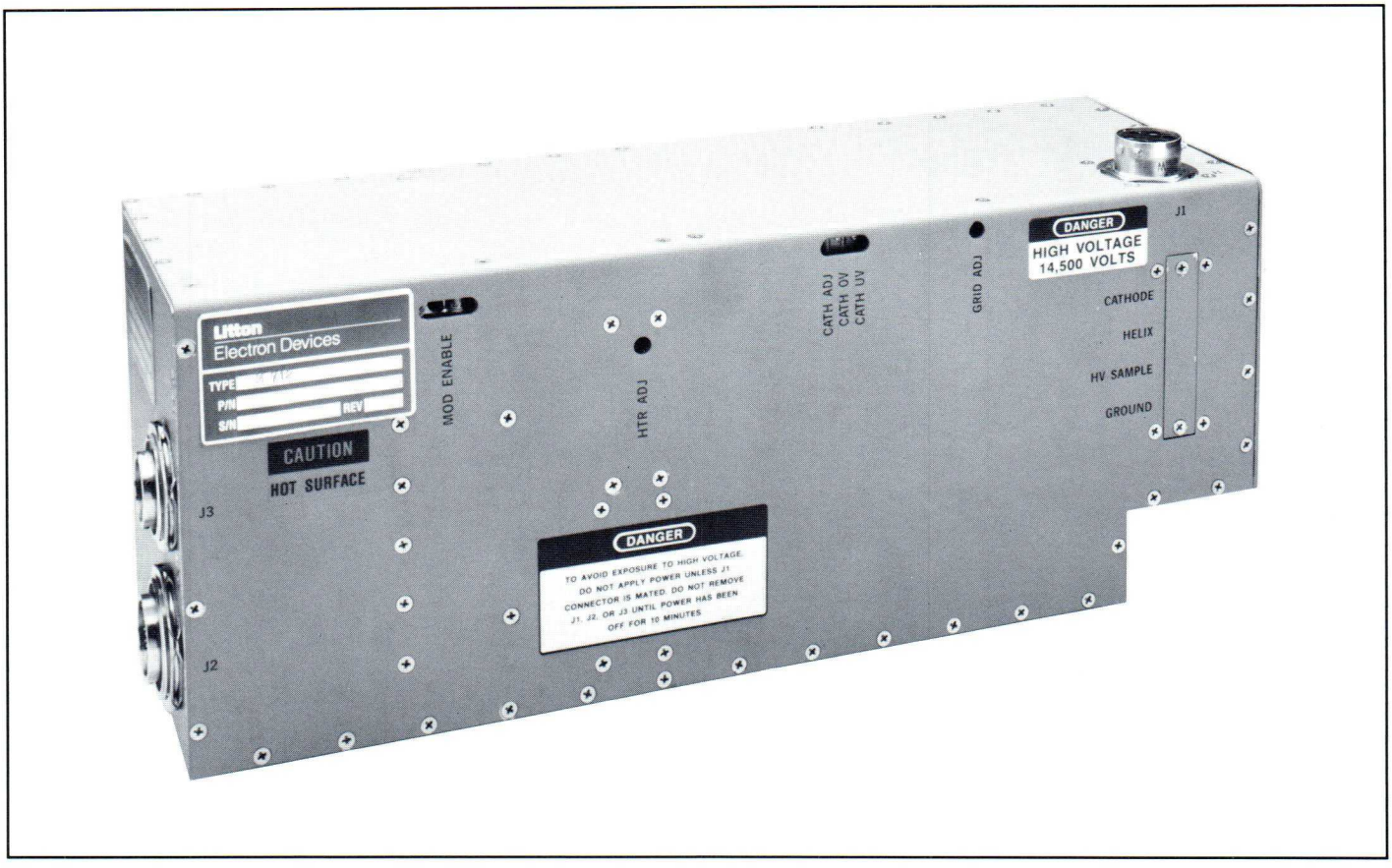
Pulsed TWT Power Supply

M-712



Environmental Capabilities

Military specifications:
Designed to meet MIL-E-5400 (DOD) and MIL-E-16400 (NAVY).

Operating temperature . . . . . – 54 degrees C to + 85 degrees C at baseplate
Storage temperature . . . . . – 54 degrees C to + 95 degrees C
Altitude . . . . . 70,000 feet maximum
Humidity . . . . . 95% Relative Humidity
Vibration . . . . . 10 g to 2000 Hz
Shock . . . . . 20 g, 11 ms

Mechanical Specifications

Cooling method . . . . . *Conductive
Weight . . . 27 lbs (12.2 kg) maximum for power supply only
Dimensions . . . . . See outline drawing

*Can be provided with aircooled heat sink

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The Model 712 Power Supply is designed for shipboard, airborne, and ground-based military use. It drives many of Litton's pulsed helix traveling wave tubes at duty cycles up to 10%. It has been optimized for radar TWT's which possess the following characteristics:

- Power output of up to 4 kW peak
- GHz plus bandwidths within the range of 1 to 18 GHz
- Low noise radar applications
- Gains from 35 to 60 dB

State-of-the-art components—IC's, MOS FET's, and ferrite magnetics—provide a very fast modulator and enhance overall performance.

The power supply is usually supplied fully integrated with an associated TWT on a single conduction-cooled baseplate, thereby forming a self-contained pulsed microwave amplifier. It is also available in an air cooled version.

Both power supply and associated TWT are designed for complete control from a remote location. Monitoring outputs provided include control status signals, TWT voltage and current signals, and a number of diagnostic test point signals.

An accompanying manual provides complete instructions for installing, operating and maintaining the amplifier.

Automatic Fault Protection

TWT Power is automatically removed to prevent damage from:

- Cathode over and under voltage
- Excess average helix current
- TWT arcing (Excess peak cathode current)
- Over duty (Excess average cathode current)
- Overheated power supply
- Power converter over current
- TWT over temperature

Monitoring Signals

- Beam current 1 volt/ampere, 1M-ohm load
- Cathode voltage: 1 volt/kilovolt, 10M-ohm load
- Helix current: 1 volt/ampere into 1 M-ohm load
- Fault and status signals: Each of these is TTL compatible (See pin listing for Connector J2)
- Power supply internal fault
- Excessive helix current
- Power supply over temperature

Specifications

Input

Video input pulse to modulator:

- A pulse with a rise and fall time less than 30 ns to turn the TWT on and off
- Standard input, differential TTL:
- Pulse width: 300 ns minimum, 100 microsecs maximum
- The power supply is capable of being synchronized between 74 KHz to 110 KHz in order to stabilize any switching interference in the RF output

Output of TWT

RF power, frequency and gain are determined by the TWT used.

Maximum duty cycle 10%
Maximum pulse width . . . . . 100 microseconds
Pulse repetition frequency . . . . . 165 kHz maximum
Pulse rate jitter . . . . . Less than 2 ns
RF rise time . . . . . 30 ns maximum
RF fall time . . . . . 50 ns maximum
Delay from leading edge of input video pulse to full RF out . . . . . 200 ns
Delay from trailing edge of input video pulse to full RF cutoff . . . . . 250 ns
Maximum spurious FM . . . . . 70 dB below carrier PRF synchronized and measured in a 100 Hz bandwidth

Output of Power Supply

Maximum output power . . . . . 1600 W
Helix voltage . . . . . 10.8 kV to 12.7 kV (1.9 kV adjustment range)
2 Collectors:
Coll 1 = 66 ±5% wrt cathode
Coll 2 = 41.6 ±5% wrt cathode
Helix current . . . . . 500 mA maximum
Cathode current . . . . . 2.1A maximum
Grid voltage . . . . . +165 to 240 V
Grid bias . . . . . −200 V. maximum
Grid current . . . . . 325 mA maximum
Modulator output rise time . . . . . 40 ns maximum
Modulator output fall time . . . . . 50 ns maximum
Acquisition time . . . . . 200 ns maximum (neglecting TWT delay)
Heater voltage . . . . . −6.3 Vdc plus or minus 1%
Heater current . . . . . 2.5 A maximum

High-Voltage Connections to TWT, Connector J1 (Reynolds 178-8528)

Pin 1	Cathode
Pin 2	Collector 1
Pin 3	Grid
Pin 4	Collector 2
Pin 5	Filament
Pin 6	High Voltage Interlock

Prime Power Input, Connector J3

Pin A, B and C	AC power, 180 to 220 v, 400 Hz, line to line, 3-phase per MIL-STD-704B
Pin D	No connection
Pin E	Ground

