MINIZAP

OPERATING INSTRUCTIONS

ThermoFisher
SCIENTIFIC

MiniZap®
Operator Manual
6/13/07

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MiniZap® Manual

SAFETY

The MiniZap is not a toy. High Voltage (as high as 15 kV) is present at the tip. Contact with this voltage can produce a painful shock.

Do not use near cardiac pacemakers!

Do not use as a "cattle prod"!

GENERAL: The ESD simulator is a high voltage instrument, capable of producing voltage levels up to 15 kV. Although the energy level of a single discharge at this voltage is below that which is considered lethal for a normal healthy adult, this energy level can give the user an unpleasant shock. Therefore, there is an inherent danger when performing ESD tests.

Operating and working around any high voltage instrument or device requires a high degree of responsibility, care, and common sense. Normal high voltage safety practices should be exercised when performing these tests. The ESD simulator manufacturer's safety practices must also be followed.

EXCLUDED PERSONNEL: ESD testing may be hazardous to wearers of electronic life-support equipment. Personnel with pace-makers, heart problems, nervous disorders, and similar problems should not be allowed to operate the ESD simulator or be present during ESD testing.

HUMIDITY: do not use the MiniZap in condensing humidity.

PRODUCT SAFETY

- **Read Instructions** – Read all safety and operating instructions before operating the instrument.
- **Retain Instructions** – Retain all safety and operating instructions for future reference.
- **Heed Warnings** – Adhere to all warnings on the instrument and in the operating instructions.
- **Follow Instructions** – Follow all operating and use instructions.
- **Water and Moisture** – Do not use the instrument near water.
- **Heat** – The instrument should be situated away from heat sources such as heat registers or other instruments which produce heat.
- **Power Sources** – Connect the instrument only to the type of power source described in the operating instructions or as marked on the instrument.
- **Grounding or Polarization** – Take precautions to insure that the grounding and polarization of the instrument is not defeated. Operate only with grounded power cord.
- **Power Cord Protection** – Place power supply cords so that they are not likely to be walked on or pinched by items placed on them or against them. Pay particular attention to cords at plugs, convenience receptacles, and the point where they enter and exit the instrument.
- **Cleaning** – Clean the instrument only as recommended by the manufacturer.
- **Defects and Abnormal Stress** – Whenever it is likely that the normal operation has been impaired, make the equipment inoperable and secure it against further operation. Normal operation is likely to be impaired if, for example, the instrument:
  - Shows visible damage.
  - Fails to perform the intended function.
  - Has been subject to prolonged storage under unfavorable conditions.
  - Has been subjected to severe transport stresses.
- **Damage Requiring Service** – The instrument should be serviced by qualified service personnel when:
  - The power supply cord or the plug has been damaged.
  - The instrument has been exposed to rain.
  - The instrument does not appear to operate normally or exhibits a marked change in performance.
  - The instrument has been dropped, or the exclosure has been damaged.
- No User Serviceable parts inside; do not remove covers.

INSTALLATION

Electrical Supply Requirements

The MiniZap power supply is configured for one of two voltage ranges:

100 - 120 Vac, 50/60 Hz
220 - 240 Vac, 50/60 Hz

Verify the voltage range of the MiniZap is properly set for your AC Mains BEFORE connecting the power supply to the AC Mains.

Physical Environment

MiniZap systems are intended for operation in a laboratory environment, protected from excess dust and liquids.

- No condensing humidity or standing water on the floor or work surfaces.
- No significant dust or other contamination.

Operating limits

Temperature:	15 - 40˚ C
Humidity:	10 - 50%, non-condensing
Altitude:	5000 feet max.

Storage limits

Temperature:	0 - 50˚ C
Humidity:	10 - 90%, non-condensing
Altitude:	5000 feet max.

Test Area Considerations and Site Preparation

Special Consideration for ESD Testing

This device complies with the requirements of the EMC Directive, 89/336/EEC, as slated in the declaration of Conformity. However, the ESD test pulse is by nature as interference test and can therefore create a possible source of disturbance to other electronic equipment that is not intended for test. This device should be used in an environment free of other equipment that could be affected by these emissions, or in a shielded room.

Maintenance

There are no, user serviceable parts within the MiniZap. Service is solely by Thermo Fisher-trained, authorized technicians.

Decommission Issues

When decommissioning the MiniZap the following precaution must be taken.

The MiniZap contains nickel-cadmium batteries. These are considered a hazardous material which must be removed before disposal of the remainder of the unit. Local laws and regulations may require special consideration in disposal. Consult the factory for recommendations for disposal.

INTRODUCTION

The patented MiniZap model MZ-15/EC is a small, portable, lightweight ESD* simulator designed with special emphasis on simulating real world ESD phenomena in a repeatable manner. The MZ-15/EC and the MZEC1 through MZEC4 Model Groups that are based on it are designed for Engineering, Production and Field Service applications.

