Indirect Lightning Induced Transient Susceptibility Test System

LSS 160SM6 & ETS 160MB

Datasheet

In Compliance with

> RTCA/DO-160G S22
> MIL-STD-461G
> AECTP 250
> AECTP 500
> GJB 8848-2016
> HB 6167.24

Introduction

When an aircraft is flying in severe convection environment, it will be frequently affected by lightning stroke, which will generate transient induced voltage or current on circuits and cables of airborne equipment, such phenomenon is called indirect lightning effect. It may make the aircraft get out of control, even bring about fuselage fire and other serious accidents. For safety reasons, the airborne equipment must be designed properly and tested completely to ensure the system and equipment with critical safety function to perform normally and its flight security when the aircraft is influenced by lightning stroke.
The LSS 160SM6 and ETS 160MB test systems are designed according to RTCA/DO-160 Section 22, The LSS 160SM6 is capable of generating waveforms 1,4 and 5A/5B, and ETS 160MB is of waveforms 2, 3 and 6. Both test level are from 1 to 5 for pins injection test and cable bundle test; Additionally, the test system is not only meet the test requirement of lightning induced transients conducted susceptibility in MIL-STD-461G CS117, but also the A/B/C/D EUT pulse injection level requirement in GJB 8848: 2016 is satisfied.
The ETS 160MB test system includes various test auxiliary equipment to make it convenient to conduct tests, such as coupling transformer, power blocking device, transient blocking device, pin injection probe, external DC capacitor etc. What's more, the Corelab software is also available for test remote control, which makes your test easy and convenient.

Features

> Modular design, the waveform module is detachable;
> Capable of generating 6 kinds of waveforms and performing pins injection test and cable bundle test;
> 5.7" color touch screen with easy and distinct operation control;
> Phase synchronization function in signal pins & power pins-direct injection method;
> Corelab software are available for remote control;

Application Areas

> Military
> Aviation

Technical Parameters for LSS 160SM6	
Technical Parameters—Current Waveform 1 Cable Bundle Cable Induction	
For tests as per DO-160G S22, MIL-STD-461G CS117(WF2/1) etc.	
Coupling Mode	Cable Induction (CI)
Output Module	W1 CI/GI
Current Waveform 1	6.4 μs ± 20 % / 69 μs ± 20 %
Single Stroke Output	50 A ~ 3500 A (-0%~+20%); Output Impedance≤0.5 Ω
Multiple Stroke Output	50 A ~2000 A (-0%~+20%) (first stroke); Output Impedance≤1 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤1 Ω
Number of Subsequent Pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
Coupler	LCT- L5

Technical Parameters—Current Waveform 1 Cable Bundle Ground Injection	
For tests as per DO-160G S22 etc.	
Coupling Mode	Ground Injection (GI)
Output Module	W1 CI/GI
Current Waveform 1	6.4 μs ± 20 % / 69 μs ± 20 %
Single Stroke Output	50 A ~ 3500 A (-0%~+20%); Output Impedance≤0.5 Ω
Multiple Stroke Output	50 A ~ 2000 A (-0%~+20%) (first stroke); Output Impedance≤1 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤1 Ω
The Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
Maximum EUT Power Supply	AC 230 V / 32 A 50/60 Hz; DC 230 V/32 A
Coupler	LCT- L5

Technical Parameters—Voltage Waveform 4 Signal Pins & Power Pins Direct Injection	
For tests as per DO-160G S22 etc.	
Coupling Mode	Pins Direct Injection (PDI)
Output Module	W4 PI
Output Impedance	5 Ω ± 10 %
Voltage/Current Waveform 4	6.4 μs ± 20 % / 69 μs ± 20 %
Output Voltage	50 V ~ 3400 V (-0%~+10%), (open circuit)
Output Current	10 A ~ 680 A (-0%~+10%), (short circuit)
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s (shortest time depends on output amplitude)
EUT Power Supply	Max. 230 V
EUT Frequency	Max. 800 Hz
Power Blocking Device	Greater than peak value of signal or power voltage (optional)

