

Radiation Tolerant Multicell Battery Monitor

FEATURES

- 15kRad (SI) Total Ionizing Dose (TID) per MIL-STD-883 TM1019 Condition A
- Single Event Effect (LET) Threshold Linear Energy Transfer (LET) $\geq 21.17\text{MeV}\cdot\text{cm}^2/\text{mg}$
- Processed Using MIL-PRF-38535 Class N and PEM-INST-001 as a Guideline
- TID and SEE Reports Available
- Measures Up to 12 Battery Cells in Series
- Stackable Architecture Supports 100s of Cells
- Built-In isoSPI™ Interface:
 - 1Mbps Isolated Serial Communications
 - Uses a Single Twisted Pair, Up to 100 Meters
 - Low EMI Susceptibility and Emissions
- 1.2mV Maximum Total Measurement Error
- 290μs to Measure All Cells in a System
- Synchronized Voltage and Current Measurement
- 16-Bit Delta-Sigma ADC with Frequency Programmable 3rd Order Noise Filter
- Engineered for ISO26262 Compliant Systems
- Passive Cell Balancing with Programmable Timer

DESCRIPTION

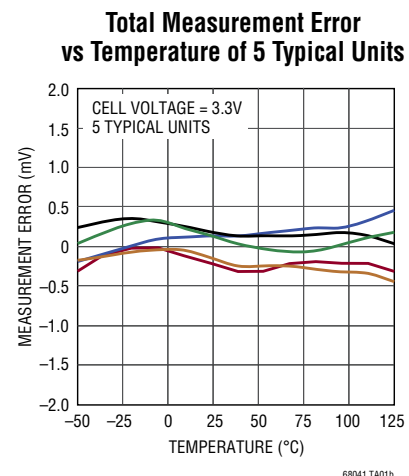
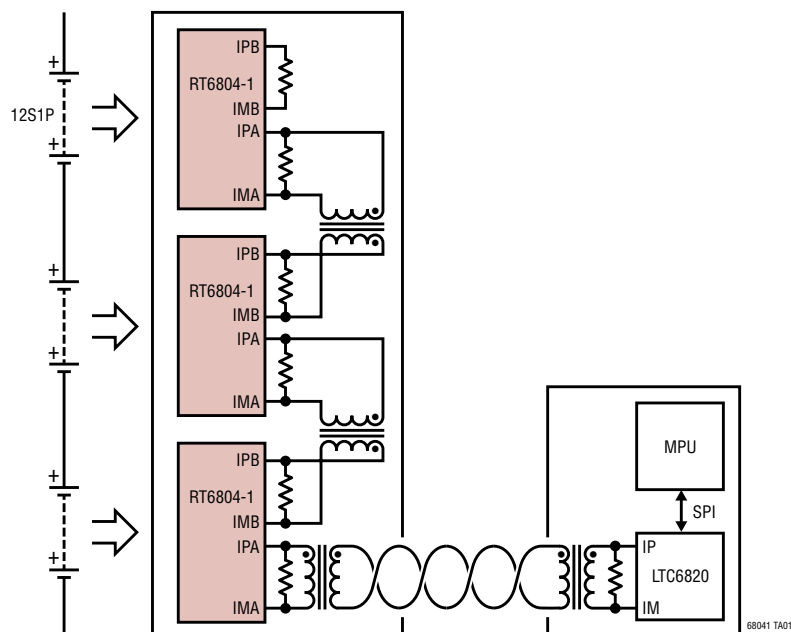
The RT[®]6804 is a 3rd generation multicell battery stack monitor that measures up to 12 series connected battery cells with a total measurement error of less than 1.2mV. The cell measurement range of 0V to 5V makes the RT6804 suitable for most battery chemistries. All 12 cell voltages can be captured in 290μs, and lower data acquisition rates can be selected for high noise reduction.

Multiple RT6804 devices can be connected in series, permitting simultaneous cell monitoring of long, high voltage battery strings. The RT6804 has an isoSPI interface for high speed, RF-immune, local area communications. Using the RT6804-1, multiple devices are connected in a daisy-chain with one host processor connection for all devices.

Additional features include passive balancing for each cell, an on-board 5V regulator, and 5 general purpose I/O lines. In sleep mode, current consumption is reduced to 4μA. The RT6804 can be powered directly from the battery, or from an isolated supply.