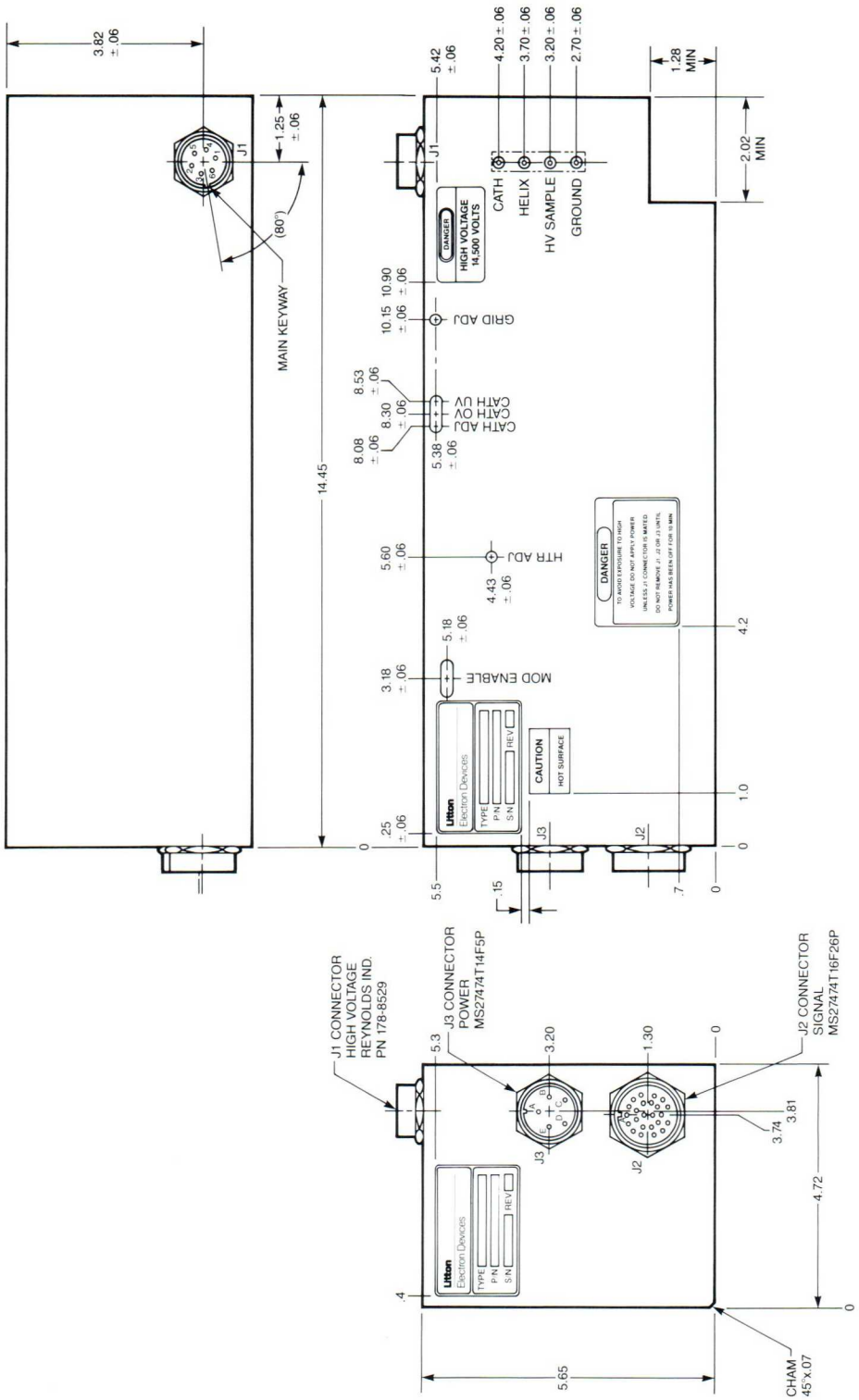
Power consumption . . . . . 1900 W maximum
Power factor . . . . . 0.9 lagging

Control Input, Status Output, and Monitoring Signals, Connector J2 (MS 27484 T16F26S)

	Description		Compatibility
Pin A	Modulator (L)	Input	Differential TTL (SN 55115)
Pin B	Modulator (H)	Input	Differential TTL (SN 55115)
Pin C	Shield Return (Modulator)	Input	
Pin D	Sync (L)	Input	Differential TTL (SN 55115)
Pin E	Sync (H)	Input	Differential TTL (SN 55115)
Pin F	Shield Return (Sync)	Input	
Pin H	STANDBY/OPERATE COMMAND Standby Operate	Input	 Logic "0" Stdby, 54 TTL Logic "1" On, 54 TTL
Pin G	Spare		
Pin J	Reset (L)	Input	Differential TTL, (SN 55115)
Pin K	Reset (H)	Input	Differential TTL, (SN 55115)
Pin L	Modulator Inhibit	Input	Logic "0" to Inhibit, 54 LSTTL
Pin M	Beam Pulse Over Current	Output	Logic "0" to Fault, 54 TTL (Open Coll)
Pin N	Helix Pulse Over Current	Output	Logic "0" to Fault, 54 TTL (Open Coll)
Pin P	Helix Avg Over Current	Output	Logic "0" to Fault, 54 TTL (Open Coll)
Pin R	P.S. Sync Status	Output	Logic "0" for Internal, 54 TTL (Open Coll)
Pin S	Cathode Under Voltage	Output	Logic "0" Fault, 54 TTL (Open Coll)
Pin T	Cathode Over Voltage	Output	Logic "0" Fault, 54 TTL (Open Coll)
Pin U	Thermal Fault	Output	Logic "0" Fault, 54 TTL (Open Coll)
Pin V	P.S. Fault	Output	Logic "0" Fault, 54 TTL (Open Coll)
Pin W	Spare	—	
Pin X	Shield Return (Reset)	Input	
Pin Y	Spare	—	
Pin Z	Spare	—	
Pin a	Spare	—	
Pin b	Ground (Signal)	Input	
Pin c	Identification Resistor	—	17.8 K $\pm$ 1% to Ground

Pulsed TWT Power Supply

M-712



Litton

Electron Devices

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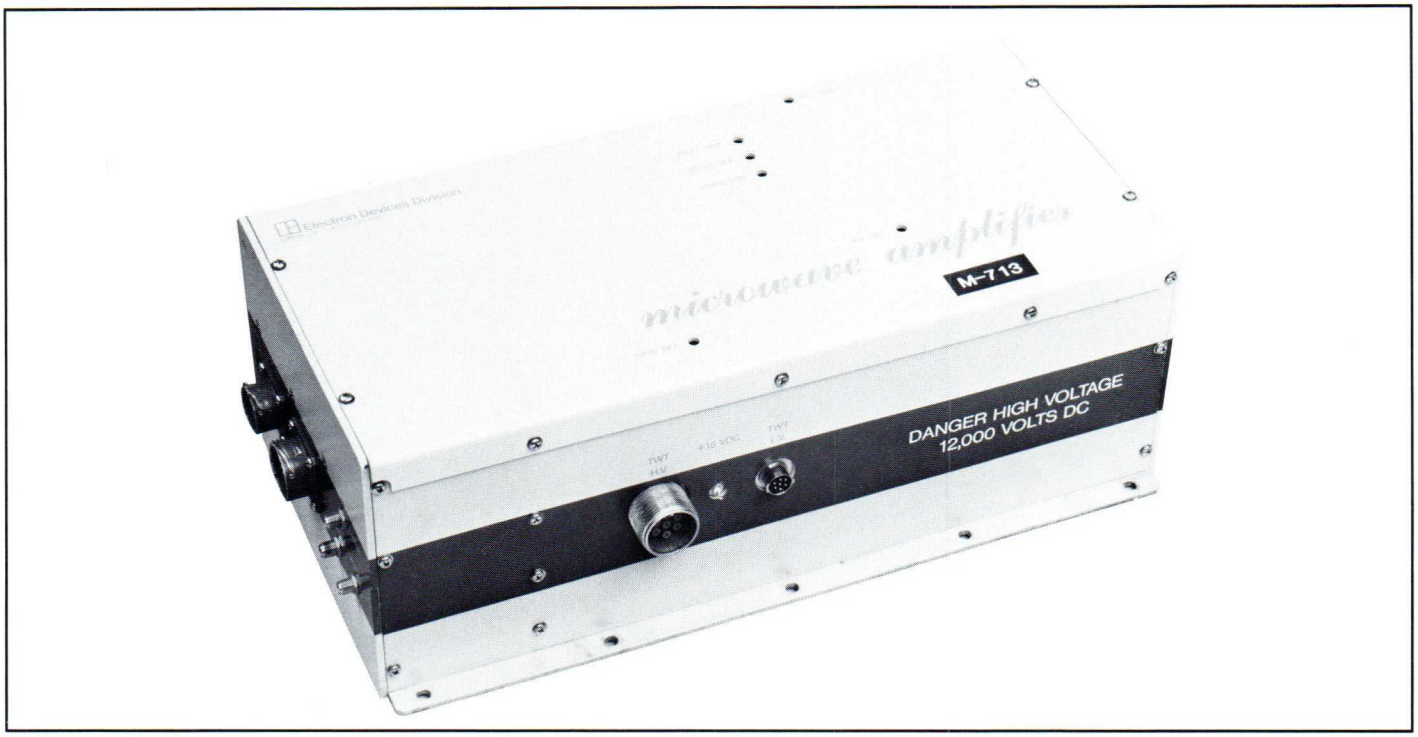
Pulsed TWT Power Supply

M-713



The Model 713 Power Supply is designed for shipboard, airborne, and ground-based military use. It drives many of Litton's pulsed helix traveling wave tubes at duty cycles up to 4%. It has been optimized for TWT's which possess the following characteristics:

- Minimum power output of 1 kW peak
- Octave-plus bandwidths within the range of 1 to 18 GHz for ECM useage or optimized narrow bandwidths for low noise radar applications
- Gains from 35 to 60 dB

State-of-the-art components —IC's, MOS FET's, and ferrite magnetics — provide a very fast modulator and enhance overall performance.

The power supply is usually supplied fully integrated with an associated TWT on a single conduction-cooled baseplate, thereby forming a self-contained pulsed microwave amplifier.

Both power supply and associated TWT are designed for complete control from a remote location. Monitoring outputs provided include control status signals, TWT voltage and current signals, and a number of diagnostic test point signals.

An accompanying manual provides complete instructions for installing, operating and maintaining the amplifier.

Automatic Fault Protection

TWT Power is automatically removed to prevent damage from:

- Excess average helix current
- TWT arcing (Excess peak beam current)
- Over duty (Excess average beam current)
- Line voltage too high or too low
- Logic voltage dropout
- Overheated TWT
- Overheated power supply
- Power converter over current
- Excessive VSWR (A standard option)

Monitoring Signals

- Beam current: 1 volt/ampere, 1M-ohm load
- Cathode voltage: 1 volt/kilovolt, 10M-ohm load
- Helix current average: 0.1 volt/milliampere, 1 M-ohm load
- Fault and status signals: (Each of these is a two-state output from a Type 7830 differential line driver. See pin listing for Connector J2)
- Line fault
- Power supply internal fault
- Excessive VSWR
- Excessive helix current
- TWT over temperature
- Power supply over temperature

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Electron Devices

Revised 10/87

Specifications

Input

RF input to TWT, choice of:

1. Continuous wave (CW) or
2. Pulse of width desired at TWT RF output

Video input pulse to modulator:

- A pulse with a rise and fall time less than 30 ns to turn the TWT on and off
- Standard input, TTL:
  Input level to hold TWT on: +2.4 v into 50 ohms
  Input level to hold TWT off: +0.8 v into 50 ohms
- Optional — TTL differential input
- Pulse width: 200 ns minimum, 30 microsecs maximum

Output of TWT

RF power, frequency and gain are determined by the TWT used.