Technical Parameters—Voltage Waveform 4 Cable Bundle Ground Injection	
For tests as per DO-160G S22	
Coupling Mode	Ground Injection (GI)
Output Module	W4 CI/GI
Voltage Waveform 4	6.4 μs ± 20 % / 69 μs ± 20 %
Single Stroke Output	50 V ~ 3400 V (-0%~+20%); Output Impedance≥0.5 Ω
Multiple Stroke Output	25 V ~ 1000 V (-0%~+20%) (first stroke); Output Impedance≥0.5 Ω
	10 V ~ 500 V (-0%~+50%) (subsequent stroke); Output Impedance≥0.5 Ω
Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
EUT Power Supply	Max. AC 230 V / 32 A 50/60 Hz; DC 230 V/32 A
Coupler	LVT-1

Technical Parameters—Voltage Waveform 4 Cable Bundle Cable Injection	
For tests as per DO-160G S22, etc.	
Coupling Mode	Cable Induction (CI)
Output Module	W4 CI/GI
Voltage Waveform 4	6.4 μs ± 20 % / 69 μs ± 20 %
Single Stroke Output	50 V ~ 3400 V (-0%~+20%); Output Impedance≥0.5 Ω
Multiple Stroke Output	25 V ~ 1000 V (-0%~+20%) (first stroke); Output Impedance≥0.5 Ω
	10 V ~ 500 V (-0%~+50%) (subsequent stroke); Output Impedance≥0.5 Ω
Number of Subsequent pulses	1 ~ 14(or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
Coupler	LVT-1

Technical Parameters—Current Waveform 5A Cable Bundle Cable Induction	
For tests as per DO-160G S22, MIL-STD-461G CS117(WF4/5A) etc.	
Coupling Mode	Cable Induction (CI)
Output Module	W5A CI/GI
Current Waveform 5A	40 μs ± 20 % / 120 μs ± 20 %
Single Stroke Output	50 A ~ 10000 A (-0%~+20%); Output Impedance≤0.3 Ω
Multiple Stroke Output	50 A ~ 2000 A (-0%~+20%) (first stroke); Output Impedance≤0.3 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤0.3 Ω
Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
Coupler	LCT- L5

Technical Parameters—Voltage Waveform 5A Signal Pins & Power Pins Direct Injection	
For tests as per DO-160G S22	
Coupling Mode	Pins Direct Injection（PDI）
Output Module	W5A PI
Output Impedance	1 Ω ± 10 %
Voltage/ Current Waveform 5A	40 μs ± 20 % / 120 μs ± 20 %
Output Voltage	50 V ~ 3200 V (-0%~+10%) （open circuit）
Output Current	50 A ~ 3200 A (-0%~+10%) （short circuit）
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s (shortest time depends on output amplitude)
EUT Power Supply	Max. 230 V
EUT Power Frequency	Max. 800 Hz
Power Blocking Device	Greater than peak value of signal or power voltage (optional)

Technical Parameters—Current Waveform 5A Cable Bundle Ground Injection	
For tests as per DO-160G S22, MIL-STD-461, CS117 (WF4/5A) etc.	
Coupling Mode	Ground Injection (GI)
Output Module	W5A CI/GI
Current Waveform 5A	40 μs ± 20 % / 120 μs ± 20 %
Single Stroke Output	50 A ~ 10000 A (-0%~+20%) Output Impedance≤0.3 Ω
Multiple Stroke Output	50 A ~ 2000 A (-0%~+20%) (first stroke); Output Impedance≤0.3 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤0.3 Ω
Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
EUT Power Supply	Max. AC 230 V / 32 A 50/60 Hz; DC 230 V/32 A
Coupler	LVT- 5

