

Cause of Instrument Failure & Preventive Tip

MSD Korea

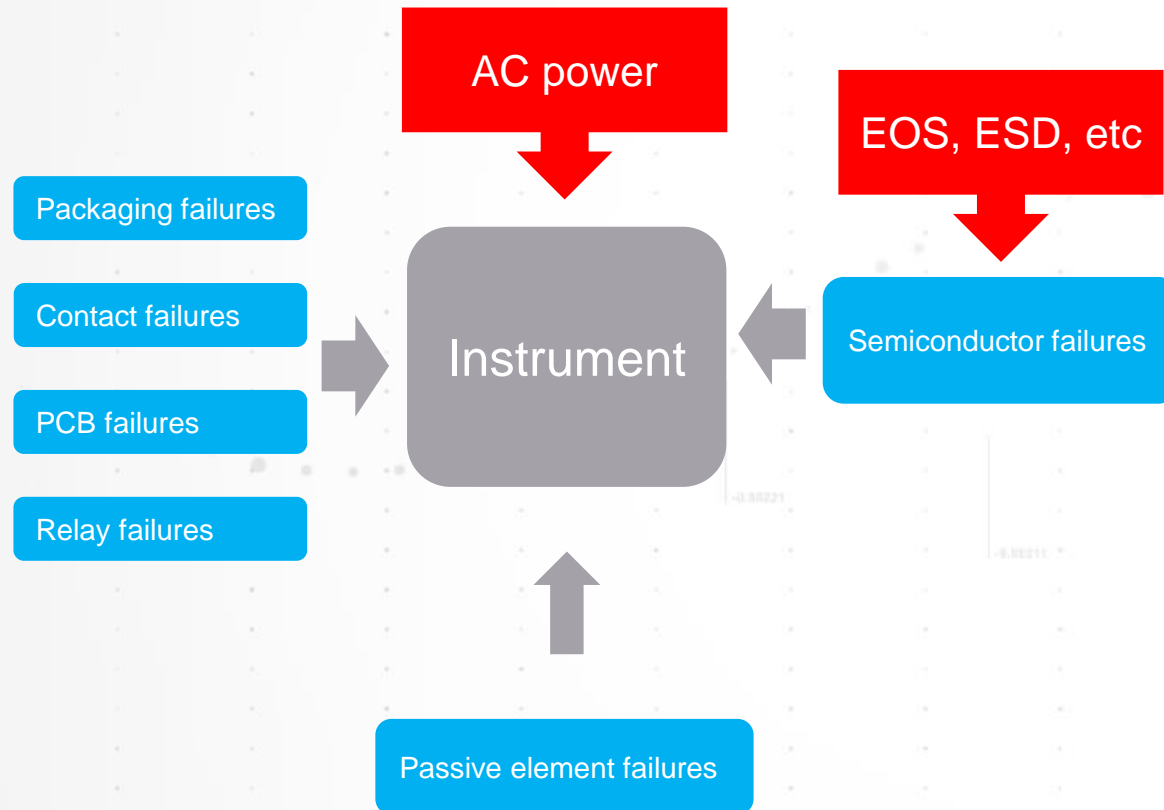
2018.06.28

KD, KIM



Root Cause of Units

Root Cause of Instrument Failure.



- EOS (Electric Over-Stress)
- ESD (Electric Static Discharge)
- AC Power

EOS (Electrical Over-Stress)

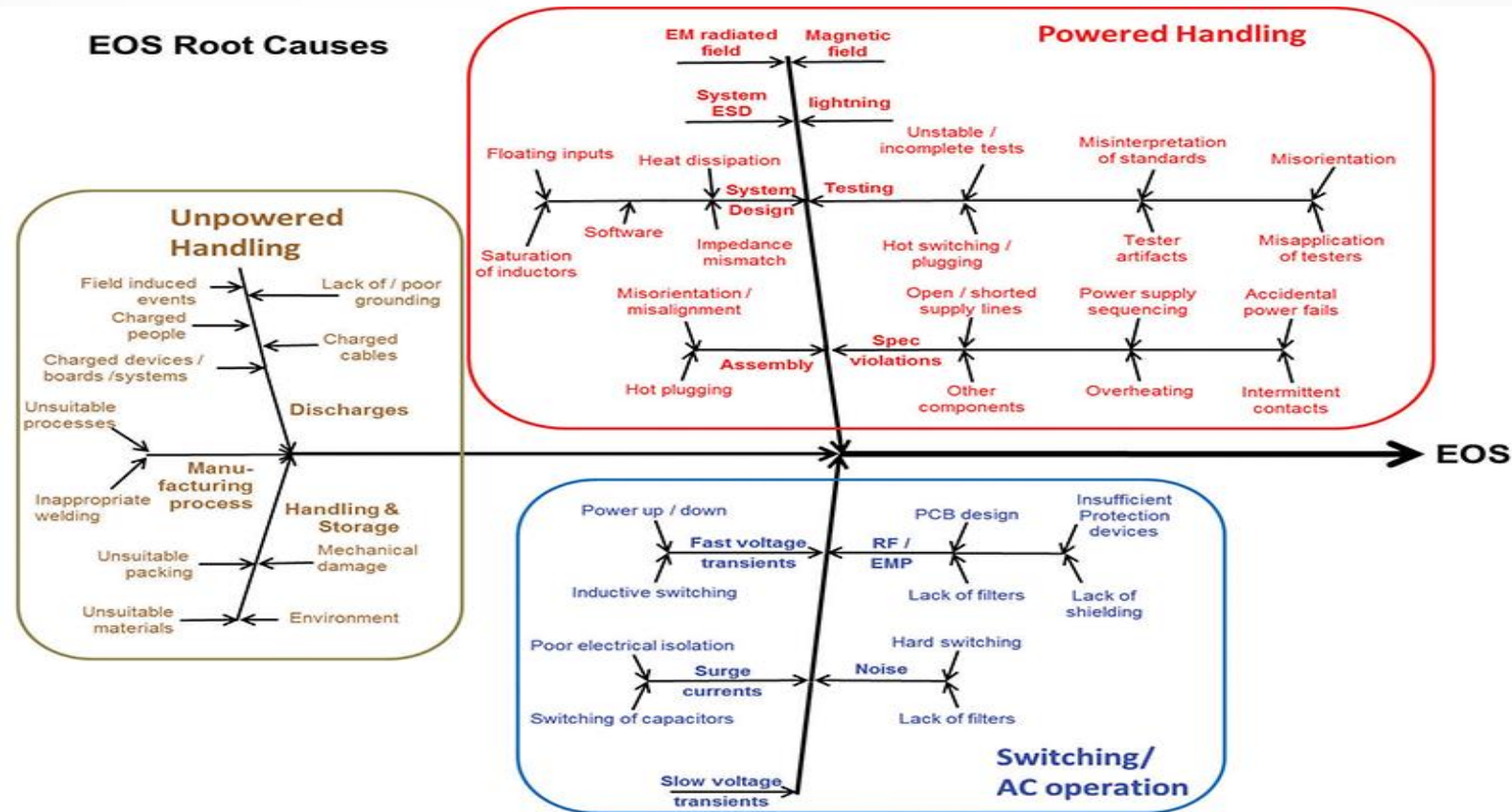
Definition of Electrical Over-Stress

Thermal damage that may occur when an electronic device is subjected to a current or voltage that is beyond **the specification limits of the device.**

From Industry Council on White Paper 4

Electrical Over-Stress (EOS)

