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HAEFELY ESD TARGET VERIFICATION

ESD TARGET VERIFICATION PER ISO 10615:2001 & 10615:2008

1. PURPOSE

1.1. To provide specific test method setup configuration instructions in full compliance with OEM specifications and international standards.

2. SCOPE

2.1. To establish consistency and repeatability in test method results using the equipment and technical resources available in EMC laboratory inventory.

3. RESPONSABILITY

3.1. EMC laboratory authorized personnel.

4. EQUIPMENT AND MATERIALS

4.1. All test equipment that requires calibration shall be within its calibration period and shall be traceable to A2LA certified labs.

4.2. EMC lab personnel must ensure that certificates of calibration are obtained when equipment is sent out for calibration or repair.

Fig.4-1

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Tbl.4-1

IDX	TITLE	DESCRIPTION	MODEL / MAKER	INVENTORY#
1.	ESD SYSTEM PESD 3010 (1 to 30 KV)	ESD generator serial# 249963 Capacitor Module 330 pF Capacitor Module 150 pF Resistor Module 330 OHM Resistor Module 2000 OHM	H507174 / Haefely	INV2267
2.	Coaxial target - as specified in IEC 61000-4-2 2 Ohm Shunt (target verification)	serial# 153476	Haefely	
3.	Electrometer with minimum input resistance of 100 GOHM used to verify the ESD simulator charging voltage. voltage	serial# 18103	Sensitive Research	INV1744
4.	Reference plane at least 1,2 m × 1,2 m & coaxial current target		Haefely	
5.	Wideband attenuator - 50 OHM, 20 dB attached to the output of the coaxial target during the ESD simulator verification ISO-10605:2001 ANNEX-A		Haefely	
6.	Double shielded coaxial cable less than 2 meter long.			
7.	Ground strap			
8.	Oscilloscope TDS-784A	serial# B010315	Tektronix	INV2282

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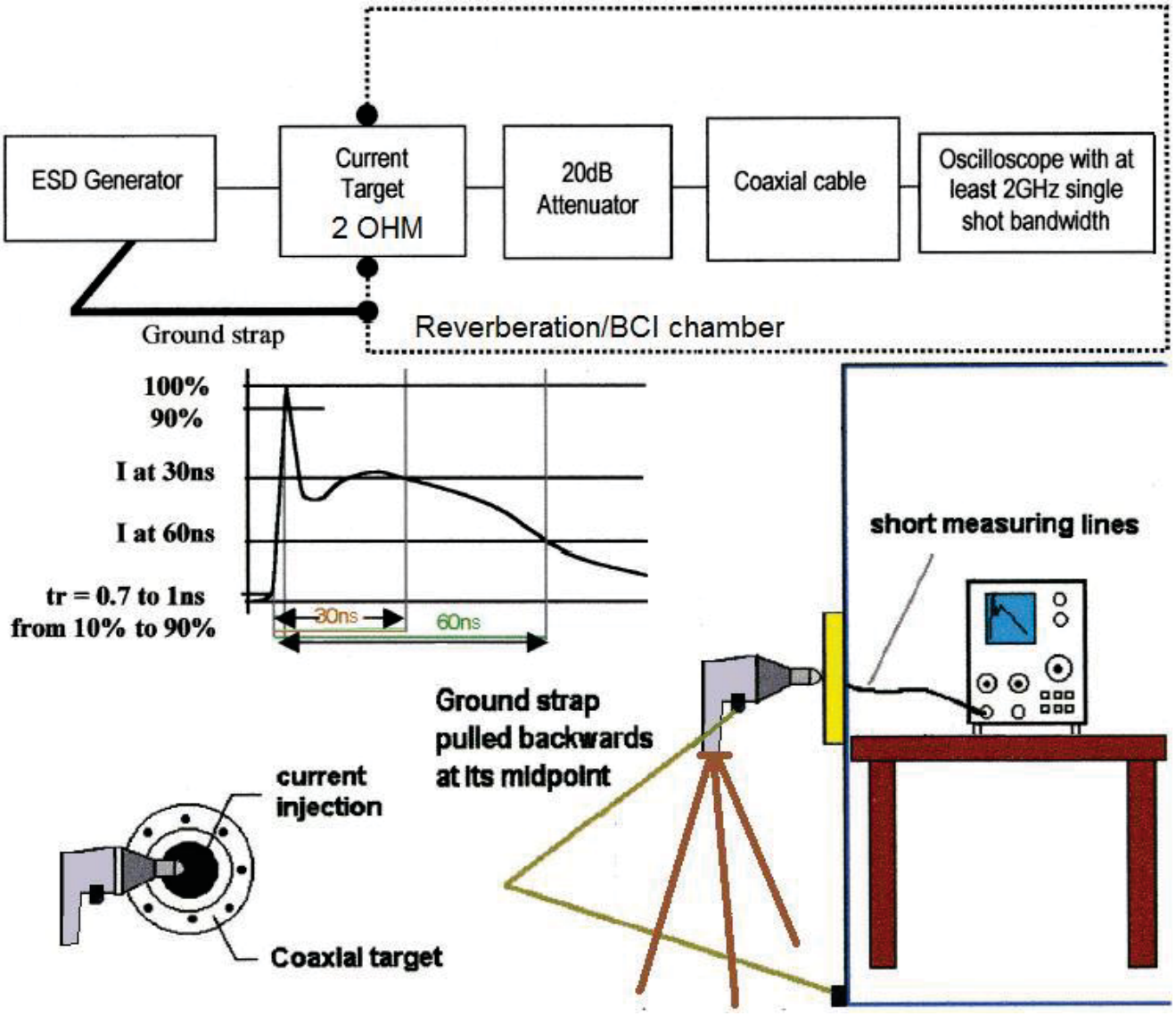
5. SUMMARY OF METHOD