Maximum duty cycle 4%
Maximum pulse width ..... 30 microseconds
Pulse repetition frequency ..... 100 kHz maximum
Pulse rate jitter ..... Less than 2 ns
RF rise time .....30 ns maximum
RF fall time .....70 ns maximum
Delay from leading edge of input video pulse to full RF out .....65 ns
Delay from trailing edge of input video pulse to full RF cutoff.....110 ns
Maximum spurious FM ..... 60 dB below carrier
PRF synchronized and measured in a 100 Hz bandwidth
Lower FM noise values are available on special order

Output of Power Supply

Maximum output power ..... 650 W
Helix voltage ..... 10 Kv to 11.5 kV (1.0 kV adjustment range)
Collector voltage as percent of helix voltage .. 50 to 70%
Helix current .....500 mA maximum
Beam current..... 1.8 A maximum
Grid voltage ..... 80 to 175 V
Grid bias ..... –200 V. maximum
Grid current .....400 mA maximum
Modulator output rise time .....20 ns maximum
Modulator output fall time .....25 ns maximum
Acquisition time .....50 ns maximum (neglecting TWT delay)
Heater voltage .....–6.3 Vdc plus or minus 1%
Heater current ..... 2.5 A maximum

Monitoring Indicator

Cumulative time heater on .....000 to 999 hours
Auxillary Power Supply
+15 Volts at 200 mA (see J2)

High-Voltage Connections to TWT, Connector J3 (Rowe 2RMC1615S)

Pin 1	Cathode
Pin 2	No connection
Pin 3	Heater
Pin 4	No connection
Pin 5	Collector
Pin 6	No connection
Pin 7	Grid

Video Input, Connector J4

Coax, SMA Female Jack

VSWR Detector Signal, Connector J5

Coax, SMA Female Jack
Trip point is adjustable from 50 to 300 milli-volts. (Z in= 60 ohms)

Low-Voltage Connections to TWT, Connector J6 (Cannon PV70L 10-6S, MS3470)

Pin A	No connection
Pin B	Helix (grounded)
Pin C	No connection
Pin D	TWT thermostat (normally closed)
Pin E	TWT thermostat return (grounded)

Prime Power Input, Connector J1 (MS3120E14-5P)

Pin A, B and C	AC power, 180 to 220 v, 400 Hz, 3 amperes, 3-phase per MIL-STD-704B
Pin D	No connection
Pin E	Ground

Power consumption .....900 W maximum
Power factor .....0.95 lagging

Control Input, Status Output, and Monitoring Signals, Connector J2 (MS3120E16-26P)

	Description	Source Z	Output Voltage
Pin A	Beam current	—	1 volt/ampere, 1 M ohm load
Pin B	Beam current return	—	
Pin C	Line fault signal	350 ohms	Fault: 13 V nom. Normal: <1 V
Pin D	Line fault signal	350 ohms	Fault: <1 V Normal: 13 V nom.
Pin E	PS fault signal	350 ohms	Fault: 13 V nom. Normal: <1 V
Pin F	PS fault signal	350 ohms	Fault: <1 V Normal: 13 V nom.
Pin H	STANDBY/OPERATE COMMAND Standby Operate	 Open circuit (or 8 to 15 V into 10k ohms) commands the unit to assume the STANDBY state Ground (or less than 2 Vdc into 10k ohms) commands the unit to assume the OPERATE state	
Pin G	Ground Return For Standby/Operate Command		
Pin J	+15 Vdc supply, Auxillary	—	+15 Vdc at 200 mA maximum
Pin K	Ground return for +15 Vdc	—	Ground level
Pin L	VSWR signal	350 ohms	Excess: 13 V nom. Normal: <1 V
Pin M	VSWR signal	350 ohms	Excess: <1 V Normal: 13 V nom.
Pin N	Standby signal	350 ohms	On: 13 V nom. Off: <1 V
Pin P	Standby signal	350 ohms	On: <1V Off: 13 V nom.
Pin R	Operate signal	350 ohms	On: 13 V nom. Off: <1 V
Pin S	Operate signal	350 ohms	On: <1 V Off: 13 V nom.
Pin T	Helix current signal	350 ohms	Excess: 13 V nom. Normal: <1 V
Pin U	Helix current signal	350 ohms	Excess: <1 V Normal: 13 V nom.
Pin V	TWT hot signal	350 ohms	Hot: 13 V nom. Normal: <1 V
Pin W	TWT hot signal	350 ohms	Hot: <1 V Normal: 13 V nom.
Pin X	PS hot signal	350 ohms	Hot: 13 V nom. Normal: <1 V
Pin Y	PS hot signal	350 ohms	Hot: <1 V Normal: 13 V nom.
Pin Z	Average helix current monitor	—	0.1 volt per milliampere, into 1 meg ohm
Pin a	Ground return, Avg. Hx monitor	—	
Pin b	Cathode voltage monitor	—	1 volt per kV, into 250K ohm
Pin c	Ground return, cathode monitor	—	

Environmental Capabilities

Military specifications:
Designed to meet MIL-E-5400 (DOD) and MIL-E-16400 (NAVY).

Operating temperature ..... -54 degrees C to +71 degrees C at baseplate
Storage temperature ..... -54 degrees C to +85 degrees C
Altitude ..... 50,000 feet minimum
Humidity ..... 95% Relative Humidity
Vibration ..... 10 g to 2000 Hz
Shock ..... 20 g, 11 ms

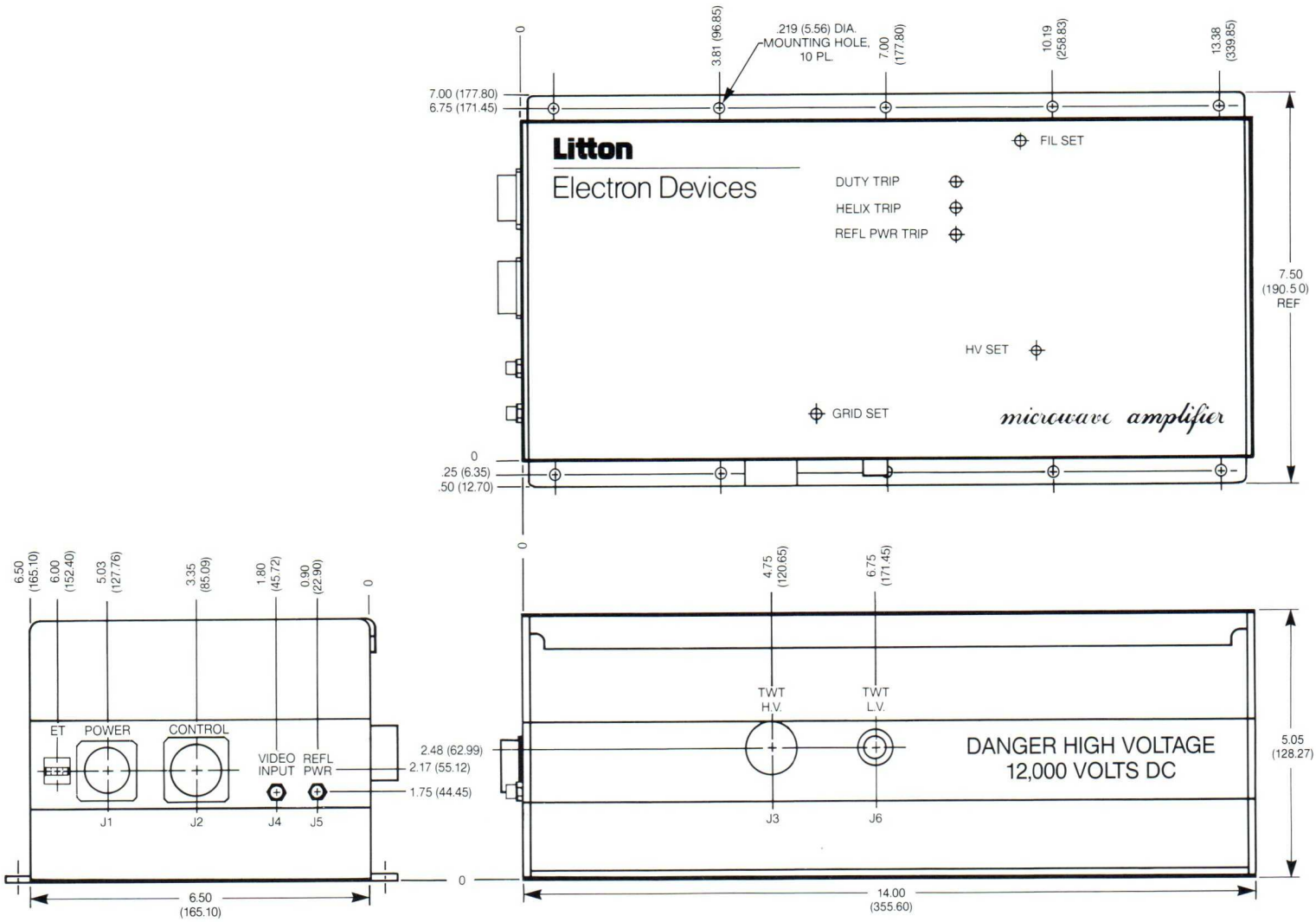
Mechanical Specifications

Cooling method ..... Conductive
Weight .... 24 lbs (11 kg) maximum for power supply only
Dimensions ..... See outline drawing

NOTE: THIS UNIT MEETS THE GERMAN VDE-804 SAFETY STANDARD

Pulsed TWT Power Supply

M-713



NOTES:
1. Dimensions in ( ) are millimeters.
2. Tolerances:
   .xx = ±.020 (0.51)
   .xxx = ±.005 (0.127)

Personnel should not be exposed to the microwave energy which may radiate from this device if improperly used or connected. All input and output microwave connections, waveguide flanges and gaskets must be microwave leak proof and properly engaged. Never operate this device without a microwave energy absorbing load attached. Never look into an open waveguide or antenna while this device is energized.

This device may produce X-radiation when energized. Operating personnel must be protected by appropriate shielding. X-ray caution signs or labels should be permanently attached to equipment directing operating personnel never to operate this device without X-ray shielding in place.

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Specifications and dimensions are subject to change without notice.

Electron Devices

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Pulsed TWT Power Supply

M-687

The Model 687 Power Supply is designed to drive Litton's high power ring-loop pulsed traveling wave tubes at duty cycles up to 4%. The unit, as well as its associated TWT, will operate at high altitudes and over a wide range of temperatures.