Root Cause of EOS

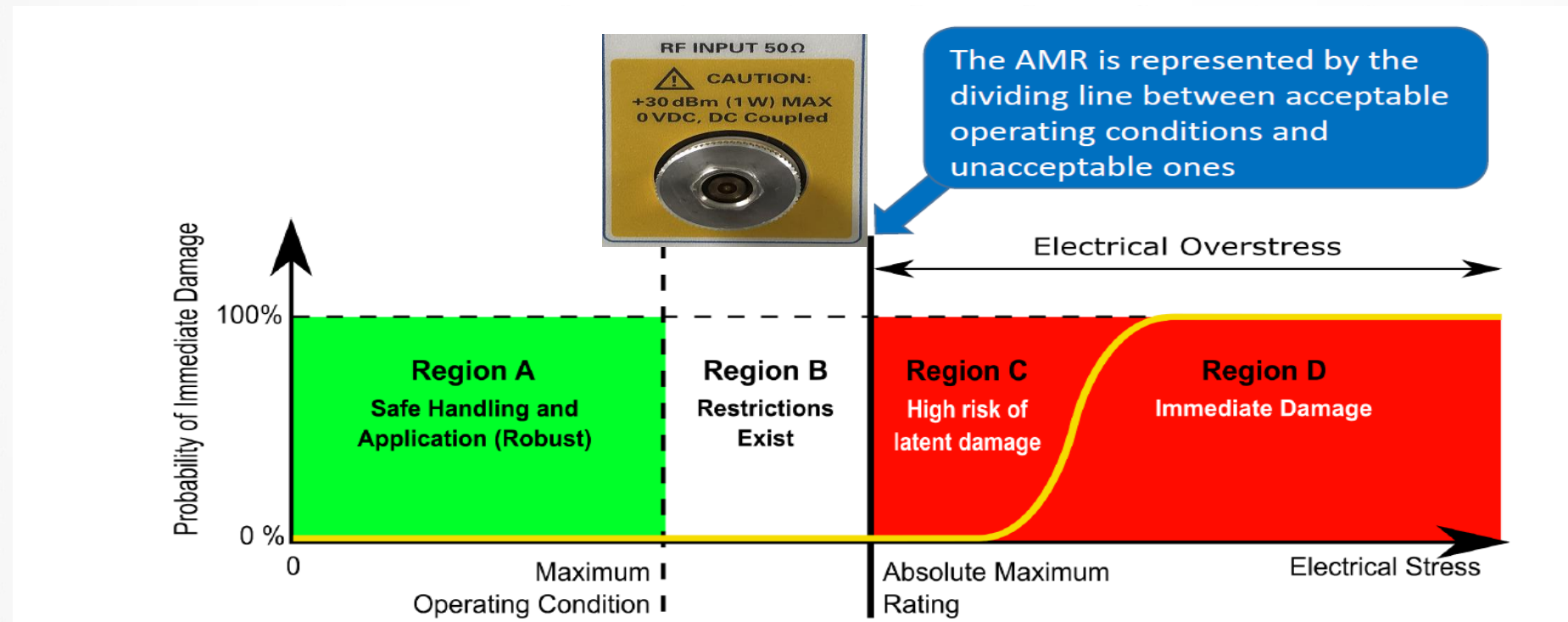


From Industry Council on White Paper 4

Electrical Over-Stress (EOS)

AMR(Absolute Maximum Ratings)

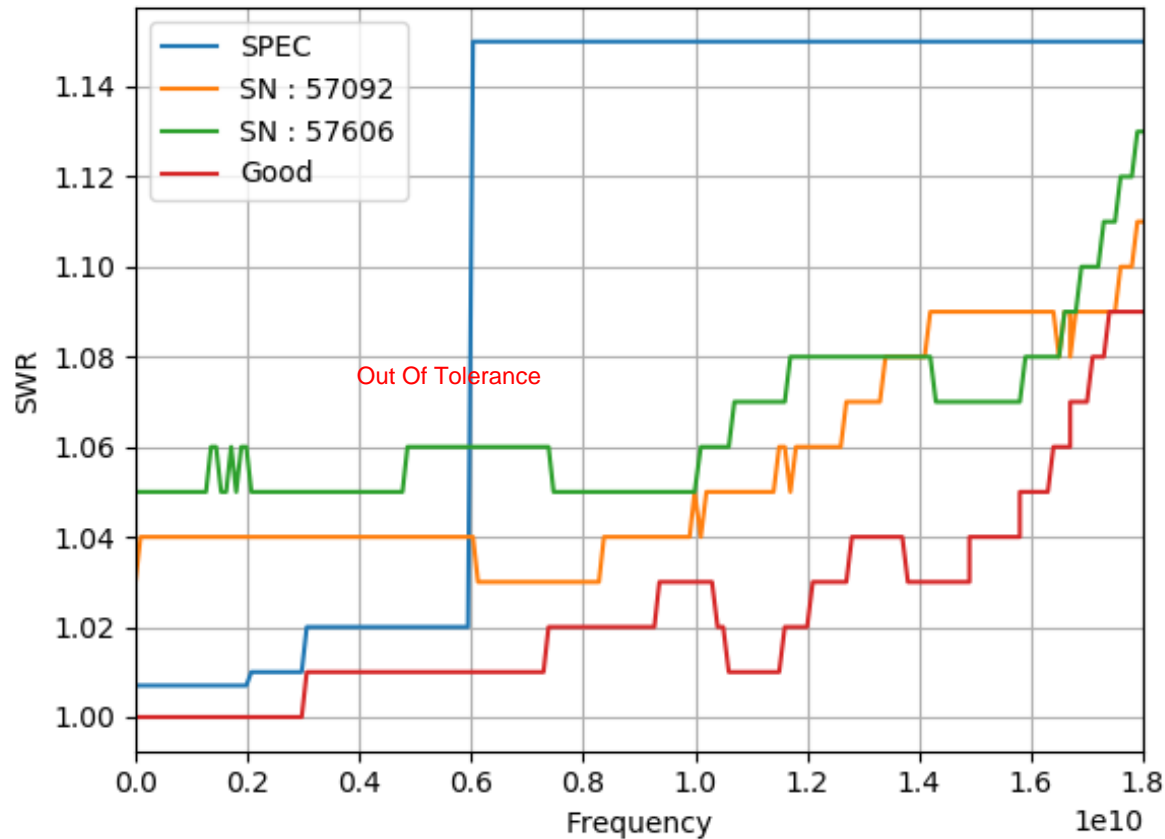
An electrical device suffers an electrical overstress event when a **maximum limit** for either the voltage across, the current through, or power dissipated in the device is exceeded and causes immediate damage or malfunction, or latent damage resulting in an unpredictable reduction of its lifetime.



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Electrical Over-Stress (EOS)

Example of Latent Damage.(AMR)