5.1. The ESD generator (gun) is placed on a tripod or equivalent non metal low loss support and it is powered in the same way as it will be used during test.

5.2. Prior to verifying the discharge current, determine the amplitude of the ESD generator using the ESD voltmeter. The accuracy of the test voltage measurement is as specified in Table A.1. ISO 10605:2008. Record environmental conditions (temperature and humidity)

Fig.5-1



6. SAFETY PRECAUTIONS

6.1. The operating temperature per ISO 10605:2008 is relaxed from 23±5°C to 25±10°C.

6.2. Allowing testing to 15°C could lead to possible electrical shock accidents (dew could form on the test equipment, the device under test or other objects and form and unexpected discharge path).

7. TEST PLAN

7.1. Test method scheduled per LMS011 (EMC LAB, PROFICIENCY TESTING PROGRAM PROCEDURE)

7.2. ESD target verification must be logged in EMC database section Equipment compliance to spec.

Fig.7-1

Test Method (AEMCLAP)	Period	Competence through	Submit to A2LA	Next Scheduled Date
Electrostatic Discharge (ESD) *AEMCLRP Rev. 4, Appendix D* ISO 10605 (2001); GMW3097 (2006) Section 3.6; DC-I 1224 (Change A) Sections 10. 1 and 10.2; ES-XW7T-IA278-AC (CI280)	2 years	AEMCLRP Program. Quarterly waveform verifications may also be submitted. ESD gun voltage verification is done daily prior to each injection voltage level.	ESD gun voltage verification voltage waveform monitored by a calibrated Electrometer, equipment calibration records, and employee training records.	Sep 2008 ☒ Sep 2010 ☐
Conducted Emissions (CISPR 25) AEMCLRP Rev. 4, Appendix F CISPR 25 (2002) Sections 6.2 and 6.3; DC-I 1224 (Change A) Sections 6.2 and 6.3; GMW3097 (2006) Section 3.3.2; ES-XW7T-IA278-AC (CE420)	6 months	Internal performance data through system verification using Flextronics Automotive Inc.'s Comb Generator ComPower CG-515.	Data, equipment calibration records, and employee training records.	Dec 2006 ☒ Jun 2007 ☒ Dec 2007 ☒ Jun 2008 ☒ Dec 2009 ☐ Jun 2010 ☐
Bulk Current Injection (BCI) AEMCLRP Rev. 4, Appendix I ISO 11452-4 (2005); GMW3097 (2006) Section 3.4.1; ES-XW7T-IA278-AC (RI 112); DC-I 1224 (Change A) Section 7.2	2 years	AEMCLRP Program artifact testing.	Data, equipment calibration records, and employee training records.	Sep 2008 ☒ Sep 2010 ☐
Radiated Emissions AEMCLRP Rev. 4 Appendix G CISPR 25 (2002) Section 6.4; DC-I 1224 (Change A) Section 6.4; GMW3097 (2006) Section 3.3.2; ES-XW7T-IA278-AC (RE 310)	2 years	AEMCLRP Program artifact testing. System verification data (taken with a Reference Radiator) and chamber quiet sweeps may also be submitted when periodic checks are made in the time period between the 2 year intervals.	Data, equipment calibration records, and employee training records.	Sep 2008 ☒ Sep 2010 ☐
Transverse Electromagnetic Cell (TEM) 1 MHz to 200 MHz, up to 150 V/m AEMCLRP Rev. 4, Appendix J (DC); ISO 11452-3, DC-11224 *Removed from A2LA accreditation*	2 years	Internal performance data	Data, equipment calibration records, and employee training records.	Sep 2008 ☐
Absorber-Lined Shielded Enclosure (ALSE) AEMCLRP Rev. 4, Appendix K ISO 11452-2 (2004); Ford, GM, Chrysler DC-11224 (Change A), Sections 7.3 and 7.4	2 years	Internal performance data	Data, equipment calibration records, and employee training records.	Sep 2008 ☒ Sep 2010 ☐

