Dragonchip

The Prevention and Control of Electrostatic Discharge (ESD)

AppNote082

Document Revision 1.1

February, 2018

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1 Introduction to ESD

We experience occurrences of static electricity every day.

Example:
Walking along a carpeted floor in a heated room during winter

Electrostatic discharge sensitive (ESDS) parts are commonly characterized to three defined models:

- Human Body Model (HBM)
- Machine Model (MM)
- Charged Device Model (CDM)

Could damage electronic devices!!!

2 Prevention and Control

2.1 Sources of static electricity

Object or process	Material or activity
Work surfaces	Waxed, painted or plastic surfaces
Floors	Waxed, common vinyl tiles, sealed concrete
Clothes	Common smocks, non-conductive shoes, synthetic materials (e.g. nylon)
Chairs	Vinyl, fiber-glass, finished wood
Packaging	Common plastic bags, foam, trays, tote boxes
Assembly area	Spray cleaners, heat guns, blowers, plastic tools (e.g. solder suckers, brushes), cathode ray tubes.

2.2 Industrial Standard

MIL-STD-1686C, with HBM subgroups per ESD STM5.1-2001

ESD Model	ESD Classification	Voltage Range
Human Body Model (HBM)	0	0 – 249V
	1A	250 – 499V
	1B	500 – 999V
	1C	1000 – 1999V
	2	2000 – 3999V
	3A	4000 – 7999V
	3B	>= 8000V
Machine Model (MM)	M1	0 – 100V
	M2	101 -200V
	M3	201 – 400V
	M4	401 – 800V
	M5	>800V

Charged Device Model (CDM)	C1	0 – 124V
	C2	125 – 249V
	C3	250 – 499V
	C4	500 – 999V
	C5	1000 – 1499V
	C6	1500 – 2999V
	C7	>= 3000V

2.3 Damage in an electronic device

Two kinds of damage from ESD:

1. Catastrophic damage

1.1. Electronic device is rendered inoperable immediately after the ESD event.

1.2. A semiconductor junction or a connecting metallization could have been damaged by ESD.

2. Latent damage

2.1. Electronic device appears to be working fine following the ESD event.

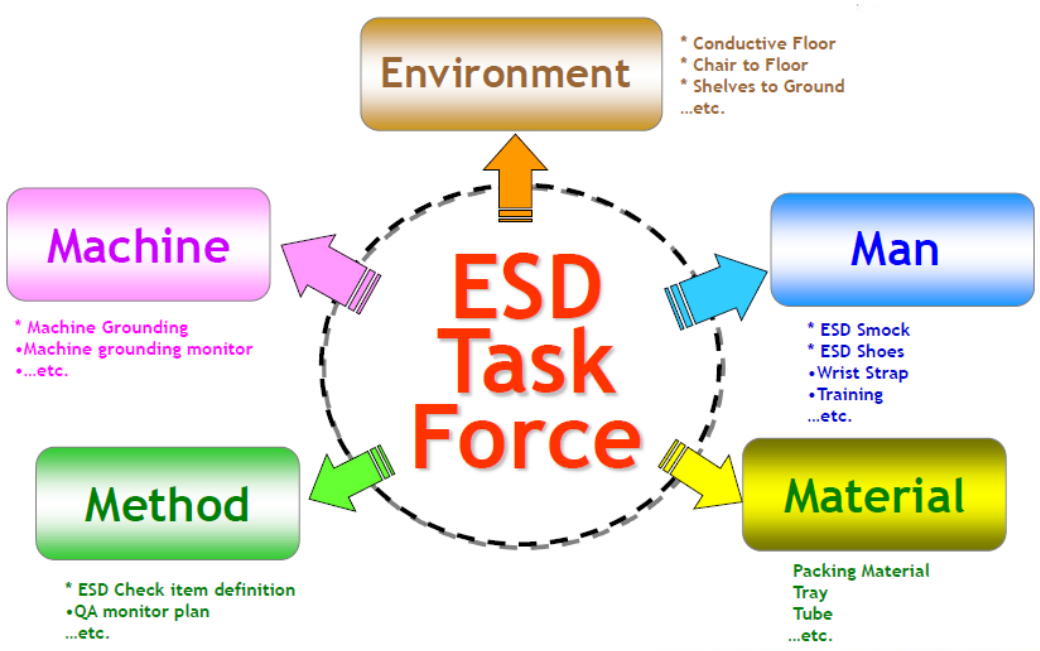
2.2. The sensitive circuitry could be damaged and fail to operate at some time in the future

