

# ES622 Series TLP Pulsed IV-Curve System

## (External Modules Available for HMM, HBM, MM)



*(Enclosure and Software maybe updated without notice)*

## 1. Description

The model ES622 Series TLP Pulsed IV-Curve System is an advanced IV-curve characterization system designed to simulate ESD events (TLP/ VF-TLP/ HMM/ HBM/MM pulse) and monitor a device (semiconductors, discrete, circuit modules, etc.) in high power time domain. The ES622 has a higher specification, more functionality, greater expansion capability and better software experience compared to the previous model ES620 and ES621.

The TLP (transmission line pulse) test function is designed to meet the latest ANSI/ESD STM5.5.1 test standard and applies high quality rectangular pulses to devices and records both the voltage across and current through the device. This gives pulsed IV curves, allowing users to characterize a device's transient response over ns time windows. Advanced automatic device failure detection methods are incorporated, such as DC Spot Check (V or I), Static IV curve, Fuse, Breakdown, and Bias Source Fluctuation.

The VF-TLP test is designed to simulate the CDM speed ESD event and captures the voltage across the DUT and current through the DUT under a high speed (such as <100 ps rise-time) ESD transient. This allows the user to study the response speed and peak clamping voltage of a device.

The HMM (Human Metal Model) test function is an alternative test method to IEC61000-4-2 system level ESD. It gives the equivalent waveform to an ideal standard waveform for low ohm devices and eliminates many IEC gun test problems for components or wafer level tests, such as repeatability, imprecision gun tip, impedance mismatches, EMI interferences from unshielded relays and special setup with large ground plane and coupling plane etc. HBM and MM test functions are also available.

## 2. Features

- Most configurable TLP Pulsed IV-Curve System
- Ultra-Compact Design System
- Fast test speed with multi-thread processing
- 20 A, 40A, 50 A, 100 A, 125A, 150 A models are available (Customization available)
- Advanced system and accessory monitor and control in software available (switch lifespan monitor, E-Cal module, oscilloscope attenuation adjustment)
- Test Function Expandable with VF-TLP, HMM, HBM, MM options
- Multiple automatic failure detection methods (DC spot check (V or I) or IV sweep, fuse, breakdown, and bias current change)
- Software controlled pulsing: Burst, Continuous, IV-Curve Characterization
- Rise-Time options from 40 ps to 1200 ns \*(depends on model, customization available)
- Pulse-Width options from 1 ns to 2000 ns \*(depends on model, customization available)

Note\*: Longer pulse applications are supported by EOS series with pulse width from few hundred of ns to few ms.

## 3. Applications

- ESD performance characterization
- Wafer/ package level ESD test
- System / circuit module ESD test
- Safe operation area (SOA) test
- Charge recovery time test
- Solar panel diode characterization
- Touchscreen ITO trace fuse and breakdown test

Related Standards:

- ✓ TLP / VF-TLP option meets ANSI/ESD STM 5.5.1
- ✓ HMM option meets ANSI/ESD SP5.6
- ✓ HBM option meets ANSI/ESDA/JEDEC JS-001
- ✓ MM option meets ANSI/ESDA SP5.2