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HAEFELY ESD TARGET VERIFICATION

8. ESD VOLTAGE VERIFICATION

8.1. Calibrate the display voltage of the simulator by adjusting the ESD simulator voltage to the desired level and polarity.

8.2. Using the electrometer specified in 4.8, verify the voltage setting of the simulator at voltage levels of ± 2 kV, ± 4 kV, ± 6 kV, ± 8 kV, ± 15 kV and ± 25 kV.

8.3. The readings shall be within ± 500 V for voltages less than ± 5 kV and ± 10 % for voltages greater than ± 5 kV.

Fig.8-1

Tbl.8-1

IDX	DISCHARGE NETWORK (example report table)	TEST VOLTAGE & TOLERANCE Temperature: 22 C, Humidity: 32%	POLARITY	READING
1.	150 pF & 2000 OHM (ISO-10605:2001)	e.g. 15 KV (+/- 10%)	+	14.8 KV
2.	150 pF & 2000 OHM (ISO-10605:2001)	e.g. 15 KV (+/- 10%)	-	14.8 KV
3.	330 pF & 2000 OHM (ISO-10605:2001)	e.g. 25 KV (+/- 10%)	+	26.5 KV
4.	330 pF & 2000 OHM (ISO-10605:2001)	e.g. 25 KV (+/- 10%)	-	26.5 KV
5.	150 pF & 330 OHM (Chrysler)			
6.	330 pF & 330 OHM (Chrysler)			

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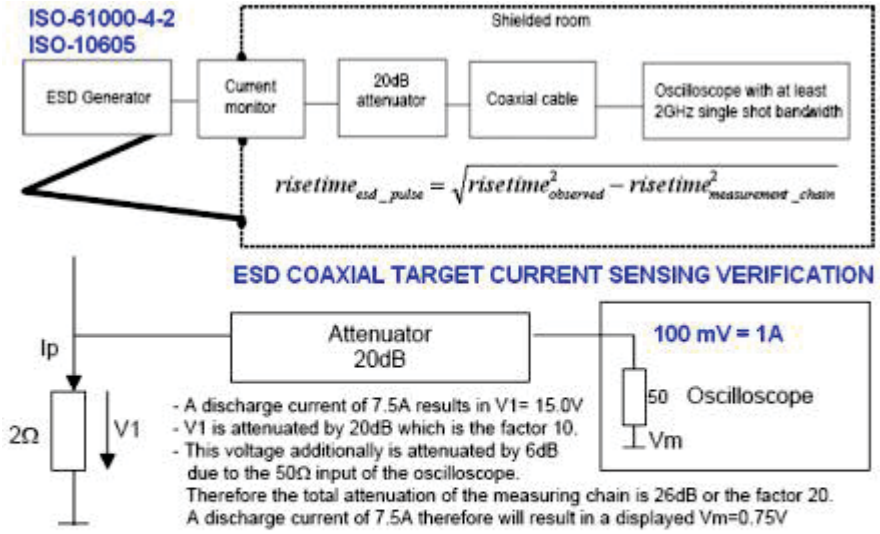
HAEFELY ESD TARGET VERIFICATION

9. ESD COAXIAL TARGET CURRENT SENSING VERIFICATION

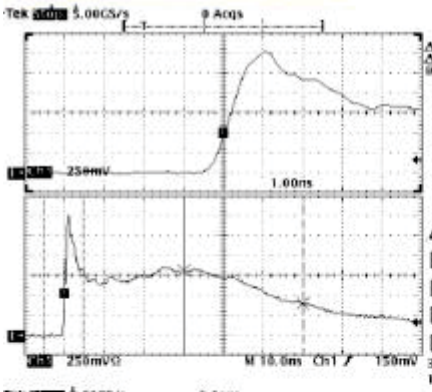
9.1.