2.4 Scope of area in factory

Five areas should we pay attention to:

1. Assembly
2. Test
3. Lab
4. Packing
5. Storage

2.5 ESD Control Diagram



2.6 Practice Sample

Equipment Grounding (0Ω)

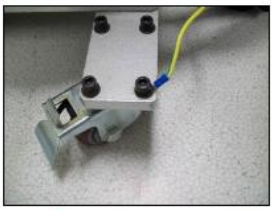



Table Grounding (1MΩ)



Self grounding (0Ω)



2.7 ESD Measuring Equipment

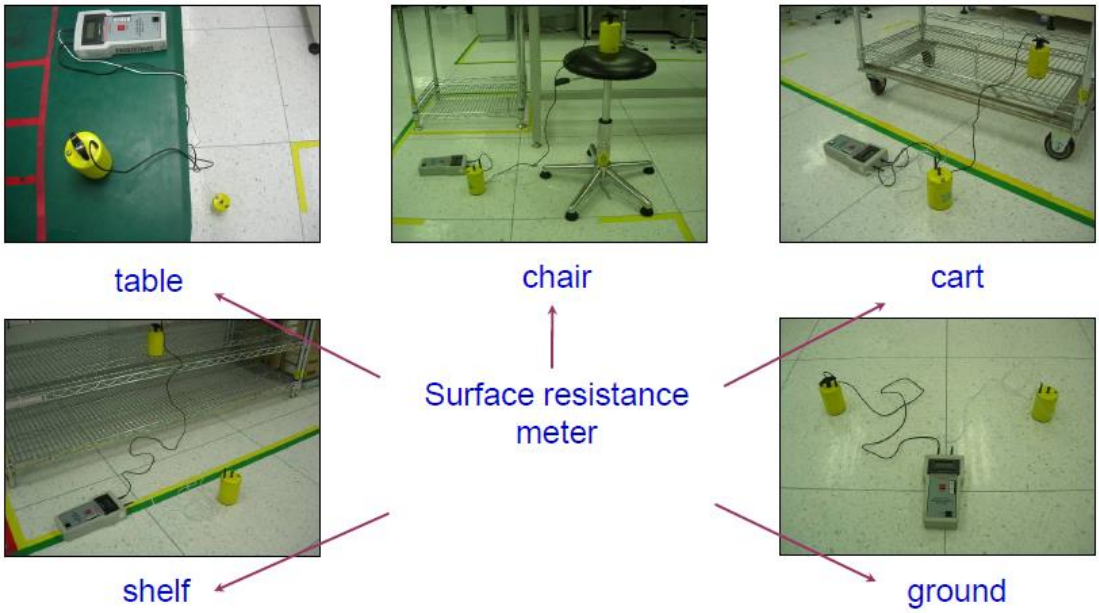
Surface resistance meter

Field meter

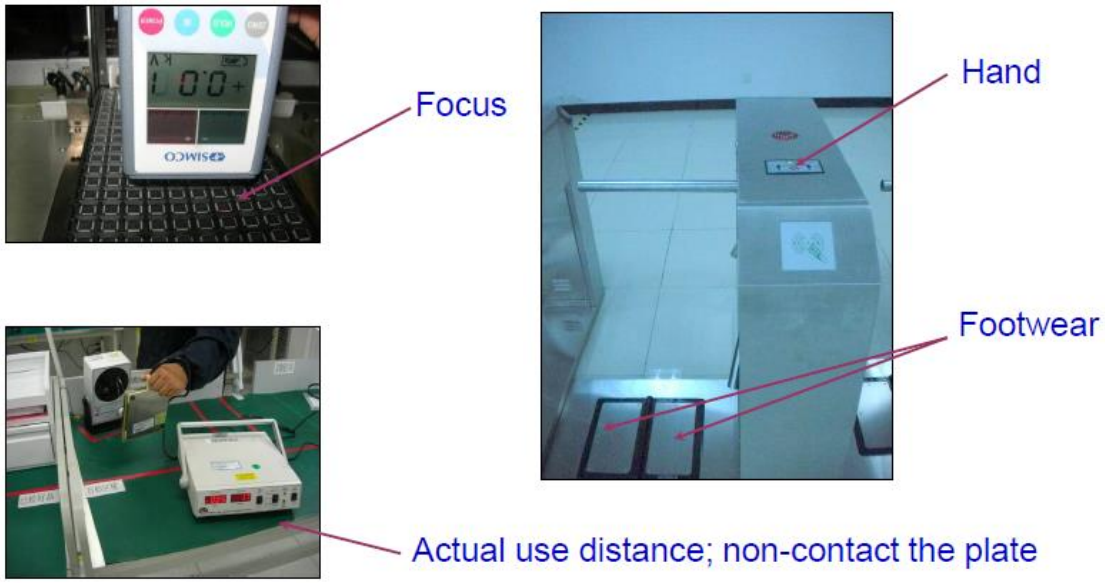
Charge plate monitor

Multi-meter

2.8 ESD Test Method - 1



2.9 ESD Test Method - 2



2.10 ESD Check Frequency & Criteria

Item	Material	Measure	Measure method	Criteria	Frequency	Sampling ratio
EPA area	Floor	NA	Point-to-point	1.0e5~1.0e9 ohm	Quarterly	3pts
	Equipment	Grounding wire	Grounding resistance	< 1 ohm	Monthly	10%
	Work table	ESD mat	Surface resistance	1.0e5~1.0e9 ohm	Monthly	10%
			Resistance to floor	1.0e5~1.0e9 ohm		10%
	Chair	ESD chain	Surface resistance	1.0e5~1.0e9 ohm	Monthly	10%
			Resistance to floor	1.0e5~1.0e9 ohm		10%
	Cart	ESD chain	Resistance to floor	1.0e5~1.0e9 ohm	Monthly	10%
	Shelf	Grounding wire / chain	Resistance to floor	1.0e5~1.0e9 ohm	Monthly	10%
Personnel	Anti-static clothing	Electrostatic dissipation materials	Surface resistance	1.0e5~1.0e911ohm	Monthly	10EA
Ionization	Ionizer	NA	Decay time	< 5s	Monthly	20%
			Balance voltage	Abs < 30V		
Static dissipative materials	Anti-static bag, Anti-static finger sets, Anti-static dust-free cloth, etc.	NA	Surface resistance	1.0e4~1.0e11 ohm	Monthly	5EA
			Static voltage	< 100V		5EA

