



DESIGN RELIABILITY VERIFICATION REPORT

Date Released	January 28, 2016	Reference Number	RE-PH15/140B
Model No.	73-936-0125 (iHP module)	Manufacturing Site	Laguna
Product Spec Rev	Rev.05	Product Spec Release Date	10-16-2014
BOM Release Date	8-05-2015	Schematic Rev	A
Sample Size	See page 4	Product Rev	DVT

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Revision Control		
Revision	Change History	Date
A	First Release	08/31/2015
B	-Revised section 1.4.1 & 2.1 updated to pass to remark - Updated Appendix attachment 73-936-0125 DVT WCSA rev A.xlsx to rev B	01/28/2016

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Test Result Summary and Conclusion

TEST	DRV Result
	(P-Pass / F-Fail / NR-Not Required)
1.0 Reliability Test	
1.1 MTBF Prediction	P
1.2 Electrolytic Capacitor Life Prediction	P
1.3 Opto-coupler CTR Margin Calculation	P
1.4 Component Stress Analysis (DSA / WCSA)	
1.4.1 Thermal Stress Measurement	P
1.4.2 Electrical Stress Measurement	P
2.0 Robustness Test	
2.1 High Temperature Stress Test (HTST)	Survive
3.0 Appendix	

Test Report Conclusion	This product had completed the DRV tests as outlined in this report. Based on the test results depicted in this report, the product passed the DRV test.
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References:

1. Product Specifications: iHP Product Specifcation rev 05 Draft Rev.05
2. DRV Test Plan No. QAP-1146/PH
3. Design Derating Requirements [920-000114](#)
4. Design Reliability Verification [920-000095](#)
5. Schematic Diagram [710-021500-0000](#) Rev.A
6. PCB Artwork P/N's: [509-021861-0002](#) Rev.A

SAMPLE UNIT SUMMARY

Sample Unit #	Serial #	Date Code	Firmware	Product Revision
1	Unit 1	n/a	02.05.00	DVT
2	Unit 2	n/a	02.05.00	DVT
3	Unit 3	n/a	02.05.00	DVT

TEST DETAILS

1.0 Reliability Test

1.1 MTBF Prediction

Reference Document		Reliability Test Instruction 920-000098		
Test Location		RE Eastwood		
MTBF Method		Telcordia Issue 3, Method I Case 3 MTBF XLS Calculator ver 2.0		
Test Conditions	Input Voltage	380-480 Vac	Volts	
	Output Power	3000	Watts	
	Loading Conditions	125V/24.0A		
	Ambient Temp	25	°C	
	Cooling	Forced Air		
Test Equipment	Description	Model No.	Equipment No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	Tektronix Oscilloscope	DPO 5034B	QAE-587	6/8/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
	ESPEC Chamber	PSL-2K	QAE-231	4/15/2016
Test Sample	Serial Nos.	Sample 1, Sample 2		
	Date Code	See page 4		
MTBF Requirement		400	KHours	
Test Results	AC LINE (Volts)	AMBIENT TEMP (°C)	MTBF (hrs)	
	380	25	2,966,506	
	480	25	3,210,795	
Test Remarks	Based on above test results, calculated MTBF prediction result meets MTBF requirement. See MTBF calculation data on Appendix.			

MTBF Prediction Report

Rev.: 2.0

Model No.	73-936-0125	Data Released	8/29/2015
Product Rev	DVT	BOM Rev	8/5/2015
Test Condition:			
Calculation Model	Telcordia Issue 3	Calculation Method	Method 1,Case3
Input Voltage	380Vac	Output Load	125V / 24.0A
Environment	GB- Ground Fixed, Controlled		
Confidence Level	0.9	PSU Operating Temperature	25
Extrapolated Operating Temperature			
Prediction Results:			
Failure Rate (FIT)	337.096909	MTBF(hours)@ 25°C	2,966,506