Fig.9-1



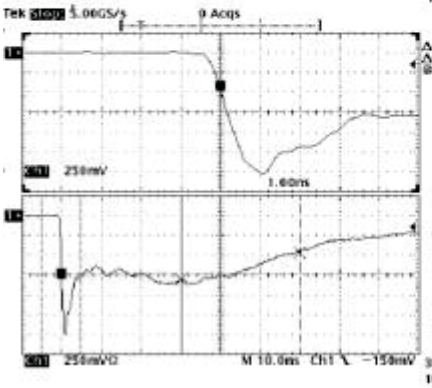
- oscilloscope single-shot sampling, at least 1GHz bandwidth
- low loss cable < 1m, double shielding
- target transfer function is ~1V/A when loaded by 50 Ohms
- attenuator 20dB is typically chosen for 10:1 ratio

Ip dependecies:
orientation to target (on axis > inangle)
ground cable position (loop closer to plane > natural loop)
approach speed
environmental factors



4000V positive, contact discharge

Rise time:	**700 to 1000 ps**	
First peak:	13,5 to 16,5 A	**(15 A)**
Duration 30 ns:	5,6 to 10,4 A	**(8 A)**
Duration 60 ns:	2,8 to 5,2 A	**(4 A)**



4000V negative, contact discharge

Rise time:	**700 to 1000 ps**	
First peak:	13,5 to 16,5 A	**(15 A)**
Duration 30 ns:	5,6 to 10,4 A	**(8 A)**
Duration 60 ns:	2,8 to 5,2 A	**(4 A)**

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10. SIMULATOR'S RESISTIVE-CAPACITIVE (RC) TIME CONSTANT VERIFICATION

10.1. Set the horizontal time base and vertical amplifier level of the measurement instrument to enable the complete ESD waveform to be viewed. Set the horizontal sweep to single-event trigger.

10.2. Verify the RC time constant of the ESD simulator, for both probes if both are used, at 15 kV (air discharge) only, at both positive and negative polarities.

10.3. Move the simulator to the target very slowly, i.e. at ~ 5 mm/s.

10.4. Review the waveform and analyze its key parameters per ISO-10605:2001:
a) RC time constant is (600 ± 130) ns for the 330 pF probe
b) RC time constant is (300 ± 60) ns for the 150 pF probe

10.5. Verify that the RC time constant is (600 ± 130) ns for the 330 pF probe.
Verify that the RC time constant is (300 ± 60) ns for the 150 pF probe

11. TEST SETUP

11.1. The vertical calibration plane with the coaxial current target is mounted in such a way that there is at least 0,6 m from the target to any edge of the plane.

11.2. The current target is mounted at the centre of the vertical calibration plane (reverberation chamber wall); .

11.3. The connection for the ESD generator return current cable (ground strap) is made at the bottom centre of the plane 0,5 m below the target (IEC 61000-4-2:2008).

11.4. The ground strap is pulled backwards at the middle of the cable, forming an isosceles triangle. It is not allowed to let the ground strap lay on the floor during calibration.

Fig.11-1

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HAEFELY ESD TARGET VERIFICATION

12. TEST PROCEDURE

12.1. Connect the target output to the oscilloscope using a 50 OHM shielded cable with high shielding integrity (e.g. double shielded) of less than 2 m in length.

12.2. Ensure the 50 OHM shielded cable is not looped and it is insulated from the ground plane.

12.3. The Faraday shielded enclosure used to separate the target from the oscilloscope is in our case the Reverberation Chamber.

12.4. Set the horizontal time base and vertical amplifier level of the oscilloscope to enable the rise-time of the ESD waveform to be viewed.

12.5. Set the horizontal sweep to single event trigger.

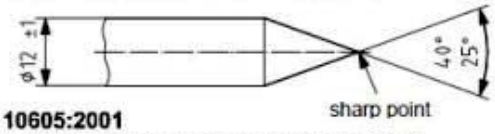
12.6. Connect the ESD simulator high-voltage ground directly to the Reverberation Chamber wall.