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TYPICAL APPLICATION



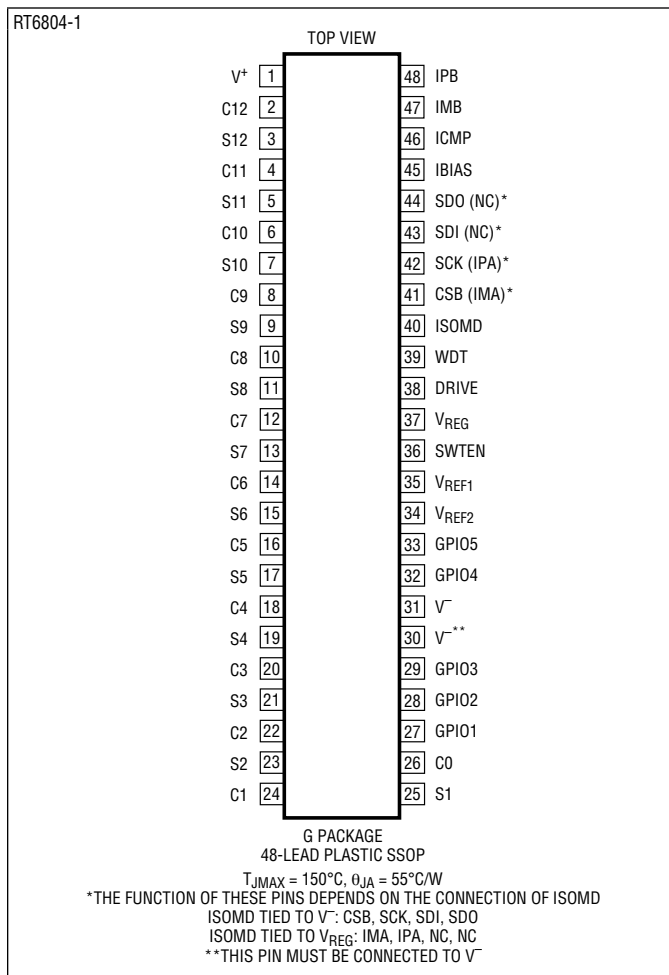
RT6804-1

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage V^+ to V^-	75V
Input Voltage (Relative to V^-)	
C0	-0.3V to 0.3V
C12	-0.3V to 75V
C(n)	-0.3V to MIN (8 • n, 75V)
S(n)	-0.3V to MIN (8 • n, 75V)
IPA, IMA, IPB, IMB	-0.3V to $V_{REG} + 0.3V$
DRIVE Pin	-0.3V to 7V
All Other Pins	-0.3V to 6V
Voltage Between Inputs	
V^+ to C12	-5.5V
C(n) to C(n - 1)	-0.3V to 8V
S(n) to C(n - 1)	-0.3V to 8V
C12 to C8	-0.3V to 25V
C8 to C4	-0.3V to 25V
C4 to C0	-0.3V to 25V
Current In/Out of Pins	
All Pins Except V_{REG} , IPA, IMA, IPB, IMB, S(n)	10mA
IPA, IMA, IPB, IMB	30mA
Operating Temperature Range	
RT6804H	-40°C to 125°C
Specified Temperature Range	
RT6804H	-40°C to 125°C
Junction Temperature	150°C
Storage Temperature	-65°C to 150°C
Lead Temperature (Soldering, 10sec)	300°C

PIN CONFIGURATION



ORDER INFORMATION

LEAD BASED FINISH	TAPE AND REEL	PART MARKING*	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE
RT6804HG-1	RT6804HG-1#TR	RT6804G-1	48-Lead Plastic SSOP	-40°C to 125°C

Contact the factory for parts specified with wider operating temperature ranges. *The temperature grade is identified by a label on the shipping container.

[Tape and reel specifications](#). Some packages are available in 500 unit reels through designated sales channels with #TRMPBF suffix.

