# M Precision Laboratories ECAT Lightning Test System (LTS)

Modular LTS platform for multiple avionic standards

The M Precision Labs ECAT Lightning Test System (LTS) is a modular test platform which tests to the lightning simulator requirements of RTCA DO-160, Sections 22, and 17. The system is expandable to meet MIL-STD-461G-CS117, Boeing, Airbus, EUROCAE and other avionic standards.

- Safe / Quick Test Set-up
- Simple user interface
- Waveforms: 1, 2, 3, 4, 5A, 5B, 6 & voltage spikes
- Levels 1, 2, 3, 4 and 5+
- Single Stroke, Multiple Stroke, Multiple Burst and Pin Injection from the same front panel
- Modular architecture
- Voltage spikes



When failure is not an option With its fully-automated test operation, the M Precision Labs ECAT Lightning Test System (LTS) yields reliable, repeatable and accurate test results to avionics lightning simulation requirements of RTCA DO 160 Section 22 and 17. It is easily expandable to meet most MIL-STD-461G-CS117, Boeing, Airbus, EUROCAE and other requirements.

Building on the legacy of the proven ECAT platform, it provides field-upgradeable modular technology featuring fast test set-up, intuitive programming, and front panel control. On-site calibration and field service is available worldwide.

System description
The ECATLTS is configured as a basic test system available as a Level 3, Level 4, or Level 5 tester. MIL-STD-461G-CS117 requires a level 5 system and a DCVI-1 clamp. All test systems feature Single stroke, Multiple Stroke, Pin Injection and Multiple Burst test capability integral to the system controls without any external connections.

The systemis composed of a frame that houses power and control functions for the system. Waveforms are produced from the modules inserted into the frame. Both the frame and modules can be purchased separately. Owning multiple frames allows increased capability by "swapping" modules between frames, and testing with each frame simultaneously.



## **The Total System**

The ECAT LTS provides a modular test platform based on the requirements of RTCA DO-160G Section 17 (Voltage Spikes) and Section 22 (Lightning Induced Transient Susceptibility), Mil-STD-461G-CS117, EUROCAE, Boeing, Airbus and others. The LTS can perform Pin Injection, Cable Bundle and Ground Injection testing with Single Stroke, Multiple Stroke and Multiple Burst modes from the same module. The system can be expanded as test requirements evolve or to allow the operator to double his capacity using existing modules without purchasing another system.

## **Turn-key Testing**

With the advent of the ECATLTS, lightning testing of avionics comes of age with an easy to use, turn-key solution for test engineers and technicians. Until recently, the availability of commercial equipment for testing to lightning standards for avionics, such as RTCA DO-160G. has been limited. Most test equipment used in the industry was home-made: difficult and time consuming to set-up and awkward to use, often unsafe and requiring skilled engineers for their operation and maintenance.

Testing with the ECATLTS insures repeatable, reproducible test results while virtually eliminating tester set-up time. Waveforms and functions are selected with the push of a button rather than by reconfiguring test equipment and moving around bulky generator boxes and wiring. The ECATLTS can significantly reduce total test time resulting in significant cost savings.

#### Versatile, Modular Architecture

ECATLTS modular systems are totally open-ended to protect you as industry standards evolve. Built upon the proven modular construction of the M Precision Labs ECATSystem, ECATLTS waveform simulators useplug-in modules that can be added or replaced by the operator at any time without a field service engineer or shipping to the factory, at considerably less expense than purchasing new instruments.