The power supply is usually supplied fully integrated with an associated TWT on a single conduction-cooled baseplate, thereby forming a self-contained pulsed microwave amplifier.

Both power supply and associated TWT are designed for complete control from a remote location. Monitoring outputs provided include control status signals, TWT voltage and current signals, and a number of diagnostic test point signals.

An accompanying manual provides complete instructions for installing, operating and maintaining the amplifier.

Litton

Electron Devices

Specifications

Automatic Fault Protection

Power is automatically removed to prevent damage from:
TWT arcing (Excess peak beam and helix current).
Excess duty cycle.
Line voltage too high or too low.
Overvoltage applied to TWT.
Undervoltage applied to TWT.
Overheated TWT.
Overheated power supply.
Excess average beam current.
Excess average helix current.

Input

RF input, to TWT, choice of:
1. Continuous wave (CW) or
2. Pulse of width desired at TWT RF output.

Video input pulse to modulator (J5).
A pulse with a rise and fall time of less than 100 ns to turn the TWT on and off.
Input level to hold TWT on ..... +5v to +15v into 50 ohms.
Input level to hold TWT off ..... less than +0.8v into 50 ohms.
Pulse width:
Minimum ..... 200 ns
Maximum ..... 30 microsecs (Wider on special order)

Output of TWT

Pulse power ..... See "Table of Standard Power Supplies and Associated TWT's"
Duty cycle ..... See "Table of Standard Power Supplies and Associated TWT's"
Pulse repetition frequency (PRF):
50 kHz maximum is standard. (Higher on special order)
Pulse rate jitter ..... 2 ns maximum.
RF rise time ..... 60 ns maximum.
RF fall time ..... 150 ns maximum.
Delay from leading edge of modulator pulse to full RF out ..... 150 ns max.
Delay from trailing edge of modulator pulse to full RF cutoff ..... 180 ns max.
Maximum spurious FM ..... 65 dB below carrier, measured in a 100 Hz bandwidth. Lower FM noise values are available on special order.

Output of Power Supply

Maximum output power ..... 1100 W.
Helix voltage:
Models 687-00 and 687-01 ..... 11 kv.
Models 687-02 and 687-03 ..... 15 kv.
Collector voltage as percent of helix voltage:
66% min, 70% typical, 80% max. (Depending on associated TWT)
Helix current ..... 600 mA typical, 900 mA max.
Collector current ..... 2.5 mA max.
Grid voltage ..... 60 v min., 130 v typical, 240 v max.
Grid bias ..... –90 v min., –125 v typical, –150 v max.
Grid current ..... 240 ma typical, 500 mA max.
Modulator output rise time ..... 70 ns typical, ... 100 ns max.
Modulator output fall time ..... 90 ns typical, ... 125 ns max.
Acquisition time ..... 110 ns typical, 150 ns max.
Heater voltage AC/DC ..... 6.1 v min., 6.3 v typical, 6.5 v max. regulated ± 1.5%.
Heater current ..... 3.5 A max.

Monitoring Indicator

Cumulative time heater on ..... 0000 to 9999 hours.

Prime Power Requirement

Line power: (MS3470L14-5 PN)
Models 687-01, -02 and -03, J1: ..... 200 v, 400 Hz, (200 v line to line) per MIL-STD-704A. 3-phase, 4-wire, pins A,B,C pin D neutral, pin E ground.
Model 687-00, JO ..... 115 v, 50 to 400 Hz, 3-phase, 3-wire, delta, pins A,B,C, pin D N/C, pin E ground.
Power consumption ..... 1300 W max.
Power factor: 0.9 typical.

Environmental Capabilities

Military specifications:
Designed to meet MIL-E-5400 (DOD) and MIL-E-16400 (NAVY)
Operating temperature ..... –54 degrees C to +85 degrees C.
Storage temperature ..... –54 degrees C to +95 degrees C.
Altitude ..... 70,000 ft. max.
Humidity ..... 95% relative humidity
Vibration ..... 5g, 5 to 2000 Hz.
Shock ..... 20g for 11 milliseconds (half sine wave).

Mechanical Specifications

Cooling method ..... Conduction
Weight:
Power supply alone ..... 37 lbs.
Associated TWT ..... 5 to 15 lbs.
Dimensions ..... See outline drawing.

M-687-00, -01, -02, -03
Control Input and Status Output Signals, Connector J2, (MS 3476L16-26SN)
Control inputs required

Pin A	Standby	Open circuit (or 8 to 15 Vdc into 600 ohms) commands the unit to assume the STANDBY state.
	Operate	Ground (or less than 2 Vdc into 600 ohms) commands the unit to assume the OPERATE state.

Status output signals which appear

	State	Source Z	Output Voltage	Load Current
Pin B	Operate Non-Operate	15 ohms 15k ohms	< 2 V 15 V nominal	Max. sink I = 100 mA Max. source I = 10 mA
Pin C	Standby Non-Standby	15 ohms 15k ohms	< 2 V 15 V nominal	Max. sink I = 100 mA Max. source I = 10 mA
Pin D	Fault No Fault	15 ohms 15k ohms	< 2 V nominal 15 V nominal	Max. sink I = 100 mA Max. source I = 10 mA
Pin E	Prime Power On Prime Power Off	1M ohms 1M ohms	15 V nominal 0 V	—— ——

Models 687-00, -01, -03.
Monitoring and Test Signals, Connector J3. (No connection is required for operation,) (MS 3476L20-41SN)

	Description	Source Z	Output Voltage
Pin A	Beam current		1 volt/ampere into 1M ohms
Pin B	Helix current		1 volt/ampere into 1M ohms
Pin C	Cathode voltage		1 volt/kilovolt into 10M ohms
Pin D	Fault signal	1M ohms	Fault: >4 V No fault: <1 V
Pin E	+DC bus monitor	1M ohms	Approx. +250 V with respect to Pin a.
Pin a	–DC bus monitor	1M ohms	Approx. –250 V with respect to Pin E.
Pin G	Line voltage Too high or too low Normal	 5k ohms 5k ohms	 Clock pulses >8 V peak (Random freq. <1 V 1 kHz to 20 kHz)
Pin H	Regulated +15 Vdc	1M ohms	+15 Vdc nominal
Pin J	Delayed +15 Vdc	1M ohms	+14 Vdc nominal
Pin K	Unregulated +20 Vdc	1M ohms	+20 Vdc nominal
Pin M	TWT hot signal. Overheated Normal	 1.5k ohms Zero ohms	 15 V Ground
Pin N	TWT over/under voltage.	1M ohms	Over/under voltage: >8 V Normal: <1 V
Pin T	HV inverter stop pulse Fault (or Standby) Normal	 1M ohms 1M ohms	 <5 V (Shuts down HV inverter) >13 V
Pin U	Inverter switch base current.		1 volt/ampere into 1M ohms (Typical current is 4 amperes).
Pin V	Inverter primary current		1 volt/ampere into 1M ohms (Typical current is 18 amperes).
Pin k	Clock signal	5k ohms	13 V peak (27 kHz square wave)
Pin m	Clock signal return.		

Model 687-02
Monitoring and Test Signals, Connector J3. (No connection is required for operation, MS 3470L20-41SN)

	Description	Source Z	Output Voltage
Pin A	Beam current		1 volt/ampere into 1M ohms
Pin B	Helix current		1 volt/ampere into 1M ohms
Pin C	Cathode voltage		1 volt/kilovolt into 10M ohms
Pin D	Line voltage monitor Too high or too low Normal	 100 ohms Infinite	 <2 V (Sink current is 20 mA) Open drain
Pin E	+DC bus monitor	1M ohms	Approx. +250 V with respect to Pin a.
Pin a	–DC bus monitor	1M ohms	Approx. –250 V with respect to Pin E.
Pin G	Hot TWT or PS Overheated Normal	 100 ohms Infinite	 <2 V (Sink current is 20 mA) Open Drain
Pin H	Regulated +15 Vdc	1M ohm	+15 Vdc nominal
Pin J	Delayed +15 Vdc	1M ohm	+14 Vdc nominal
Pin K	Beam current Excess average Normal	 100 ohms Infinite	 <2 V (Sink current is 20 mA) Open drain
Pin M	TWT hot signal. Overheated Normal	 1.5k V Zero ohms	 15 V Ground
Pin N	TWT over/under voltage.	1M ohms	Over/under voltage: >8 V Normal: <1 V
Pin T	TWT arcing Arcing Normal	 100 ohms Infinite	 <2 V (Sink current is 20 mA) Open drain
Pin U	Inverter switch base current.		1 volt/ampere into 1M ohms (Typical current is 4 amperes)
Pin V	Inverter primary current.		1 volt/ampere into 1M ohms (Typical current is 18 amperes)
Pin k	Clock signal	5k ohms	+13 V peak (27 kHz square wave)

M-687-00, -01, -02, -03

TWT Connectors	Description	Function
J4	SMA-F	TWT Thermostat (normally closed, Blue)
J6	#6-32 Stud	TWT Helix (grounded, Black)
J7	LGH1I (Amp)	TWT Collector (Red)
J8	LGH1I (Amp)	TWT Cathode (Yellow)
J9	LGH1I (Amp)	TWT Grid (Green)
J10	LGH1I (Amp)	TWT Heater (Brown)

M-687-00, -01, -02, -03
Video Input Pulse, J5 (SMA-F) See Specifications, Video Input.

Standard Power Supplies and Associated TWT's

Power Supply Model Number	Associated TWT				
	TWT Model No.	Frequency Range	Power Output	Gain	Maximum Duty Cycle at Rated Power
M687-01	L-5570-51	1.5 to 1.35 GHz	6 kW	50 dB	4%
M687-02	L-5600-52	2.7 to 3.2 GHz	10 kW	45 dB	2%
M687-01	L-5366-50	3.0 to 3.5 GHz	3 kW	60 dB	3%
M687-02*	L-5679-55*	3.2 to 3.7 GHz	10 kW	46 dB	2.5%
M687-02	L-5591-50	8.9 to 9.5 GHz	6 kW	60 dB	2%
M687-02	L-5581-51	8.9 to 9.4 GHz	8 kW	60 dB	2%
M687-02	L-5601-50	9.5 to 10.0 GHz	8 kW	60 dB	2%
M687-01	L-5785-50	16.0 to 16.5 GHz	3 kW	60 dB	3%

*TWT is liquid cooled. A liquid cooled baseplate for the TWTA assembly can be provided at additional cost.

