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Control No. PCN-23181

Revision 1: Update Effective Date and add Appendix 2

June 23, 2023  
September 6, 2023

## PRODUCT/PROCESS CHANGE NOTIFICATION

TYPE OF CHANGE:

☒ Design

☐ Manufacturing

☐ Other

This notification is provided in accordance with Power Integrations policy of major change notification. If you have any questions or need further assistance, please contact your regional Power Integrations sales office.

### DESCRIPTION OF CHANGE

Primary controller logic adjustment. No change to device functionality or to data sheet parameters.

### REASON FOR CHANGE

Address inverter system start up problem when input voltage ramp is non monotonic, such that the device DRAIN pin voltage exceeds 10V but immediately dips below 10V before increasing beyond 10V DC.

### PRODUCTS AFFECTED

INN3977CQ-TL, INN3996CQ-TL

### QUALIFICATION STATUS

Please refer to Appendix 1 for the qualification data.

### EFFECT ON CUSTOMER

There will be no adverse impact in manufacturers' applications for customers who do not experience an input voltage dip. However, the Ordering Part Numbers (OPNs) are changed per the table below:

OPNs	Description
INN3977CQ-TL	Continue to receive products with the existing primary controller until the effective date at which point will receive products with the new primary controller.
INN3996CQ-TL	
INN3977CQ0500-TL	Only receive products with the new primary controller.
INN3996CQ0500-TL	
INN3977CQ0501-TL	Continue to receive products with the existing primary controller.
INN3996CQ0501-TL	

### EFFECTIVE DATE

June 24, 2024

### SAMPLE AVAILABILITY

Samples are available upon request. Please send the request for samples within two weeks after receipt of this notification to the local Power Integrations sales office.

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The information in this report contains confidential and proprietary information of Power Integrations and its manufacturing partners. By receiving this report, the customer agrees to use this information for the sole purpose of addressing the issues reviewed in this report and to keep the contents confidential. If it becomes necessary for the customer to disclose this information to a third party, a non-disclosure agreement, which provides reasonable and customary protection for the disclosed information, must be executed.



Appendix 1  
Reliability Engineering  
Qualification Report

Qualification Project: E230704

**Project Title: InnoSwitch3-AQ Products Primary Controller Change Qualification**
**Qual Summary:**

Reliability testing was performed on InnoSwitch3-AQ products to qualify a minor circuit change within the logic section of the primary controller die implemented to address start-up issues under specific application conditions. PTC, ESD and Latch-up were conducted on INN3977CQ and INN3996CQ (results shown in separate AEC-Q100 report below) to satisfy AEC-Q100 requirements for this change for InnoSwitch3-AQ products and additional reliability tests were conducted on similar InnoSwitch3 products with the same change. All reliability tests were completed with passing results. Yield analysis and temperature characterization were completed on the INN3977CQ and INN3996CQ with acceptable results. Based on these results, the updated primary controller is now fully qualified for INN3996CQ and INN3977CQ InnoSwitch3-AQ products.

Qualification Vehicles: INN3996CQ (InnoSwitch3-AQ), INN3977CQ (InnoSwitch3-AQ), INN3165C (InnoSwitch3-CE), and SC1548C & INN1557C (InnoSwitch3-CP) in the InSOP-24D Package

**Reliability Test Descriptions and Conditions**

Test Name	Conditions	Reference Specification
DOPL (Dynamic Operating Life Test)	Tj=125°C, Vd(peak)=520V	EIA/JESD22-A108
THBT (Temperature Humidity Bias Test)	85°C, 85% RH, Vd=30V, Vbp=Vshunt	EIA/JESD22-A101
PTC (Power Temperature Cycle)	-40°C to +125°C, air to air, alternating bias 5 minutes on, 5 minutes off	EIA/JESD22-A105
TMCL (Temperature Cycle, Air to Air)	-40°C to +125°C, air to air, unbiased	EIA/JESD22-A104
UHASt (Unbiased Highly Accelerated Temperature & Humidity Stress)	130°C, 85% RH, unbiased	EIA/JESD22-A118
Human Body Model ESD	1500 Ohms, 100pF, 3 units per voltage	JESD22-A114F
Charge Device Model ESD	CDM, 3 units per voltage	JESD22-C101
Latch-up	+/- 100mA, 1.5 x Vcc, 125°C	JESD78D