#### Currently Available LTS Modules1:

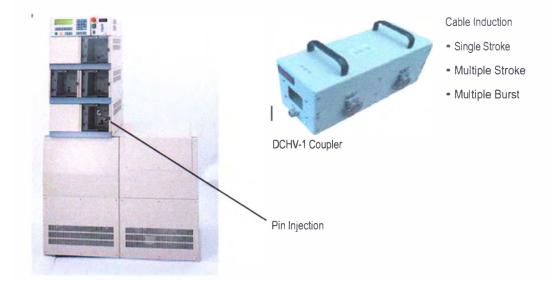
Waveform	Pin Injection	Single Stroke	Multiple Stroke	Multiple Burst	Description	Plug-in Module
WF1					6.4µs X 69µs Current Wave	D561, D566
WF2	•				≤100ns x 6.4µs Voltage Wave	D562
WF3- 1 MHz					1 MHz Oscillatory Voltage Wave	D563
WF3- 10 MHz					10 MHz Oscillatory Voltage Wave	D563
WF4	•				6.4µs X 69µs Voltage Wave	D561, D566
WF5A	•				40μs X 120μs Current Wave	D561, D567
WF5AAirbus/Boeing					40μs X 120μs Voltage & Current Wave	D568
WF5B					50μs X 500μs Current Impulse	D564
WF6					0.25µs X 4.0µs Current Impulse	D569
Voltage Spikes				2	≤2µs X ≥10µs, ≤2µs X ≥50µs, ≤2µs X ≥100µs, ≤2µs X≥200µs, ≤2µs X≥400µs	D570

See specifications

## One example of the multiple standards supported for WF3 Multiple Burst Test Mode:

LTS Display	Standards Compliance	Min. Applic. Time	Max # Trans	Max # Bursts	Time Between Bursts	Time Between Transients
DO160	DO160 Boeing D6-16050-5 Airbus ABD0100.1.2-F Airbus ABD0100.1.2-G	3 sec	20	3	30-300ms	50-1,000µs
Airbus/E	Airbus ABD0100.1.2-E	15 sec	500	1		10-1,000µs
Boeing-4	Boeing D6-16050-4 NH-90	3 sec	20	24	10-200ms	10-50µs
Mil-std-461G	CS117	3 sec	20	3	30-300ms	50-1,000us

<sup>&</sup>lt;sup>2</sup>Up to 50 pulses in 60 seconds

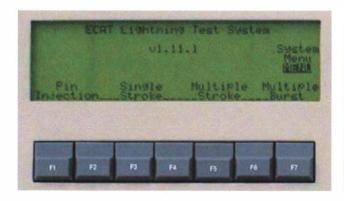


Controller front panel programming for above example



1. Select Test Type: Pin Injection, Single Stroke, Multiple Stroke or Multiple Burst

2. Select waveform type, voltage levels and timing





It doesn't get any easier than this!



Model:F-LTS-X	(xindicates level 3, 4 or 5)
LTS Frame/Controller for the	operation of individual modules
System Voltage	190-230 VAC, 50/60 Hz, 3Ø Wye, 30 Amax (Optional 190-230VAC, 50/60Hz, 1Ø 50 Amax)
Test Types	Single Stroke Multiple Stroke: 1-24 pulses; 10 – 200 ms fixed, random or irregular 1st pulse and subsequent pulse spacing Multiple Burst: 1-500 pulses; 50 – 1000 us fixed, random or irregular pulse spacing; 1-24 bursts; 30 – 300 ms fixed, random & random non-repeating or irregular burst spacing Pin Injection Voltage Spikes
NumberofTests	1 to 999
Test Repetition Rate	3 s to 255 s (at maximum level, min rep rate may be >3 s)
Control Interface	Display 8x40 characters LCD; Remote USB, RS232, Fiber-optic (future feature)
Safety Features	Emergency off switch, external interlock for users (mats, Lexan barrier, etc); lockout/tag out capability
Module Bays	3 full-width / 4 half-width plug-in module capability
Operating Temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
Physical Specifications	Height 160 cm (66.6 in); Width 107 cm (42 in); Depth 69 cm (27 in); Weight 360 kg (800 lb) fully configured
Options	LTS-1PHASE: Adds a power converter to accept 190-230 VAC, 50/60 Hz, 1Ø50 Amax to power the LTS
CEMarking	Safety and EMC Directives
Model:D561-Lx	(xindicates DO160 level 3, 4 or 5)
LTS Module for WF1, WF	F4, WF5A, full-width ECAT plug-in module
WF1(Cl <sup>1</sup> ,Gl)	Single Stroke, 6.4/69 μs, 50-3800 A. 2000 Voc Multiple Strokes, 6.4/69 μs, 25-1200 A
WF4(GI)	Single Stroke, 6.4/69 µs, 25-2000V, 2100Asc Multiple Strokes, 6.4/69 µs, 10-600 V
WF4PinInjection	6.4/69 µs, 50-2000 Voc/10-400 Asc = 5 Ohm
WF5A(Cl <sup>1</sup> , Gl)	Single Stroke, 40/120 μs, 50-10000 A. 1300 Voc Multiple Strokes, 40/120 μs, 30-1500 A
WF5APinInjection	40/120 μs, 50-1800 Voc/50-1800 Asc = 1 Ohm
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating Temperature	+15°C to +35°C