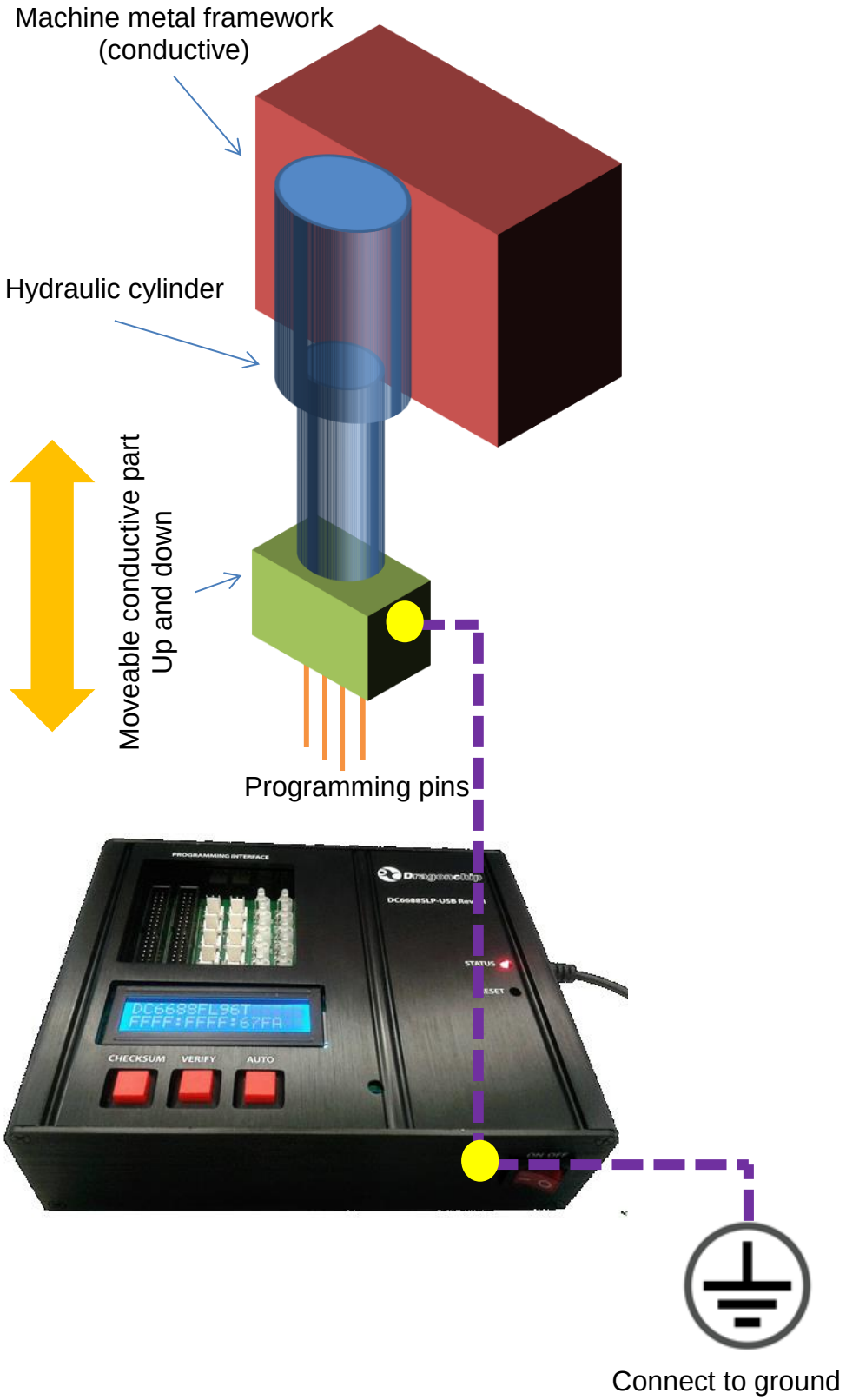
Monitor Data + QA Audit

3 Machine handler for programming

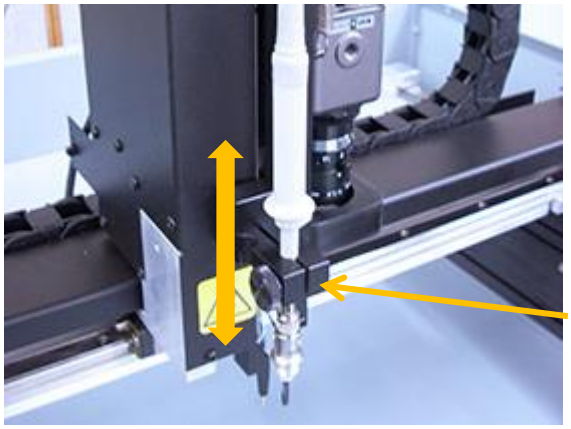
Friction between movable parts, no matter conductive or not, can generate ESD continuously while moving.

An effective grounding path is an earth wire (yellow/green, or black) between movable conductive parts as shown below.

Below diagram illustrates the grounding path on a handler of a machine.
A handler consists of test probes mounting on a conductive part with insulator separated, which then mounting on one end of a hydraulic cylinder and keeps moving up and down. Even though all parts are conductive, but the contact in between is not perfect after some days of consumption. Friction between the cylinder and the rod generates the charges and induces on the test probe. To minimize the ESD, a grounding path is jointed from the conductive part in the handler to metal framework which is then jointed to the earth.


Machine metal framework
(conductive)
Hydraulic cylinder
Moveable conductive part
Up and down
Programming pins
Connect to ground

Grounding example:



Conductive part
Joint a wire to the ground

If the reading of resistance measurement keeps changing between conductive materials while static or moving, it is an indication that the contact is not stable, and a new grounding path should be installed.

Revision History

Document Rev. No.	Issued Date	Section	Page	Description	Edited By	Reviewed By
1.1	Jan, 2018	All		Changed to word	Danny Ho	Patrick Li
		3		Add machine handler grounding for programming		

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