*Electrostatic Discharge

The model MZ-15/EC operates at voltage settings to ± 15 kV in the Air Discharge mode and to ± 8 kV in the Contact or Current Injection mode. Operation can be either hand held or while mounted on a (user supplied) tripod, preferably with a plastic head.

The model MZ-15/EC may be operated with an AC plug-in adapter or with internal rechargeable NiCd batteries.

Thermo has refined the simulation technology to provide air discharge and Contact Mode (current injection) test waves that not only meet the requirements of ESD test standards and simulate real-world ESD's, but also allow correlation of test results between the MZ-15/EC and any appropriately configured Thermo Series 2000 simulator, since both series are totally repeatable.

The fast risetimes produced simulate a fast approach hand/metal discharge stressing the EUT (equipment under test) properly even with normal variation in actual tester approach speeds.

TRU-ESD® Air Discharge ("NORMAL" mode): Simulates a fast approach hand/metal discharge (see specifications). Standard MiniZap models are supplied with 150pF/330 ohm (standard) or many optional RC discharge networks.

Fast Rise Current Injection, FR/CI™ ("CONTACT" mode): Provides current injection "equivalent" per IEC 61000-4-2 with a fast rising slope (see specifications). Supplied with 150pF/330 ohm (standard) or many optional RC networks. (They include the Model HBM-MZ-15, providing human body model ***waves*** for MIL-STD-883E.

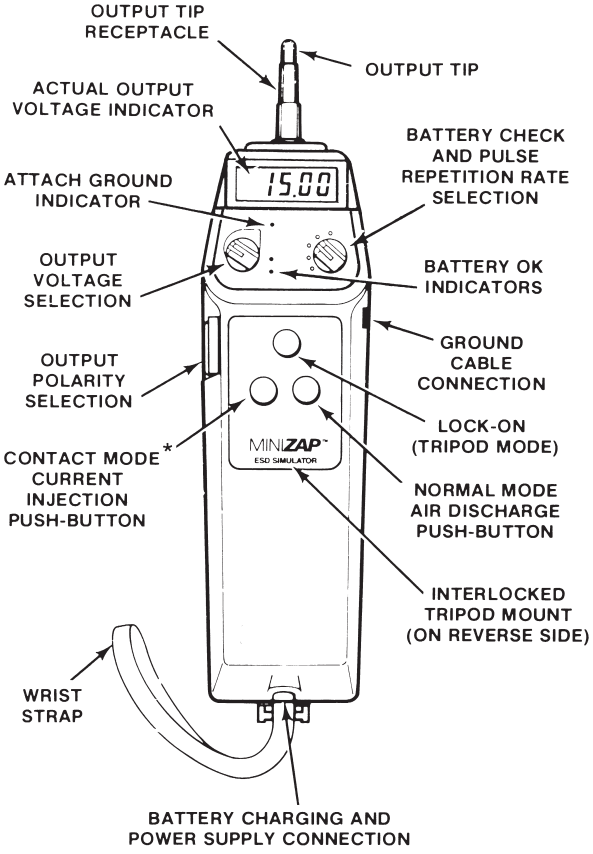


Figure 1
Typical MiniZap ESD Simulator

SPECIFICATIONS

System Description

The Model MZ-15/EC MiniZap is tripod mountable, and includes IEC Air Discharge ball tip TPA-2, IEC Contact Mode pointed TPC-2A OMNI-TIP, a safe IEC ground cable, AC adapter/battery charger, set of four built-in long life rechargeable batteries, and operator manual, all fitted into a soft carry case.

Feature

Voltage Range Air Discharge	± 0.5 to ± 15kV Standard IEC 61000-4-2 TPA-2 tip, and optional, TPA-1 tip with fastest and most realistic risetime up to 4kV.
Contact Mode (See Notes 1,2)	0.7 to 1.0 ms risetime independent of charge voltage; 3.75/kV ± 10% peak current, i.e 30A @ 8kV.
RC Network (See Note 3)	150 pF/330 ohm std per IEC 61000-4-2.
Lock On	std (w/safety interlock)
Rep Rate	Single shot as well as 1/sec and 20/sec repetitive operation.

Notes:
(1) Relay actuated per the revised IEC 61000-4-2. (Two million shot warranty on replaceable relay module in the MZ-15/EC.)

(2) The standard TPC-2A OMNI-TIP is specifically designed to meet the reduced requirements of the IEC 61000-4-2 standard (namely 0.7 to 1.0 ns risetime, and 3.75A/kV peak current). The optional TPC-1 provides a much faster (~200 ps) risetime wave, with higher peak (~5 to 8A/vK), typical of actual, worst-case human discharge.

(3) Consult factory for other RC network requirements.

SPECIFICATIONS (CONT.)