<sup>&</sup>lt;sup>1</sup>(For Cable Induction WF1 use Model DCI-1 Cable Induction Coupler, Use DCVI-1 induction coupler for cable induction of WF4) (For MIL-STD-461G-CS117 internal testing use D561-L4, for external testing use D561-L5)

Model: D562-Lx	(x indicates level 3, 4 or 5)		
LTSModule for WF2, half-	width ECAT plug-in module		
WF2 (CI <sup>1</sup> , GI <sup>2</sup> )	Single Stroke, 0.1/6.4 μs, 25-1920 V, 1700 Asc Multiple Strokes, 0.1/6.4 μs, 25-1200 V		
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED		
Operating Temperature	+15°C to +35°C		
Humidity	10-75%, non-condensing		
CE Marking	Safety and EMC directives		

10-75%, non-condensing

Safetyand EMC directives

Humidity

CEMarking

<sup>&</sup>lt;sup>2</sup> (Add wire to clamp between ground planes

Model: D563-Lx	(x indicates level 3, 4 or 5)
LTS Module for WF 3, 1 MHz	z and 10MHz, full-width ECAT plug-in module
WF3(Cl <sup>-1</sup> , Gl)	Single Stroke, 1 MHz, 25-4000V, 160 Asc Multiple Strokes, 1 MHz, 25-2400V Multiple Burst, 1 MHz, 25-2300V Single Stroke, 10 MHz, 25-4000 V, 60 Asc Multiple Strokes, 10 MHz, 25-2400V Multiple Burst, 10 MHz, 25-2300V
WF3PinInjection	1 MHz, 30-4000 Voc/1.2-160 Asc = 25 Ohm
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
CEMarking	Safety and EMC directives

<sup>&</sup>lt;sup>1</sup> (For Cable Induction use Model DCHV-1 Cable Induction Coupler)

(For MIL-STD-461G-CS117 internal testing use D563-L4, for external testing use D563-L5)

Model: D564-Lx	(xindicates level 3, 4 or 5)
LTS Module for WF5B, full-	width ECAT plug-in module
WF5B (Cl <sup>1</sup> , Gl <sup>2</sup> )	Single Stroke, 50/500 μs, 150-6000 A, 900 Voc Multiple Strokes, 50/500 μs, 30-1500 V
WF5BPinInjection	50/500 μs, 50-1800 Voc /50-1800 Asc = 1 Ohm
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
CEMarking	Safety and EMC directives
1/For Cable Induction use	a Model DCI-1 Cable Induction Coupler)

<sup>&</sup>lt;sup>1</sup>(For Cable Induction use Model DCI-1 Cable Induction Coupler)

Not a required test waveform for MIL-STD-461G-CS117

<sup>&</sup>lt;sup>2</sup>(DCI-1 clamp cal loop)

widthECATplug-inmodule
Single Stroke, 6.4/69 µs, 50-3800 A, 2000 Voc Multiple Strokes, 6.4/69 µs, 25-1200 A
Single Stroke, 6.4/69 µs, 25-2000V, 2100 Asc Multiple Strokes, 6.4/69 µs, 10-600 V
6.4/69 μs, 50-2000 Voc/10-400 Asc = 5 Ohm
Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
+15°C to +35°C
10-75%, non-condensing
Safety and EMC directives

<sup>&</sup>lt;sup>1</sup> (For Cable Induction use Model DCI-1 Cable Induction Coupler for WF1, Use DCVI-1 induction coupler for cable induction of WF4) (For MIL-STD-461G-CS117 internal testing use D566-L4, for external testing use D566-L5)





