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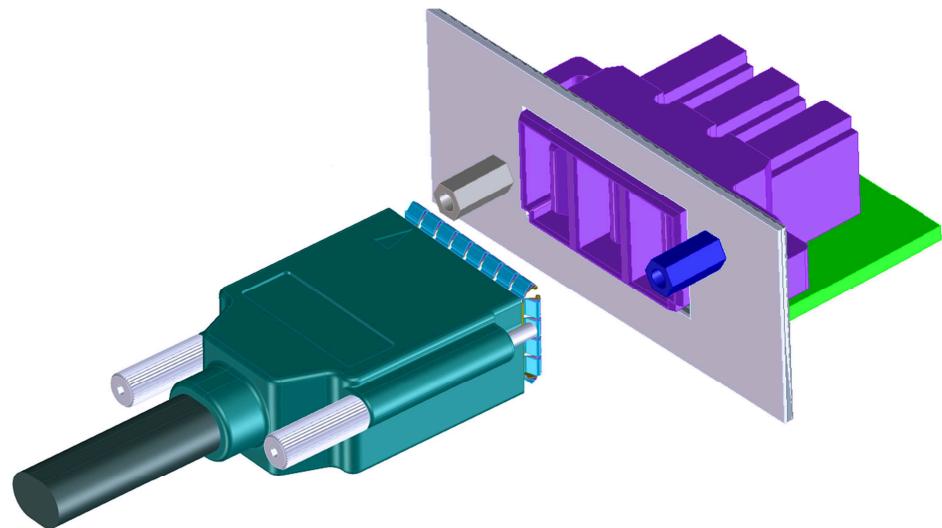
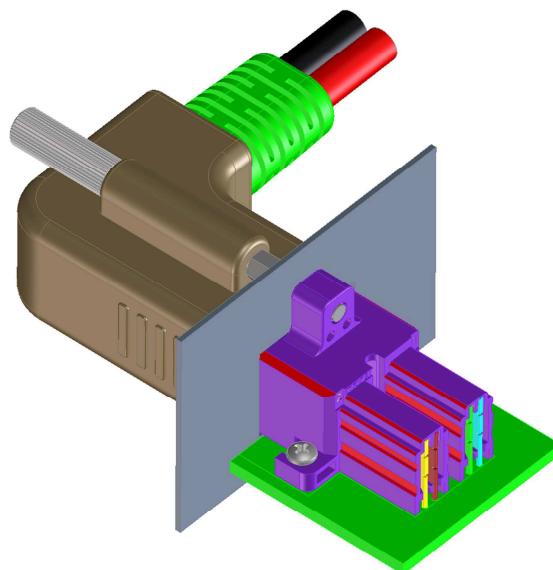
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PRODUCT SPECIFICATION

GUARDIAN CONNECTOR SYSTEM



REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 1 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL



PRODUCT SPECIFICATION

TABLE OF CONTENTS :

1.0 SCOPE

2.0 SUMMARY OF RESULTS

3.0 DOCUMENTS & SPECIFICATIONS

- 3.1 Testing Procedure & Sequences
- 3.2 Other Documents

4.0 MECHANICAL PERFORMANCE

- 4.1 Component Level
- 4.2 Free Hanging Load Test

5.0 ELECTRICAL REQUIREMENTS

- 5.1 Crimp Stress Test-Millivolt Drop
- 5.1.1 Crimp Stress Acceptance Criteria
- 5.2 Electrical Performance and Rating
- 5.3 Temperature Rise Current Charts

6.0 TEST PLAN, ENVIRONMENTAL TEST PER EIA-364-1000.01

7.0 TEST RESULTS, ENVIRONMENTAL TESTING

8.0 SOLDER PROFILE

9.0 SAFETY AGENCY RATING APPROVAL

- 9.1 C.S.A. File Number – LR 19980
- 9.2 U.L. File Number – E29179

REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 2 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL



PRODUCT SPECIFICATION

1.0 SCOPE

The specification covers the test sequence performance of the high current wire-to-board interconnect system:

2.0 SUMMARY OF RESULTS

The product meets all the Mechanical, Electrical and Environmental test criteria at component and harness level, and is considered a qualified product.

3.0 DOCUMENTS AND SPECIFICATIONS

3.1 Testing Procedure & Sequences:

Item	Test Report	Test Description
1	TR-1.8582	Qualification Test Per EIA-364-1000 Group 1,2,3, & 5
2	TR-1.8583	Electrical Crimp Qualification of 8 & 10 AWG
3	TR-1.8584	Construction analysis
4	TR-1.8733	Harness Pull Force and Torque Retention Test, in mated condition
5	TR-1.8570	T-Rise Test per EIA-364B
6	TR-1.8595	Normal Force Analysis
7	63801-7900	Mech. Crimp Qualification
8		EIA-364-1000 Group 4 Mixed Flowing Gases
9	TR-1.8931	Hot-mating/Resistance to Arc

3.2 Other Documents:

See series specific sales drawings for additional information.