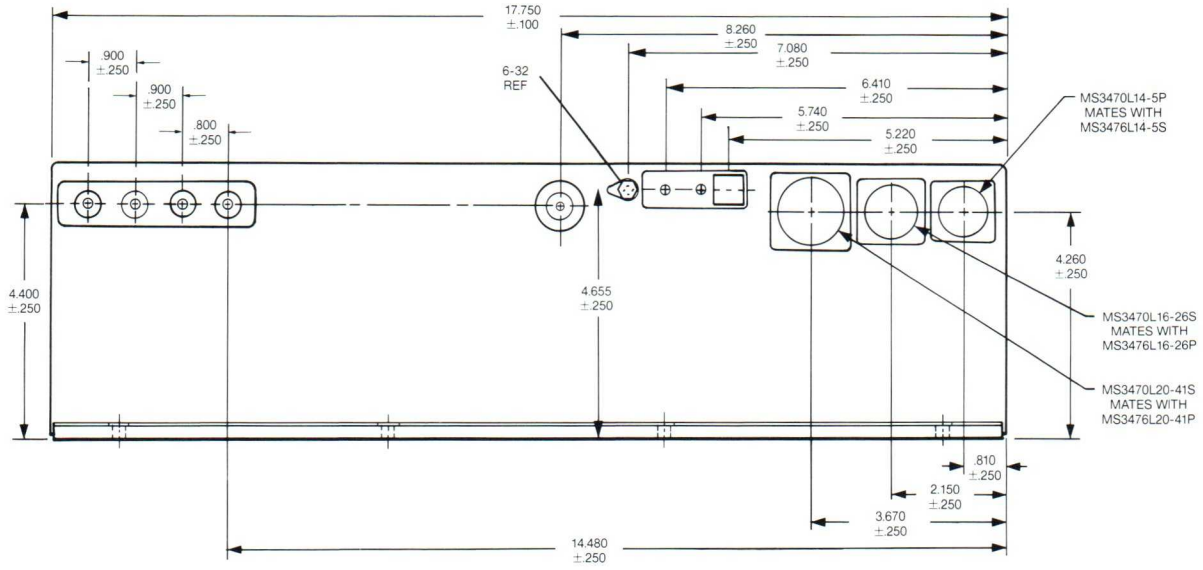
NOTE: Other TWT and power supply combinations are available on special order.

Personnel should not be exposed to the microwave energy which may radiate from this device if improperly used or connected. All input and output microwave connections, waveguide flanges and gaskets must be microwave leak proof and properly engaged. Never operate this device without a microwave energy absorbing load attached. Never look into an open waveguide or antenna while this device is energized.

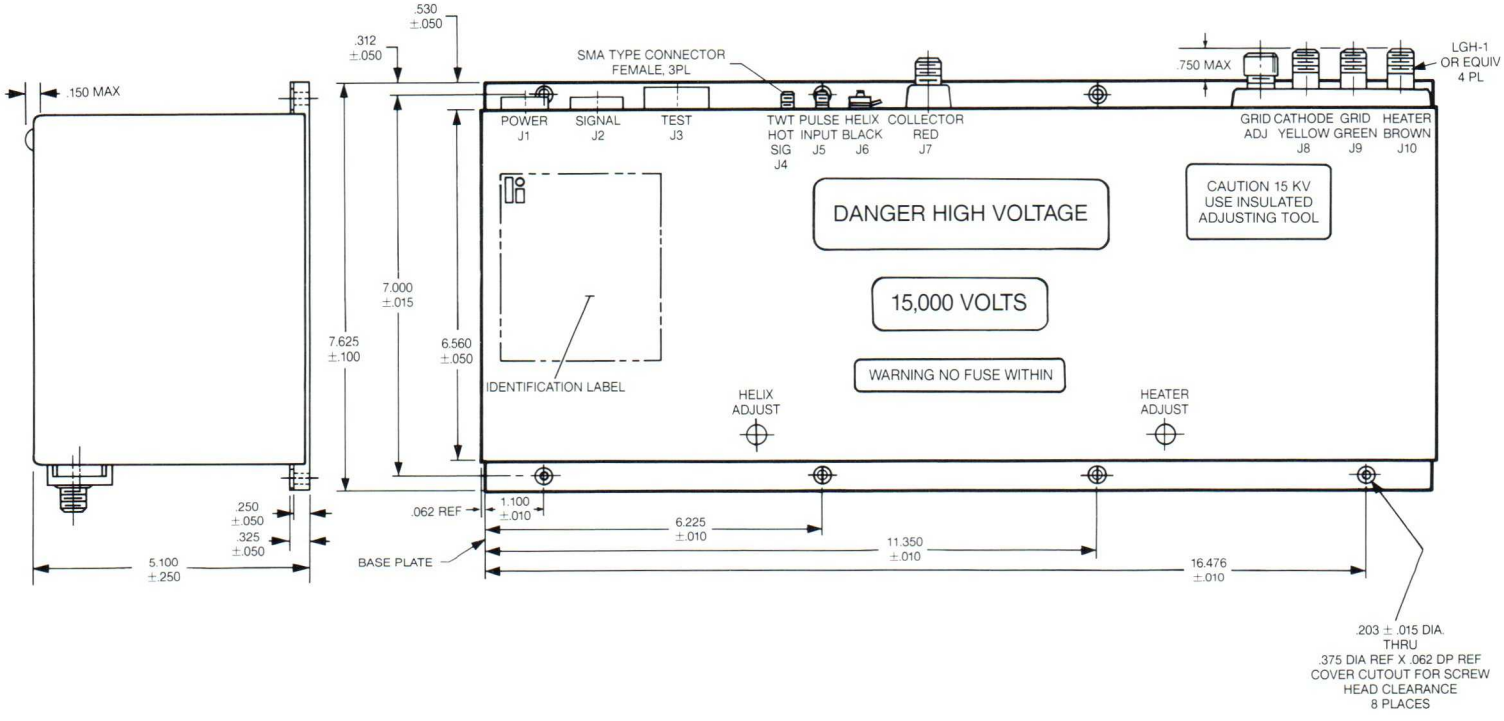
This device may produce X-radiation when energized. Operating personnel must be protected by appropriate shielding. X-ray caution signs or labels should be permanently attached to equipment directing operating personnel never to operate this device without X-ray shielding in place.

Pulsed TWT Power Supply

M-687



NOTES:
1. Ship mounting screws (10 - 32 x ½ socket HD)
   Part No. 41896-C and washers (split LCK #10)
   Part No. 152734-C, 8 ea. with amplifier.



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Litton Precision Products Int. Inc.
6 First Avenue, Globe Park,
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Tel: Marlow (06284) 6060 Telex: 847548

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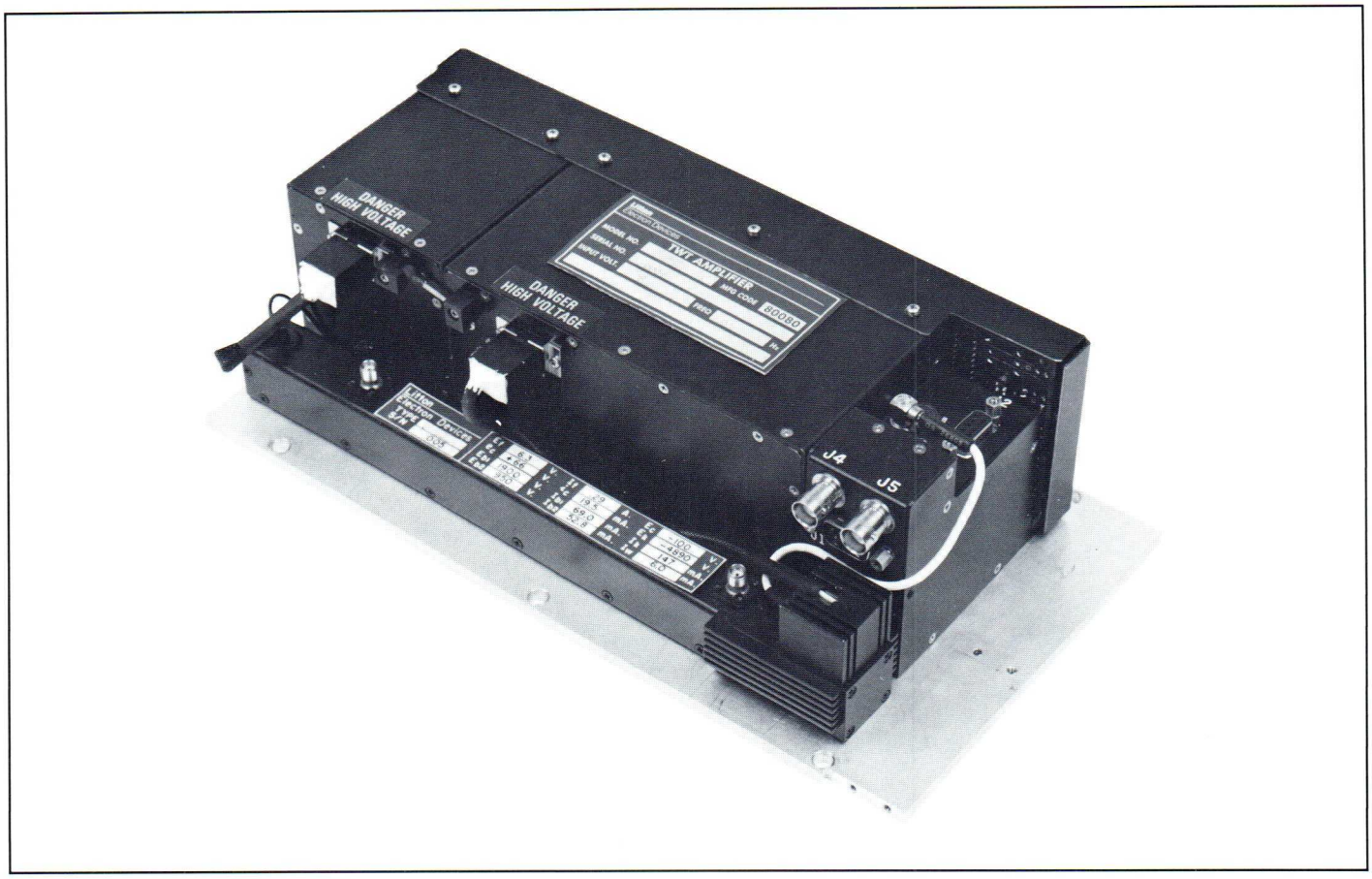
Pulsed TWT Power Supply

M-720



The Model M-720 Power Supply is a lightweight, compact, low noise power supply designed for use in military systems. It is capable of driving Litton's L-2307 Traveling Wave Tube at duty cycles up to 30% with maximum spurious FM sideband levels less than −70 dBc.