Model: D567-Lx	(xindicates level 3, 4 or 5)
LTS Module for WF5A, fu	ıll-width ECAT plug-in module
WF5A(Cl <sup>1</sup> , Gl <sup>2</sup> )	Single Stroke, 40/120 μs, 50-10000 A, 1300 Voc; Multiple Strokes, 40/120 μs, 30-1500 A
WF5APinInjection	40/120 μs, 50-1800 Voc /50-1800 Asc = 1 Ohm
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating Temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
CE Marking CE Marking	Safety and EMC directives
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<sup>&</sup>lt;sup>1</sup> (For Cable Induction use Model DCI-1 Cable Induction Coupler)

(For MIL-STD-461G-CS117 internal testing use D567-L4, for external testing use D567-L5)

Model: D568-L5	(x indicates level 3, 4 or 5)
LTS Module for WF5A fo	r Airbus/Boeing specifications, full-width ECAT plug-in module
WF5A(SS, MS)	40/120 μs, 50-2000 voltage & current, output impedance =1 Ohm
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating Temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
CE Marking CE Marking	Safety and EMC directives

<sup>&</sup>lt;sup>1</sup> (For Cable Induction up to 1500V/1500A use Model DCVI-1 Cable Induction Coupler and use 2 for Level 5, use 3 for 2000V/2000A) Not a required test waveform for MIL-STD-461G-CS117

Model: D569-Lx	(xindicates level 3, 4 or 5)	
LTS Module for WF6, full-v	vidth ECAT plug-in module	
WF6(Cl <sup>1</sup> , Gl)	Multiple Burst, 0.25/4.0 µs, 5-160 A, 4500 Voc	
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED	
Operating Temperature	+15°C to +35°C	
Humidity	10-75%, non-condensing	
CEMarking	Safety and EMC directives	

<sup>1 (</sup>For Cable Induction use Model DCHV-1 Cable Induction Coupler) (For MIL-STD-461G-CS117 internal and external testing use D569-L5)

Model: D570	(x indicates level 3, 4 or 5)
LTS Module for RTCA Do	O-160G, Section 17, Voltage Spikes, full-width ECAT plug-in module
≤2µs X≥10µs ≤2µs X≥50µs ≤2µs X≥100µs ≤2µs X≥200µs ≤2µs X≥400µs	$50\Omega$ or $100\Omega$ $5\Omega$ or $10\Omega$ $5\Omega$ or $10\Omega$ $5\Omega$ or $10\Omega$ $5\Omega$ or $10\Omega$
Safety Features	Door interlocks, safety sockets, outputs only connected during transient, active module indicator LED, voltage present indicator LED
Operating Temperature	+15°C to +35°C
Humidity	10-75%, non-condensing
CEMarking Not a required test wavefor	Safety and EMC directives rms for MIL-STD-461G-CS117



<sup>&</sup>lt;sup>2</sup> (For Ground Injection take from cal loop on DCI-1)

### **Accessories**

Option: DCI-1		
Cable Induction Coup	oler for WF1, 4, 5A, 5B	
WF1	6.4/69 μs, >2000 VLimit, >5000 A Test	
WF4	See Technical Note #201	
WF5A	40/120 μs, >1200 VLimit, >10,000 A Test	
WF5B	50/500 μs, >900 VLimit, >6000 A Test	
Safety Features	Double insulated, safety sockets	
Dimensions	Height 21.6 cm (8.5 in); Width 28.3 cm (11.1 in); Depth 34.3 cm (13.5 in)	
Aperture	3.8 cm x 7.6 cm (1.5 in x 3 in)	
Weight	48 kg (106 lb)	
CEMarking	Safety and EMC directives	

Option: DCV-1		
Cable Induction Coupler for WF2 (use 2 for Level 5)		
WF2	0.1/6.4 μs, >2000 VTest, >1700 A Limit	
Safety Features	Double insulated, safety sockets	
Dimensions	Height 14.2 cm (5.6 in); Width 12.7 cm (5.0in); Depth 31.8 cm (12.5 in)	
Aperture	3.8 cm x 5.1 cm (1.5 in x 2 in)	
Weight	13 kg (29 lb)	
CE Marking	Safety and EMC directives	