## 4. Specifications

### ES622 Series TLP Unit Specifications

| Typical Models                      | ES622-20                                             | ES622-50     | ES622-100    | ES622-125    | ES622-150    | Unit | *Special models such as 40, 60, 80, 100, 200+ A are available per request |
|-------------------------------------|------------------------------------------------------|--------------|--------------|--------------|--------------|------|---------------------------------------------------------------------------|
| Output voltage @ Open load          | ± 0.5 ~ 1000                                         | ± 0.5 ~ 2500 | ± 0.5 ~ 5000 | ± 0.5 ~ 6250 | ± 0.5 ~ 7500 | V    |                                                                           |
| Min Voltage step @ Open load        | 0.1                                                  | 0.1          | 0.1          | 0.1          | 0.1          | V    |                                                                           |
| Output current @ Short load         | ± 0.01 ~ 20                                          | ± 0.01 ~ 50  | ± 0.01 ~ 100 | ± 0.01 ~ 125 | ± 0.01 ~ 150 | A    |                                                                           |
| Voltage precision                   | Accuracy adjustable between 1 - 10 %                 |              |              |              |              | %    | Speed / accuracy software adjustable                                      |
| Fastest rise-time* (default 20-80%) | ≤ 50                                                 | ≤ 200        | ≤ 300        | ≤ 300        | ≤ 300        | ps   | Fastest 10-90% 40 ps risetime is available with special configuration     |
| Rise-time range                     | 0.05 ~ 1200                                          | 0.2 ~ 1200   | 0.3 ~ 1200   | 0.3 ~ 1200   | 0.3 ~ 1200   | ns   |                                                                           |
| Rise-time options                   | Unlimited programable or manual options              |              |              |              |              |      | per customization                                                         |
| Pulse-width (default 50-50%)        | 100 ± 1                                              |              |              |              |              | ns   | Default                                                                   |
| Min Pulse-width                     | 0.5                                                  | 1            | 5            | 5            | 5            | ns   |                                                                           |
| Max Pulse-width                     | 2000                                                 | 2000         | 1500         | 1500         | 1000         | ns   |                                                                           |
| Pulse-width options                 | Unlimited programable or manual options              |              |              |              |              |      | per customization                                                         |
| Test Speed                          | Typical 0.2 ~ 2                                      |              |              |              |              | Sec  | Varies between hardware setups                                            |
| Dimensions                          | 347 W X 300 D X 145 H                                |              |              |              |              | mm   | May change per customization                                              |
| Weight                              | 8                                                    | 8            | 8            | 10           | 12           | kg   |                                                                           |
| Supported Oscilloscopes             | Major Series from Tektronix, Agilent, LeCroy, Rigol. |              |              |              |              |      | Others supported on request                                               |
| Supported SMU                       | Keithley 24xx/26xx series SMU                        |              |              |              |              |      | Others supported on request                                               |

**ES62X-HMM2 External Human Metal Model Module**

(Short circuit DUT, 100  $\Omega$  HMM per ANSI/ESD SP5.6)

| Typical Models       | ES622-20 | ES622-50 | ES622-100 | ES622-125 | ES622-150 | Unit | Comments                                                                       |
|----------------------|----------|----------|-----------|-----------|-----------|------|--------------------------------------------------------------------------------|
| IEC equivalent level | 6        | 12       | 24        | 30        | 36        | kV   |                                                                                |
| HMM peak current     | 22.5     | 45       | 90        | 112.5     | 135       | A    | 3.75 A per 1 kV $\leq \pm 10\%$<br>IEC 61000-4-2 (R=330 $\Omega$ ,<br>C=150pF) |
| HMM current @ 30 ns  | 12       | 24       | 48        | 60        | 72        | A    | $\leq \pm 10\%$ (better than<br>$\pm 30\%$ IEC)                                |
| HMM current @ 60 ns  | 6        | 12       | 24        | 30        | 36        | A    | $\leq \pm 10\%$ (better than<br>$\pm 30\%$ IEC)                                |

**ES62X-HBM2 External Human Body Model Module**

(ANSI/ESDA/JEDEC JS-001 R=1.5 k $\Omega$ , C=100 pF)

| Typical Models             | ES622-20      | ES622-50 | ES622-100 | ES622-125 | ES622-150 | Unit | Comments               |
|----------------------------|---------------|----------|-----------|-----------|-----------|------|------------------------|
| Maximum HBM Test Level     | $\pm 2$       | $\pm 4$  | $\pm 8$   | $\pm 10$  | $\pm 12$  | kV   |                        |
| Minimum HBM Test Level     | $\pm 50$      |          |           |           |           | V    |                        |
| Minimum Test Level Step    | 1             |          |           |           |           | V    | PCB controlled via USB |
| Charge Removal Resistance  | 10 K          |          |           |           |           | Ohm  |                        |
| Voltage Output Sensitivity | 1/201         |          |           |           |           | V/V  | $\pm 3\%$ into 50 Ohm  |
| Current Sensor Sensitivity | 1             |          |           |           |           | V/A  | $\pm 3\%$ into 50 Ohm  |
| Test Speed                 | $\geq 1$      |          |           |           |           | S    | Per Standard 1P/S      |
| Physical Dimensions        | 90 X 90 X 130 |          |           |           |           | mm   |                        |