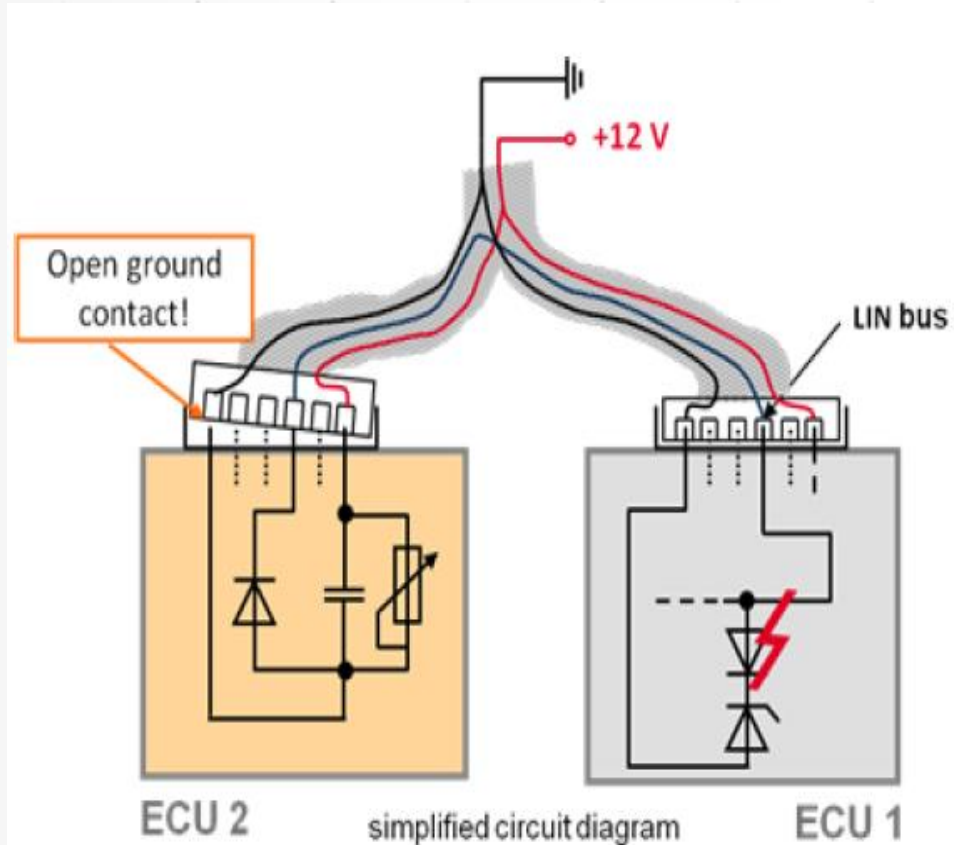


AMR OF 909F 500 mW avg.; 100 W peak, 10 μ S/pulse

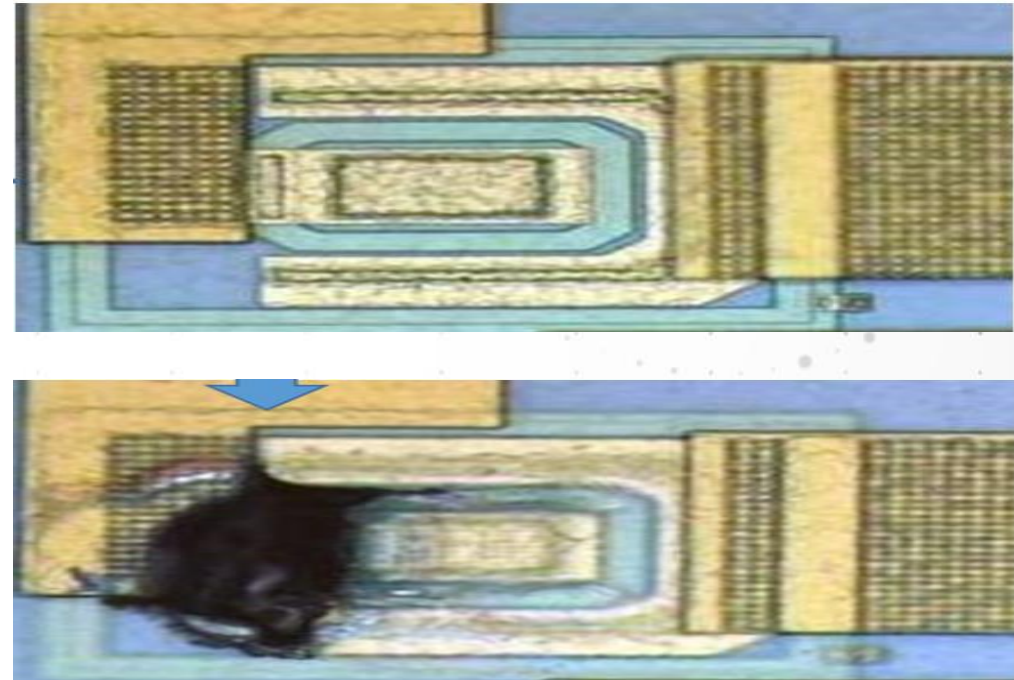


Electrical Over-Stress (EOS)

Example of EOS.(Hot plugging)



Result of Hot Plugging (Coupling diode)



From Industry Council on White Paper 4

Electrical Over-Stress (EOS)

EOS MITIGATION

- PROPER UNDERSTANDING OF **AMR** AND REALIZATION BY CUSTOMER
- ACCURATE DETERMINATION OF THE LOCATION AND POSSIBLE CAUSES OF THE DAMAGE AND FINDING THE ROOT CAUSE EVENT WHICH CREATED A DAMAGE
- **CRUCIAL TOPIC: COMMUNICATION BETWEEN SUPPLIER AND CUSTOMER**

Root Cause of Common Failure

Definition of Electrostatic Discharge (ESD)

Electrostatic discharge (ESD) is defined as

“The rapid, spontaneous transfer of **electrostatic charge** induced by a high electrostatic field. Note: Usually, the charge flows through a spark between two bodies at different electrostatic potentials as they **approach one another**”.

2013, ESD Association, Rome, NY

EDS

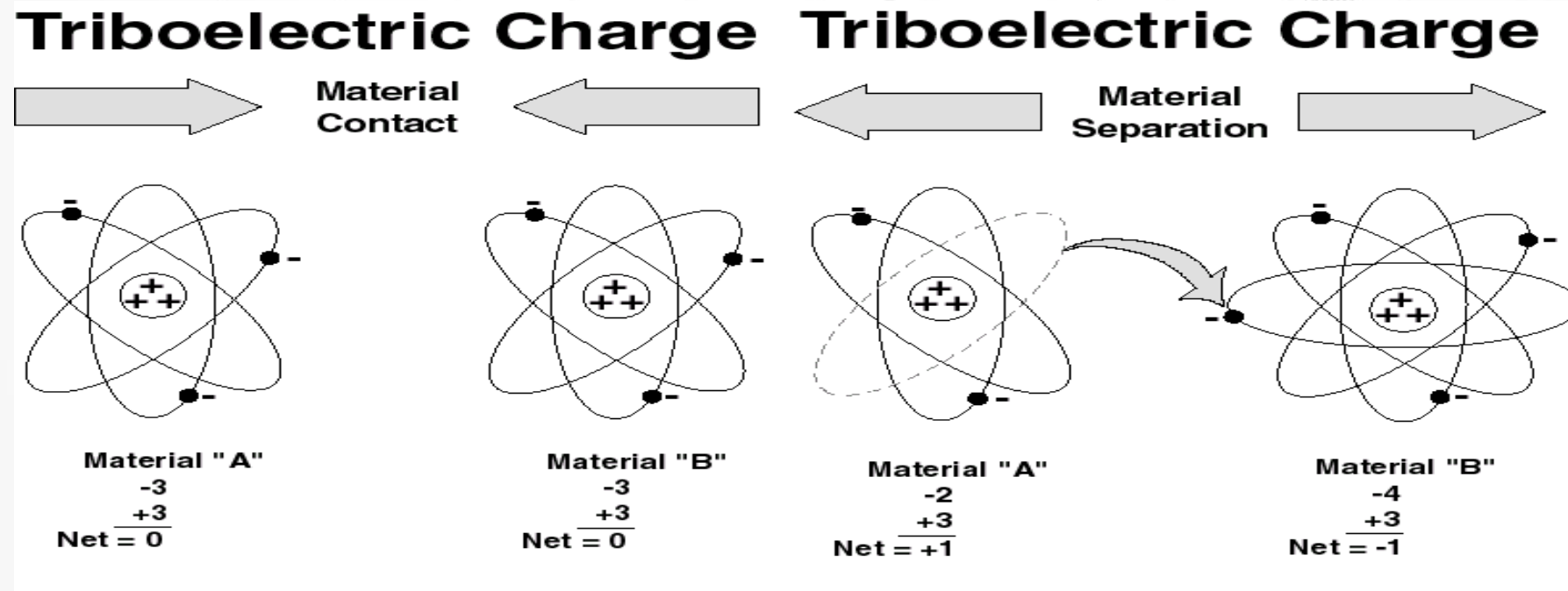
EOS vs. ESD

- 'EOS' is about the **amount of stress**, while 'ESD' is one **specific form of stress**
- ESD: A very high voltage (generally >500V) and moderate peak current (~1A to 10A) event that occurs in a short time frame (generally <1 μ s).
- EOS: A lower voltage (100V) event that occurs over longer time frame (generally >1ms).
- EOS and ESD are not alternatives to each other; ESD can be a cause of EOS damage

Electrostatic Discharge (ESD)