Technical Parameters—Voltage Waveform 5B Signal Pins & Power Pins Direct Injection	
For tests as per DO-160G S22 etc.	
Coupling Mode	Pins Direct Injection（PDI）
Output Module	W5B PI
Output Impedance	1 Ω ± 10 %
Voltage/ Current Waveform 5B	50 µs ± 20 % / 500 µs ± 20 %
Single Stroke Output	50 V ~ 1600 V (-0%~+10%) （open circuit）
	50 A ~ 1600 A (-0%~+10%) （short circuit）
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s (shortest time depends on output amplitude)
EUT Power Supply	Max. AC/DC 230 V
EUT Power Frequency	Max. 800 Hz
Power Blocking Device	Greater than peak value of signal or power voltage (optional)

Technical Parameters—Current Waveform 5B Cable Bundle Cable Induction	
For tests as per DO-160G S22	
Coupling Mode	Cable Injection (CI)
Output Module	W5B CI/GI
Current Waveform 5B	50 µs ± 20 % / 500 µs ± 20 %
Single Stroke Output	50 A ~ 5000 A (-0%~+20%) Output Impedance≤0.3 Ω
Multiple Stroke Output	50 A ~ 2000 A (-0%~+20%) (first stroke); Output Impedance≤0.3 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤0.3 Ω
Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	30 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
Coupler	LCT ~ L5

Technical Parameters—Current Waveform 5B Cable Bundle Ground Injection	
For tests as per DO-160G S22	
Coupling Mode	Ground Injection (GI)
Output Module	W5B CI/GI
Current Waveform 5B	50 µs ± 20 % /500 µs ± 20 %
Single Stroke Output	50 A ~ 5000 A (-0%~+20%); Output Impedance≤0.3 Ω
Multiple Stroke Output	50 A ~ 2000 A (-0%~+20%) (first stroke) Output Impedance≤0.3 Ω
	25 A ~ 1000 A (-0%~+50%) (subsequent stroke); Output Impedance≤0.3 Ω
Number of Subsequent pulses	1 ~ 14 (or 1 ~ 30)
Interval Time of Subsequent Pulses	10 ms ~ 200 ms, random mode is also available
Polarity	positive or negative
Number of Test Times	1 ~ 99
Test Repetition	30 s ~ 60 s
EUT Power Supply	Max. AC 50/60 Hz 230 V / 32 A; DC 230 V/32 A
Coupler	LCT -L5

List of waveform module and test type	
Waveform Module	Test type
W1 CI/GI	Current waveform 1 – cable bundle cable induction test Current waveform 1 – cable bundle ground injection test
W4 PI	Voltage waveform 4 – signal pins & power pins direct injection method
W4 CI/GI	Voltage waveform 4 - cable bundle cable induction test Voltage waveform 4 - cable bundle ground injection test
W5A PI	Voltage waveform 5A – signal pins & power pins direct injection method
W5A CI/GI	Current waveform 5A – cable bundle cable induction test Current waveform 5A – cable bundle ground injection test
W5B PI	Voltage waveform 5B – signal pins & power pins direct injection method
W5B CI/GI	Current waveform 5B – cable bundle cable induction test Current waveform 5B – cable bundle ground injection test

Technical Parameters for ETS 160MB	
Technical Parameters—Voltage Waveform 2 Cable Bundle Cable Induction Tests	
Coupling Mode	Cable Induction
Rise Time	< 100 ns
Duration	6.4 μs ± 20%
Test Level for Single Stroke Tests	50 V ~ 2000 V +20%, -0%
Test Level for Multiple Stroke Tests	50 V ~ 2000 V +20%, -0% (first stroke)
	25 V ~ 1000 V +50%, -0% (subsequent stroke)
Polarity	Positive or negative
Coupling Transformer	LVT-2