## ES62X-MM2 External Machine Model (MM) Module

(Per ANSI/ESD STM5.2)

| Parameters                              | MM-2K                         | Unit | Comments                                     |
|-----------------------------------------|-------------------------------|------|----------------------------------------------|
| Output Voltage                          | $\pm 10 \sim 2000$            | V    |                                              |
| Discharge RC Value                      | C: 200 pF, R: 0 $\Omega$      |      |                                              |
| Short Load Peak Current $I_{p1}$        | 1.75 $\pm$ 10% per 100V       | A    | Tolerance may be different if socket is used |
| Short Load $I_{p2}$                     | 67% $\sim$ 90% of $I_{p1}$    | A    |                                              |
| Short Load Pulse Period $t_{pm}$        | 66 < $t_{pm}$ < 90            | ns   |                                              |
| 500 $\Omega$ Load Peak Current $I_{pr}$ | 0.85 – 1.2                    | A    | @400V condition per standard                 |
| 500 $\Omega$ Load $I_{100}$             | 0.23 – 0.4                    | A    | @400V condition per standard                 |
| 500 $\Omega$ Load $I_{200}$             | 30 -50% of measured $I_{100}$ | A    |                                              |

## 5. Ordering Information

| Line                                                        | Part # or Option # | Description                                                                                                                         |
|-------------------------------------------------------------|--------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>TLP Generator Basic Unit Options</b>                     |                    |                                                                                                                                     |
| 1.1                                                         | ES622-20           | ES622 TLP Pulsed IV-Curve System, 20 A Base Unit                                                                                    |
| 1.2                                                         | ES622-25           | ES622 TLP Pulsed IV-Curve System, 25 A Base Unit                                                                                    |
| 1.3                                                         | ES622-40           | ES622 TLP Pulsed IV-Curve System, 40 A Base Unit                                                                                    |
| 1.4                                                         | ES622-50           | ES622 TLP Pulsed IV-Curve System, 50 A Base Unit                                                                                    |
| 1.5                                                         | ES622-60           | ES622 TLP Pulsed IV-Curve System, 60 A Base Unit                                                                                    |
| 1.6                                                         | ES622-80           | ES622 TLP Pulsed IV-Curve System, 80 A Base Unit                                                                                    |
| 1.7                                                         | ES622-100          | ES622 TLP Pulsed IV-Curve System, 100 A Base Unit                                                                                   |
| 1.8                                                         | ES622-125          | ES622 TLP Pulsed IV-Curve System, 125 A Base Unit                                                                                   |
| 1.9                                                         | ES622-150          | ES622 TLP Pulsed IV-Curve System, 150 A Base Unit                                                                                   |
| <b>Rise-time Options</b>                                    |                    |                                                                                                                                     |
| (example configuration only, customizable option available) |                    |                                                                                                                                     |
| 2.1                                                         | ES62x-PRT4         | Programmable pulse rise-time filter X4 module<br>(Default: Intrinsic, 1 ns, 5 ns, 10 ns, customization available)                   |
| 2.2                                                         | ES62x-PRT7         | Programmable pulse rise-time filter X7 module<br>(Default: Intrinsic, 0.5ns, 1 ns, 2ns, 5 ns, 10 ns, 20ns, customization available) |
| 2.3                                                         | ES62x-ERTF         | External Manual Rise-time Filter                                                                                                    |
| <b>Pulse-width Options</b>                                  |                    |                                                                                                                                     |
| (example configuration only, customizable option available) |                    |                                                                                                                                     |
| 3.1                                                         | ES620-PPL4         | Programmable Internal pulse length X4 module<br>(Default: 5ns, 10ns, 100ns, 200ns, customization available)                         |