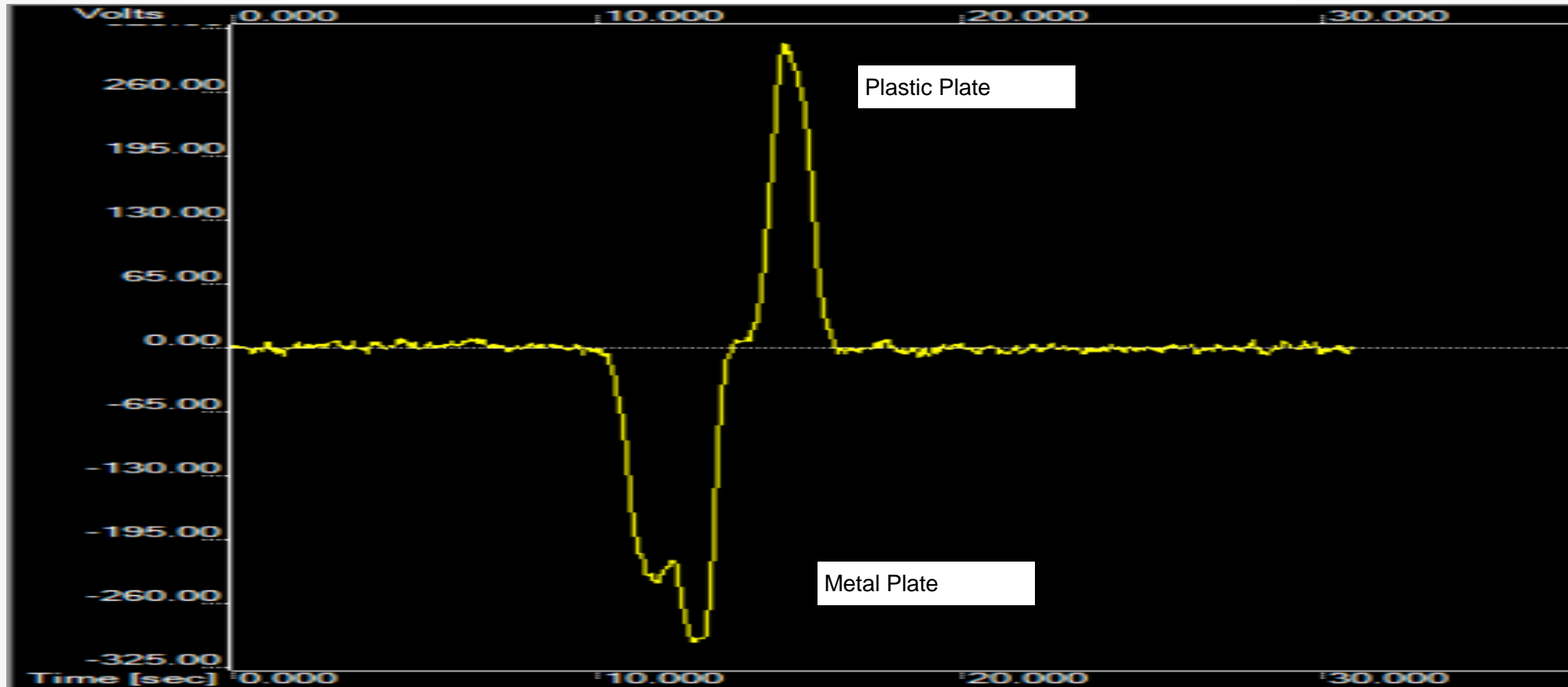
Electrostatic Charge

- **Static Electricity (Non-moving)**
 - An imbalance of Electric charge is the physical property of matter that causes it to experience a force when placed in an electromagnetic field within or on the surface of a material.



Electrostatic Discharge (ESD)

Transfer of electrostatic charge



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Electrostatic Discharge (ESD)

Triboelectric Electricity(Matters & Humidity)

+ Positive	Rabbit fur
	Glass
	Mica
	Human Hair
	Nylon
	Wool
	Fur
	Lead
	Silk
	Aluminum
	Paper
	COTTON
	Steel
	Wood
	Amber
	Sealing Wax
	Nickel, copper Brass, silver
	Gold, platinum
Negative -	Sulfur
	Acetate rayon
	Polyester
	Celluloid
	Silicon
	Teflon

Examples of Static Generation: Typical Voltage Levels

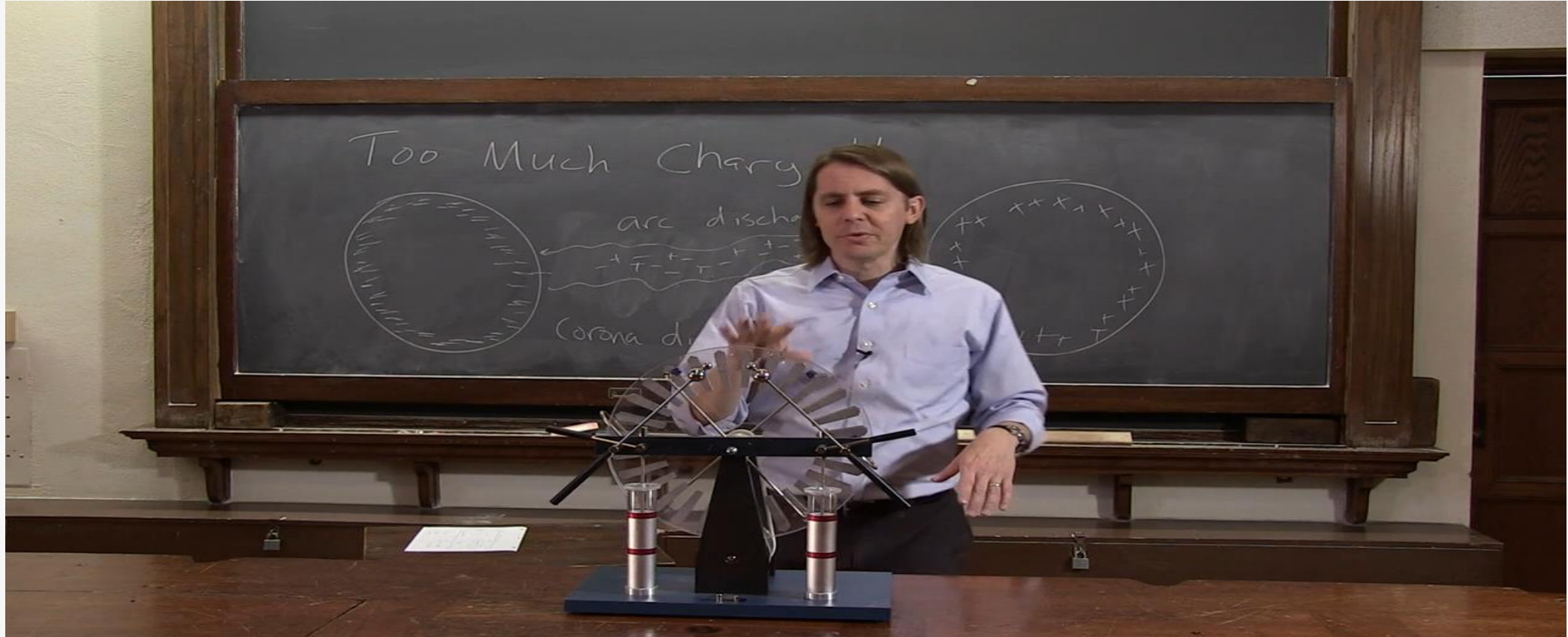
MEANS OF GENERATION	10-25% RELATIVE HUMIDITY	65-90% RELATIVE HUMIDITY
Walking across carpet	35,000V	1,500V
Walking across vinyl tile	12,000V	250V
Worker at bench	6,000V	100V
Poly bag picked up from bench	20,000V	1,200V
Chair with urethane foam	18,000V	1,500V

SOURCE: ELECTROSTATIC DISCHARGE ASSOCIATION, 2013.

ESD Association

Electrostatic Discharge (ESD)

Too Much Charge (Wimshurst generator)

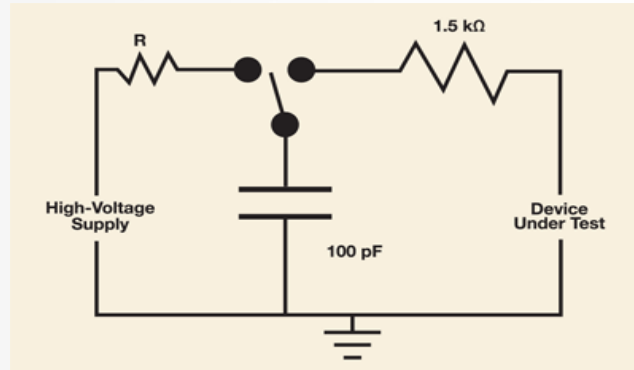


Video segment from PHYS102x on edX.

