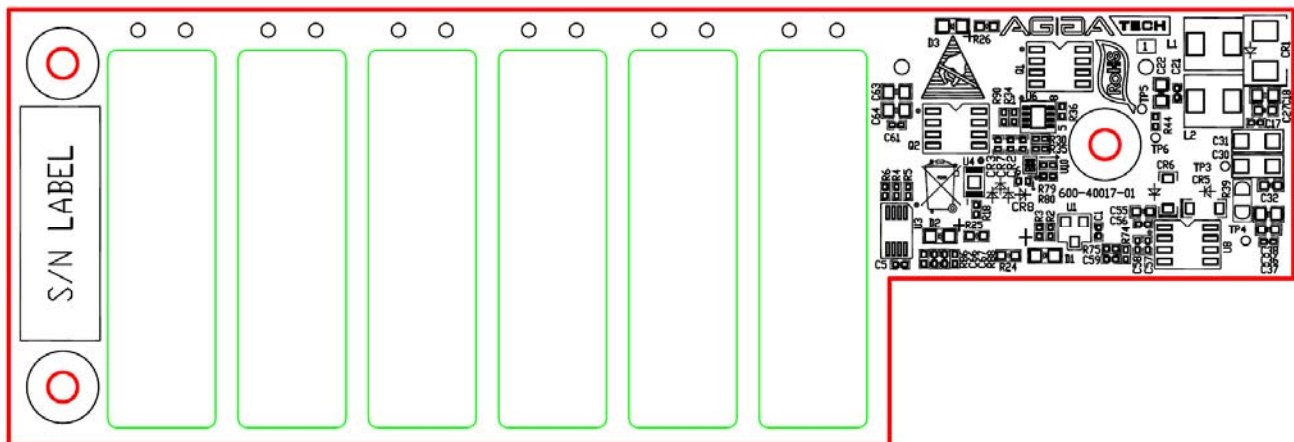


AGIGA TECH TOPAZ POWERGEMTM FOR IBM CROCODILE ASIC FAMILY

AGIGA9IBM-501



1. Overview

- 1.1 The AgigA Tech Topaz PowerGEM™ is an ultracapacitor based power supply. The custom module takes 12 volts input and supplies an unregulated output voltage to the IBM Crocodile ASIC system, both for steady state operation and during power fail operations. This Topaz module comes pre-programmed from AgigA Tech and is field upgradable.
- 1.2 The host controls Topaz by accessing a set of registers using the standard I²C bus, and conforming to a subset of the SMB protocol. Topaz uses ultracapacitors for energy storage because they offer high power density, quick charge time and long cycle life. Topaz uses six series/parallel-connected ultracapacitors as shown in Figure 1 below.