**DOPL (Dynamic Operating Life)**

Product	Lot #	Primary Controller	Test Duration	No. Failures/Sample Size
INN3165C	MCU841B	Updated with Logic Change	MSL3 + 1000 hours	0 / 45
INN3165C	MCD009C	Updated with Logic Change	MSL3 + 1000 hours	0 / 45

**THBT (Temperature Humidity Bias)**

Product	Lot #	Primary Controller	Test Duration	No. Failures/Sample Size
INN3165C	MCU841B	Updated with Logic Change	MSL3 + 1000 hours	0 / 45
INN3165C	MCD009C	Updated with Logic Change	MSL3 + 1000 hours	0 / 45

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**PTC (Power Temperature Cycle)**

Product	Lot #	Primary Controller	Test Duration	No. Failures/Sample Size
INN3977CQ	MDH958B	Updated with Logic Change	MSL3 + 1000 hours	0 / 45

Note: All units were ATE tested at room and hot temperature before and after stress per AEC-Q100 requirements

**TMCL (Temperature Cycling)**

Product	Lot #	Primary Controller	Test Duration	No. Failures/Sample Size
SC1548C	MCG498D	Updated with Logic Change	MSL3 + 850 cycles	0 / 45
INN3165C	MCU841B	Updated with Logic Change	MSL3 + 850 cycles	0 / 45
SC1557C	MCD508D	Updated with Logic Change	MSL3 + 850 cycles	0 / 45
INN3165C	MCD009C	Updated with Logic Change	MSL3 + 850 cycles	0 / 45

**UHASt (Unbiased Highly Accelerated Temperature & Humidity Stress)**

Product	Lot #	Primary Controller	Test Duration	No. Failures/Sample Size
SC1548C	MCG498D	Updated with Logic Change	MSL3 + 96 hours	0 / 45
SC1557C	MCD508D	Updated with Logic Change	MSL3 + 96 hours	0 / 45

**ESD & Latch-up**

Product	Lot #	Primary Controller	Stress Test	No. Failures/Sample Size
INN3977CQ	MDH958A	Updated with Logic Change	HBM ESD: $\pm 2000V$ All Pins	0 / 3
INN3977CQ	MDH958A	Updated with Logic Change	CDM ESD: $\pm 500V$ All Pins	0 / 3
INN3977CQ	MDH958A	Updated with Logic Change	Latch-up: $\pm 100$ ma on all I/O pins and $>1.5 \times V(\text{max})$ on all Supply pins	0 / 6

Note: All units were ATE tested at room and hot temperature before and after stress per AEC-Q100 requirements

Conclusion: Based on passing reliability results, the updated primary controller is qualified for production with INN3996CQ and INN3977CQ InnoSwitch3-AQ products.

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Appendix 2  
Reliability Engineering  
AEC-Q100 Revision H - QTP

Qualification Project: E230704

**Q100 Qualification Test Plan**

Automotive Grade Level = 1 -40 to +125C

MSL = 3

<b>Supplier Name:</b>	Power Integrations	<b>General Specification:</b>	AEC-Q100 Rev. H
<b>Supplier Code:</b>	N/A	<b>Supplier Wafer Fabrication:</b>	Lapis (Miyagi, Japan)
<b>Supplier Part Number:</b>	INN3996CQ	<b>Supplier Wafer Test:</b>	N/A
<b>Supplier Contact:</b>	Edward Ong	<b>Supplier Assembly Site:</b>	Hana (Ayutthaya, Thailand)
<b>Supplier Family Type:</b>	Integrated Circuit	<b>Supplier Final Test Site:</b>	Hana (Ayutthaya, Thailand)
<b>Device Description:</b>	CV/CC QR Flyback Switcher IC	<b>Supplier Reliability Signature:</b>	Nick Stanco
<b>PPAP Submission Date:</b>	TBD	<b>Customer Test ID:</b>	E232202-03, E203306-09/3411/3902
<b>Reason for Qualification:</b>	New Part Qualification	<b>Customer Part Number:</b>	N/A
<b>Prepared by Signature:</b>	Tina He	<b>Customer Approval Signature:</b>	N/A
	Date: 8/18/23		Date: N/A

Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results Lot/Pass/Fail	Comments: (N/A =Not Applicable)
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**TEST GROUP A – ACCELERATED ENVIRONMENT STRESS TESTS**