Feature	
High Voltage and Display	Digital display with 10V resolution measures actual HV at the tip. DC voltage accuracy ± 3% typical, ± 5% maximum.
Ground Connect Warning	LED indicates ground cable not connected to MiniZap.
Power	Operated either from 120 VAC, 50/60 Hz or 4 internal NiCd batteries w/LED charge status indicator. (220/240 VAC, 50/60 Hz and European plugs optional.)
MiniZap Size	10" x 3.5" x 3.2" (25.4 cm x 8.9 cm x 8.1 cm)
MiniZap Weight	29 oz. (822 gm) nominal plus case & accessories.

POWER SELECTION

(see Figure 1)

The MZ-15/EC can be powered by the internal rechargeable NiCd batteries or by the plug-in AC adapter.

AC Operation: Plug the AC adapter into any 120 VAC 50/60 Hz outlet (220/240 VAC where applicable), and plug the cable end into the power jack on the MiniZap unit.

Battery Operation: The MiniZap will automatically switch to battery operation when the AC adapter is unplugged. To check the state of charge of the batteries move the rotary switch to the "BATTERY" position for about 30 seconds. If the green LED (OK) remains on, the batteries are sufficiently charged for full operation. If the red LED (CHARGE) lights the batteries must be charged, or the AC adapter must be used.

If the batteries become fully discharged during operation the red LED will light and the operation of the MiniZap will be inhibited to prevent possible damage to the batteries. Just prior to this time the red LED will begin to flash during operation.

To Charge Batteries: Plug in the AC adapter and place the rotary switch in the OFF position. Full charge takes 10-12 hours (overnight). The MiniZap may also be used for ESD testing while it is being recharged; the batteries will continue to charge, but at a reduced rate.

MODE/VOLTAGE SELECTION

(see Figure 1)

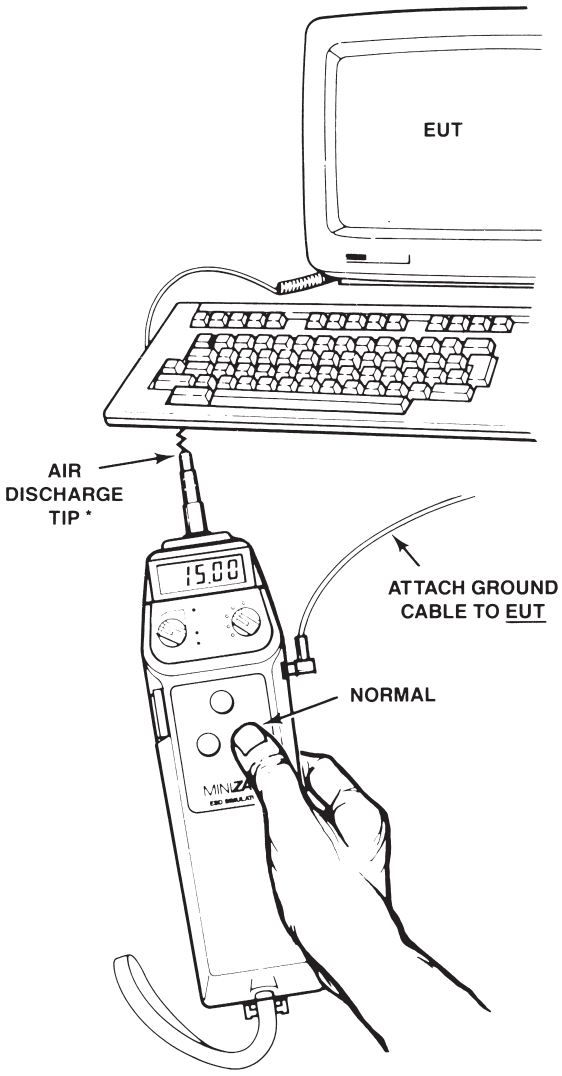
To set voltage, connect the ground cable from the MiniZap to the chassis of the EUT or to Earth ground (an LED on the MiniZap will light if the ground cable becomes unplugged from the MiniZap). Turn the rotary mode selection knob to the desired mode of operation (single shot, once per second or 20 per second) and press and hold the "NORMAL" button.

With the discharge tip away from the EUT, adjust the "INCREASE VOLTAGE" knob until the digital display indicates the desired test voltage.

The display indicates **actual tip voltage,** with 10V resolution; accuracy is typically ±3%.

Tip voltage decays in just seconds when voltage is reduced on the "NORMAL" or "CONTACT" button is released.

NOTE: See front inside cover for maximum voltage operation.



*TPA-2 (standard) for IEC 61000-4-2; optional TPA-1 for True-ESD®, fastest and most realistic air discharge risetime.