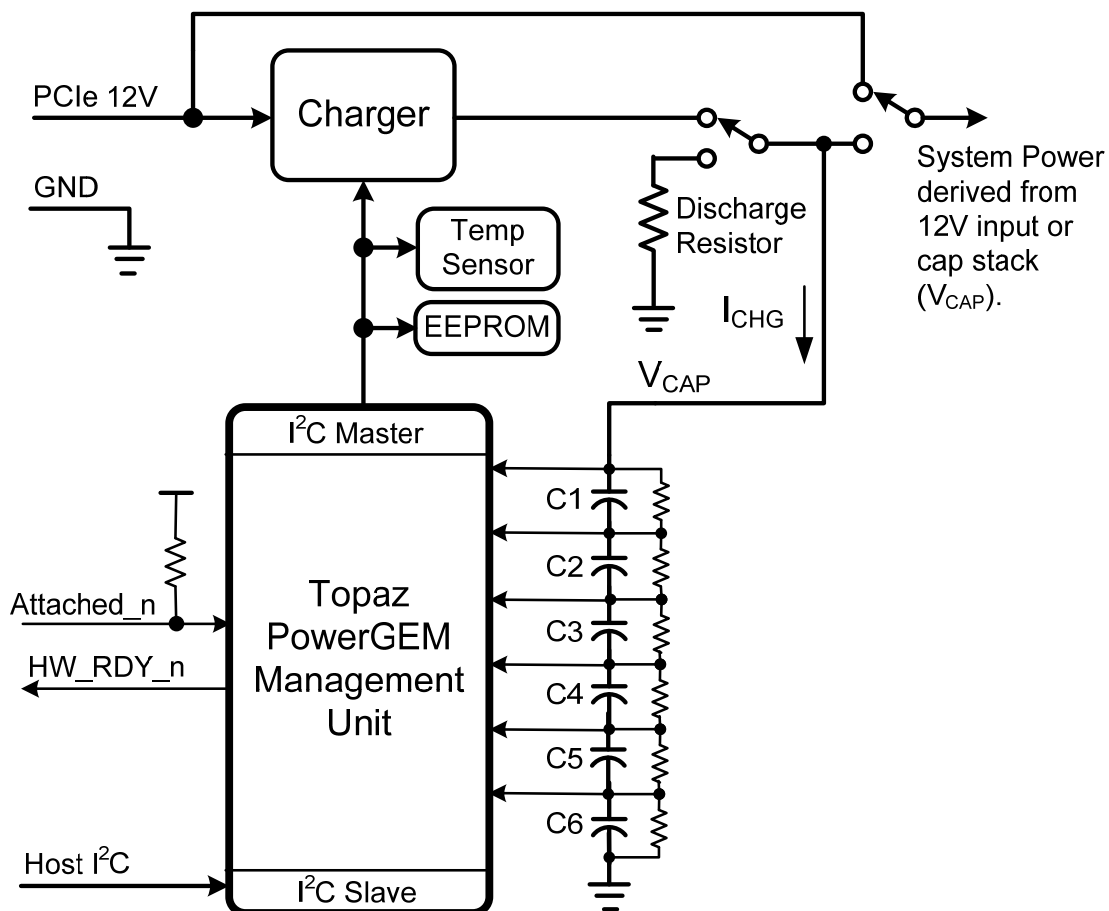


Figure 1. Simplified Topaz PowerGEM Diagram

2. Key Features

- Ultracapacitor configuration: 6 x 28F (pre-qualified by AgigA Tech's reliability test lab)
- Real-time health monitoring and logging
- Factory configurable charge voltage
- Factory configurable charge current up to 8A
- Safe online ultracapacitor measurement (no downtime required)
- Auto-discharge feature (upon removal and programmable low-voltage trigger)
- HW_RDY active LOW and floated when it is not ready
- Voltage output will automatically shut-off at 4.5V.
- Online firmware upgrade
- Energy Rating: 155 Joules
- Operating Life: 7 years
- Operating Temperature: 0° to 55° C with 200 LFM airflow
- 40-pin connector
- RoHS 6/6-compliant

