2 screws from top of I/O panel and 2 screws from bottom of I/O panel, which hold fuse board assembly. Retain hardware.

5. Carefully pull out fuse board.

Reinstallation

The following procedure assumes that the transmitter is out of the cabinet and that the exciter, transmitter bottom panel, and PA RF compartment are removed.

1. Place fuse board assembly so that top and bottom screw holes are aligned.

2. Reinstall hardware used during removal.

3. Restore connectors removed during removal.

4. Reattach + and - wires.

9.6 Bottom Panel

Removing the bottom panel of the transmitter allows convenient access to connections inside the transmitter. This procedure assumes that the exciter has been removed *(Paragraph 9.3)*.

Before beginning a procedure, place the transmitter upside down on a bench.

Removal

1. If necessary, remove PA RF compartment.

2. Remove screws which hold bottom panel in place, in front and on each side.

3. Mark orientation of bottom panel for reinsertion later. Slide bottom panel to front and out of transmitter chassis.

Reinstallation

1. Slide bottom panel into transmitter chassis.

2. Reattach screws on sides and on front.

3. If necessary, reinstall other assemblies.

9.7 Fans

Heed all cautions at the beginning of this section.

Removal

Before replacing a fan suspected to be defective, determine that it has operating voltage supplied to it. The fan fuses are located on the fuse board behind the I/O panel. Open the transmitter rear door and observe the row of fuses on the left, behind the **28VDC OUTPUTS.** Also be certain that the wires from the fans are attached to the fuse board.

Remove power to cabinet before beginning procedure.

1. Mark and remove power wires to fan.

2. Note location of external temperature sensor and remove from heat sink.

3. Remove hardware which holds fan to rear panel.