Detailed Data			
Components Type	Mean Failure Rate	Standard Deviation Square	Failure Rate (FIT)
IC	19.224189	8.924863	23.138360
Resistor	35.362505	48.531964	44.532486
Capacitor	25.051653	1.166709	26.435913
Transistor	1.082639	0.019736	1.266127
MOSFET	86.851534	88.253547	99.087426
Diode	11.021890	2.794751	13.211258
Zener	11.203992	2.547919	13.292125
Thyristor	0.000000	0.000000	
Inductor	65.566272	127.605422	80.395532
Optical	54.679024	165.775834	71.691788
Relay	0.000000	0.000000	
Switches	0.000000	0.000000	
Connectors	0.000000	0.000000	
Miscellaneous	0.000000	0.000000	
User Defined	0.000000	0.000000	
Totals	310.043700	445.620744	337.096909

MTBF Prediction Report

Rev.: 2.0

Model No.	73-936-0125	Data Released	8/29/2015
Product Rev	DVT	BOM Rev	8/5/2015
Test Condition:			
Calculation Model	Telcordia Issue 3	Calculation Method	Method 1,Case3
Input Voltage	480Vac	Output Load	125V / 24.0A
Environment	GB- Ground Fixed, Controlled		
Confidence Level	0.9	PSU Operating Temperature	25
Extrapolated Operating Temperature			
Prediction Results:			
Failure Rate (FIT)	311.449322	MTBF(hours)@ 25°C	3,210,795

Detailed Data			
Components Type	Mean Failure Rate	Standard Deviation Square	Failure Rate (FIT)
IC	16.663175	6.739052	20.064580
Resistor	33.162558	41.710244	41.661650
Capacitor	23.880139	1.030672	25.181196
Transistor	1.018966	0.017467	1.191583
MOSFET	82.975185	81.286956	94.718976
Diode	10.432675	2.478849	12.494410
Zener	10.744994	2.343931	12.747799
Thyristor	0.000000	0.000000	
Inductor	62.435603	114.989478	76.511874
Optical	45.618790	115.394765	59.812878
Relay	0.000000	0.000000	
Switches	0.000000	0.000000	
Connectors	0.000000	0.000000	
Miscellaneous	0.000000	0.000000	
User Defined	0.000000	0.000000	
Totals	286.932085	365.991415	311.449322

1.2 Electrolytic Capacitor Life Estimation

Reference Document		Reliability Test Instruction 920-000098		
Test Location		RE Eastwood		
Test Conditions	Input Voltage	380-480Vac	Volts	
	Output Power	2400 (80% FL)	Watts	
	Loading Conditions	125V/19.2A		
	Ambient Temp	30	°C	
	Cooling	Forced Air		
Test Equipment	Description	Model No.	Equip No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	Tektronix Oscilloscope	DPO 5034B	QAE-587	6/8/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
	ESPEC Chamber	PSL-2K	QAE-231	4/15/2016
Test Sample	Serial Nos.	Sample 1, Sample 2		
	Date Code	See page 4		
Product Useful Life / Cap Life Expectancy		87,600	Hours	
Test Results	All E-cap meets life requirements			
Test Remarks	Based on above test results, calculated E-cap prediction result meets Life Expectancy requirement. See E-cap Life calculation data on Appendix.			

1.3 Opto-coupler CTR Margin Calculation

Reference Document		Reliability Test Instruction 920-000098		
Test Location		RE Eastwood		
Test Conditions	Input Voltage	400Vdc	Volts	
	Output Power	3000	Watts	
	Loading Conditions	125V/24.0A		
	Ambient Temp	25	°C	
	Cooling	Forced Air		
Test Equipment	Description	Model No.	Equip No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	Tektronix Oscilloscope	DPO 5034B	QAE-587	6/8/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
	ESPEC Chamber	PSL-2K	QAE-231	4/15/2016
Test Sample	Serial Nos.	Sample 1, Sample 2		
	Date Code	See page 4		
Product Useful Life		10	Years	
Test Results	Opto coupler U809 has the lowest CTR margin of 108.71% Refer to the attachment at the appendix section for details.			
Test Remarks	Passed			