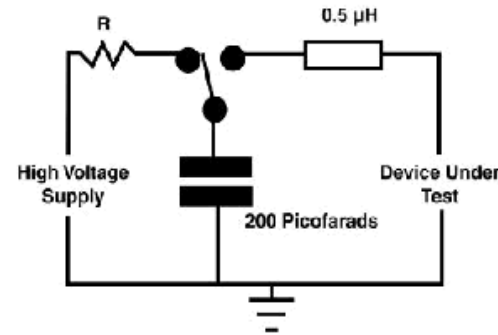
Electrostatic Discharge (ESD)

Discharge Model

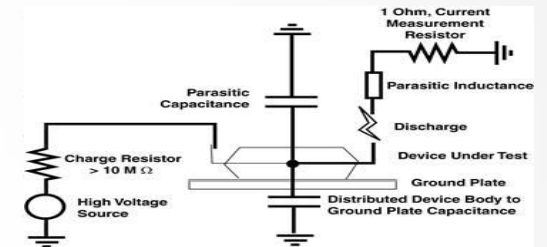
Human Body Model



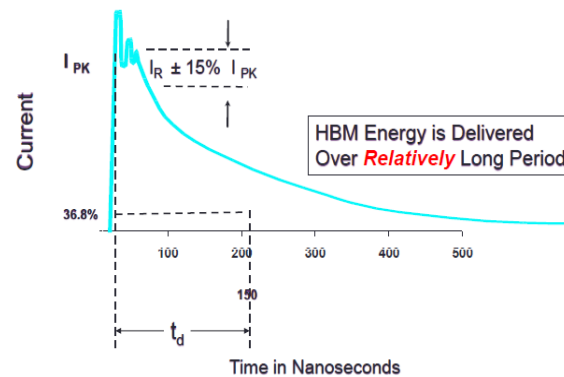
Machine Model



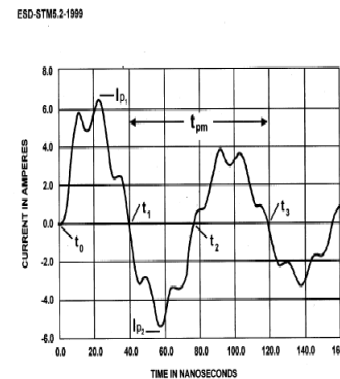
Charged Device Model



HBM Theoretical Waveform

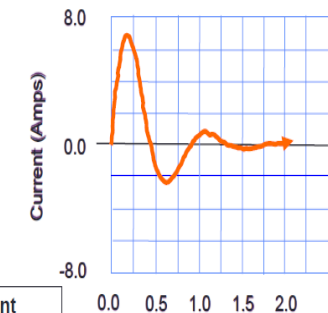


Machine Model Discharge Curve



CDM Discharge Verification Trace

(From ESD-STM5.3.1-1999 @ 3.5 GHz)



CDM Event
Could be many
10's of Amps

2 Nanoseconds

Electrostatic Discharge (ESD)

Device HBM

Table 4	
ESD Sensitivity of Representative Electronic Devices	
Devices or Parts with Sensitivity Levels of 0-1,999 volts (HBM)	
Device or Part Type	
Microwave devices (Schottky barrier diodes, point contact diodes and other detector diodes >1 GHz)	
Discrete MOSFET devices	
Surface acoustic wave (SAW) devices	
Junction field effect transistors (JFETs)	
Charged coupled devices (CCDs)	
Precision voltage regulator diodes (line of load voltage regulation, <0.5%)	
Operational amplifiers (OP AMPs)	
Thin film resistors	
Integrated circuits	
AMR and GMR Disk Drive Recording Heads	
Laser Diodes	
Hybrids	
Very high speed integrated circuits (VHSIC)	
Silicon controlled rectifiers (SCRs) with $I_o < 0.175$ amp at 10°C ambient	

Electrostatic Discharge (ESD)

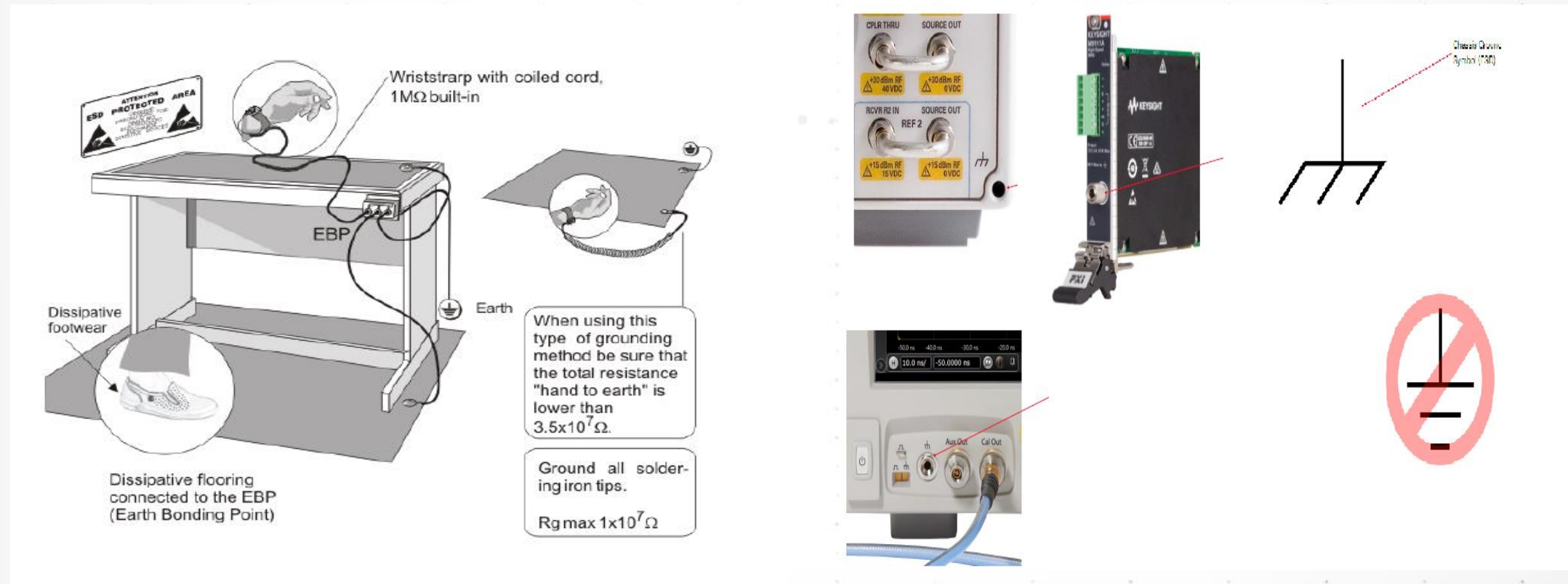
ESD Preventive Tip

- Revisit definition of ESD
 - “The **rapid, spontaneous transfer** of electrostatic charge induced by a high electrostatic field.”
- How
 - Conductor: Slowly dissipated Static Electricity into the **Ground**.
 - Insulator: **Away from** ESD sensitive device or instrument.