Figure 2
Air Discharge (NORMAL Mode)

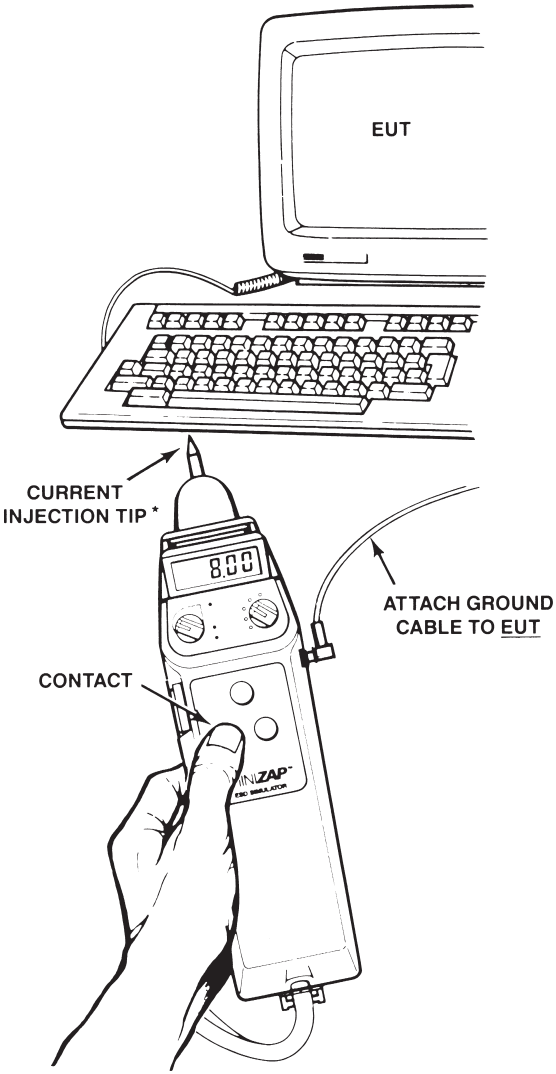
OPERATION

TRUE-ESD® AIR DISCHARGE ("NORMAL" MODE). After setting the test voltage, press and hold the "NORMAL" push-button and approach the EUT with the TPA-1 or TPA-2, 8mm diameter air discharge (ball) tip until a discharge occurs, See Figure 2. (The TPA-2 meets the physical dimension requirements of IEC 61000-4-2; the smaller TPA-1 will typically provide somewhat faster risetimes at test voltages below about 4 kV.) The MiniZap indicates a discharge with both a rapid drop of the digital indication and an audible beep.

In the single shot mode, the MiniZap will produce one discharge and stop. The push button must be released and pressed again to produce another.

In the once per second and 20 per second modes the MiniZap will produce discharges automatically at the selected rate as long as the button is pressed. Note that once per second and 20 per second operation may become erratic or stop entirely if the air gap spacing becomes too large for the test voltage. This is perfectly normal for an air discharge.

NOTE: Do not operate MiniZap with the ground cable unplugged or disconnected from EUT or Earth. Internal damage may occur.



*TPC-2A (standard) Omni-Tip for IEC 61000-4-2; optional TPC-1 for True-ESD®, fastest and most realistic contact mode risetime.

Figure 3
CONTACT Mode

CONTACT MODE (FAST RISE CURRENT INJECTION, (FR/CI™): In Contact Mode, a special high voltage relay in the MiniZap is used between the discharge network and the discharge tip as a substitute for the air gap.

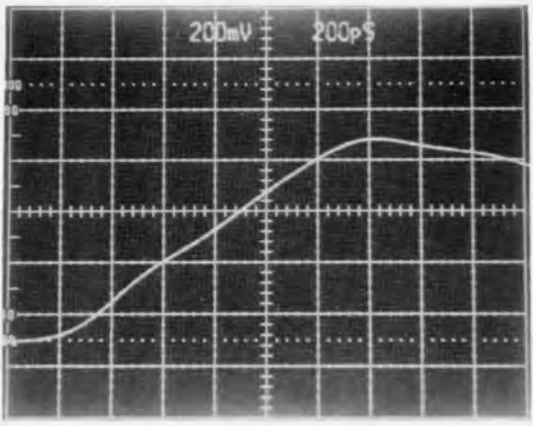
The discharge tip should be placed in direct contact with metal on the EUT (see Figure 3)*. This mode allows very reproducible simulation of the fast rise ESD produced by human hand/metal discharges, with none of the variations associated with an air discharge (approach speed, humidity, etc.)

Operation in this mode is essentially identical with the Air Discharge mode except that the discharge tip is placed in contact with metal on the EUT before the Current Injection button is pressed. Two pointed tips are available for the MiniZap, as alternates to the 8mm diameter, air discharge (ball) tips, to pierce through paint or protective coatings on the EUT if needed.