Technical Parameters—Voltage Waveform 3 (1MHz) Signal Pins & Power Pins Injection Tests	
Coupling Mode	Pin injection
Output Impedance	25 Ω
Frequency	1 MHz± 20 %
Decay Rate of 5th Waveshape	25% ~ 75%
Test Level for Single Stroke Tests	100 V ~ 4500 V +10%, -0%
	4 A ~ 180 A +10%, -0% （short-circuit current）
Polarity	Positive or negative
Phase Sync	0° ~ 359°, resolution 1°
EUT Power Supply	Max. AC 230 V, DC ±50 V
EUT Power Frequency	800 Hz

Technical Parameters—Voltage Waveform 3 (1 MHz-H) Cable Bundle Cable Induction Multiple Burst	
Coupling Mode	Cable Induction
Frequency	1 MHz± 20 %
Decay Rate of 5th Waveshape	25% ~ 75%
Output Impedance	⩾60 ohm
Coupling Transformer	LVT-2

Technical Parameters—Voltage Waveform 3 (1 MHz) Cable Bundle Cable Induction Tests	
Coupling Mode	Cable Induction
Frequency	1 MHz± 20%
Decay Rate of 5th Waveshape	25% ~ 75%
Test Level for Single Stroke Tests	50 V ~ 4500 V +20%, -0%
Test Level for Multiple Stroke Tests	50 V ~ 4500 V +20%, -0% (first stroke)
	50 V ~ 2250 V +50%, -0% (subsequent stroke)
Polarity	Positive or negative
Coupling Transformer	LVT-2

Technical Parameters—Voltage Waveform 3 (10 MHz) Cable Bundle Cable Induction Tests	
Coupling Mode	Cable Induction (CI)
Frequency	10 MHz± 20 %
Decay Rate of 5th Waveshape	25% ~ 75%
Test Level for Single Stroke	50 V ~ 4000 V +20%, -0%
Test Level for Multiple Stroke	50 V ~ 4000 V +20%, -0% (first stroke)
	50 V ~ 2000 V +50%, -0% (subsequent stroke)
Polarity	Positive or negative
Coupling Transformer	LVT-2

Technical Parameters—Current Waveform 6 Cable Bundle Cable Induction Tests	
Coupling Mode	Cable Induction
Current Waveform	5 A ~ 160 A
Rise Time	0.25 μs ±20%
Duration	4 μs ±20%
Coupling Transformer	LVT-3

General parameters

Display	5.7” TFT touch screen
Working Power	220 V，±10%，50/60Hz
Fuse	10 A
User’s Memory Space	Infinite (PC)
Communication Mode	Ethernet LAN, RJ45
Working Status Indication	LED indication and LCD display on front panel
Grounded Connection	Flat earth line
Waveform Output Terminal	Banana plug line
Dimension	LSS 160SM6: 600 mm(L) x 800 mm(W) x1800 mm(H) (35U rack) ETS 160MB: 445 mm(L) x 690 mm(W) x600 mm(H) (4U×2)
Weight	LSS 160SM6: Approx. 150 kg ETS 160MB: 37 kg
Ambient Temperature	15 °C ~ 35 °C
Relative Humidity	45% ~ 75%
Atmospheric Pressure	86 kPa ~ 106 kPa

Accessories

Fuse, Power line, Flat ground line, Test line, alligator clip, User Manual, Coaxial line

Options (LSS 160SM6)

1. Line Impedance Stabilization Network LISN AR 50 	The LISN AR 50 is used for isolating electric wave in cable bundle test and supply stable impedance for test system; Max AC 530 V, DC 600 V I_{rms}: 50 A; Frequency Range: 10 kHz ~ 400 MHz;
2. Current Coupling Transformer LCT-L5 	The LCT-L5 is used for coupling current waveforms 1,5A,5B and meet the test requirement of single/multiple stroke (level 1~5) test;
3. External DC Capacitor C3350 /C33400 	The C3350/C33400 is used together with LISN for conducting cable bundle tests; Maximum DC voltage is 400 V (general configuration is 50 V); Capacitance: 33000 μF;