3. Reference Documents

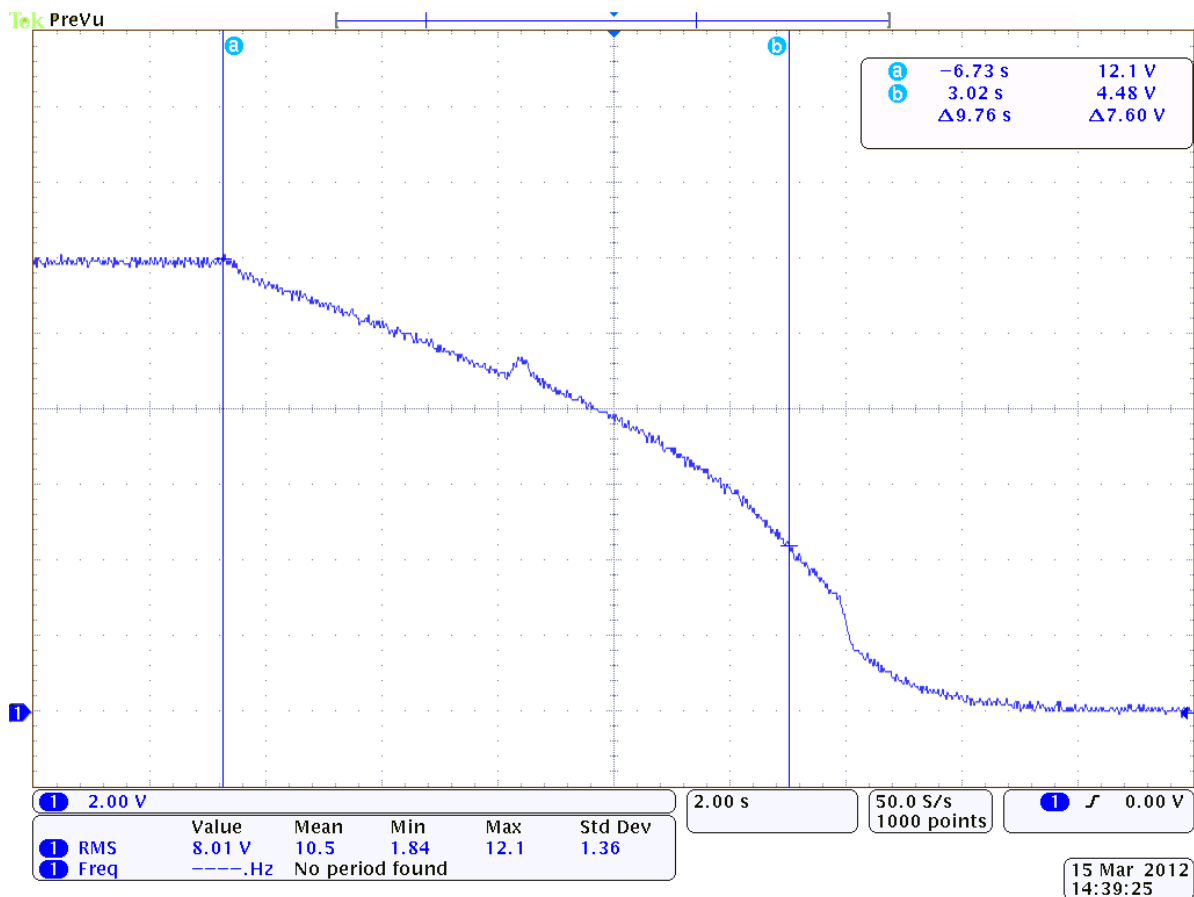
- TOPAZ Firmware Specification

4. Design Parameters*

N Caps	6	Number of Ultracaps	Number of rows of Caps in series
M Caps	1	Number of Ultracaps	Number of columns of Caps in parallel
F	28	Individual Cap Farads (F)	Assuming all caps the same value or greater
ESR_{Caps}	40	ESR (mohms)	Cap ESR value
V_{CAP-MAX}	11.9	Max V_{CAP} (V)	Set this according to charger V _{out}
Tol-V_{CAP-MAX}	1	Tolerance of Max V_{CAP} (+/-%)	Set according to % tolerance of V _{CAP-MAX}
V_{CAP-MIN}	4.5	Min V_{CAP} (V)	Set according to downstream regulator min V _{in}
I_{CHG}	2	Charge Current (A)	Set according to charger
°C	55	Operating Temp max (°C)	Set according to environment
EFF_{REG}	100	Average Regulator Efficiency (%)	Used to Calculate Joules available at V _{OUT}
P_{SYS}	26	(Watts)	System Power
J_{INIT-USABLE}	248.13	Extracted Joules (J)	Total initial energy extracted at V _{OUT}
J_{EOL-USABLE}	154.68	Extracted Joules at EOL (J)	Total end of life energy extracted at V _{OUT}
Life(yrs)	7.25	(yrs)	hrs/(24*365)
T_{chg}	112.2	Charge Time (sec)	t=CV/I

***Design parameters:** The amount of Joules available at the end of 7 years is ~ 155 Joules, which would support a 26W load for ~ 6 seconds.