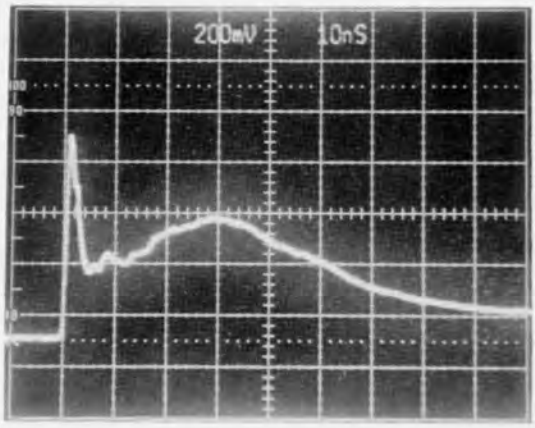
IEC 61000-4-2 TESTING: The standard IEC 61000-4-2 TPC-2A pointed OMNI-TIP (shown in Figure 3) is used to obtain the slowed down risetimes specified by IEC 61000-4-2. Results are a 0.7 to 1.0 ns risetime, and a peak of 3.75A/kV. The optional TPC-1 Contact Mode pointed tip is used to simulate real ESD stress levels (see specifications). The MZ-15/EC with TPC-1 (not the IEC tip) produces less than a 0.2 ns risetime, and about 6A/kV.

NOTE: If the MiniZap is used in Contact Mode with the tip either not quite making contact with EUT metal, or with the tip in contact with EUT plastic, operation will be essentially the same as in the Air Discharge mode except that the internal relay will be exercised. This will result in a current waveform different from both Contact Mode and Air Discharge, giving test results likely to correlate with neither. This mode of operation should therefore be avoided.

*Some pressure may be needed to insure that the tip will penetrate any surface oxide film, paint, etc.



(a)
200 ps/div, 2A/div



(b)
10ns/div, 2A/div

Figure 4
Typical TPC-2A Omni-Tip Current Discharge
Wave for 2 kV Charge Voltage

IEC OMNI-TIP™: Current injection with an IEC waveform is basically the same as Fast Rise Current Injection (FR/CI™) obtained with the optional TPC-1 (fastest) Contact Mode tip. The only difference is that the much slower TPC-2A Omni-Tip is used.

The TPC-2A tip is designed specifically to conform to IEC 61000-4-2, when used with a model MZ-15/EC MiniZap ESD simulator, in the Contact (current injection) Mode only.

The OmniTip produces the slowed-down, 0.7 to 1.0 ns risetime, and reduced amplitude, 3.75A/kV of charge voltage, in accordance with IEC 61000-4-2.

The optional TPC-1 Contact Mode tip is used if you choose to simulate risetimes and intensities which more closely match those of "real" human/metallic ESD. Typical risetime is less than 0.2 ns and intensity is much greater than 3.75A/kV. The TPC-1 will provide higher stress to the EUT due to this faster risetime and higher intensity of the initial spike.

So use the IEC TPC-2A Omni-Tip to test in accordance with IEC 61000-4-2. Use the optional TPC-1 Contact Mode tip to determine susceptibility levels to real ESD. Both tips are only for use in the Contact Mode. The "ball tips" are for air discharge testing.

Photographs of the typical output wave form provided by a TPC-2A are shown in Figure 4. Figure 4(a) shows the risetime on an oscilloscope scale of 200 ps/div; Figure 4(b) shows the complete wave on a scale of 10 ns/div. Waves for each specific Omni-Tip are included with each MiniZap.

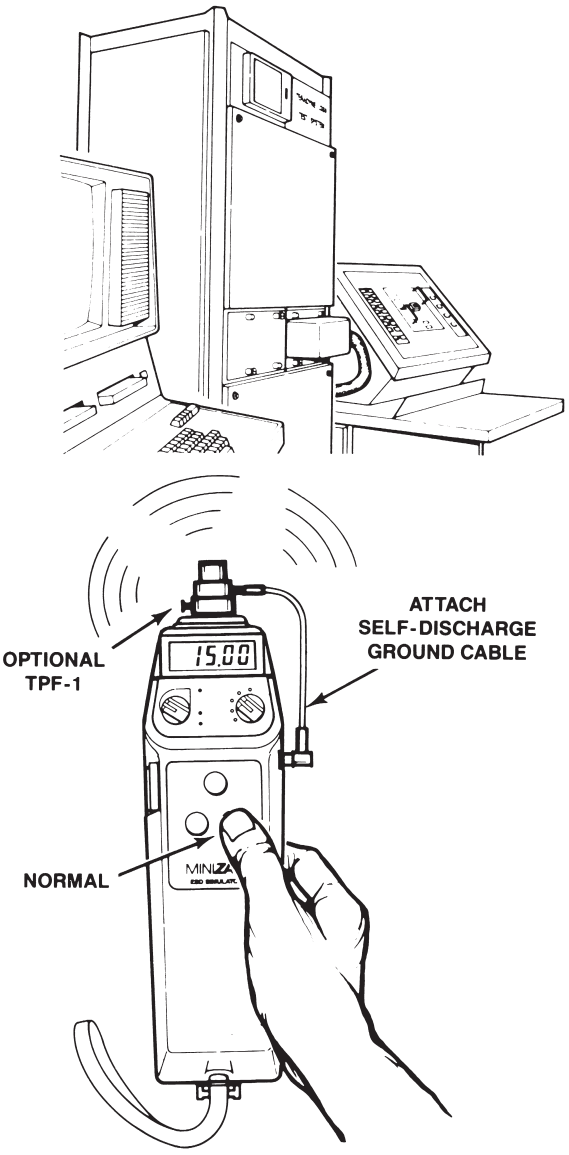


Figure 5
Self Discharge Mode

COMBINED AIR DISCHARGE/CURRENT INJECTION MODE: A convenient feature of the MiniZap is the ease of switching from Air Discharge to Contact Mode simply by moving the thumb from the Air Discharge button to the Current Injection button and bringing the discharge tip into contact with the EUT.