ELECTRICAL CHARACTERISTICS (Pre-Irradiation)Specifications are at $T_A = 25^\circ\text{C}$. The test conditions are $V^+ = 39.6\text{V}$, $V_{\text{REG}} = 5.0\text{V}$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	T _A = 25°C			SUB-GROUP	-40°C ≤ T _A ≤ 125°C			SUB-GROUP	UNITS	
			MIN	TYP	MAX		MIN	TYP	MAX			
ADC DC Specifications												
	Total Measurement Error (TME) in Normal Mode	C(n) to C(n-1) = 2.0	-0.8	±0.1	0.8	1	-1.4		1.4	2, 3	mV	
		GPIO(n) to V ⁻ = 2.0	-1.4		1.4	1	-1.4		1.4	2, 3	mV	
		C(n) to C(n-1) = 3.3	-1.2	±0.2	1.2	1	-2.2		2.2	2, 3	mV	
		GPIO(n) to V ⁻ = 3.3	-2.2		2.2	1	-2.2		2.2	2, 3	mV	
		C(n) to C(n-1) = 4.2	-1.6	±0.3	1.6	1	-2.8		2.8	2, 3	mV	
		GPIO(n) to V ⁻ = 4.2	-2.8		2.8	1	-2.8		2.8	2, 3	mV	
		VREG Pin	-0.25	±0.1	0.25	1	-0.25	±0.1	0.25	2, 3	%	
	Total Measurement Error (TME) in Filtered Mode	VREG Pin	-0.25	±0.1	0.25	1	-0.25	±0.1	0.25	2, 3	%	
I _L	Input Leakage Current When Inputs Are Not Being Measured	C(n), n = 0 to 12	-250	10	250	1	-250	10	250	2, 3	nA	
		GPIO(n), n = 1 to 5	-250	10	250	1	-250	10	250	2, 3	nA	
Voltage Reference Specifications												
V _{REF1}	1st Reference Voltage	VREF1 Pin, No Load	3.1	3.2	3.3	1	3.1	3.2	3.3	2, 3	V	
V _{REF2}	2nd Reference Voltage	VREF2 Pin, No Load	2.99		3.01	1	2.99		3.01	2	V	
General DC Specifications												
I _{VP}	V+ Supply Current	State: Core = SLEEP, isoSPI = IDLE	V _{REG} = 0V		3.8	6	1		3.8	10	2	μA
			V _{REG} = 5V		1.6	3	1		1.6	5	2	μA
		State: Core = STANDBY		18	32	50	1	10	32	60	2, 3	μA
		State: Core = REFUP or MEASURE		0.4	0.55	0.7	1	0.375	0.55	0.725	2, 3	mA
I _{REG(CORE)}	V _{REG} Supply Current	State: Core = SLEEP, isoSPI = IDLE	V _{REG} = 5V		2.2	4	1		2.2	6	2	μA
				State: Core = STANDBY		10	35	60	1	6	35	65
		State: Core = REFUP		0.2	0.45	0.7	1	0.15	0.45	0.7	2, 3	mA
		State: Core = MEASURE		10.8	11.5	12.2	1	10.7	11.5	12.2	2, 3	mA
	DRIVE output Voltage	Sourcing 1μA	5.4	5.6	5.8	1	5.2	5.6	6.1	2, 3	V	
	Discharge Switch ON Resistance	V _{CELL} = 3.6V		10	25	1		10	25	2	Ω	
SPI Interface DC Specifications												
I _{LEAK(DIG)}	Digital Input Current	Pins CSB, SCK, SDI,ISOMD, SWTEN, A0 to A3		-1		1	1	-1		1	2, 3	μA
isoSPI DC Specifications												
V _{BIAS}	Voltage on IBIAS Pin	READY/ACTIVE State		1.9	2	2.1	1	1.9	2	2.1	2, 3	V
A _{IB}	Isolated Interface Current Gain	V _A ≤ 1.6V	I _B = 1mA	18	20	22	1	18	20	22	2, 3	mA/ mA
isoSPI Pulse Timing Specifications												
t _{1/2PW(D)}	Data Half-Pulse Width			40	50	60	4	40	50	60	5, 6	ns