5. Measured Power Delivery



- 5.1 26-Watt constant power discharge curve. This data was captured with prototype units; production units will have slightly higher capacitance values.

6. Electrical Characteristics

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
INPUT CHARACTERISTICS						
Input voltage range	V_I	Over I_{OUT} range	11.04	12	12.96	V
Input Supply Current	$I_{S(VIN)}$	$V_{IN} = 12V$	-	-	5	A
	V_I	Over I_{OUT} range	11.04	12	12.96	V
OUTPUT CHARACTERISTICS						
Capacitor Stack Voltage	$V_{CC\ CAP}$	$V_{IN} = 12V$	11.9	12	12.1	V
		$V_{IN} = 0V$; Voltage will drop to 4V and then shutoff.	0	-	13	V
Continuous Output Current Range	I_{OUT}	Duration longer than 300us	-	-	5.5	A
Instantaneous Output Current Range	I_{OUT_INST}	Max duration of 300us	-	-	30	A
CAPACITOR CHARACTERISTICS						
Initial Effective Capacitance	C_{INIT}	This value is the result of a capacitance measurement commanded over I2C at time of manufacture.	4.67 (100%)	-	-	F
End Of Life Effective Capacitance	C_{EOL}	This value is 70% of Initial Effective Capacitance	3.27 (70%)	-	-	F
Capacitor Stack Voltage	$V_{CC\ CAP}$	Measured when capacitor stack is fully charged	11.9	12	12.1	V

	Min	Typical	Max	Notes
Storage Temperature	-10°C		+65°C	1

Notes: [1] Max storage temperature should not exceed max operating temperature in order to meet lifetime requirements. Storage temp in excess of max operating temp will degrade lifetime spec.

7. LED Functional Description**

PGEM States	Yellow LED	Blue LED
Init State	Off	On
Charging	Fast blinking	On
Charge_done/ Normal state	Slow blinking	Slow blinking
Discharging	Fast blinking	Fast blinking
CAP Power Low/ Power Output shutoff	Slow blinking	Off
CAP Failure	Slow blinking	Fast blinking