The power supply is usually supplied fully integrated with an associated TWT, thereby forming a self-contained pulsed microwave amplifier.

The power supply and associated TWT are designed for complete control from a remote location. Monitoring outputs provided include control status signals, TWT voltage and current signals, and a fault warning signal.

An accompanying manual provides complete instructions for installing operating and maintaining the amplifier.

Automatic Fault Protection

Fault protection is provided to prevent damage from:

- TWT arcing (Excess peak helix current).
- Over duty (Excess average beam current).
- Excess pulse width.
- Excess average helix current.
- Excess peak beam current.
- Excess cathode voltage.
- Primary 28 Vdc voltage too high or too low.
- Overheated TWT.
- Overheated power supply.

Analog Monitoring Signals

- Cathode voltage.
- Helix current.

Status Signals

- Standby state.
- Operate state.
- Fault state.

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Specifications

Power Supply Outputs

Warm-up time . . . . . 3 minutes
Maximum output power . . . . . 60 W
Helix voltage, adjustable . . . . . 4500 to 5100 Vdc
Collector voltage as percent of helix voltage . . 20%, 40%
Helix current . . . . . 12 mA peak, typical
Collector current . . . . . 55 mA peak, typical
Grid voltage, adjustable . . . . . .20 to 80 V
Grid bias . . . . . −100 V minimum
Modulator output rise time . . . . . 20 ns maximum
Modulator output fall time . . . . . 20 ns maximum
Acquisition time . . . . . 175 ns maximum
Heater voltage, adjustable . . . . . .6.0 to 6.6 V
Heater current . . . . . 0.3 A typical

RF Modulation and Sync Inputs

RF input to TWT:
A continuous wave or a pulse of width desired at output.
Video input to pulse modulator (Connector J4):
TWT on . . . . . TTL high, differential input.
TWT off . . . . . TTL low, differential input.
Pulse width . . . . . 20 microsec. max., 200 ns min.
Video input rise and fall times . . . . . 10 ns maximum
Duty cycle . . . . . .30% maximum
Pulse repetition frequency . . . . . 175 kHz maximum
Pulse separation . . . . . 200 ns minimum

Sync Input (Connector J5)

Frequency Range . . . . . 140 to 180 kHz
Amplitude . . . . . .TTL levels, differential input
Pulse Width . . . . . 300 ns minimum
600 ns maximum

TWT Outputs

RF power, frequency and gain are determined by the specific TWT selected peak. Typical values for the Litton L-2307 TWT are:
Saturated peak power output* . . . . . .40 W minimum
Frequency range* . . . . . 8-18 GHz
Duty cycle* . . . . . .30% maximum
Pulse repetition frequency . . . . . 175 kHz maximum
Time jitter . . . . . 2 ns maximum
RF rise time . . . . . 15 ns maximum
RF fall time . . . . . 20 ns maximum
Delay from leading edge of video input pulse to full RF out . . . . . 175 ns
Delay from trailing edge of video input pulse to full RF cutoff . . . . . 175 ns

Power Requirements, Connector J1

Pins 1, 2, 6 . +28 Vdc per MIL-STD-704B (+20 Vdc min)
Pins 4, 5, 9 . . . . . Ground return
Pins 3, 7, 8 . . . . . No connection
Power consumption . . . . . .125 W maximum at 28 Vdc and 30% duty cycle

*Power output can be optimized to 100 watts peak over selected portions of the band, but duty cycle at 100 watts is limited to 10%.

Control, Status, and Monitoring Signals, Connector J2

Control inputs

Pin 3	Standby/operate command Standby: Open circuit (or +12 V) commands the unit to assume the STANDBY state. Operate: Ground (or TTL Logic 0) commands the unit to assume the OPERATE state.
Pin 1	Standby/operate command ground return.

Status output signals

Description		Output Voltage
Pin 8	Fault indicator	
	On	12 V minimum
	Off	0.8 V maximum
Pin 4	Standby indicator	
	On	12 V minimum
	Off	0.8 V maximum
Pin 9	Operate indicator	
	On	12 V minimum
	Off	0.8 V maximum
Pin 5	Prime Power On Indicator	
	On	12 V minimum
	Off	0.8 V maximum

Monitoring signals

Pin 2	Cathode voltage: 1 volt/kilovolt into 20k ohms min
Pin 6	Helix current: 100 volts/ampere into 30k ohms min
Pin 7	Not connected

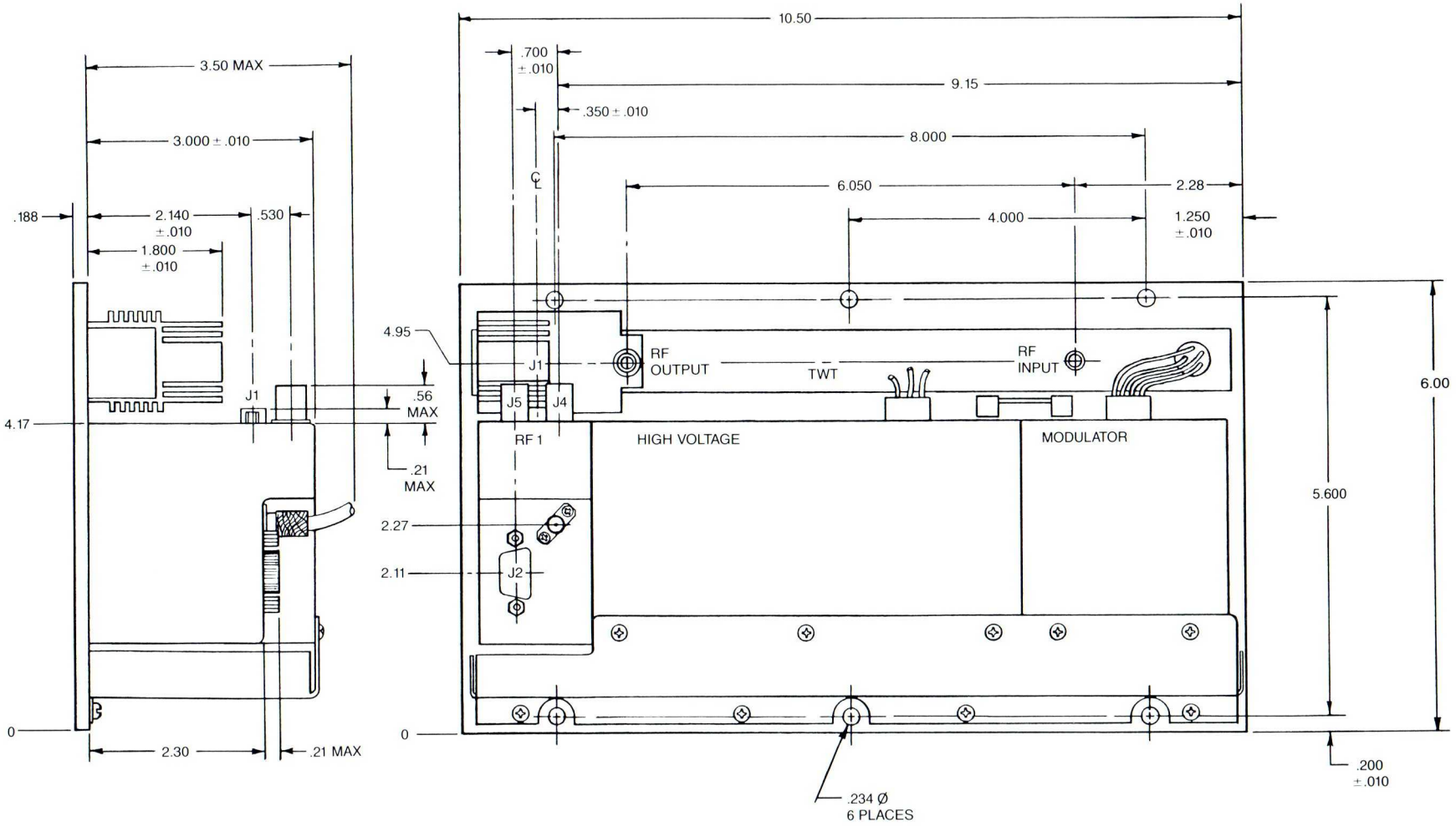
Environmental Capabilities

Operating temperature . . . . . −40 degrees C to +70 degrees C
Storage temperature . . . . . −62 degrees C to +105 degrees C
Altitude . . . . . 40,000 feet maximum
Humidity . .95% relative humidity, including condensation
Vibration . . . . . 5 g, 5 to 2000 Hz
Shock . . . . . 15 g, 11 ms

Mechanical Specifications

Cooling . . . . . Conduction cooled baseplate
Weight . . . . . 7 lbs maximum without TWT

Personnel should not be exposed to the microwave energy which may radiate from this device if improperly used or connected. All input and output microwave connections, waveguide flanges and gaskets must be microwave leak proof and properly engaged. Never operate this device without a microwave energy absorbing load attached. Never look into an open waveguide or antenna while this device is energized.