Electrostatic Discharge (ESD)

ESD Preventive Tip

ESD Safety Area



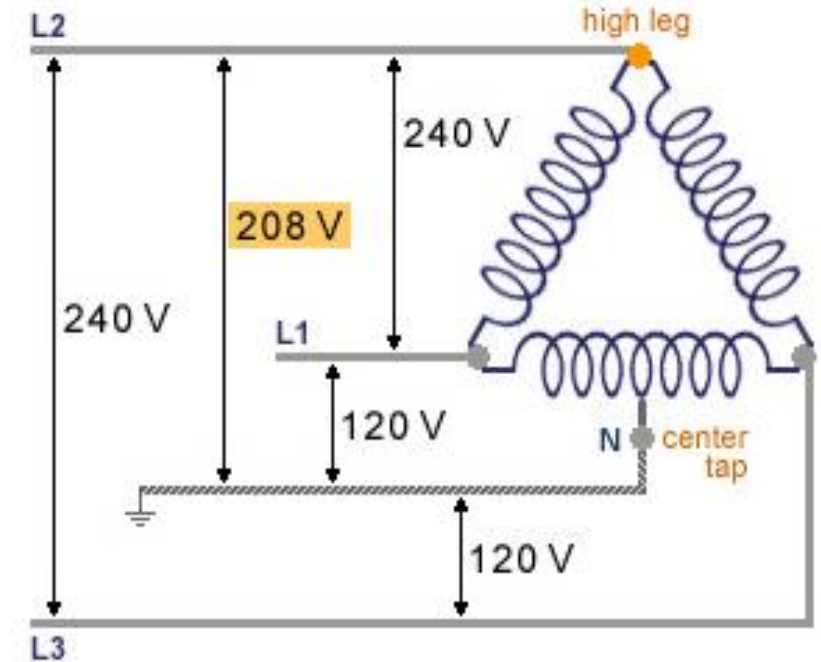
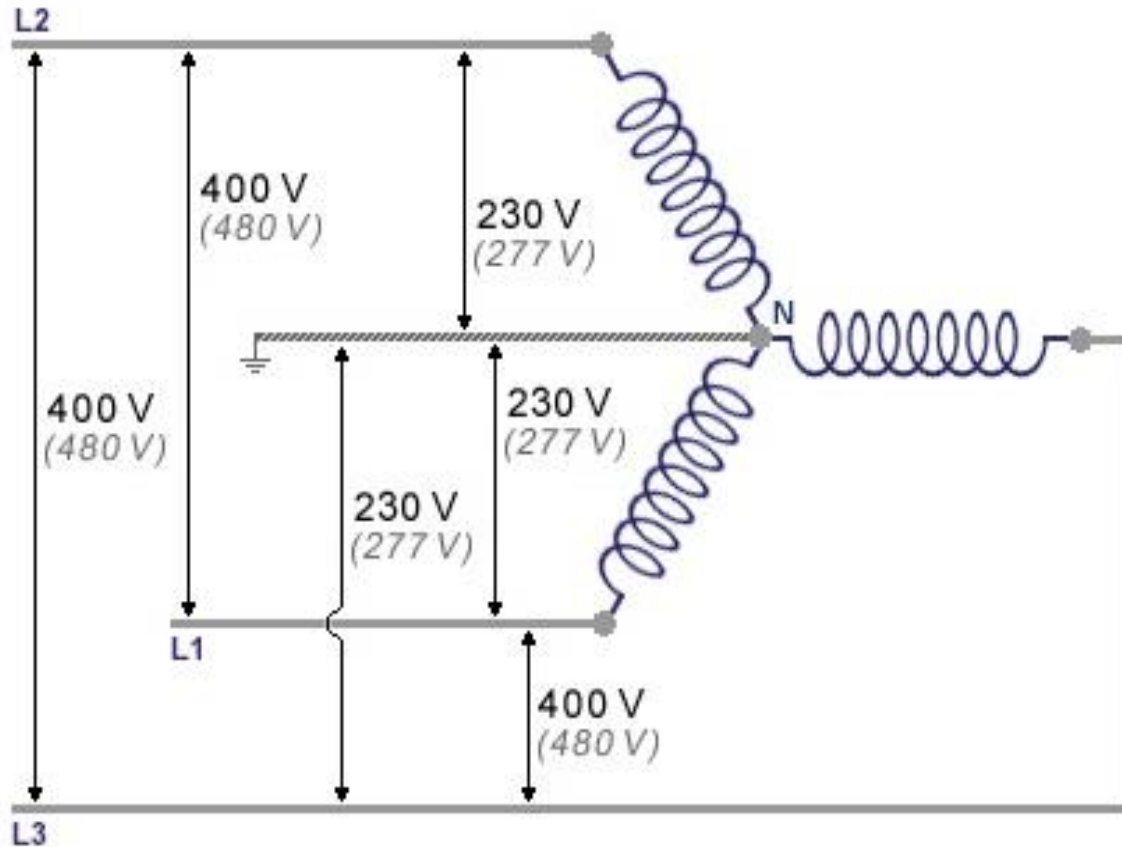
Electrostatic Discharge (ESD)

ESD Preventive Tip



Root Cause of Common Failure

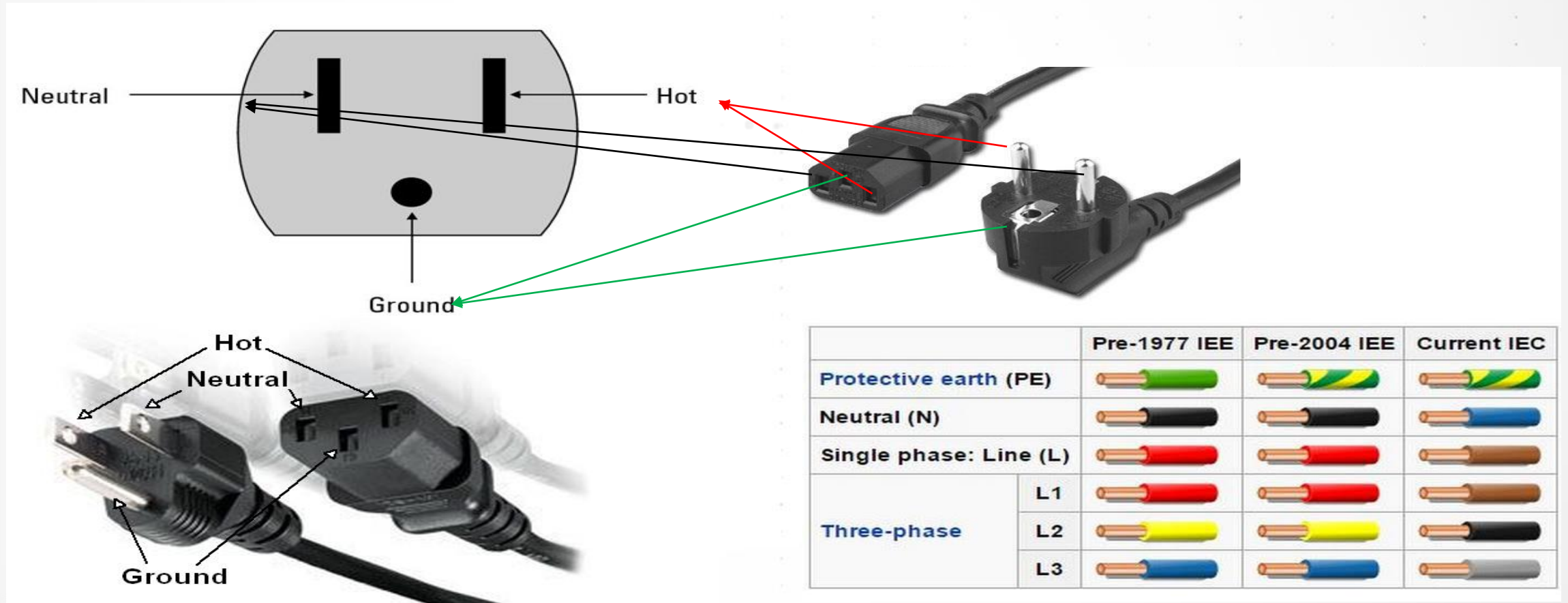
AC Power 3 Phase Wye and Delta Connection