This facilitates using the Air Discharge mode to rapidly test a large number of points on the EUT to determine where the ESD sensitive areas are, and then using the more repeatable Contact Mode to get an accurate appraisal of the true sensitivity level.

SELF DISCHARGE MODE: The optional TPF-1 self discharge/proximity tip adapter can be used to simulate the electromagnetic field associated with an ESD. (Fig. 5).

Since no electrical contact with the EUT is required, a rapid scan may be made of a large EUT and its cables for vulnerable points before the NORMAL or CONTACT modes are used.

The optional TPF-1 self discharge adapter slides over the discharge tip (use with round tip), and plugs into the ground socket. The adapter can be moved up or down on the tip to adjust the voltage at which it will operate (6 kV is a good choice), and the set screw can be used to keep it in position.

TRIPOD OPERATION "LOCK-ON' MODE (Contact Mode): The MZ-15/EC has a mounting plate (1/4-20 threaded hole) on the bottom which allows it to be used with a user-supplied camera tripod for long term testing of equipment in the Current Injection or CONTACT mode. The "LOCK ON" feature will only work when a tripod is used. A non-metallic tripod head (or entire tripod) is recommended for best results.

After screwing a tripod into the MiniZap, position it so that the discharge tip is in contact with the EUT (CONTACT mode). Connect the ground cable from the MiniZap to the EUT or earth ground. Select either once per second or 20 per second and press the LOCK ON button. AC power is recommended for this mode.

"LOCK-ON" will not function unless a tripod is properly attached to the MZ-15/EC.

NOTE: Indiscriminate use of LOCK-ON will reduce the Fast Rise Current Injection, FR/CI relay life.

POLARITY: To change the polarity of the discharge, turn the MiniZap off and unplug the polarity plug from the MiniZap, rotate it and plug in again. The selected polarity is displayed on the top of the polarity block.

CALIBRATION CHECK

The MiniZap is factory calibrated and will maintain a high degree of accuracy through many years of normal use. There are no user adjustments needed.

Making an accurate, noise free measurement of an ESD waveform from a simulator or human source can be extremely difficult due to the wave's very fast sub-nanosecond risetimes and to the large amounts of EMI that are generated.

The equipment used at Thermo Fisher includes the following:

1. Tektronix TDS 680 B 1 GHz mainframe with EMI option
2. Faraday shield for oscilloscope
3. Narda Model 766-20, high-power 20 db attenuator
4. Thermo Fisher manufactured IEC revised* ESD target, Model CTC-3
5. 1.5 meter square Aluminum vertical plane to mount target
6. 2m Belden 9913 coax cable with type "N" connectors.

*The IEC revised target is essential to obtain accurate results in a 1 GHz bandwidth environment. The earlier IEC target design gives highly distorted results.

Contact the Thermo Customer Service department for assistance, calibration and extended warranty program.

*25 resistors in outer ring, 5 in center ring.

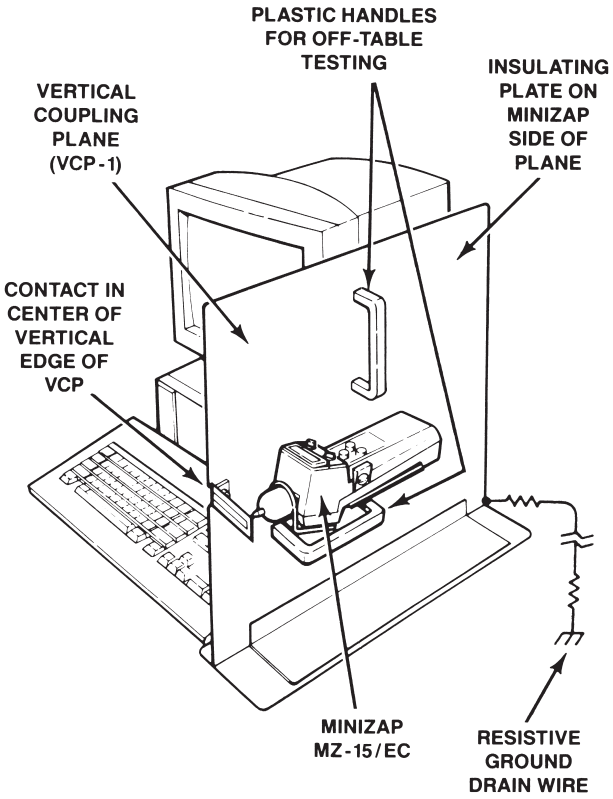


Figure 6
Indirect ESD Testing
With a Vertical Coupling Plane (VCP)