10.50
.700
±.010
9.15
3.50 MAX
.350 ± .010
3.000 ± .010
8.000
℄
6.050
2.28
.188
2.140
±.010
.530
4.000
1.250
±.010
1.800
±.010
4.95
J1
RF
OUTPUT
TWT
RF
INPUT
J5
J4
.56
MAX
4.17
RF 1
HIGH VOLTAGE
MODULATOR
6.00
5.600
.21
MAX
2.27
2.11
J2
0
0
2.30
.21 MAX
.200
±.010
.234 Ø
6 PLACES

Pulsed TWT Power Supply

M-720

Summary of Connector Functions

Connector	Type	Function
J1	Amp 842920-9	See "Power Requirements."
J2	Amp 842925-9	See "Control, Status, and Monitoring Signals."
J3	SMC plug, straight	TWT thermal overload. Normally closed. Opens at 140 degrees C. Isolated.
J4	BNC Twinax Amphenol 31-2225	See "Specifications, Video input pulse."
J5	BNC Twinax Amphenol 31-2225	See "Specifications, Sync input pulse"
J12	Amp 867471-3	To TWT collectors.
J15	Amp 867471-3	To TWT gun end.

Sales Offices

Main marketing offices and applications engineering services are located at 960 Industrial Road, San Carlos, California 94070. Phone (415) 591-8411 or TWX 910-376-4900. Regional Marketing Offices are listed below:

EAST
288 Littleton Road
Suite 32
Westford, Massachusetts 01886
(617) 692-6220

DISTRICT OF COLUMBIA
1755 Jefferson Davis Highway
Suite 510
Arlington, Virginia 22202
(703) 920-4100

MID-ATLANTIC
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Springfield, New Jersey 07081-0516
(201) 379-3131

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WEST
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Westlake Village, California 91361
(818) 889-4903

SOUTHWEST
840 E. Central Parkway
Suite 120
Plano, Texas 75074
(214) 881-0822

Sales outside the United States are handled through the following companies:

WESTREX
Litton-Westrex
CPO Box 760
Tokyo, Japan
(81) 3-211-6791

LITTON PRECISION PRODUCTS INTERNATIONAL:

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F-78150 Le Chesnay
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CH-8050 Zurich
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San Carlos, California 94070
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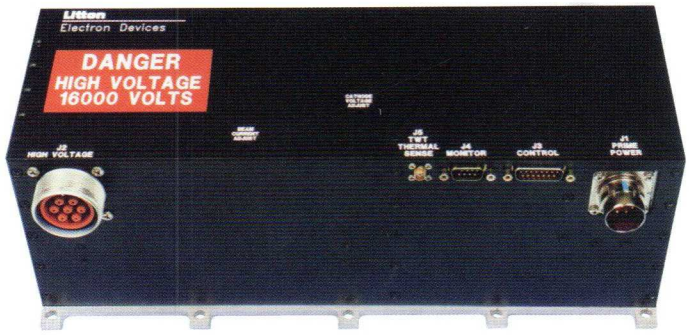
POWER SUPPLIES

M-755
TWT Power Supply

Features:

- **Compact and Lightweight**
- **Low Noise, High Performance**
- **High Reliability**
- **Operates a Wide Variety of TWTs**
- **1600 Watts of Output Power**



The M-755 is a very lightweight, compact and high performance TWT power supply designed specifically for medium-power military radar applications.

It is capable of operating TWTs with up to 500 watts of average RF output power.

Figure 1 shows the 8kW, 5% duty X-band L-5982 TWT. The M-755 can be configured to operate in pulse or CW mode and is suitable for ECM, military communications, and other applications as well as radar.

State-Of-The-Art Power Electronics

- High frequency zero-current switching
- Independent mag-amp control of the filament supply
- A high speed and low noise floating-deck modulator
- A linear post-regulator for extremely low helix ripple voltage
- Modern, high performance components used throughout: high-speed power MOSFETs and high voltage diodes, lightweight high voltage capacitors, high frequency power magnetics, advanced power integrated circuits.

High-Reliability, Long-Life Design

- Component derating generally meets the requirements of U.S. government documents *NAVMAT P-4855-1* and *AS-4613.*
- Junction temperatures maintained to less than 110°C.
- Relatively low voltage stress in the high voltage section.

Advanced Packaging Techniques

- Surface-Mount Technology (SMT)
- Hybrid Power Electronics
- Proprietary Potting Compounds
- Modular Design

Special Features

- Serial data link for transmission of status information with minimal wiring.
- Heater voltage can be reduced during standby to extend TWT life.
- Rapid recovery to full power output after momentary loss of prime power.
- Optional +12 Vdc output available for driver SSA or other purposes.

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Litton M-755 Power Supply

TECHNICAL SPECIF

Electrical Performance

Cathode Voltage . . . . . 13 to 16 kV, 2 kV adjustment range (Can be adjusted for lower voltages)

Collector Voltages . . . . Can modified for different voltages or TWTs with single stage or three stage collectors

Collector 1 Voltage . . . . 70% of E_K

Collector 2 Voltage . . . . 40% of E_K

Heater . . . . . Settable from 6.0 to 6.6 Vdc

3 amps max.

Can be programmed to a lower voltage during standby, extending TWT life.

Warm-Up Timer . . . . . 180 seconds maximum upon first applying prime power

In case of temporary loss of prime power, warm-up time reduced proportionately

Modulator . . . . . Grid or Focus Electrode types available Voltages shown below are typical, other ranges available.

Intercepting Grid . . . . . On-bias settable from +80 to +110 volts Off-bias of -125 volts

Shadow Grid . . . . . On-bias settable from +275 to +300 volts Off-bias of -240 volts

Focus Electrode . . . . . On-bias settable from -3 to -30 volts Off-bias of -1000 volts

Modulator Waveform . . . 125 nsec acquisition time

40 nsec voltage rise time (10 nsec typ. for RF)

Pulse width from 100 nsec to 50 µsec PRF from CW to 100 kHz (25 kHz max. for focus electrodes)

Input Prime Power . . . 270 Vdc or 3-phase, 200 V_{LL}, 400 Hz per MIL-STD-704E 1900 watts input, 0.9 power factor

Output Power . . . . . 1600 watts to the TWT +12 Volts, 0.8 amps available for driver SSA or other purposes

Controls, Indicators, and Monitors

The following interface signals are available on the M-755. Typical applications use a subset of these signals and Litton can configure the interface per customer requirements. The control and indicator signals are available as TTL or as differential line driver/receiver signals.

Controls

- Standby / Operate (HV On / Off)
- Pulse (Modulator On / Off)
- Fault Reset
- PRF Synchronization
- Pre-Trigger (Blanking)
- Battle Override

Indicators

- High Voltage On
- Operate
- Standby
- Warm-Up
- Fault
- Serial Link (see next page)

Monitors

Cathode Voltage	(1000:1)
Beam Current	(1 Volt/Amp)
Helix Current	(1 Volt/Amp)
Heater Voltage	(1:1)
Heater Current	(1 Volt/Amp)
Grid Voltage	(100:1)

Mechanical

Cooling . . . . . Conduction to mounting surface

Weight . . . . . 24 lbs

Dimensions . . . . . 14.25" long x 6" wide x 5" high 428 ci (362mm x 153mm x 127mm) 7034 cc

Environmental

Temperature . . . . . -55 to +85°C

Altitude . . . . . 50,000 feet

Vibration . . . . . 15 g's rms, 5 to 2000 Hz

Shock . . . . . 30 g's, 11 msec

Humidity . . . . . Up to 100% including condensation

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Serial Data Link Description

The following serial data is transmitted asynchronously at 9600 bits per second, continuously retransmitting 400 12-bit words. Only Words 1 through 4 contain information. All signals are active high.

Bit	Word 1	Word 2	Word 3	Word 4	Words 5–400
0	Low	Low	Low	Low	High
1	Low	Low	High	High	High
2	Low	High	Low	High	High
3	HV Off Indicator	HVPS Inverter Overcurrent Fault	Heater Over Voltage Fault	TWT Overtemperature	High
4	Warm-Up / Standby Indicator	Cathode Over Voltage Fault	Heater Under Voltage Fault	Heater Under Current Fault	High
5	Summary Fault Indicator	Cathode Under Voltage Fault	Beam Peak Current Fault	High Voltage Interlock Fault	High
6	PRF Synchronization Fault	HVPS Thermal Fault	Beam Average Current Fault	Excess Duty Fault	High
7	Battle Override	HVPS Logic Over Voltage Fault	Helix Peak Current Fault	Prime Power Over/Under Voltage Fault	High
8	Low Heater Voltage Disabled	HVPS Logic Under Voltage Fault	Helix Average Current Fault	Safety Overtemperature Fault	High
9	Operate	Standby Indicator	High	High	High
10	High	High	High	High	High
11	High	High	High	High	High

Associated TWTs

The M-755 is capable of operating a wide variety of TWTs.
Some examples are listed below.

Model	Frequency	Power	Duty Cycle
L-5827	1.0 - 2.0 GHz	1 kW	4%
L-6020	2.5 - 8.0 GHz	1 kW	7%
L-5833	6.5 - 18.0 GHz	1.5 kW	6%
L-6022	7.5 - 18.0 GHz	1.5 kW	6%
L-5845	8.5 - 9.6 GHz	4 kW	8%
L-5850	8.5 - 10.5 GHz	2 kW	6%
L-5982	9.0 - 10.0 GHz	8 kW	5%

Model	Frequency	Power	Duty Cycle
L-5819	9.4 - 10.0 GHz	3.6 kW	10%
L-5813	9.5 - 10.5 GHz	1 kW	30%
L-5785	16.0 - 16.5 GHz	3 kW	3%
L-6019	2.5 - 8.0 GHz	150 Watts	CW
L-5918	5.85 - 6.425 GHz	400 Watts	CW
L-5832	6.5 - 18.0 GHz	200 Watts	CW
L-6021	7.5 - 18.0 GHz	150 Watts	CW

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M-755

Fault Protection Matrix

Fault Condition	RF Off	HV Off	Auto Reset, Latches After 3 Tries	Auto Reset After Fault Clears	External Reset	Cycles Back To Warm-Up
TWT Arc	X	X	X		X	
Excess Peak Helix Current	X	X	X		X	
Excess Average Helix Current	X	X	X		X	
Excess Peak Beam Current	X	X	X		X	
Excess Average Beam Current	X	X	X		X	
Cathode Over-Voltage	X	X	X		X	
Cathode Under-Voltage	X			X		
Heater Over-Current	X	X		X		X
Heater Under-Current	X	X		X		X
Heater Over-Voltage	X	X	X		X	X
Heater Under-Voltage	X	X		X		X
Prime Power Over-Voltage	X	X		X		
Prime Power Under-Voltage	X	X		X		
Prime Power Over-Current	X	X	X		X	
TWT Over-Temperature	X	X		X		
Power Supply Over-Temperature	X	X		X		
HV Connector Interlock	X	X			X	X
Internal Power Supply Voltage	X	X		X		
Excess Duty Cycle	X			X		
Excess Pulse Width*	X			X		

* TWTA remains operational, pulses truncated.