AC Power

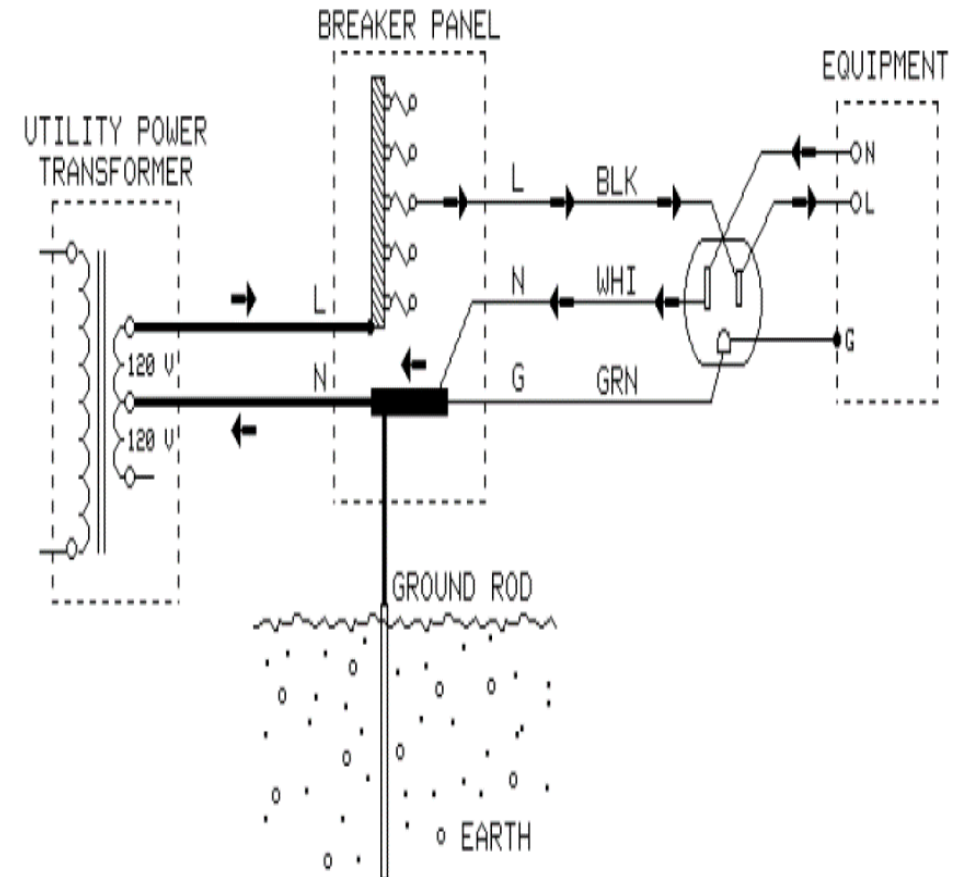
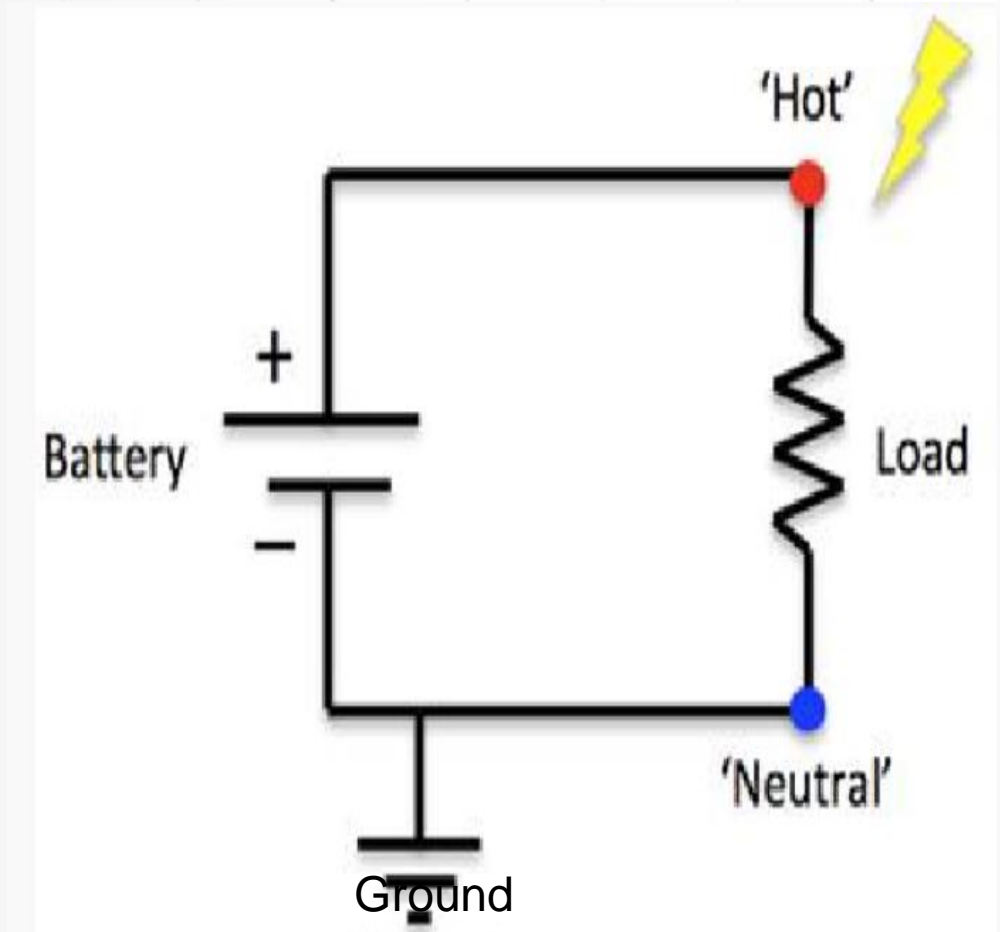
110 V

220V (Euro type 2)