PC	A1	JESD22 A113 J-STD-020	Preconditioning: (Test @ Rm) SMD only; Moisture Preconditioning for THB/HAST, AC/UHST, TC, & PTC; Peak Reflow Temp = 260°C	Min. MSL = 3			MSL = 3	
THB or HAST	A2	JESD22 A101 JESD22 A110	Temperature Humidity Bias: (Test @ Rm/Hot) 85°C / 85%R.H.; 1000 hours; Vd = 30V Highly Accelerated Stress Test: (Test @ Rm/Hot)	1	77	77	0 of 77	
AC or UHST or TH	A3	JESD22 A102 JESD22 A118 or JESD22-A101	Autoclave: (Test @ Rm) Unbiased Highly Accelerated Stress Test: (Test @ Rm) Temperature Humidity without Bias: (Test @ Rm) 130°C / 85%R.H.; 96 hours	1	77	77	0 of 77	
TC	A4	JESD22 A104	Temperature Cycle: (Test @ Hot) -40°C to +125°C; 1700 Cycles	1	77	77	0 of 77	
PTC	A5	JESD22 A105	Power Temperature Cycle: (Test @ Rm/Hot) -40°C to +125°C; 1000 Cycles	1	45	45	0 of 45	
HTSL	A6	JESD22 A103	High Temperature Storage Life: (Test @ Rm/Hot) 150°C; 1000 Hours	1	45	45	0 of 45	

**TEST GROUP B – ACCELERATED LIFETIME SIMULATION TESTS**

HTOL	B1	JESD22 A108	High Temp Operating Life: (Test @ Rm/Cold/Hot) Tj = 125°C; 1000 hours; Vd = 720V	1	77	77	0 of 77	
ELFR	B2	AEC-Q100-008	Early Life Failure Rate: (Test @ Rm/Hot) Tj = 125°C; 48 hours; Vd = 720V	1	800	800	0 of 800	
EDR	B3	AEC-Q100-005	NVM Endurance & Data Retention Test: (Test @ Rm/Hot)	1	77	-	of	N/A

**TEST GROUP C – PACKAGE ASSEMBLY INTEGRITY TESTS**

WBS	C1	AEC-Q100-001 AEC-Q003	Wire Bond Shear Test: (Cpk > 1.67)	30 bonds	5 parts Min.	180 bonds	0 of 180	Generic Data applied (see INN3977CQ)
WBP	C2	Mil-STD-883, Method 2011 AEC-Q003	Wire Bond Pull: (Cpk > 1.67); Each bonder used	30 bonds	5 parts Min.	180 bonds	0 of 180	Generic Data applied (see INN3977CQ)
SD	C3	JESD22 B102 JSTD-002D	Solderability: (>95% coverage) 8hr steam aging prior to testing	1	15	15	0 of 15	
PD	C4	JESD22 B100, JESD22 B108 AEC-Q003	Physical Dimensions: (Cpk > 1.67)	1	10	10	0 of 10	
SBS	C5	AEC-Q100-010 AEC-Q003	Solder Ball Shear: (Cpk > 1.67); 5 balls from min. of 10 devices	-	50 balls		of	N/A
LI	C6	JESD22 B105	Lead Integrity: (No lead cracking or breaking); Through- hole only; 10 leads from each of 5 devices	-	50 leads		of	N/A

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Test	#	Reference	Test Conditions	Lots	S.S.	Total	Results Lot/Pass/Fail	Comments: (N/A =Not Applicable)
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**TEST GROUP D – DIE FABRICATION RELIABILITY TESTS**

EM	D1	JESD61	Electromigration:	-	-	-	0	Data Available 3 Total of 51 chips from 3 lots.
TDDb	D2	JESD35	Time Dependant Dielectric Breakdown:	-	-	-	0	Data Available Total of 432 chips from 1 lot.
HCI	D3	JESD60 & 28	Hot Carrier Injection:	-	-	-	0	Data Available Total of 90 chips for LV and 125 chips for MV from 3 lots.
NBTI	D4	JESD90	Negative Bias Temperature Instability:	-	-	-	0	Data Available Total of 15 chips from 1 lot.
SM	D5	JESD61, 87, & 202	Stress Migration:	-	-	-	0	Data Available Total of 318 chips from 5 lots.