1.4 Component Stress Analysis

1.4.1 Thermal Stress Measurement

Reference Document		Reliability Test Instruction 920-000098		
Test Location		RE Eastwood		
Test Conditions	Input Voltage	400Vdc	Volts	
	Output Power	3000	Watts	
	Loading Condition	125V/24.0A		
	Ambient Temp	50	°C	
	Cooling	Forced Air		
Test Equipment	Description	Model No.	Equipment No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	ESPEC Chamber	PSL-2K	QAE-231	4/15/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
Test Sample	Serial Nos.	Sample 1, Sample 2		
	Date Code	See page 4		
Test Results	<p>All components are found within Artesyn Component Thermal Derating Requirement.</p> <p>Note: Verified thermal test to include update for CMC.</p>			
Test Remarks	<p>Based on the above test results, the product passed the Thermal Derating CSA / Worst-Case CSA. See CSA test data on Appendix.</p>			

1.4.2 Electrical Stress Measurement


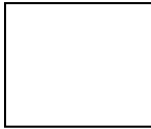
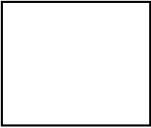


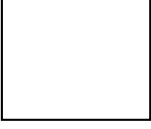
Reference Document		Reliability Test Instruction 920-000098		
Test Location		RE Eastwood		
Test Conditions	Input Voltage	400Vdc	Volts	
	Output Power	3000	Watts	
	Loading Condition	125V/24.0A		
	Ambient Temp	25	°C	
	Cooling	Forced Air		
Test Equipment	Description	Model No.	Equipment No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	Tektronix Oscilloscope	DPO 5034B	QAE-587	6/8/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
Test Sample	Serial Nos.	Sample 1, Sample 2		
	Date Code	See page 4		
Test Results	All components are found within Artesyn Component Electrical Derating Requirement.			
Test Remarks	Based on the above test results, the product passed the Electrical Derating CSA / Worst-Case CSA. See CSA test data on Appendix.			

2.0 Robustness Test

2.1 High Temperature Stress Test (HTST)

Reference Document		Robustness Test Instruction 920-000099-0000		
Test Location		RE Eastwood		
Test Conditions	Input Voltage	400Vdc (4days)		Volts
	Output Power	3000		Watts
	Ambient Temperature	50+15+15		°C
	Cooling	Forced Air by system box (Fan 19.8cfm)		
Test Equipment	Description	Model No.	Equipment No.	Calibration Due Date
	Chroma	63204	QAE-424	6/26/2016
	ESPEC Chamber	PSL-2K	QAE-231	4/15/2016
	HP	401A	QAE-222	1/7/2016
	Chroma	62150H-1000S	QAE-533	9/15/2015
Test Sample	Serial No.	Sample 3		
	Date Code	See page 4		
1.) Load Cycling Test	Output Loading	Min Load	0	A
		Full Load	62.5	A
	Cycling Sequence	16 hours FL, 8 hours ML		
	Duration	96 hours		
2.) Output Short Circuit Test	Input Line	On all the time		
	Output	ML then, short output to common, repeat 10X.		
Test Results	<p>The unit was not able to operate at 70°C even with OTP being disabled.</p> <p>DE Corrective Action: D750, D751 & D752 schottky diode was removed due to high leakage current at high temperature. It causes a mis-trigger of the stuck high protection of the unit.</p>			
Failure Analysis (Yes/NR)	NA			
Test remarks	Based on above test results, sample unit did survive HTST.			

Appendix

Attachment	Revision	File Name
	Rev A	73-936-0125 DVT E-cap Life Calculator revA .xlsx
	Rev B	73-936-0125 DVT WCSA rev B.xlsx
	Rev A	73-936-0125 DVT DSA@50°C revA.xlsx
	Rev A	73-936-0125 DVT Opto CTR Calculation.xls
	Rev A	73-936-0125 MTBF @ 380Vac revA.xls
	Rev A	73-936-0125 MTBF @ 480Vac revA.xls