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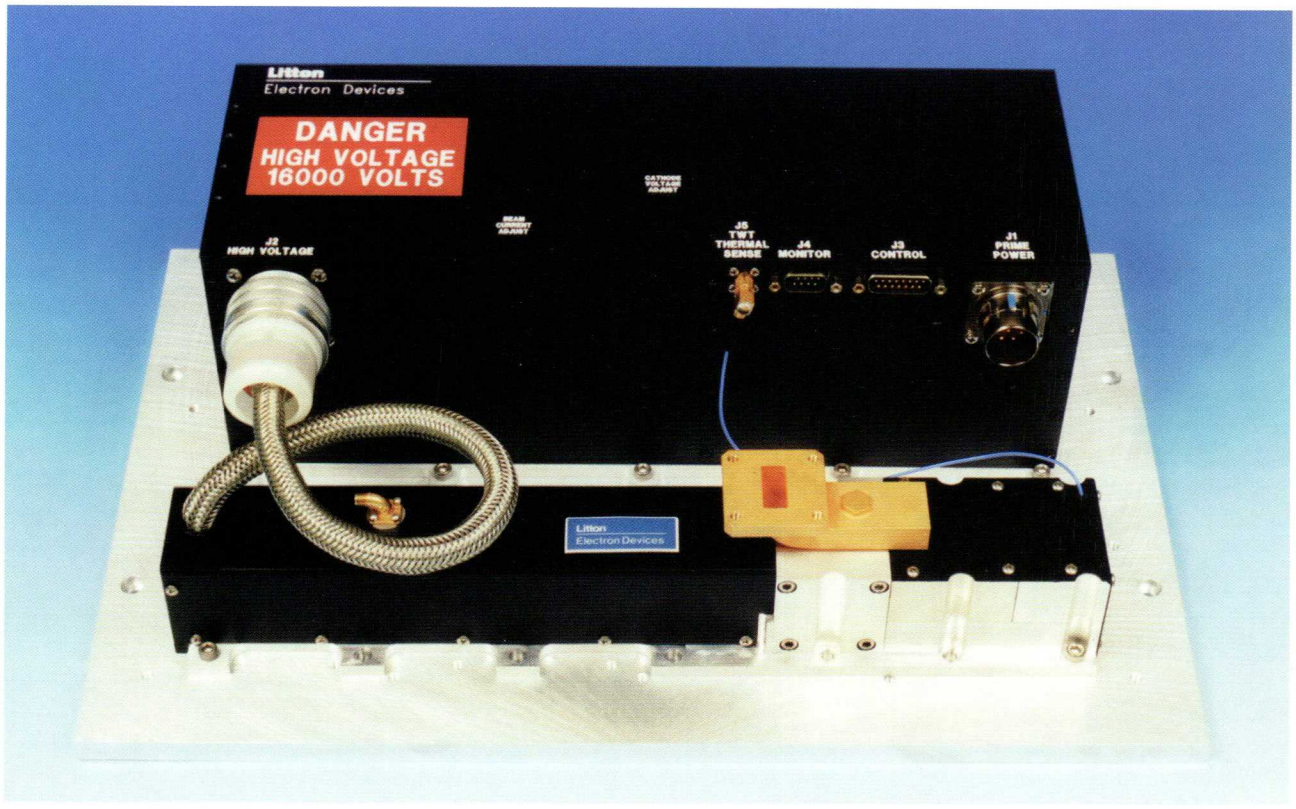
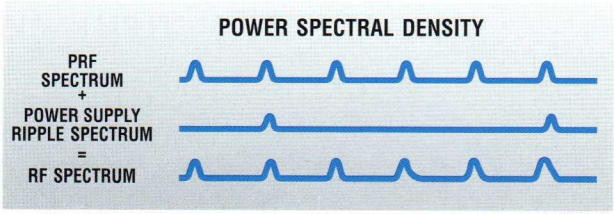


Figure 1. The M-755 is shown above with the L-5982 TWT, forming a compact 8kW, 5% duty X-band TWTA.

Phase Noise

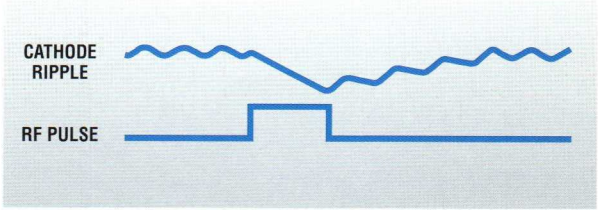
The M-755 has been optimized for modern radar systems which require a low phase noise TWTA. The primary contributor to phase noise in TWTAs is ripple voltage on the TWT cathode and grid. In addition to very accurate regulation and significant filtering, the M-755 has two phase noise reduction techniques which can be utilized to achieve ultra-low noise: PRF synchronization and blanking (pre-trigger). Depending on the TWT and the phase noise reduction technique employed, the M-755 can achieve noise levels of -90 dBc/Hz with a maximum spur of -70 dBc at 2400 Hz (six times the line frequency).

PRF Synchronization



With PRF synchronization the ripple voltage is not reduced, rather it is controlled in frequency such that the phase noise effects of the ripple are effectively eliminated. This technique requires an input signal with a frequency of 380 ± 10kHz and an integer multiple of the pulse frequency (PRF). This signal is used to synchronize the power supply switching frequency, and hence the output ripple frequency, of the M-755. As can be seen by the pictorial example above, the phase noise spectrum generated by the ripple voltage is masked by the spectrum generated by the output pulse.

Blanking (Pre-Trigger)



The blanking technique eliminates ripple voltage during the pulse by turning the high voltage power processing circuits off during the pulse. This is best achieved with a pre-trigger input which turns the power supply off slightly before the application of the pulse, but for wide pulse width applications this input may be omitted. The high voltage outputs are supported by high voltage capacitors during the pulse. This technique, illustrated above, works best with relatively long pulse widths and low pulse frequencies.

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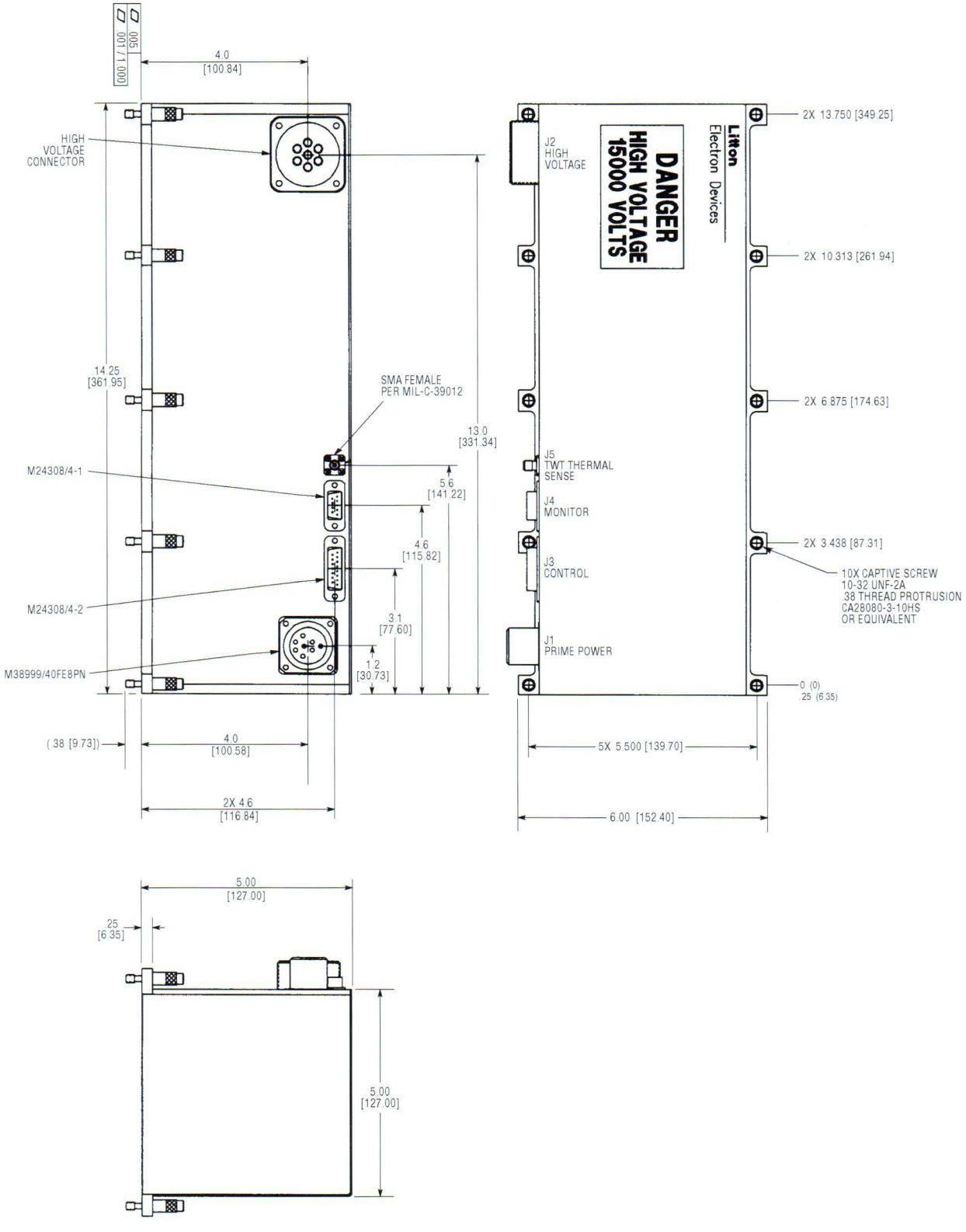
M-755 Outline Drawing



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