ELECTRICAL CHARACTERISTICS (Post-Irradiation)Specifications are at $T_A = 25^\circ\text{C}$. The test conditions are $V^+ = 39.6\text{V}$, $V_{\text{REG}} = 5.0\text{V}$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	10kRad (SI)		15kRad (SI)		UNITS	
			MIN	MAX	MIN	MAX		
ADC DC Specifications								
	Total Measurement Error (TME) in Normal Mode	C(n) to C(n-1) = 2.0	-1.8	1.8	-2.6	2.6	mV	
		GPIO(n) to V ⁻ = 2.0	-2.4	2.4	-3.2	3.2	mV	
		C(n) to C(n-1) = 3.3	-2.6	2.6	-4.0	4.0	mV	
		GPIO(n) to V ⁻ = 3.3	-3.6	3.6	-5.0	5.0	mV	
		C(n) to C(n-1) = 4.2	-3.4	3.4	-5.3	5.3	mV	
		GPIO(n) to V ⁻ = 4.2	-4.6	4.6	-6.5	6.5	mV	
		VREG Pin	-17.5	17.5	-31.5	31.5	mV	
	Total Measurement Error (TME) in Filtered Mode	VREG Pin	-16.5	16.5	-32.5	32.5	mV	
I _L	Input Leakage Current When Inputs Are Not Being Measured	C(n), n = 0 to 12	-360	360	-360	360	nA	
		GPIO(n), n = 1 to 5	-360	360	-360	360	nA	
Voltage Reference Specifications								
V _{REF1}	1st Reference Voltage	VREF1 Pin, No Load	3.10	3.30	3.10	3.30	V	
V _{REF2}	2nd Reference Voltage	VREF2 Pin, No Load	2.98	3.01	2.98	3.01	V	
General DC Specifications								
I _{VP}	V ⁺ Supply Current	State: Core = SLEEP, isoSPI = IDLE	V _{REG} = 0V	15		325		μA
			V _{REG} = 5V	3.6		100		μA
		State: Core = STANDBY		140		180		μA
		State: Core = REFUP or MEASURE		0.3	0.8	0.3	0.8	mA
I _{REG(CORE)}	V _{REG} Supply Current	State: Core = SLEEP, isoSPI = IDLE	V _{REG} = 5V	425		2800		μA
				475		3000		μA
		State: Core = REFUP		0.1	1.2	0.1	3.3	mA
		State: Core = MEASURE		10.4	12.6	8.6	14.4	mA
	DRIVE Output Voltage	Sourcing 1μA		5.3	5.9	5.3	5.9	V
	Discharge Switch ON Resistance	V _{CELL} = 3.6V		27		27		Ω
SPI Interface DC Specifications								
I _{LEAK(DIG)}	Digital Input Current	Pins CSB, SCK, SDI,ISOMD, SWTEN, A0 to A3		-1.15	1.15	-1.25	1.25	μA
isoSPI DC Specifications								
V _{BIAS}	Voltage on IBIAS Pin	READY/ACTIVE State		1.8	2.2	1.8	2.2	V
A _{IB}	Isolated Interface Current Gain	V _A ≤ 1.6V	I _B = 1mA	17	23	17	23	mA/mA
isoSPI Pulse Timing Specifications								
t _{1/2PW(D)}	Data Half-Pulse Width			39	61	38	62	ns

ELECTRICAL CHARACTERISTICS: BURN-IN DELTA PARAMETERS

Specifications are at $T_A = 25^\circ\text{C}$.

SYMBOL	PARAMETER	CONDITIONS	DELTA LIMITS		UNITS
			MIN	MAX	
V_{REF1}	1st Reference Voltage	VREF1 Pin, No Load	-5	5	mV
V_{REF2}	2nd Reference Voltage	VREF2 Pin, No Load	-5	5	mV
I_{VP}	V^+ Supply Current	State: Core = STANDBY	-0.5	0.5	μA

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: The ADC specifications are guaranteed by the Total Measurement Error specification.

Note 3: V^+ needs to be greater than or equal to the highest C(n) voltage for accurate measurements.

ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
Final Electrical Test Requirements (Method 5004)	1*,2,3,4,5,6
Group A Test Requirements (Method 5005)	1,2,3,4,5,6
Group B and D for Class S, and End Point Electrical Parameters (Method 5005)	1,2,3

*PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

The PDA is specified as 5% based on failures from group A, subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

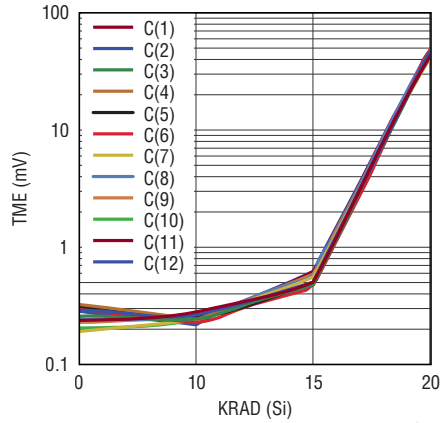
Analog Devices reserves the right to test to tighter limits than those given.