12.7. Set up the ESD simulator and turn it on in accordance with its instruction manual.

12.8. Perform test per ISO10605:2008 Table A.1 — Contact discharge verification procedure

12.9. Save each valid ESD waveform acquired via oscilloscope on floppy disk.

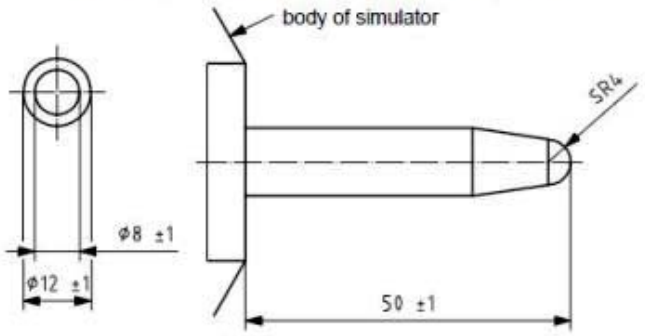
Fig.12-1 **Contact discharge mode electrode of the ESD generator**



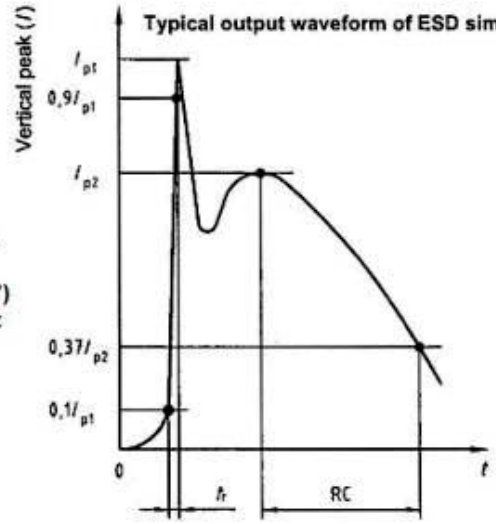
ISO 10605:2001
Direct contact discharge verification parameters

Level	Indicated voltage	First peak current	Risetime with discharge switch
	kV	A	ns
1	2 ± 0,5	7,5 $^{+2,25}_{0}$	
2	4 ± 0,5	15 $^{+4,5}_{0}$	0,7 to 1
3	6 ± 0,6	22,5 $^{+6,75}_{0}$	
4	8 ± 0,8	30 $^{+9}_{0}$	

Air discharge mode electrode of the ESD generator



Typical output waveform of ESD simulator



Air discharge

1) Place the ESD simulator a minimum of 15 mm from the coaxial target.

2) Hold the simulator with fingertip probe attached perpendicular (± 15°) to the target and move it very slowly, i.e. at ~ 5 mm/s towards the target until a single discharge is obtained.

3) Report only single event discharge waveforms.

4) The test voltages for air discharge risetimes are at ± 15 kV only.

5) Verify that the risetime is less than 5 ns.