HEADER	2 CKT	46817 SERIES
	3 CKT	46817 SERIES
HARNESS	2 CKT	68790 SERIES
	3 CKT	111119 SERIES

Ref. terminal in harness - 46819-****

REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 3 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL
TEMPLATE FILENAME: PRODUCT_SPEC[SIZE_A](V.1).DOC			



PRODUCT SPECIFICATION

4.0 MECHANICAL PERFORMANCE

4.1 MECHANICAL PERFORMANCE AT COMPONENT LEVEL

EQUIPMENT/FIXTURE	TEST DESCRIPTION	TEST RESULT							
Force Gauge	Terminal Retention to the Housing (Header) per EIA-364-29	Avg.(3 CKT)				13.83 N			
		St. Dev.				0.56			
Solder Pot	Solderability Test (Header) per EIA-364-52	Meets 95% min Coverage							
X-Ray Fluoroscope	Plating Verification (Plug & Crimp Terminal)	Meets Specification							
Instron	Normal Force per EIA-364-04, Method	3.90 g (Avg)/Beam @ 0.45 mm deflection							
Instron	Insertion/Withdrawal Force per EIA-364-13	1 st Cycle	Insertion Force (Newtons)			Withdrawal Force (Newtons)			
			1 ckt	2 ckt	3 ckt	1 ckt	2 ckt		
		Min	7.23	11.27	26.71	6.86	10.31		
		Max	9.23	19.11	36.60	8.53	19.12		
		Avg	7.92	15.60	31.06	7.36	15.87		
		Std Dev	0.68	3.15	3.70	0.68	3.85		
Force Gauge	Crimp Terminal Retention to Housing	N/A Overmold							
*On 3 ckt configuration, 1 of the ckts is ground (pre-mate) Above forces are peak force.									
Force Gauge	Crimp Terminal to Wire Pull Force (lbs)			6 AWG		8 AWG	10 AWG		
		Avg (lbs)		315		302	216		
		Std Dev		11.17		5.06	4.45		
		Failure Mode		Wire Pull-out	Wire Break	Wire Break	Wire Break		

REVISION:	ECR/ECN INFORMATION:	TITLE:	Guardian Wire to Board Interconnect System	SHEET No.
C4	EC No: UCP2013-5363 DATE: 2013/06/12			4 of 19
DOCUMENT NUMBER:		CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
PS-46819-001		J.QUILES	J.SCHAFER	A.PATEL



PRODUCT SPECIFICATION

4.2 MECHANICAL TEST: FREE HANGING LOAD TEST (MATED CONDITION - 2.5 M CABLE)

EQUIPMENT/FIXTURE	TEST DESCRIPTION	TEST RESULT
Rigid Fixture	100 Newtons Weight Straight Inline Loading For 60 Seconds (See Figure 1)	Visually Inspected No Damage
Rigid Fixture	200 Newtons Weight at 90 degrees Loading For 60 Seconds (Both North-South and East-West directions – see Figure 2)	Visually Inspected No Damage
Rigid Fixture	150 Newtons Weight 45 degrees loading For 60 Seconds (See Figure 3)	Visually Inspected No Damage

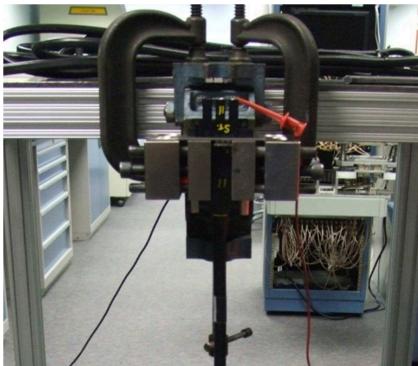


Fig. 1



Fig. 2



Fig. 3

5.0 ELECTRICAL REQUIREMENTS

5.1 CRIMP STRESS TEST-MILLIVOLT DROP

CRIMP WIRE SIZE	TEST DESCRIPTION	SAMPLE SIZE	Δ RESULT
8 AWG	<ul style="list-style-type: none"> Initial Voltage Drop Thermal Shock Vibration Accelerated Aging Final Voltage Drop End Testing <p>Applied 10 Amps See Figure 4 & 5 for test setup and measurements</p>	Qty 75 Nominal Crimp Height (Grp A)	0.30 Millivolts $\sigma = 0.053$
		Qty 30 Upper Crimp Height (Grp. B)	0.20 Millivolts $\sigma = 0.045$
		Qty 30 Lower Crimp Height (Grp C)	0.45 Millivolts $\sigma = 0.101$

REVISION: C4	ECR/ECN INFORMATION: EC No: UCP2013-5363 DATE: 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 5 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL
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PRODUCT SPECIFICATION

10 AWG	<ul style="list-style-type: none"> Initial Voltage Drop Thermal Shock Vibration Accelerated Aging Final Voltage Drop End Testing <p>Applied 10 Amps See Figures 4 & 5 for test set-up and measurements</p>	Qty 75 Nominal Crimp Height. (Grp A)	0.66 Millivolts $\sigma = 0.118$
		Qty 30 Upper Crimp Height (Grp. B)	0.76 Millivolts $\sigma = 0.177$
		Qty 30 Lower Crimp Height (Grp C)	0.56 Millivolts $\sigma = 0.120$

* *Acceptance criteria appears on page 4 of this specification*

5.1.1 CRIMP STRESS ACCEPTANCE CRITERIA

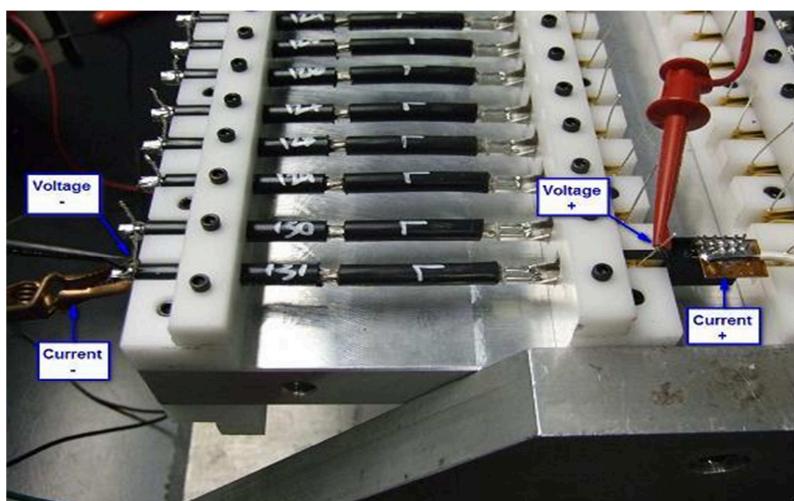
Δ = Change in Millivolts after test sequence
 σ = Standard Deviation