Hardware LED: Red, Indicates 12V Input Power Status: On/Off

**Note: All LEDs will be de-populated for production

8. Pin Layout

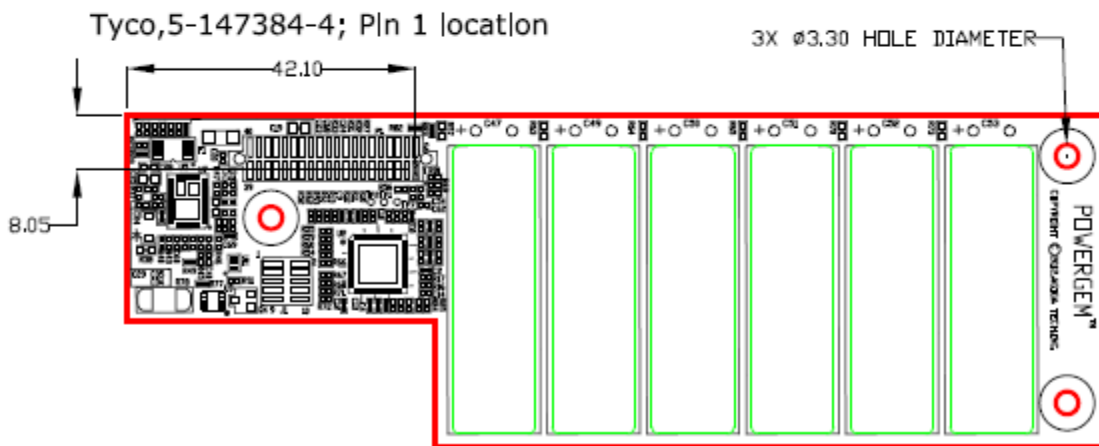
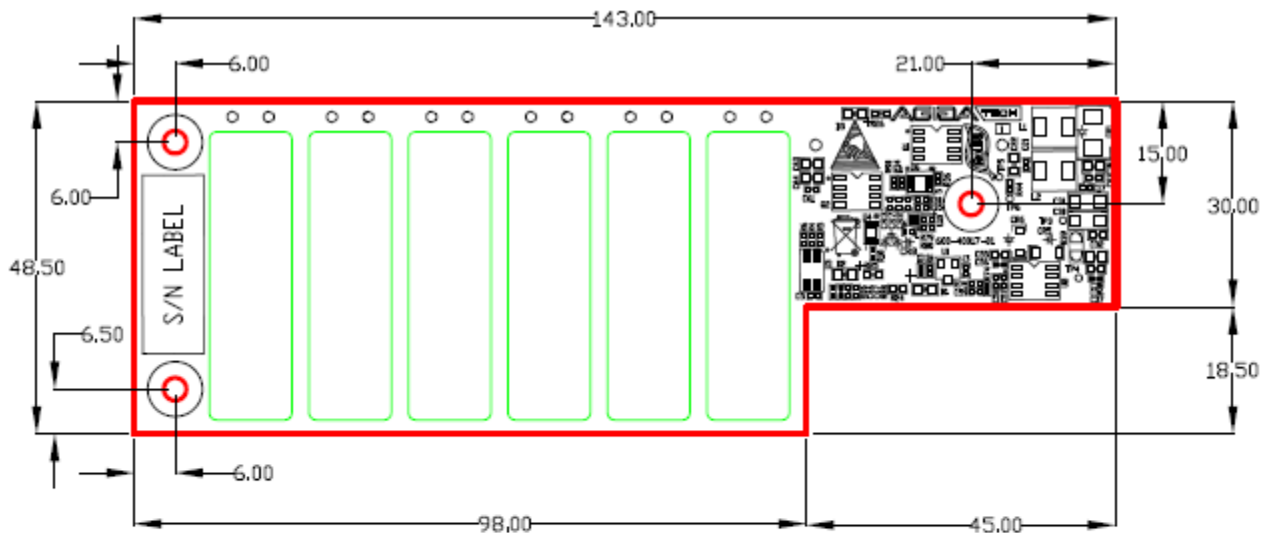
8.1 Pinout for interface connector TYCO 147384-4

OUT_V	1	2	GND
OUT_V	3	4	GND
OUT_V	5	6	GND
OUT_V	7	8	GND
OUT_V	9	10	GND
OUT_V	11	12	GND
OUT_V	13	14	GND
OUT_V	15	16	GND
Spare	17	18	I2C SCL
Attached_n	19	20	I2C SDA
HW_RDY_n	21	22	GND
GND	23	24	Spare
Spare	25	26	Spare
Spare	27	28	Spare
GND	29	30	+12V
GND	31	32	+12V
GND	33	34	+12V
GND	35	36	+12V
GND	37	38	+12V
GND	39	40	+12V