Cable Induction Coup	eler for WF3, 6		
WF3/1MHz	1 MHz, >4000 VTest, >300 A Limit		
WF3/10 MHz	10 MHz, >4000 VTest, >20 A Limit		
WF6	0.2/4µs, >4000 VLimit, >160 A Test		
Safety Features	Double insulated, safety sockets		
Dimensions	Height 14.2 cm (5.6 in); Width 12.7 cm (5.0in); Depth 31.8 cm (12.5 in)		
Aperture	3.8 cm x 5.1 cm (1.5 in x 2 in)		
Weight	13 kg (29 lb)		
CE Marking	Safety and EMC directives		

Model: D591		
Powered Pin Decoupler Module for Powered Pin Injection, half-width ECAT plug-in module		
Operating AC Voltage	0-244 VAC, 20 A	
Operating DC Voltage	0-285DC, 10 A	
Operating Frequency	0-400 Hz	
Safety Features	Safety sockets	
CE Marking	Safety and EMC directives	



# Option: DCVI-1 (Modify with 2 turn primary for WF4 cable induction for MIL-STD-461G-CS117)

D568-L5 Cable Induction Coupler for Airbus/ Boeing WF5A specifications. Includes lift and ground plane.

Topis removable to allow cable bundle insertion within the coupler. Top section weight is 180lb.

Safety and EMC directives

Ground Plane is 0.06 AL sheet, 1" perforated overhangs for attachment to adjacent ground planes if needed.

Calibration loop contains 1 turn.

 $2\,\mbox{DCVI-1}$  clamps required for obtaining waveforms up to 1500V/ 1500A

3 DCVI-1 clamps required for obtaining waveforms at 2000 V/2000 A

' '		
WF5A(SS, MS)	40/120 µs, 50-2000 voltage & current	
Safety Features	Double insulated, safetysockets	
Transformer		
Dimensions	Height 34.3 cm (13.5 in); Width 41.9 cm (16.5 in); Depth 45.7 cm (18 in) cable length	
Aperture	6.4 cm x 10.9 cm (2.5 in x 4.3 in)	
Weight	362 kg (800 lbs)	
Cart		
Lowered Height	29.8 cm (11.75in)	
Raised Height	92.7 cm (36.5 in)	
Length	90.1cm (35.5 in)	
Width	59.69 (23.5 in)	
Lift Time	25 strokes	
Capacity	498.9 kg (1100lbs)	
Weight	130.2 kg (287 lb)	
DCVI-1 total weight =	493kg 1087 lb)	

# Option: D111-1

**CEMarking** 

5 KA Current Probe suitable fo	r all waveforms except WF5B
Sensitivity	0.1 Volt/Ampere +1/-0%
Output Resistance	50 Ohms
Scope Coupling	1 MΩ DC/AC
Maximum Peak Current	5,000 Amperes
Useable Rise Time	25 nanoseconds
Low Frequency3dB Point	5 Hz
High Frequency3dB Point	15 MHz
Operating Temperature	0°C to +65°C
Output Connector	BNC
Weight	1.7 kg (3.7lb)

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50KA Current Probe suitable	le for WF5A, 5B		
Sensitivity	0.01 Volt/Ampere +1/-0%		
Output Resistance	50 Ohms Scope Coupling, 1 MΩ DC/AC		
Scope Coupling	1 MΩ DC/AC		
Maximum Peak Current	50,000 Amperes		
Useable Rise Time	200 nanoseconds		
LowFrequency3dBCut-off	5 Hz		
High Frequency 3dB Cut-off	2 MHz		
Operating Temperature	0°C to +65°C		
Output connector	UHF (SO-239)		
Weight	7.9 kg(17.5 lb)		

Option: D5KV		
Voltage Probe suitable for all Waveforms to 5KV		
Max.InputVoltage	5 kV	
Scope Coupling	1 MΩ DC/AC	
System Attenuation	100:1, +/-2%	
System Input Resistance	50 MΩ Input	
Capacitance	< 6 pF	
System BW (-3dB)	400 MHz	
Operating Temperature	0 °C to +50 °C	
Output Connector	BNC	

#### Option: DPI-1

Probe accessory kit suitable for all Waveforms to 5KV

Safety Socket Dolphin Clips

Safety Socket Crocodile Clips

Safety Socket Pointed Probes

Safety Socket Grabber Probes

Safety Socket Lug Terminals

Safety Socket Clip-On

Safety Socket Cables

Safety Socket Leads

Safety SocketPlugs

#### Option: E000

ECAT Half-width module bay blank for unused module bay locations (required if no module is present in the bay). Cannot be used in lowest module bays. Half-width ECAT plug-in module.