Requirements to pass 8 AWG wire:

Δ = Average Change + 5.46 σ \leq 1.33 Millivolt (Group A)
 Δ = Average Change + 4.21 σ \leq 1.33 Millivolt (Group B & C)

Requirements to pass 10 AWG wire:

Δ = Average Change + 5.46 σ \leq 1.68 Millivolt (Group A)
 Δ = Average Change + 4.21 σ \leq 1.68 Millivolt (Group B & C)



Test Set-up

Fig. 4

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 6 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION

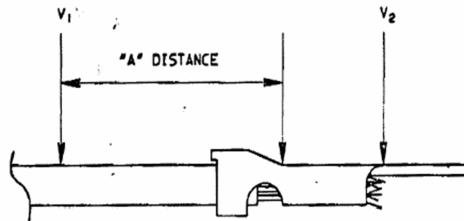


Fig. 5
 Voltage Drop

The specimen wire gauge used for testing was 10 AWG. The specimen was powered at 10 amps. Voltage drop measurements were taken after 30 seconds across individual circuits at the applied current. The maximum allowable distance 'A' between the voltage probes was 100 mm. The open circuit voltage may not exceed 0.05 volts. Instrumentation shall be such that the measured value is accurate to +/- 5%.

5.2 ELECTRICAL PERFORMANCE & RATING:

5.2.1 VOLTAGE:

Voltage: 600 V Max.

Connector Rating per UL-1977

Connector voltage rating meets the connector approval level defined by UL 1977, Sect. 11 for spacing's per table 11.1. Example: 1.2 mm for \geq 250 volt, 3.2 mm for \leq 250 volt.

Exception taken for spacing less than those specified are permitted if the device complies with the requirements in the dielectric voltage withstanding test per Sect. 17.

Application Voltage Guideline

For application voltage requirements per UL-60950 or other standards, the creepage & clearance also needs to be determined based upon pads/traces on the pcb. For example, per UL-60950-1 (Table 2N) (UL/ANSI Standard-Safety for Information Technology Equipment Requirements) below are the minimum creepage distances required:

REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 7 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL



PRODUCT SPECIFICATION

RMS Working Voltages Up to & Including: (V)	POLLUTION DEGREE 2			
	MATERIAL GROUP			
	PRINTED CIRCUIT BOARDS	OTHER MATERIALS		
		I (mm)	II (mm)	IIIa, IIIb (mm)
50	.04	0.6	0.85	1.2
125	.25	0.75	1.05	1.5
250	1.0	1.25	1.8	2.5
320	1.6	1.6	2.2	3.2
630	3.2	3.2	4.5	6.3

- *Pollution degree 2 is a typical environment for electrical connectors.
- **Material Group depends on the comparative tracking index (CTI) and is classified as follows:

Material Group I $CTI \geq 600$
 Material Group II $400 \leq CTI < 600$
 Material Group IIIA $175 \leq CTI < 400$
 Material Group IIIB $100 \leq CTI < 175$

5.2.2 OPERATING TEMPERATURE

Operating temperature (including T-rise from applied current) is -40°C to $+105^{\circ}\text{C}$.

Field temperatures and field life: Tested per EIA-364-1000.01 (see pg 14) to meet field temperature of 65°C for 10 years or 85°C for 3 years per Tables 8 & 9 application guideline.

5.2.3 CURRENT: (See Item #4)

Current rating is application dependent. The ratings listed in the chart are per EIA364-70 and should be used as a guideline only. Appropriate de-rating is required per ckt size, ambient conditions, copper trace size on the PCB, gross heating from adjacent modules or components, and other factors that influence connector performance. Wire size and stranding, tin coated or bare copper, wire length & crimp quality are other factors that influence current rating

5.2.4 DURABILITY WITH ENVIRONMENT:

25 cycles on EIA 364-1000.01 Group 4 Test sequence.

REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 8 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL

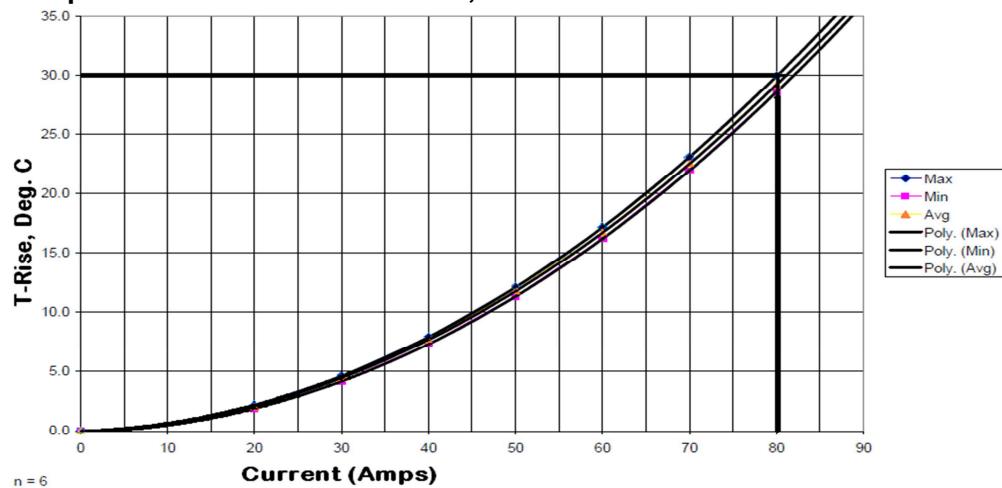


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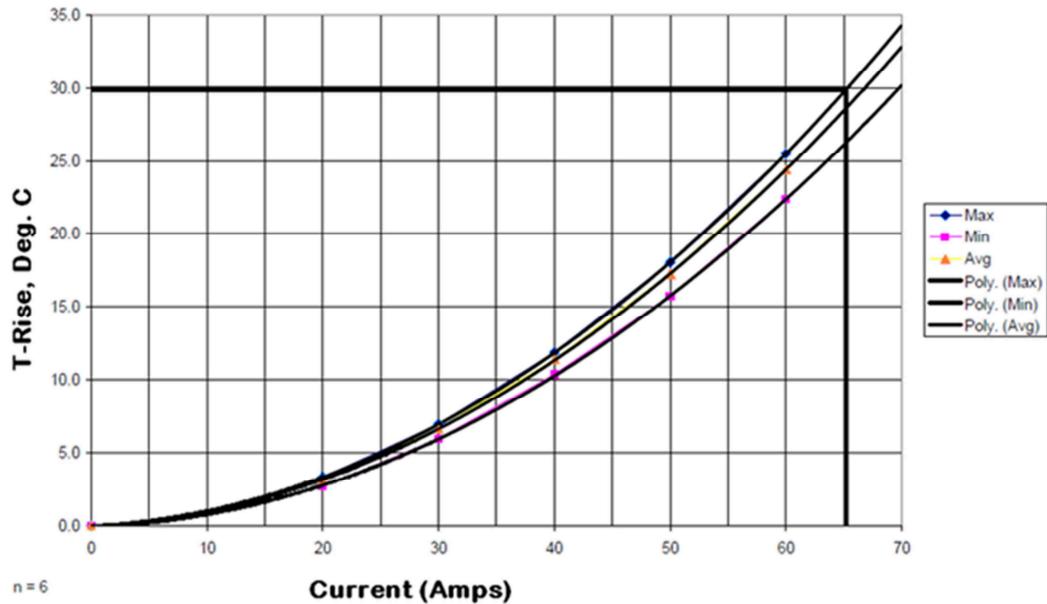
5.3 TEMPERATURE RISE & VOLTAGE DROP CHARTS

5.3.1 EPIC, 1-Circuit, 6 AWG Wire, 0.050" Cu T-Rise Current Chart

*Extrapolation based on 1-2 ckt test, no test data available



5.3.2 EPIC, 1-circuit, 8 AWG Wire, 0.032" Cu T-Rise Current Chart

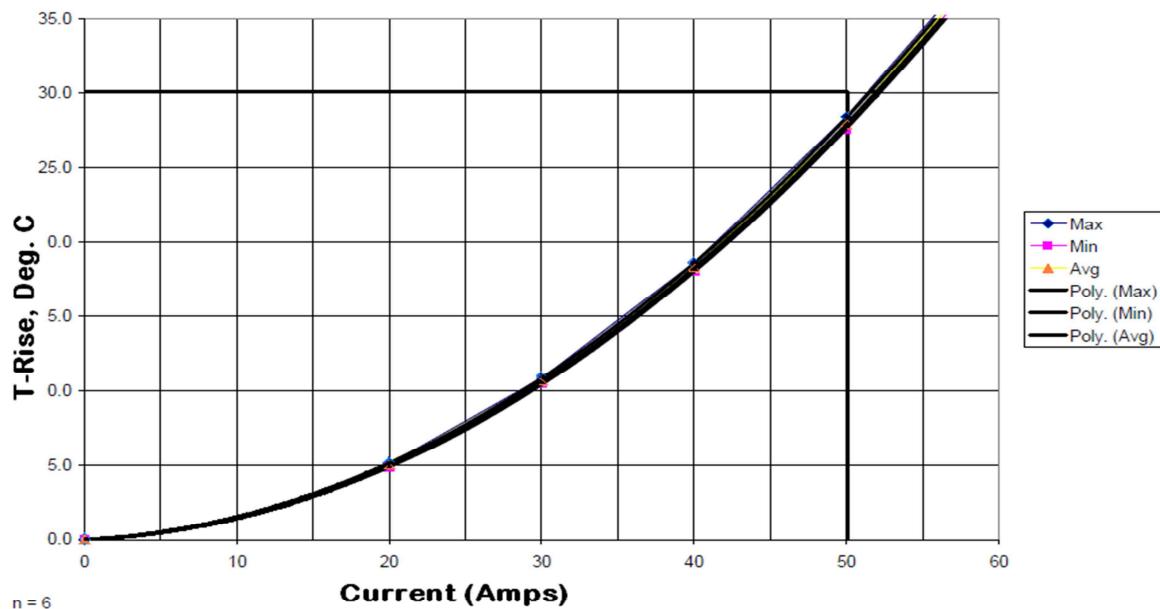


REVISION: C4	ECR/ECN INFORMATION: <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	TITLE: Guardian Wire to Board Interconnect System	SHEET No. 9 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL



PRODUCT SPECIFICATION

5.3.3 EPIC, 1-circuit, 10 AWG Wire, 0.026" Cu T-Rise Current Chart



REVISION: C4	ECR/ECN INFORMATION: EC No: UCP2013-5363 DATE: 2013/06/12	TITLE: Guardian Wire to Board Interconnect System		SHEET No. 10 of 19
DOCUMENT NUMBER: PS-46819-001	CREATED / REVISED BY: J.QUILES	CHECKED BY: J.SCHAFER	APPROVED BY: A.PATEL	



PRODUCT SPECIFICATION

5.3.4 EPIC, 2-Circuit, 8 AWG Wire, 0.032" Cu Voltage Drop vs. Current

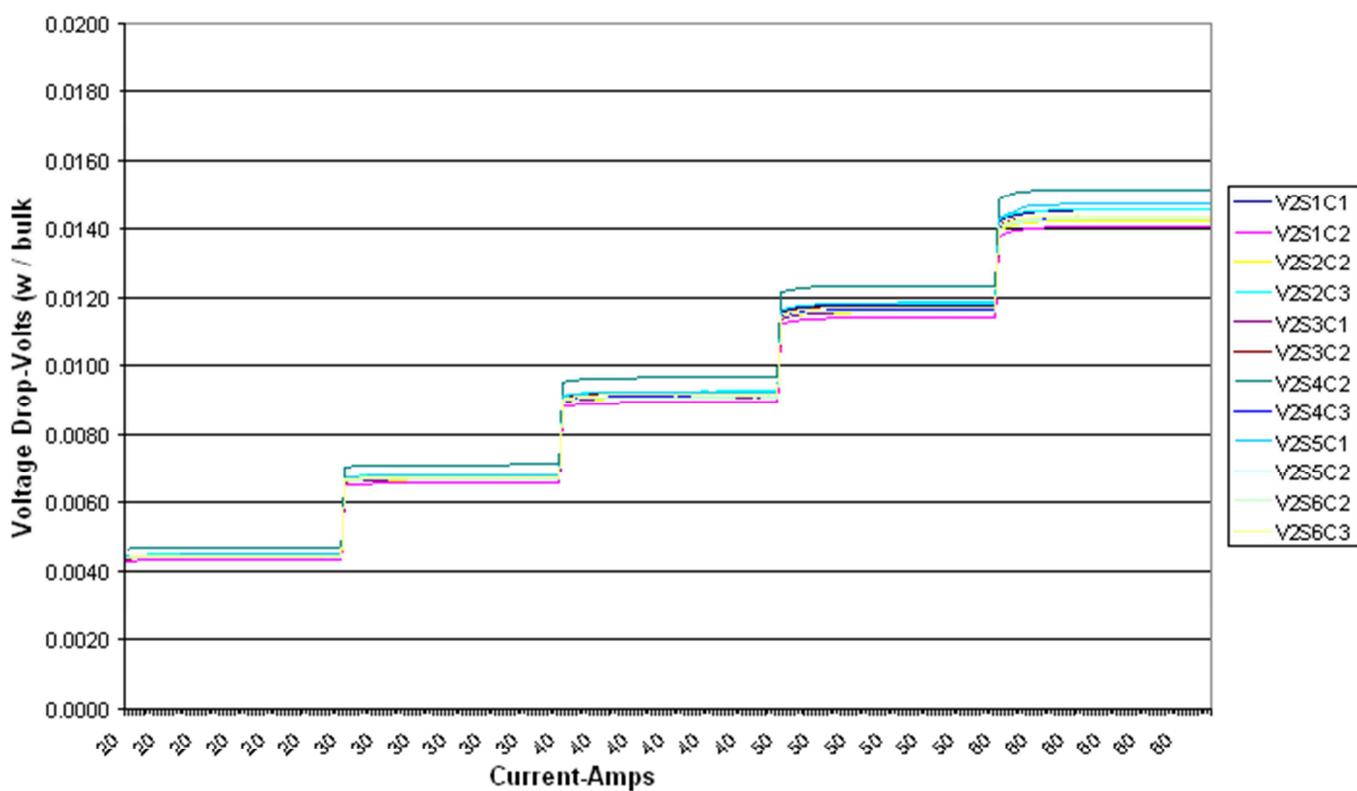


Fig. 6

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 11 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