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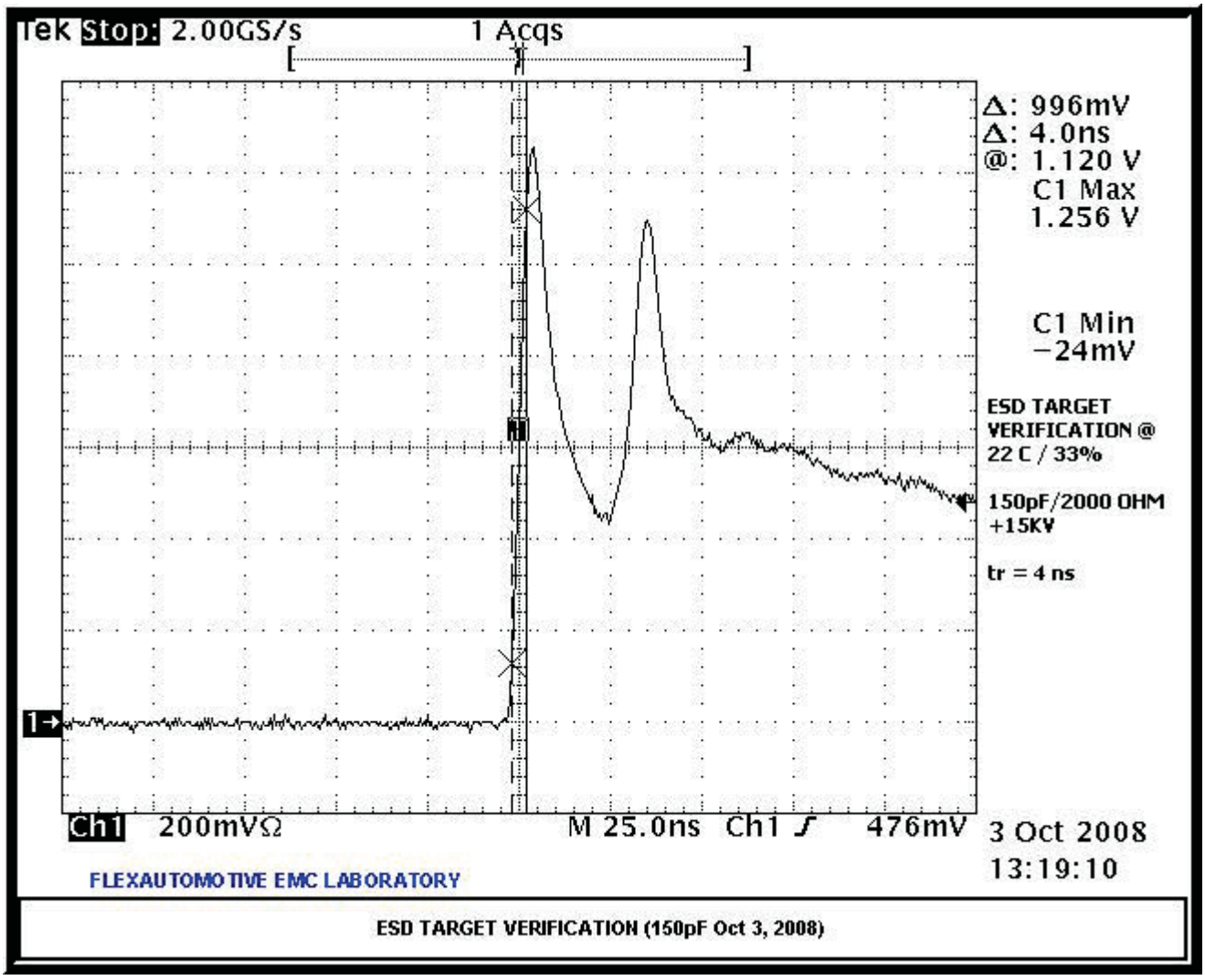
HAEFELY ESD TARGET VERIFICATION