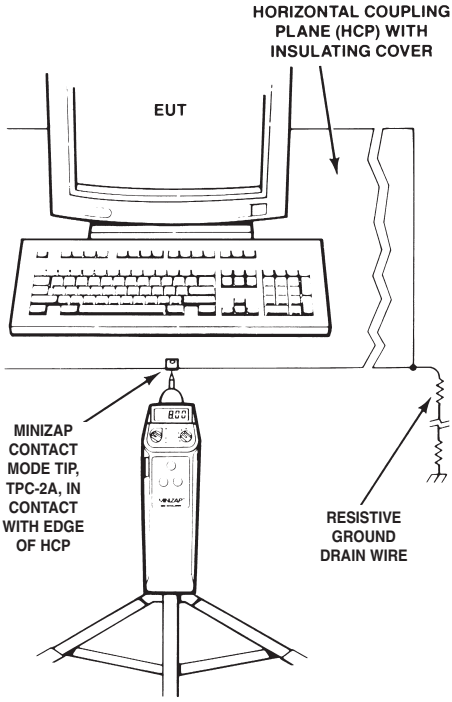
INDIRECT ESD

An ESD between two bodies near an electronic device can cause it to malfunction, due to the electromagnetic fields radiated from both of the bodies and from the ESD arc between them. The bodies can be a person and a file cabinet, a metal chair and the table on which the electronic device is resting, two metal chairs in front of a computer, etc.

For all Indirect ESD simulations the MiniZap is operated in Contact Mode rather than Air Discharge, to insure repeatability. (For IEC 61000-4-2 testing, use the standard TPC-2A tip. Then if the optional TPC-1 tip is available, use the TPC-1 to simulate worst case reality.)

VERTICAL COUPLING PLANE: Standard simulations for indirect ESD are required by IEC 61000-4-2, which specifies use of a 0.5m x 0.5m Vertical Coupling Plane or VCP (Figure 6). When the MiniZap does an ESD to the plane, it simulates a discharge between two bodies adjacent to the equipment being tested.

This test is done to the center of a vertical edge of the 0.5m x 0.5m VCP. The Thermo Fisher Model VCP-1 provides a means for mounting the MiniZap, with its tip electrically contacting the correct point on the edge. Alternatively, the MiniZap may be handheld with its tip in contact with the vertical edge.



Per IEC 61000-4-2

Figure 7
Indirect ESD Testing
With a Horizontal Coupling Plane (HCP)

HORIZONTAL COUPLING PLANE: IEC 61000-4-2 specifies use of a 1.6m x 0.8m Horizontal Coupling Plane or HCP (Figure 7), to simulate ESDs to a metal table or bench under an electronic device. As per 61000-4-2, the MiniZap is held horizontally and discharged to the edge of the HCP in Contact Mode.

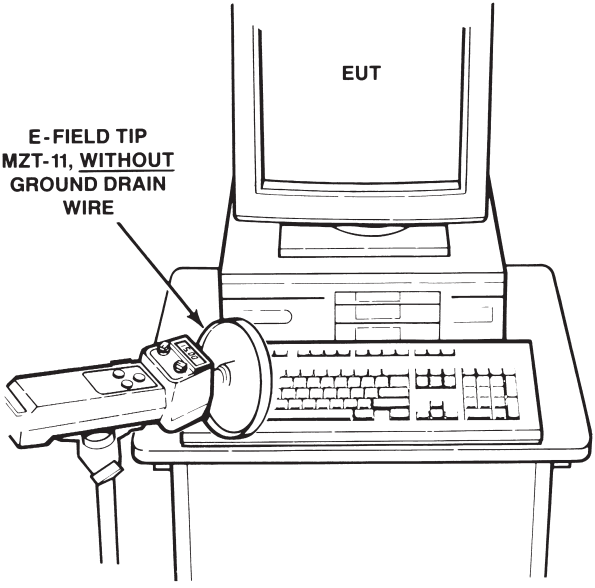


Figure 8
Diagnostic Testing
With a Static E-Field

DIAGNOSTIC E (ELECTRIC) AND H (MAGNETIC) FIELDS

When an equipment fails an ESD test, it can be difficult to pinpoint the specific part of the equipment that has the ESD sensitivity. This is particularly true when the failure results from an indirect ESD.

Diagnostic ESD testing is used to help fix equipment ESD problems. Special diagnostic MiniZap field tips provide high-intensity, limited-area E and H fields. They are used to localize ESD sensitivities within the device that's failing. They also help suggest the possible cause of failure, by facilitating separate tests with the different components of the electrostatic discharge: static E-field, dynamic E-field, dynamic H-field.