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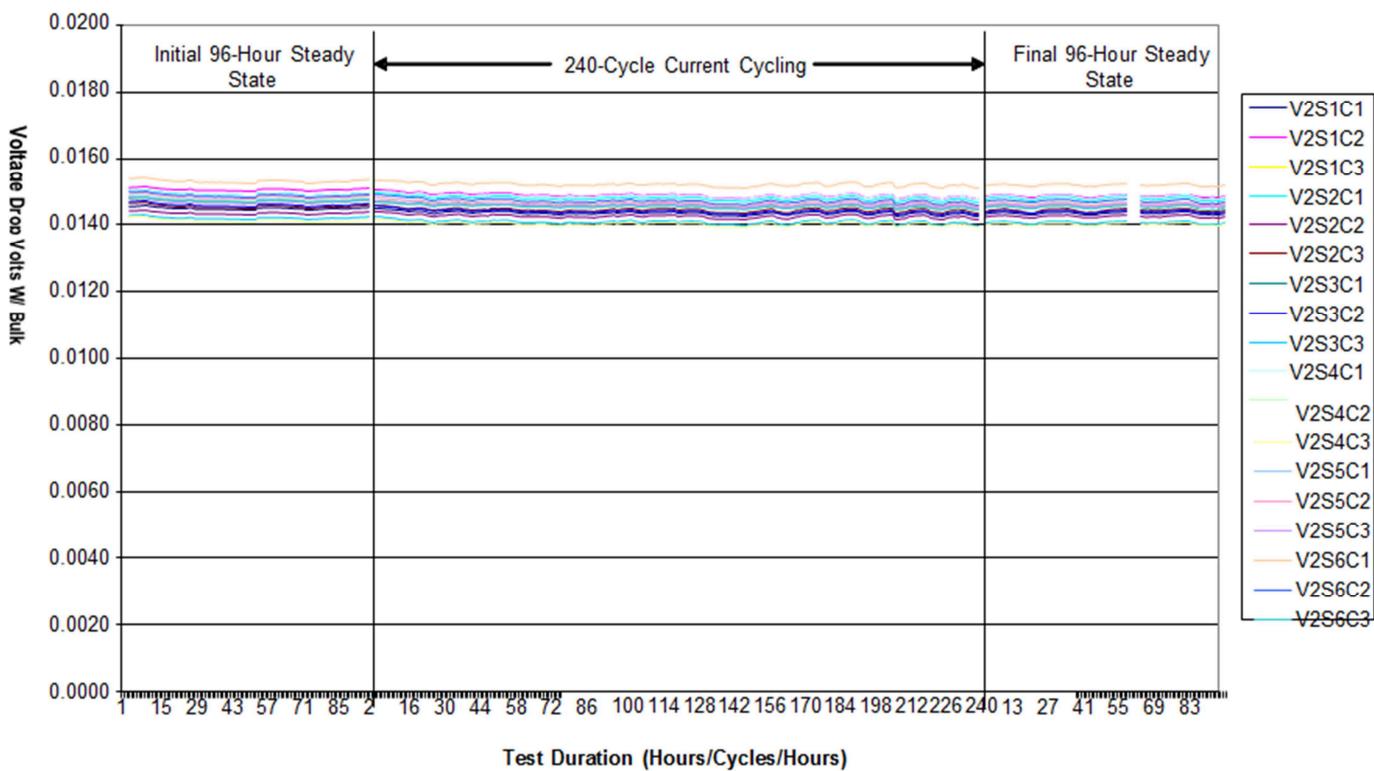


Fig. 7

NOTE: Current Cycle Duration is 1 hour (45 minutes on and 15 minutes off)

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 12 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION

6.0 TEST PLAN, ENVIRONMENTAL TEST PER EIA-364-1000.01 – Table 8

Group I Temperature Life (30 contacts)	Group II Thermal Shock (30 contacts)	Group III Vibration (30 contacts)	Group IV Flowing Mixed Gas (402 contacts)	Group V Thermal Cycling (30 contacts)
Initial Contact Resistance EIA-364-23	Initial Contact Resistance EIA-364-23	Initial Contact Resistance EIA-364-23	Initial Contact Resistance EIA-364-23	Initial Contact Resistance EIA-364-23
Durability 5 cycles EIA-364-09	Durability 5 cycles EIA-364-09	Durability 5 cycles EIA-364-09	Durability 5 cycles EIA-364-09	Durability 5 cycles EIA-364-09
Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance
Temperature Life 105°C, 240 hours 10 Yrs @ 65°C EIA-364-17	Thermal Shock 10 cycles -55°C and +85°C EIA-364-32	Temperature Life 105°C, 120 hours 10 Yrs @ 65°C EIA-364-17	Temperature Life 105°C, 120 hours 10 Yrs @ 65°C EIA-364-17	Temperature Life 105°C, 120 hours 10 Yrs @ 65°C EIA-364-17
Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance
Reseating 3 cycles	Cyclic Temperature and Humidity EIA-364-31	Random Vibration EIA-364-28 Condition VIID	Flowing Mixed Gas 10 days unmated EIA-364-65	Thermal Cycling EIA-364-1000.01
Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance	Contact Resistance
	Reseating 3 cycles		Flowing Mixed Gas 4 days mated EIA-364-65	Reseating 3 cycles
	Contact Resistance		Contact Resistance	Contact Resistance
			Thermal Disturbance EIA-364-1000.01	Thermal Disturbance EIA-364-1000.01
			Contact Resistance	Contact Resistance
			Reseating 3 cycles	Reseating 3 cycles
			Contact Resistance	Contact Resistance

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 13 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION

7.0 TEST RESULTS, ENVIRONMENTAL TESTING – Table 9

EIA-364-TS-1000 - Group 1 Testing				
	Initial mΩ	Durability 5X ΔmΩ	T. Life ΔmΩ	Reseating 3X ΔmΩ
Min	0.387	-0.010	0.001	0.002
Max	0.649	0.008	0.024	0.032
Avg	0.506	0.000	0.014	0.018
St. Dev.	0.081	0.004	0.006	0.007
n	36	36	36	36

EIA-364-TS-1000 - Group 2 Testing				
	Initial mΩ	Durability 5X ΔmΩ	T. Shock ΔmΩ	C. Humidity ΔmΩ
Min	0.419	-0.054	-0.056	-0.050
Max	0.681	0.155	0.163	0.156
Avg	0.490	0.012	0.017	0.020
St. Dev.	0.066	0.046	0.047	0.045
n	36	36	36	36