Options (LSS 160SM6)

4. Voltage Coupling Transformer LVT-L5 	The LVT-1 is used for coupling voltage waveforms 4, 5A and meet the test requirement of single/multiple stroke (level 1 ~ 5) test;
5. Power Blocking Device CN-1 	The CN-1 is used to isolate voltages at the pins of the EUT from the low generator impedance so as to protect the generator; The maximum isolating ac/dc voltage is 400 V; Meet the test requirement of powered EUT for conducting pins injection test of waveforms 4, 5A, 5B;
6. Transient Blocking Device DN-416T 	The DN-416T is used to prevent EUT power supply from being damaged by pulses 4, 5A and 5B; EUT Maximum ac/dc power supply is 400 V 16 A three-phase, 0 ~ 400 Hz (common mode); Meet the test requirement of powered EUT for conducting pins injection test of waveforms 4, 5A, 5B; **Note: Both LSS 160SM6 and ETS 160MB share the DN-416T.**
7. Transient Blocking Device DN-4200T 	The DN-4200T is used to prevent EUT power supply from being damaged by waveforms 4, 5A and 5B; Maximum AC/DC power supply is 400 V 200 A three phase, 50/60 Hz (common mode); Meet the test requirement of powered EUT for conducting pins injection test of waveforms 4, 5A, 5B;
8.Digital Oscilloscope MDO3012 (Tektronix) 	Frequency 100 MHz; Sample Rate 1.25 GS/s; Record length 10 Mb; **Note: Both LSS 160SM6 and ETS 160MB share the MDO3012.**

Options (LSS 160SM6)	
9. Wide-band Current Monitor CM 0302M 	The CM 0302M is used to measure W1, W4 and W5A/5B; Max. peak current 200 kA; Sensitivity 0.001 V/A; Frequency: 5 Hz ~ 2 MHz Current time product: 10 A·s;
10. Differential Probe THDP0100 (Tektronix) 	6 kV differential mode, 100 MHz; The THDP0100 is used for measuring voltage of all waveforms **Note: Both LSS 160SM6 and ETS 160MB share the THDP0100.**
11. Corelab Software	The software is used for remote control; Support connection with oscilloscope for monitoring waveforms; support generating test report; **Note: Both LSS 160SM6 and ETS 160MB share the Corelab software.**

Options (ETS 160MB)	
1. Coupling Transformer LVT-2 	The LVT-2 is used to couple voltage of waveform 2 and waveform 3 (1 MHz & 10 MHz); It satisfies single stroke, multiple stroke and multiple burst tests of cable bundle; Test level is from 1 to 5; Max. coupling voltage is 2000 V for W2; Max. coupling voltage is 4000 V for W3;
2. Coupling Transformer LVT-3 	The LVT-3 is used to couple current of waveform 6; It satisfies multiple burst tests of cable bundle; Test level is from 1 to 5; Max. coupling current is 160 A;
3. Power Blocking Device CN-2 	The CN-2 is used to isolate voltages at the pins of the EUT from the low generator impedance in waveform 3 pins direct injection test;
4. Handheld Pin Injection Probe HIP 5000 	The probe is used in pin injection tests of waveform 3 (1 MHz); Handheld structure design makes pin injection tests convenient;
5. Current Divider MCS 01 	The MCS 01 is used to measure current of waveforms 2, 3 and 6.
6. Wide-band Current Monitor CM 0103M 	The CM 0103M is used to measure W2, W3(1 & 10 MHz) and W6; Max. peak current 5 kA; Sensitivity 0.1 V/A; Frequency: 200 Hz ~ 20 MHz Current time product: 0.2 A·s;
7. 35U rack ETS 160MB-35U 	The ETS 160MB-35U is used to place all devices and accessories to makes the storage in order; There are two main unit storage tanks and four waveform input modules storage tanks, and each tank having sliding rail, which makes it easy to insert or pull out the modules;