9. Pin Description

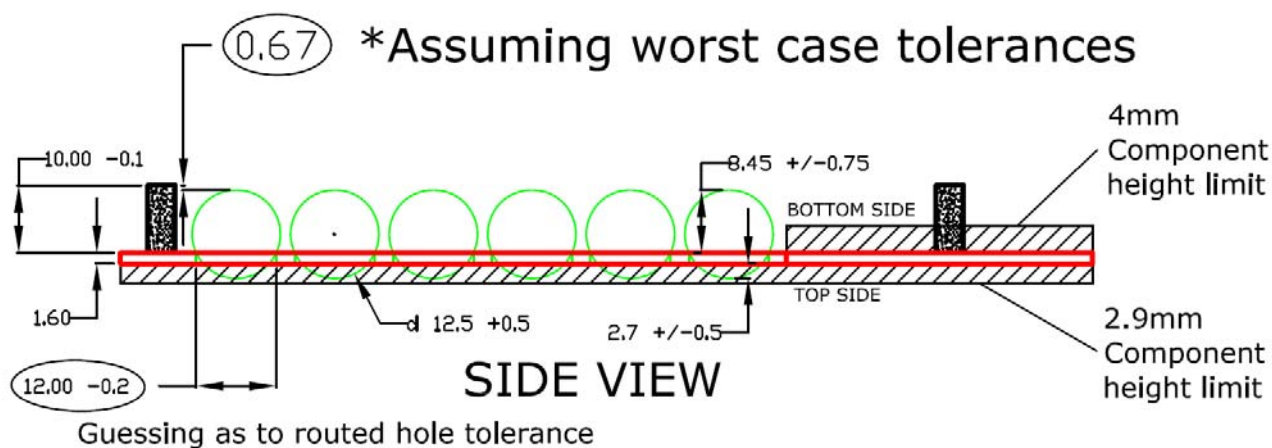
Signal Name	Signal Type	Pin Number	Pin Description
+12V	Power	30, 32, 34, 36, 38, 40	+12V input power
GND	Power	2, 4, 6, 8, 10, 12, 14, 16, 22, 23, 29, 31, 33, 35, 37, 39	Ground
OUT_V	Power	1, 3, 5, 7, 9, 11, 13, 15	Output power (12V ~ 4V)
Attached_n	Input	19	Used to determine indicate connection to host board; Grounded by host
I2C SCL	Input	18	I2C slave interface, clock
I2C SDA	Input/Output	20	I2C slave interface, data I/O
HW_RDY_n	Output	21	Open Drain Output; Driven low by Topaz when it is ready to receive I2C communication
Spare	NA	17, 24, 25, 26, 27, 28	Reserved for future use

10. Mechanical



Dimensions are in mm

11. Tolerance Stackup



12. Marketing Part Number

- 12.1 The coded AgigA Tech marketing part number is AGIGA9IBM-501xyz. Production part numbers will use a “xyz” suffix structure following the “501” to properly identify revision control on the base device and firmware revisions released by AgigA Tech. The details of this “xyz” suffix structure as shown below:

Suffix Letter	x	y	z
Definition	Product revision	Operating Range	Feature Set
Characters	Sequential letters starting with “A”	C = 0° to 55°C	A = 5 yr operating life B = 7 yr operating life

13. Vital Product Data (VPD) EEPROM contents

- 13.1 The VPD information will be written during manufacturing test. These parameters will be stored in the onboard EEPROM and will be used by the Topaz firmware. See the Topaz Firmware Specification for further details.

Bytes	Acc	Name	Offset	Contents	Units	Source	Initial Build Test Values	
512	RW	USER	0x0000	User Read/Write data		Host	unprog (0xFF)	
1	RW	MCAPINT	0x0200	Capacitance Measurement Interval	weeks	Host	0x02	
31			0x0201	Reserved			unprog(0xFF)	
32	R	TEMPHIST	0x0220	Temperature History		Topaz	0x00-0x1F counter	
32	R	CAPHIST	0x0240	Capacitance History		Topaz	0x50-0x6F counter	
4	R	T_RUN	0x0260	Total Run Time	hours	Topaz	0x00001234	
4	R	T_LASTPF	0x0264	Run Time at Last Power Fail (hrs)	hours	Topaz	0x0000012A	
2	R	PWRCYCS	0x0268	Number of Power Cycles	cycles	Topaz	0x0023	
1	R	LASTCAP	0x026A	Last PCT Capacitance Measurement	%	Topaz	0x64	100%
8	R	MODEL	0x026B	Topaz Model Number	text	Manuf	"TOPAZTST"	
8	R	FWVER	0x0273	Topaz FW Version	text	Manuf	"00000060"	
8	R	HWVER	0x027B	Topaz HW Version	text	Manuf	"00000001"	
8	R	CAPPN	0x0283	Capacitor Part Number	text	Manuf	"AGIG_028"	
8	R	SN	0x028B	Serial Number	text	Manuf	"12345678"	
8	R	PCBVER	0x0293	PCB Version	text	Manuf	"00000023"	
8	R	MFDATE	0x029B	Manufacture Date	text	Manuf	"04-01-12"	
8	R	ENDUSR	0x02A3	Manufacturer Name (End user)	text	Manuf	"Secret#1"	
8	R	PCA	0x02AB	PC Assembly Number	text	Manuf	"PCA_1234"	
1	R	CINIT	0x02B3	Measured Capacitance at time of manufacture (0.1F increments)	.1F	Manuf	0x2D	4.5F
331	R	RSRVD	0x02B4	Reserved for internal use				