13. TEST REPORT - RISE TIME

13.1. Per ISO10605:2008 Table A.1 — Contact discharge verification procedure.

13.2. Report the discharge network used, ESD voltage, temperature (23 ± 5) o C and humidity (between 30 % and 60 %).

Fig.13-1



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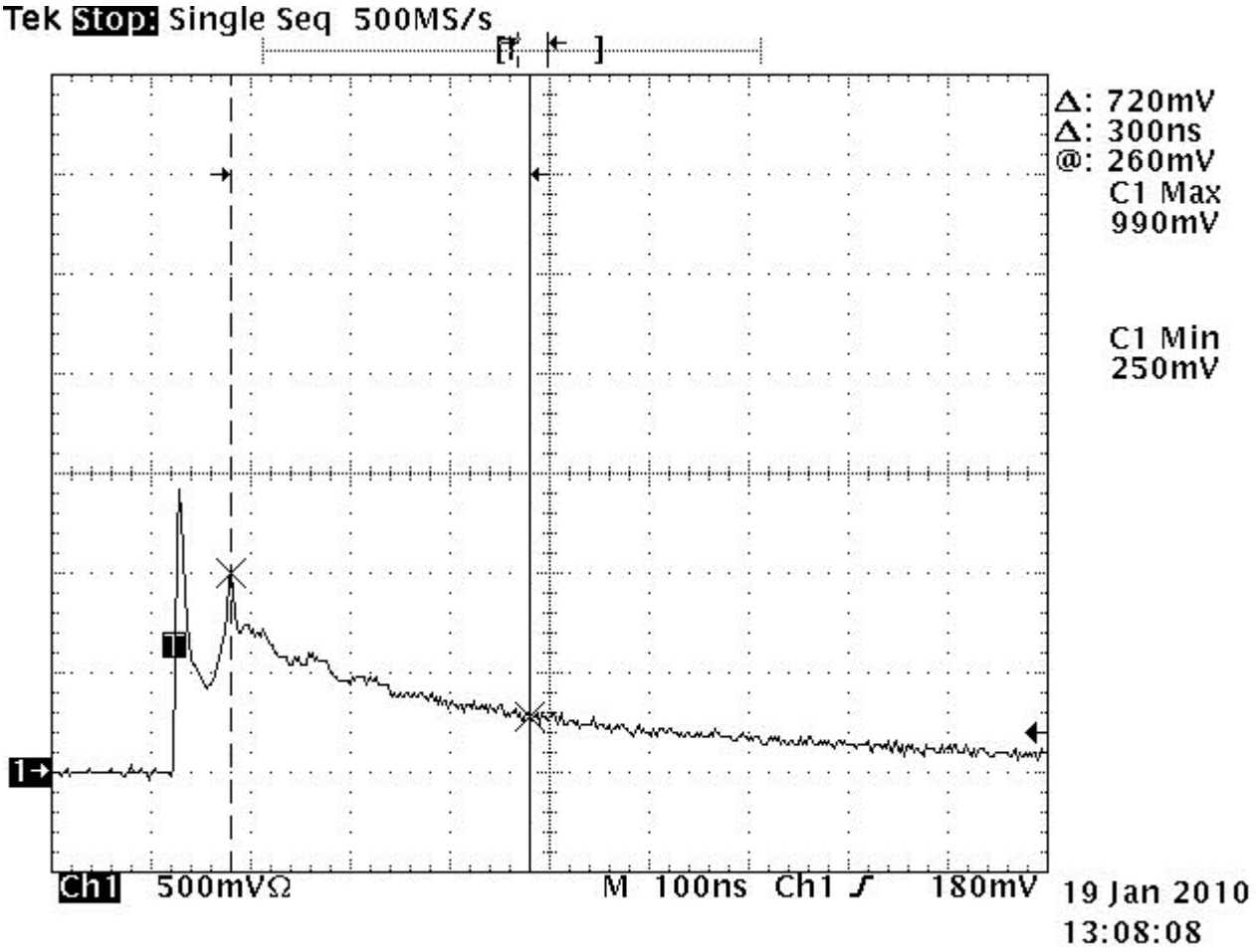
14. TEST REPORT - RC TIME CONSTANT PER ISO-10605:2001

14.1. See chapter 12 (Test procedure) for clarification on how to measure the RC time constant per ISO-10605:2001.

14.2. For each discharge network, test voltage, and polarity report the calculated RC time constant for both AEMCLRP and ISO-10605 methods. Use the same ESD target verification aquired plot whenever is possible.