**TEST GROUP E- ELECTRICAL VERIFICATION**

TEST	E1	User/Supplier Specification	Pre and Post Stress Electrical Test:	All	All	All	1 of All	
HBM	E2	AEC-Q100-002	Electrostatic Discharge, Human Body Model: (Test @ Rm/Hot); (2KV HBM / Class 2 or better)	1	12	12	0 of 12 ESD Level = 2	Passed 500V, 1KV, 1.5KV, 2KV
CDM	E3	AEC-Q100-011	Electrostatic Discharge, Charged Device Model: (Test @ Rm/Hot); (750V corner leads, 500V all other leads / Class C4B or better)	1	12	12	0 of 12 ESD Level = C3	Passed 250V, 500V, 750V, 1KV
LU	E4	AEC-Q100-004	Latch-Up: (Test @ Rm/Hot) +125C	1	6	6	0 of 6	
ED	E5	AEC-Q100-009 AEC-Q003	Electrical Distributions: (Test @ Rm/Hot/Cold) (where applicable, Cpk >1.67)	3	30	90	0 of 90	
FG	E6	AEC-Q100-007	Fault Grading:	-	-	-	Fault Grade Other (explain)	Substituting 100% functional coverage
CHAR	E7	AEC-Q003	Characterization: (Test @ Rm/Hot/Cold)	-	-	-	PPAP Data	
EMC	E9	SAE J1752/3	Electromagnetic Compatibility (Radiated Emissions)	1	1	1	0	Completed. Data available upon request.
SC	E10	AEC Q100-012	Short Circuit Characterization	-	10	-		N/A
SER	E11	JESD89-1 JESD89-2 JESD89-3	Soft Error Rate	-	3	-		N/A
LF	E12	AEC-Q005	Lead (Pb) Free: (see AEC-Q005)	-	-	-	Done	Generic Data applied (see INN3977CQ)

**TEST GROUP F – DEFECT SCREENING TESTS**

PAT	F1	AEC-Q001	Process Average Testing: (see AEC-Q001)	All	All	All	Reject units outside Avg.	
SBA	F2	AEC-Q002	Statistical Bin/Yield Analysis: (see AEC-Q002)	All	All	All	Reject units outside criteria	

**TEST GROUP G – CAVITY PACKAGE INTEGRITY TESTS (for Ceramic Package testing only)**

MS	G1	JESD22 B104	Mechanical Shock: (Test @ Rm)	1	15	15	of	N/A
VFV	G2	JESD22 B103	Variable Frequency Vibration: (Test @ Rm)	1	15	15	of	N/A
CA	G3	MIL-STD-883 Method 2001	Constant Acceleration: (Test @ Rm)	1	15	15	of	N/A
GFL	G4	MIL-STD-883 Method 1014	Gross and Fine Leak:	1	15	15	of	N/A
DROP	G5	-----	Drop Test: (Test @ Rm) MEMS cavity parts only. Drop part on each of 6 axes once from a height of 1.2m onto a concrete surface.	1	5	5	of	N/A
LT	G6	MIL-STD-883 Method 2004	Lid Torque:	1	5	5	of	N/A
DS	G7	MIL-STD-883 Method 2019	Die Shear:	1	5	5	of	N/A
IWV	G8	MIL-STD-883 Method 1018	Internal Water Vapor:	1	3	3	of	N/A

Note 1: INN3996CQ product with DX001B5 primary controller was initially qualified per AEC-Q100 standard. Additional PTC, HBM, CDM and LU tests were performed to qualify INN3996CQ with DX001B60 primary controller which has non-peripheral circuit rerouting changes relative to DX001B5.

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**CUSTOMER ACKNOWLEDGEMENT**

Power Integrations requests you acknowledge the receipt of the above-mentioned PCN. If no acknowledgment is received within 30 days of this notification, Power Integrations will assume the change is acceptable. Lack of any additional response within 90 days of this notification further constitutes acceptance of the change.

Power Integrations reserves the right to ship either version manufactured after the effective date.

If you have any questions or need further assistance, please contact your regional Power Integrations sales office. Otherwise, please check the box below, acknowledging the receipt of the PCN.

The indicated Product/Process Change Notification was received by the undersigned authority.

Name/Title: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Email Address/Phone#: \_\_\_\_\_

Company/Location: \_\_\_\_\_

**CUSTOMER COMMENTS**

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Please email this signed form to [pcn@power.com](mailto:pcn@power.com) specifying the PCN# in the subject.

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