14. APPENDIX A

- 14.1 Prototype Topaz units will be built with caps that are -5% less than spec. For production the caps will be pretested and guaranteed to be -0% to +20%. This is measured data from a prototype unit.

N Caps	6	Number of Ultracaps	Number of rows of Caps in series
M Caps	1	Number of Ultracaps	Number of columns of Caps in parallel
F	26.58	Individual Cap Farads (F)	Assuming all caps the same value or greater
ESR_{Caps}	40	ESR (mohms)	Cap ESR value
V_{CAP-MAX}	12.1	Max V_{CAP} (V)	Set this according to charger Vout
Tol-V_{CAP-MAX}	0	Tolerance of Max V_{CAP} (+/-%)	Set according to % tolerance of V _{CAP-MAX}
V_{CAP-MIN}	4.48	Min V_{CAP} (V)	Set according to downstream regulator min Vin
I_{CHG}	0.5	Charge Current (A)	Set according to charger
°C	55	Operating Temp max (°C)	Set according to environment
EFF_{REG}	100	Average Regulator Efficiency (%)	Used to Calculate Joules available at V _{OUT}
P_{SYS}	26	(Watts)	System Power
J_{INIT-USABLE}	252.79	Extracted Joules (J)	Total initial energy extracted at V _{OUT}
J_{EOL-USABLE}	158.84	Extracted Joules at EOL (J)	Total end of life energy extracted at V _{OUT}
Life(yrs)	7.03	(yrs)	hrs/(24*365)
T_{chg}	107.206	Charge Time (sec)	t=CV/I

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Edition Tracking

The table below provides the product edition.

Edition	Date	Originator	Description of Changes
A	3/08/2012	TTKG	Initial Release
B	3/14/2012	TTKG	Added both 5 and 7 yr definitions in marketing part number section. Added measured load characteristics. Added VPD section.
C	3/19/2012	TTKG	Changed charge current to 0.5A and updated electrical specifications sheet.
D	6/13/2012	TTKG	Updated block diagram to match names on IO with pin descriptions.
E	5/29/2013	TORY	Added I _{OUT} and I _{OUT_INST} to the Electrical Characteristics Table Added Storage Temperature spec to the Electrical Characteristics Table. Added "6/6" to RoHS in the Feature List
F	9/16/2013	TTKG	Updated Input voltage in Electrical Characteristics chart in section 6.

Arena Revision History

Revision	Date	Originator	Description of Changes
01	3/19/2012	TTKG	Initial Release
02	6/13/2012	TTKG	Updated block diagram to match names on IO with pin descriptions.
03	5/29/2013	TORY	Added I _{OUT} and I _{OUT_INST} to the Electrical Characteristics Table Added Storage Temperature spec to the Electrical Characteristics Table. Added "6/6" to RoHS in the Feature List
04	9/16/2013	TTKG	Updated Input voltage in Electrical Characteristics chart in section 6.