STATIC E-FIELD (MZT-11): Equipment is subjected to a "static" E-field as a charged human hand approaches it. Most modern electronic circuits are low enough in impedance to be unaffected by the static field generated by voltage extremes of even 10 or 20 kV. However some keyboards and other specialized equipment may use high impedance circuits. If not adequately protected, such equipment can fail in the presence of static fields.

Figure 8 shows use of the MiniZap MZT-11 E-Field tip. When it is in place, simply press the "NORMAL" button to provide a fixed output voltage on the MZT-11, 5-inch diameter plate. This will generate a static field whose level is controllable via the MiniZap voltage setting. Moving the MZT-11 to locations adjacent to different parts of the equipment under test will help localize static E-field sensitivity if it does not exist.

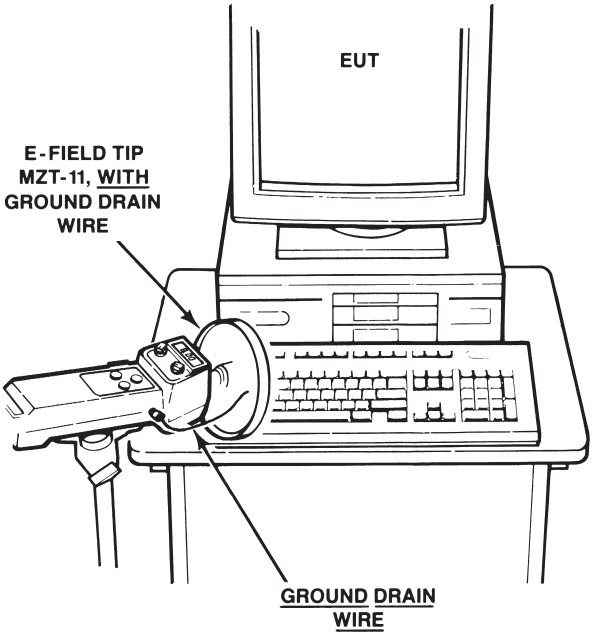


Figure 9
Diagnostic Testing
With a Dynamic E-Field

DYNAMIC E-FIELD (MZT-11): A dynamic E-field results when the ESD from a charged hand suddenly reduces its voltage. The collapse of the static E-field that preceded the ESD radiates into nearby electronic equipment.

The MiniZap MZT-11 E-field tip may be used to simulate a dynamic E-field by depressing the CONTACT button, as shown in Figure 9. When the charge on the internal MiniZap capacitor is transferred via its internal precision relay to the much lower capacitance of the MZT-11 hand-simulating plate, the result is a repeatable, sub-nanosecond radiated E-field in a localized area around the MZT-11 plate. By moving the MZT-11 around the outside of the equipment under test, the location of areas sensitive to dynamic ESD E-fields can readily be found.

Since the dynamic E-field simulation uses a Contact Mode rather than an Air Discharge, results are repeatable, and field intensity directly scales with MiniZap voltage setting.

If failure occurs during diagnostic E-field testing, the fact that it results from an E-field usually implies a high-impedance circuit problem, i.e. one or more sensitive internal circuit points, rather than oversize wiring loops.

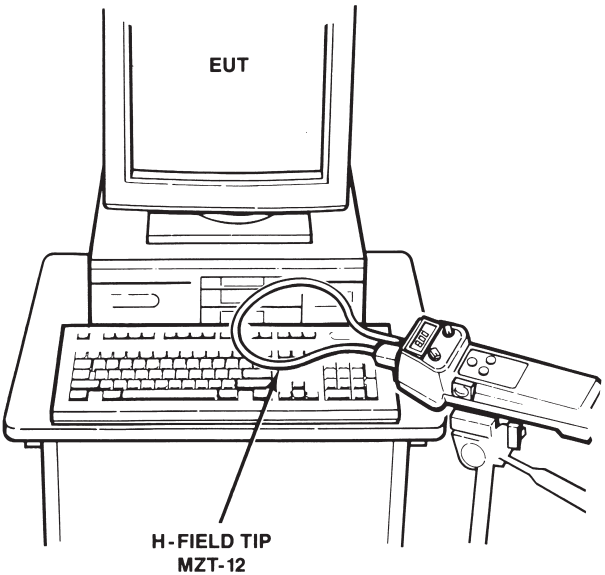


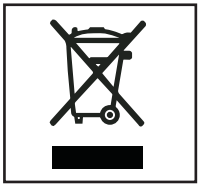
Figure 10
Diagnostic Testing
With an H-Field

H-FIELD (MZT-12): Since there is no static H-field associated with a real electrostatic discharge, ESD H-field simulation is dynamic, i.e. a pulsed field. As shown in Figure 10, the MiniZap MZT-12 magnetic loop tip is used in Contact Mode, to provide a high-intensity local magnetic field capable of probing for weak spots in the device that failed an ESD test.

Failures that occur during diagnostic H-field testing usually imply problems in a low impedance circuit. These may include wiring loops with excessive areas, including ground loops, within the equipment being tested.

WEEE Compliance:

This product is required to comply with the European Union's Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:



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