|                                                       |                   |                                                                                                                                                                                                                    |
|-------------------------------------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.2                                                   | ES620-PPL7        | Programmable Internal pulse length X7 module<br>(Default: 5ns, 10ns, 50ns, 100ns, 200ns, 500ns, 1000ns, customization available)                                                                                   |
| 3.3                                                   | ES620-PPL10       | Programmable Internal pulse length X10 module<br>(Default: 2ns, 5ns, 10ns, 20ns, 50ns, 100ns, 200ns, 500ns, 1000ns, 1500ns, customization available)                                                               |
| 3.4                                                   | ES620-MPLEx       | Manual Pulse Width Extremal Change Option                                                                                                                                                                          |
| <b>ESD Injection and IV-Curve Measurement Options</b> |                   |                                                                                                                                                                                                                    |
| 4.1                                                   | ES62X-DBLM        | TLP Automatic Test Software with PC                                                                                                                                                                                |
| 4.2                                                   | ES62X-A1          | TLP IV-Curve Test Essential Accessories                                                                                                                                                                            |
| 4.3                                                   | ES62X-BSA         | Board Level Standard TLP Test Accessories                                                                                                                                                                          |
| 4.4                                                   | ES62X-BVA         | Board Level VF-TLP Test Accessories                                                                                                                                                                                |
| 4.5                                                   | ES62X-BBA         | Board Level SOA Test Additional Accessories for one channel bias                                                                                                                                                   |
| 4.6                                                   | ES62X-A2          | Wafer Level TLP Setup Essential Test Accessories                                                                                                                                                                   |
| 4.7                                                   | ES62X-WSA         | Wafer Level Standard TLP Test Accessories                                                                                                                                                                          |
| 4.8                                                   | ES62X-WVA         | Wafer Level VF-TLP Test Accessories                                                                                                                                                                                |
| 4.9                                                   | ES62X-WBA         | Wafer Level SOA Test Additional Accessories for one channel bias                                                                                                                                                   |
| 4.10                                                  | CMPS-200A         | Compact Manual Probe Station with Trinocular Stereo Microscope<br>(Othe probe stations are available upon request)                                                                                                 |
| <b>External Pulse Module and measurement Options</b>  |                   |                                                                                                                                                                                                                    |
| 5.1                                                   | ES62X-HBM2        | Human Body Model (HBM) 2-pin Pulse Module:<br>HBM-2: 2kV HBM module, Pairing ES622-20 & ES622-25<br>HBM-4: 4kV HBM module, Pairing ES622-40 & ES622-50<br>HBM-8: 8kV HBM module, Pairing ES622-80 & ES622-100      |
| 5.2                                                   | ES62X-HMM2        | Human Metal Model (HMM) 2-pin Pulse Module:<br>HMM-6: 6kV HMM module, Pairing ES622-20 & ES622-25<br>HMM-12: 12kV HMM module, Pairing ES622-40 & ES622-50<br>HMM-24: 24kV HMM module, Pairing ES622-80 & ES622-100 |
| 5.3                                                   | ES62X-MM2         | Metal Model (MM) 2-pin Pulse Module:<br>MM-2: 2kV MM module                                                                                                                                                        |
| 5.4                                                   | HBM-BA1           | HBM Board Level Test Accessories                                                                                                                                                                                   |
| 5.5                                                   | MM-BA1            | MM Board Level Test Accessories                                                                                                                                                                                    |
| 5.6                                                   | TLP based-HMM-BA1 | TLP based HMM Board Level Test Accessories                                                                                                                                                                         |
| 5.7                                                   | TLP based-HMM-WA1 | TLP based HMM Wafer Level Test Accessories                                                                                                                                                                         |
| <b>Leakage or DC IV Measurement Options</b>           |                   |                                                                                                                                                                                                                    |
| 6.1                                                   | ES62X-SSM         | System Switch Module (switching between Pulse and DC test)                                                                                                                                                         |
| 6.2                                                   | ES62X-STP1        | SMU Transient Protector                                                                                                                                                                                            |

| Third Party Equipment Paired with TLP System |              |                                                                              |
|----------------------------------------------|--------------|------------------------------------------------------------------------------|
| <b>7.1</b>                                   | MISC-OSC1    | Digital Oscilloscope (1 GHz, 5 Gs, 4 Ch) (Recommended for standard TLP test) |
| <b>7.2</b>                                   | MISC-OSC6    | Digital Oscilloscope (6 GHz, 20 Gs, 4 Ch) (Recommended for VF-TLP test)      |
| <b>7.3</b>                                   | KSMU2401     | Keithley 2401, 20V, 1A, 1pA/100nV, 20W, 1 Channel                            |
| <b>7.4</b>                                   | KSMU2450     | Keithley 2450, 200V, 1A, 10fA/10nV, 20W, 1 Channel                           |
| <b>7.5</b>                                   | KSMU2400     | Keithley 2400, 20V, 1A, 1pA/100nV, 20W, 1 Channel                            |
| <b>7.6</b>                                   | KSMU2410     | Keithley 2410, 1100V, 1A, 1pA/100nV, 20W, 1 Channel                          |
| <b>7.7</b>                                   | KSMU2602B    | Keithley 2602B, 40V, 3A, 100fA/100nV, 40W, 2 Channel                         |
| <b>7.8</b>                                   | KSMU2635B    | Keithley 2635B, 200V, 10A, 0.1fA/100nV, 200W, 2 Channel                      |
| <b>7.9</b>                                   | KSMUB2902A   | Keithley B2902A, 210V, 10.5A, 10fA/100nV, 31.8W, 2 Channel                   |
| <b>7.10</b>                                  | KPI2230-30-1 | Keithley 2230-30-1 3-Channel Programmable DC Power Supply                    |

Many customized specifications are available upon request.