EIA-364-TS-1000 - Group 3 Testing				
	Initial mΩ	Durability 5X ΔmΩ	T. Life ΔmΩ	Random Vibration ΔmΩ
Min	0.374	-0.007	0.004	-0.010
Max	0.651	0.013	0.028	0.041
Avg	0.524	0.001	0.017	0.009
St. Dev.	0.073	0.004	0.005	0.011
n	36	36	36	36

EIA-364-TS-1000 - Group 5 Testing					
	Initial mΩ	Durability 5X ΔmΩ	T. Life ΔmΩ	Thermal Cycling ΔmΩ	Reseating 3X ΔmΩ
Min	0.343	-0.006	0.007	-0.001	0.004
Max	0.672	0.009	0.043	0.041	0.038
Avg	0.504	0.000	0.019	0.010	0.019
St. Dev.	0.093	0.003	0.007	0.008	0.010
n	36	36	36	36	36

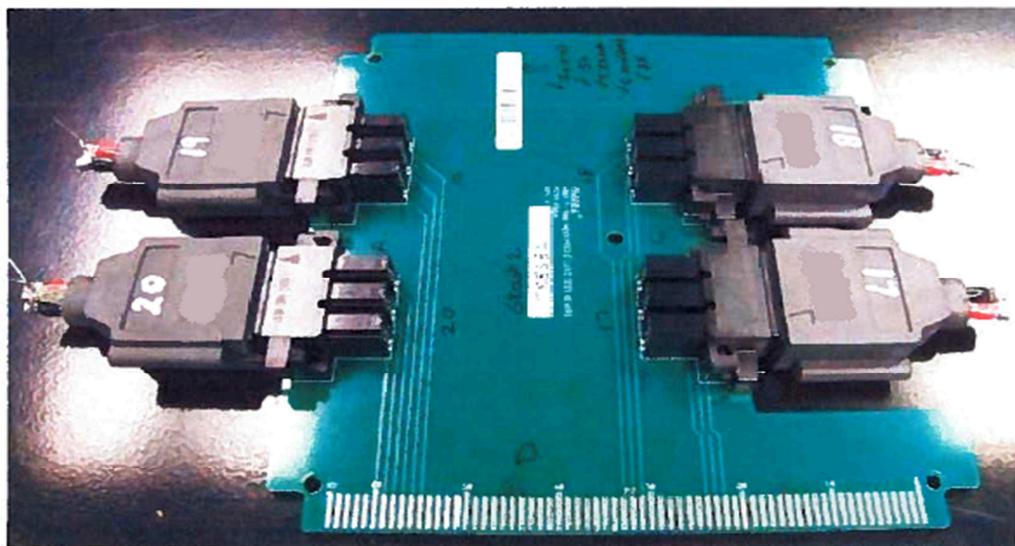
* Note: resistance includes bulk, interface and crimp. Above resistance data includes 0.24 milliohms for Power and 0.29 milliohms for ground from wire length 7 test set-up. See sample preparation detail on page 10 of this specification.

** Applied current <1.0 Amp for LLCR

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 14 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION



Test Set-up for EIA-364-1000.01
Sequences 1, 2, 3 & 5

Fig. 10

SAMPLE PREPARATION

The headers were wave soldered onto the PC boards and cleaned in the parts washer. The plugs were common bussed so LLCR measurements could be made. Due to sample preparation there is some added bulk resistance added in the measurements. There is approximately 1.75 inches of 8 AWG for the power contacts and 1.75 inches of 10 AWG wire for the ground contacts. This contributes ~0.09 milliohms of bulk resistance to the power contact measures and ~0.144 milliohms to the ground measures. The measurement leads (pigtail) also add up to 0.15 milliohms of additional bulk for a total of around 0.24 milliohms power, and 0.29 milliohms ground (See Figure 10).

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 15 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION

EIA-364-1000 Test Group 4

Description: 3 circuit board mount plug and cable receptacle

Reference Information

Environmental Test Methodology...

EIA-364-1000 (Test Group 4)

Contact Reliability

Cell	Description	Conditions	Duration	Order	Samples
1	LLCR	4-wire, dry circuit, 20 mV max		1	1-134
	Durability (pre-conditioning)	mate / unmate	5 cycles	2	all
2	LLCR	4-wire, dry circuit, 20 mV max		3	all
	Temperature Life (pre-conditioning)	105C	120 hours	4	all
3	LLCR	4-wire, dry circuit, 20 mV max		5	all
	MFG Exposure	Unmated (board mount plugs only)	10 days	6	all
4	LLCR	4-wire, dry circuit, 20 mV max		7	all
	MFG Exposure	Mated	4 days	8	all
5	LLCR	4-wire, dry circuit, 20 mV max			
	Disturbance (ATC)	15C / 85C	10 cycles	9	all
6	LLCR	4-wire, dry circuit, 20 mV max		10	all
	Reseat **	mate / unmate	3 cycles	11	all
7	LLCR **	4-wire, dry circuit, 20 mV max		12	all