AC Power

Neutral vs Ground

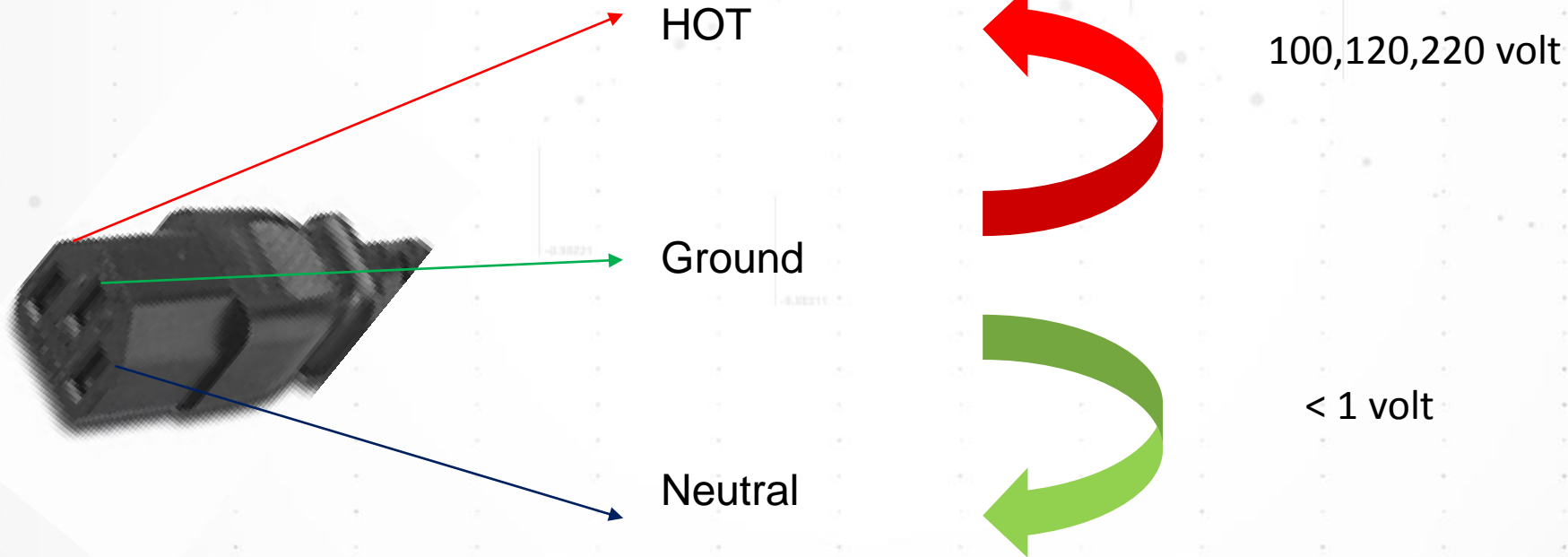


AC Power

REQUIREMENT KEYSIGHT INSTRUMENT

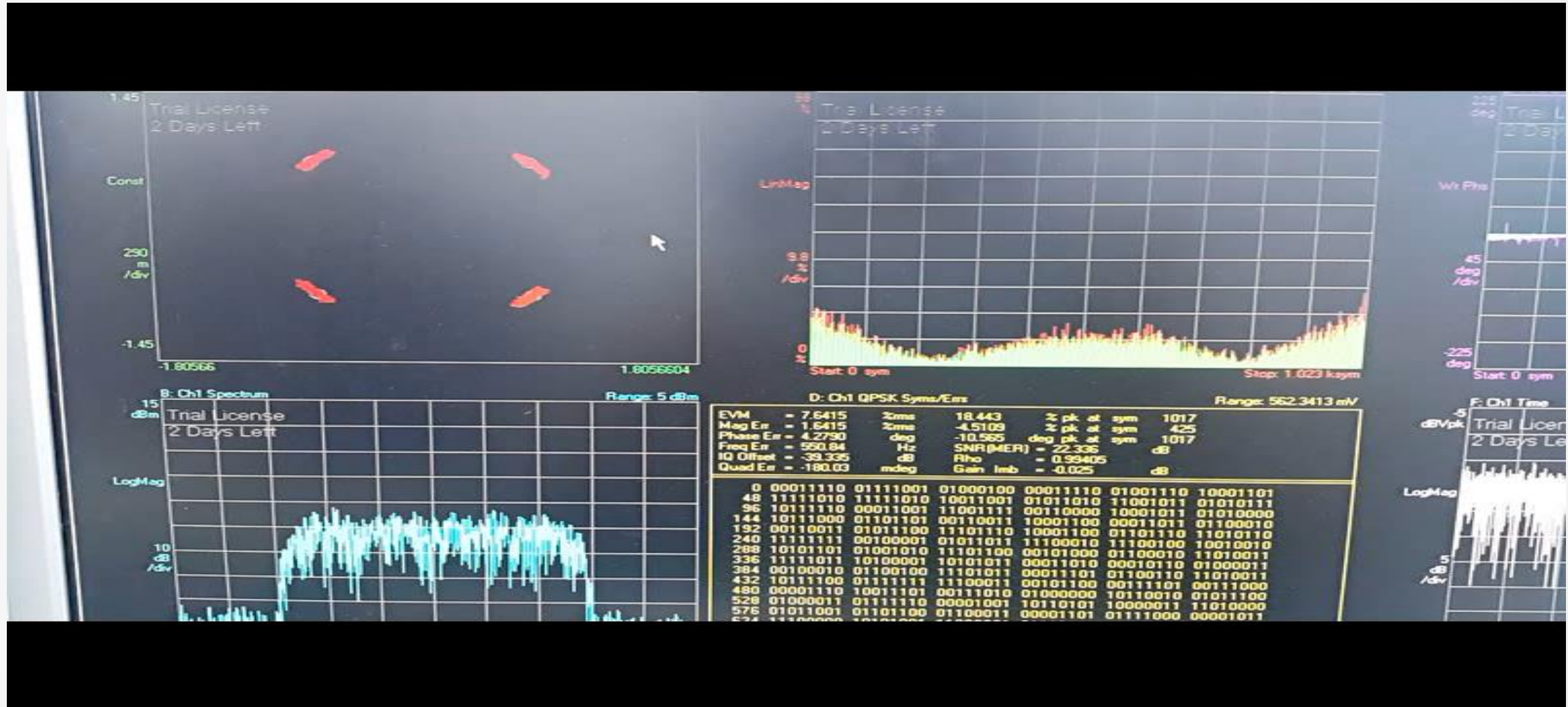
Typical AC voltage required is 100,120,220 volt, +/- 10% or 240 volt, +5%/-10%. Typical expected grounding wire resistance <1 ohm.

The voltage between neutral & ground line < 1 volt.



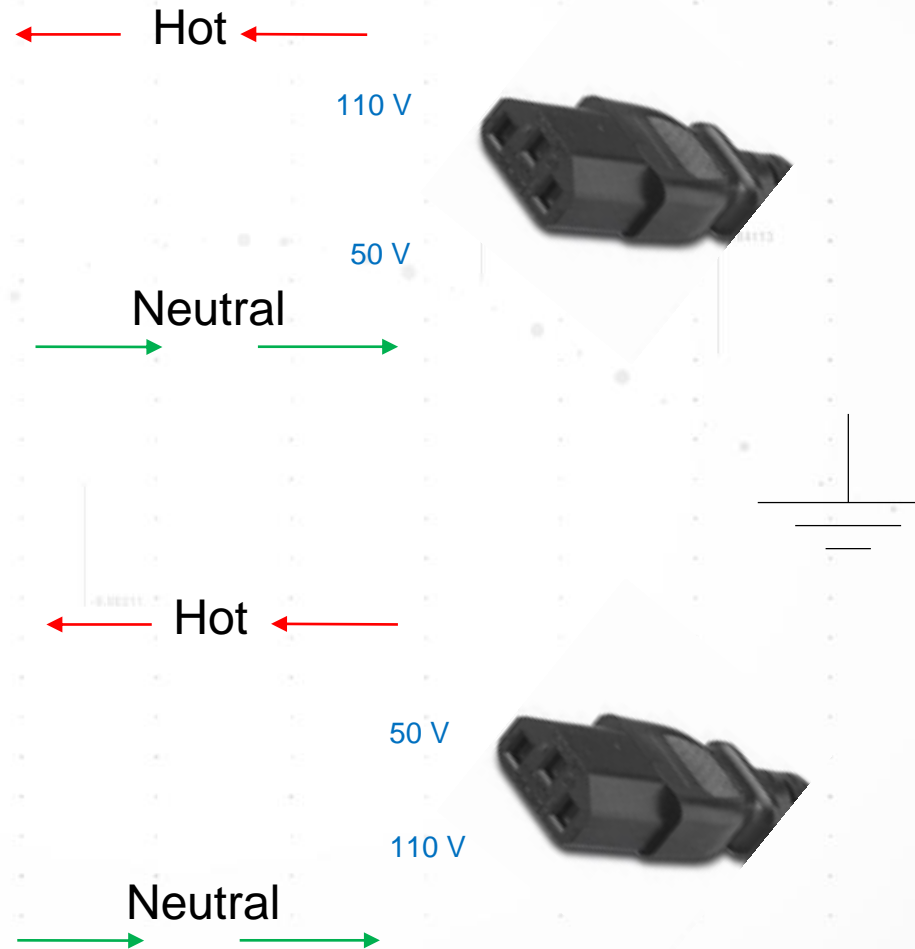
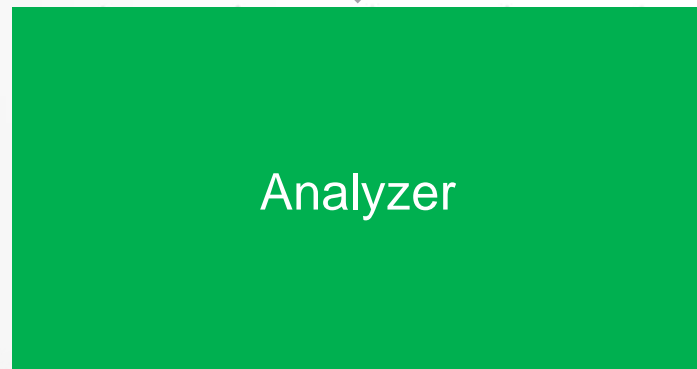
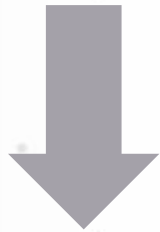
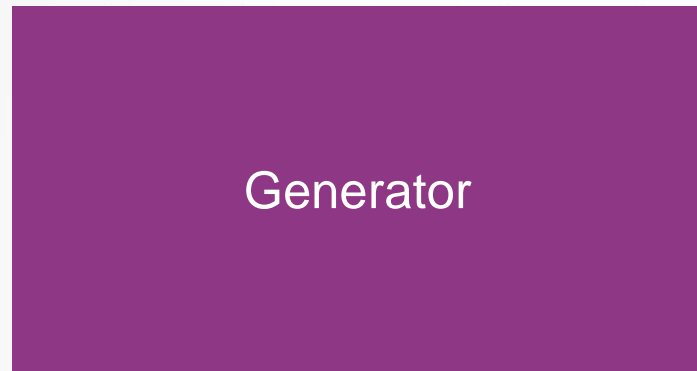
AC Power

Noise from AC Power



AC Power

Noise from AC Power





Thanks !