CE Marking Safety and EMC directives

# Option: E002

ECAT Full-width module bay blank for unused module bay locations (required if no module is present in the bay). Full-width ECAT plug-in module,

CE Marking Safety and EMC directives

## Option: LTS-1PHASE

AC converter that allow	s LTS to operate from a single phase instead of a 3 phase AC source.		
Input	1Ø 208VAC +/-10%, 50/60 Hz, 50Amax		
Output	3Ø 208VAC +/-10% 50/60 Hz, 30 Amax		
Dimensions	Height 50.8 cm (20 in); Width 38.1 cm (15 in); Depth 33 cm (13 in)		
Weight	34 kg (75 lb)		
CEMarking	EMarking Safety, EMC Directives and UL listed		

## Option: LTS-CASTERS

Add-on base for LTS with larger 5" casters to facilitate high threshold and/or aggressive ramp installations. Increases LTS caster ground clearance from 1.5" to 5"

 Dimensions
 Height 25 cm (9.8 in); Width 107 cm (42 in); Depth 69 cm (27 in)

 Weight
 34 kg (75 lb)



## Option: LTS

Kit of commonly used components for Section 22 setups

Qty = 1 39000µF, 100V bypass capacitor for DC Supply up to 50V, i.a.w. Fig. 22-17

Qty = 1 ea of the following block Varistors:

EPCOS B40K130 130VAC/170VDC¹, 40kA² EPCOS B40K150 150VAC/200VDC¹, 40kA² EPCOS B40K275 275VAC/350VDC¹, 40kA² EPCOS B40K550 550VAC/745VDC¹, 40kA²

Qty = 1ea of following Bidirectional TVS diodes:

Littlefuse AK10-058C 64-70V<sup>3</sup>, 10kA<sup>2</sup> Littlefuse AK10-076C 85-95V<sup>3</sup>, 10kA<sup>2</sup> Littlefuse AK10-170C 180-220V<sup>3</sup>, 10kA<sup>2</sup> Littlefuse AK10-240C 2250-285V<sup>3</sup>, 10kA<sup>2</sup>

# Option: LTS-100 A-LISN

-			
Line Impedance Stabiliz	ation Network		
Frequency	10kHz – 400MHz		
SupplyLines	Single Conductor		
CurrentRating:	100A		
Max Voltage Rating:	DC-1200V,60Hz-800V,400Hz-400V,800Hz-230V; Includes 10µF by-pass capacitor		
Power Connector	Superior Con Socket		
RF Output Connector	Type N		
Chassis Size	15" X 9" X 7"		
Manufacturer	Fischer Custom Communications, Model: FCC-LISN-5-100-02-DO-160F		

## Option: LTS-50 A-LISN

Line Impedance Stabiliz	ation Network		
Frequency	10kHz – 400MHz		
SupplyLines	Single Conductor		
Current Rating:	50A		
Max Voltage Rating:	DC-1200V, 60Hz-800V, 400Hz-400V, 800Hz-230V; Includes 10µF by-pass capacitor		
Power Connector	Multi-Contact Safety Socket		
RF Output Connector	Type N		
Chassis Size	9" X 6" X5"		
Manufacturer	Fischer Custom Communications, Model: FCC-LISN-5-50-1-01-DO-160F		

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Operating voltage. See EPCOS datasheet for complete specs

<sup>&</sup>lt;sup>2</sup> Peak Pulse Current with 8.20µs impulse

<sup>&</sup>lt;sup>3</sup> Reverse Breakdown Voltage. See Littlefuse datasheet for complete specs