Fig.14-1



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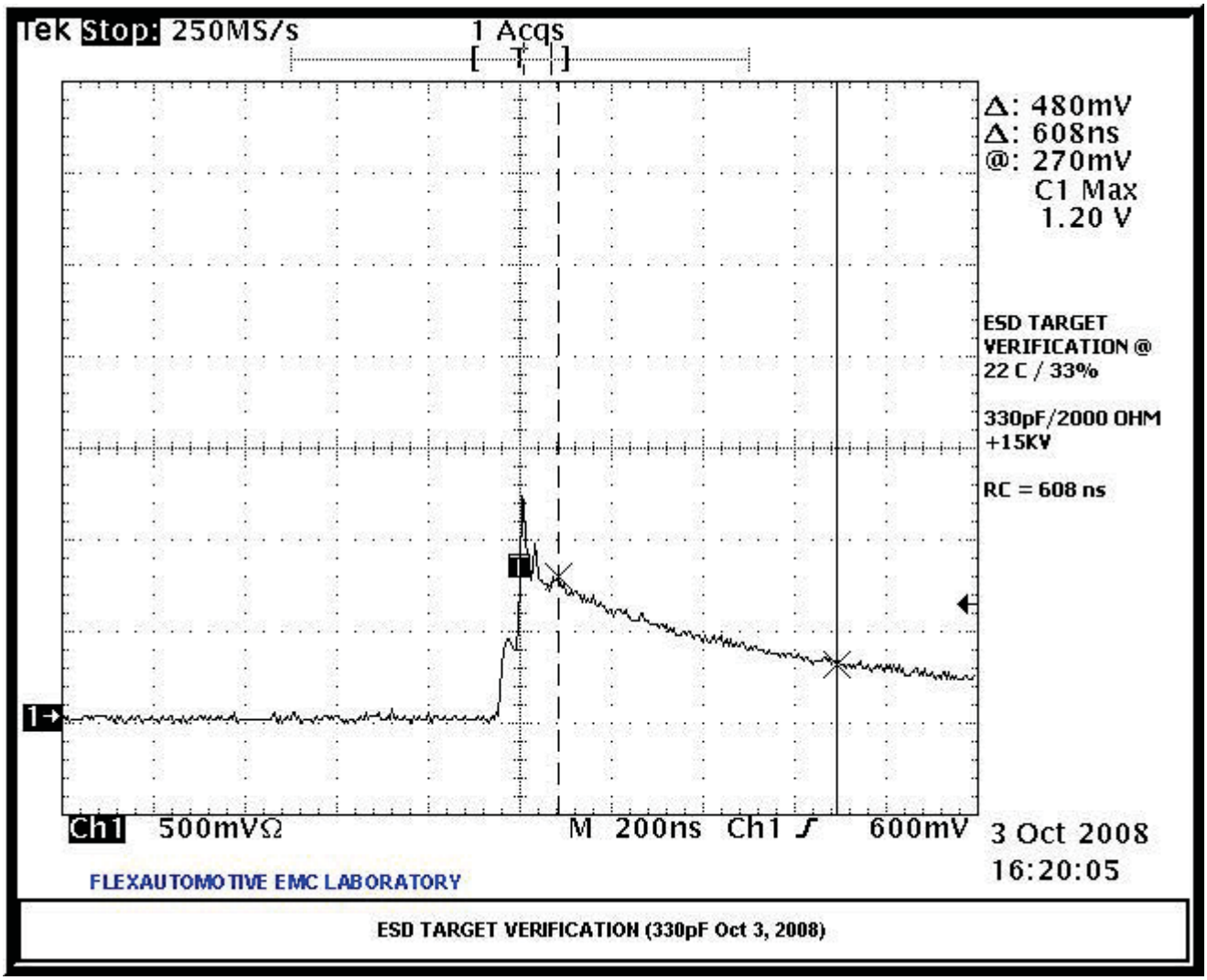
HAEFELY ESD TARGET VERIFICATION

15. TEST REPORT - RC TIME CONSTANT PER AEMCLRP

15.1. IMPORTANT: Per AEMCLRP "In determining the RC time constant, the RC time constant shall be calculated in the exponentially decaying portion of the waveform after the leading edge and/or ringing".

15.2. For each discharge network, test voltage, and polarity report the calculated RC time constant for both AEMCLRP and ISO-10605 methods. Use the same ESD target verification aquired plot whenever is possible.

Fig.15-1



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HAEFELY ESD TARGET VERIFICATION

16. DEFINITIONS

16.1. I_p = peak value of the discharge current [A] (IEC-6100-4-2:2008)

16.2. I_{30} = value of the current 30 ns after the peak current has reached 0,1 times I_p [A] (IEC-6100-4-2:2008); I_1 per ISO10605:2008

16.3. I_{60} = value of the current 60 ns after the peak current has reached 0,1 times I_p [A] (IEC-6100-4-2:2008); I_2 per ISO10605:2008

16.4. t_r = rise time of the current [ns] (from 0,1 I_{p1} to 0,9 I_{p1})

16.5. RC time constant = simulator's resistive-capacitive (RC) time constant (ISO10605:2001) (from I_{p2} to 0,37 I_{p2})

16.6. Vs = Simulator voltage

16.7. I_{p1} = First vertical peak

16.8. I_{p2} = Second vertical peak

REFERENCES

ISO 10605:2001	ED 1.2		
ISO 10605:2008	ED 2.0		
IEC 61000-4-2:2001	1-st Ed		
IEC 61000-4-2:2009	2-nd Ed		

REVISION CHANGES

Jan 15, 2010	A	RELEASE		
Jan 26, 2010	B	RC Time Constant measurement clarification per AEMCLRP	FLEXTRONICS AUTOMOTIVE	Digitally signed by Christian Rosu DN: cn=Christian Rosu, o=FLEXTRONICS AUTOMOTIVE INC., ou, email=christian.rosu@ca.flextronics.com, c=US Date: 2012.12.30 19:30:51 -05'00'

END-USER FEEDBACK

very satisfied | satisfied | neutral | dissatisfied | very dissatisfied

Please rate your overall satisfaction with this LMS document and input your suggestions or comments.
Your opinion is very important for us.

Survey Date

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