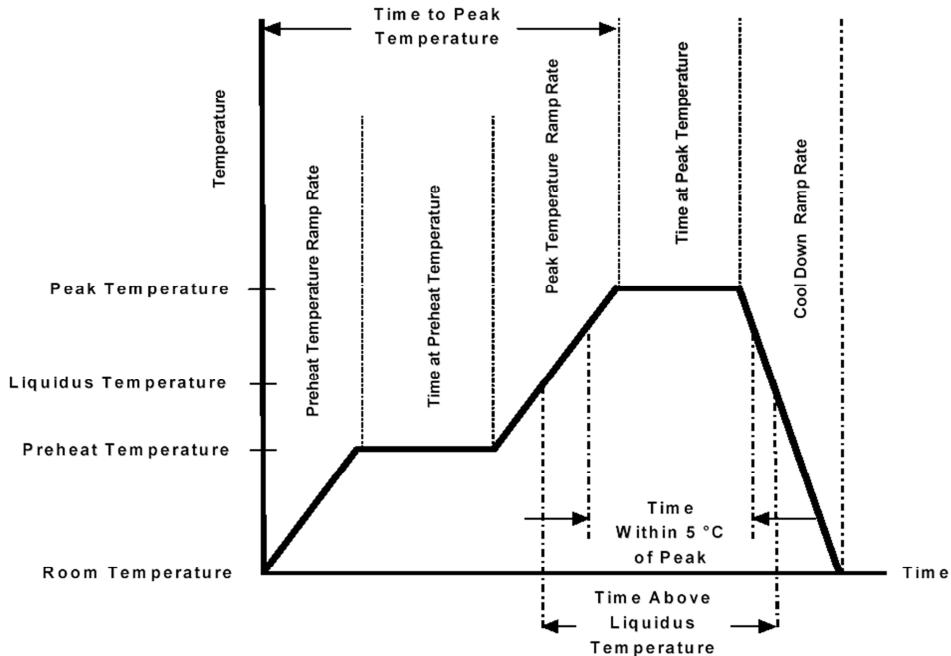
<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 16 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL
<small>TEMPLATE FILENAME: PRODUCT_SPEC(SIZE_A)(V.1).DOC</small>			



PRODUCT SPECIFICATION

8.0 SOLDERING PROFILE

(This profile is per JEDEC J-STD-020D.1 and it is for guide line only; please see notes for additional information)



Description	Requirement
Average Ramp Rate	3°C/sec Max
Preheat Temperature	150°C Min to 200°C Max
Preheat Time	60 to 180 sec
Ramp to Peak	3°C/sec Max
Time over Liquids (217°C)	60 to 150 sec
Peak Temperature	260 +0/-5°C
Time within 5°C of Peak	20 to 40 sec
Ramp - Cool Down	6°C/sec Max
Time 25°C to Peak	8 min Max

Note:

1. Temperature indicated refers to the PCB surface temperature at solder tail area.

THIS PRODUCT IS NOT DESIGNED FOR IR REFLOW PROCESS

<u>REVISION:</u> C4	<u>ECR/ECN INFORMATION:</u> <u>EC No:</u> UCP2013-5363 <u>DATE:</u> 2013/06/12	<u>TITLE:</u> Guardian Wire to Board Interconnect System	<u>SHEET No.</u> 17 of 19
<u>DOCUMENT NUMBER:</u> PS-46819-001	<u>CREATED / REVISED BY:</u> J.QUILES	<u>CHECKED BY:</u> J.SCHAFER	<u>APPROVED BY:</u> A.PATEL



PRODUCT SPECIFICATION

9.0 SAFETY AGENCY RATING APPROVAL:

Covers product series 46817, 46818, 170351

9.1



File Number*: LR-19980

Single Ckt.	Current	Voltage
6 AWG	80 Amps	600 VDC
8 AWG	60 Amps	600 VDC

CSA approval meets following standards/test procedures:

- a) CSA std. C22.2 No. 182.3
- b) UL-1977
- - "C" and "US" mark adjacent to CSA signifies that the product has been evaluated to the applicable CSA and ANSI/UL standards, for use in Canada and US respectively.

9.2 U.L. File No. E29179 Rev. 2012-09-24 Volume 10, Sec. 18, Page 1

AWG	Voltage (V)	Current (I)
6	600 AC	80 Amps
8	600 AC	65 Amps
10	600 AC	50 Amps

Flammability – V-0

Note: Approval is at the component level.

9.2.1 Hot-Plug / Overload:

250 Volt AC @ 80 Amps tested to 25 cycles.

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PRODUCT SPECIFICATION

9.2.2 HOT-MATE/RESISTANCE TO ARC RATING SYSTEM:

Tested 8 AWG 350 VDC @ 12 Amp. Conducted 50 cycle followed by T-rise max, T-rise is 30°C.

ITEM	TEST DESCRIPTION		RESULT				
1	Initial Contact Resistance (Low Level)	6 AWG	See Table 9				
		8 AWG					
		10 AWG					
2	Dielectric Withstanding for 60 sec. @ 5mAmp max. per EIA-364-52	1,700 VAC	Pass				
3	Insulation Resistance for 60 sec. @ 500 VDC	1,000 MegOhms	Pass				
4	Current carrying Capability @ 30 degree T-Rise Per EIA-70			1 Ckt (Amps)	2 Ckt (Amps)	3 Ckt (Amps)	4-6Ckt * (Amps)
			6 AWG	80	77	73	63
			8 AWG	65	62	58	50
			10 AWG	50	48	44	35
5	Reliability Test for 6 AWG @ 30 degree T-Rise Max (3ckt Power)	70 Amps for 4 days, current cycle for 10 days, 70 amps for 4 additional days	Stable for entire test duration (See 5.3.5 - Fig 7)				
6	Voltage Drop with Step Current applied per EIA 364, TP-06	2 Ckt. With 8 AWG Wire	16 Millivolt drop max (See 5.3.4 - Fig 6)				

9.2.3 Current Interrupt Rating Per UL-1977 is 30Amps @ 250VAC

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