For more information www.analog.com

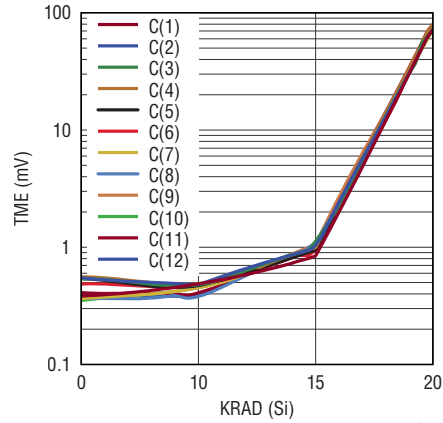


TYPICAL PERFORMANCE CHARACTERISTICS

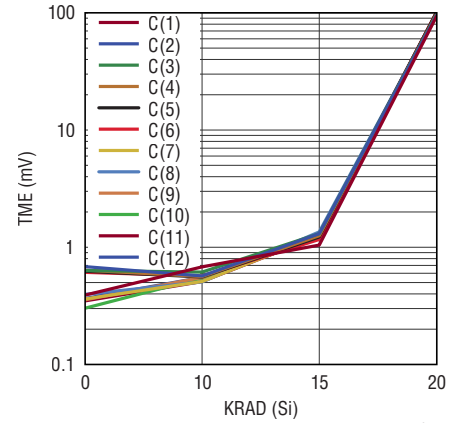
TME in Normal Mode
C(n) to C(n-1) = 2V



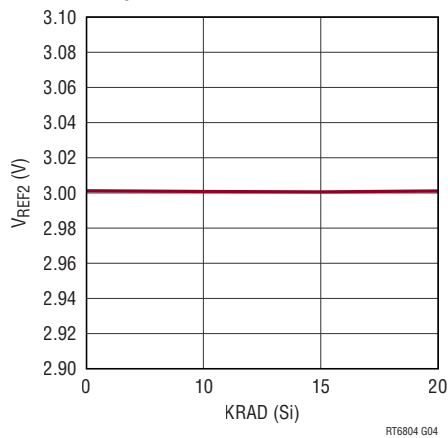
TME in Normal Mode
C(n) to C(n-1) = 3.3V



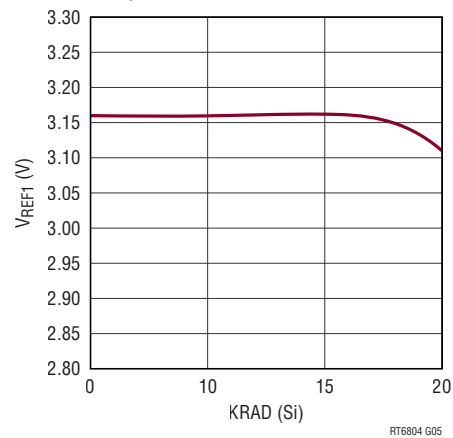
TME in Normal Mode
C(n) to C(n-1) = 4.2V



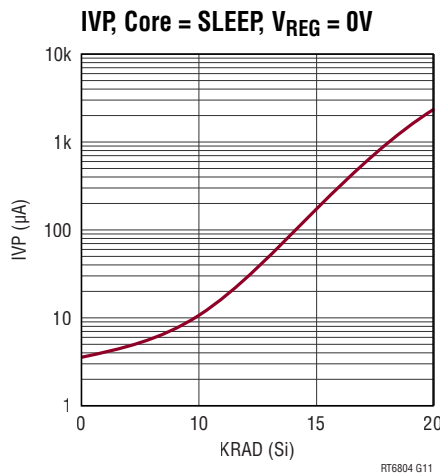
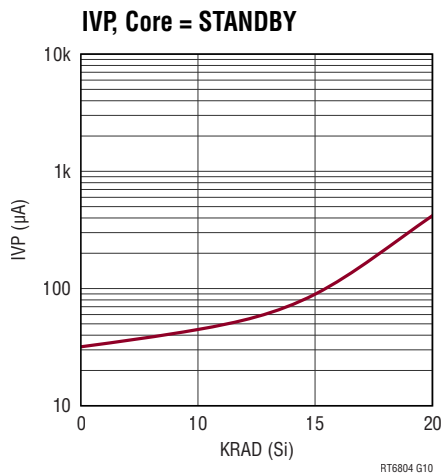
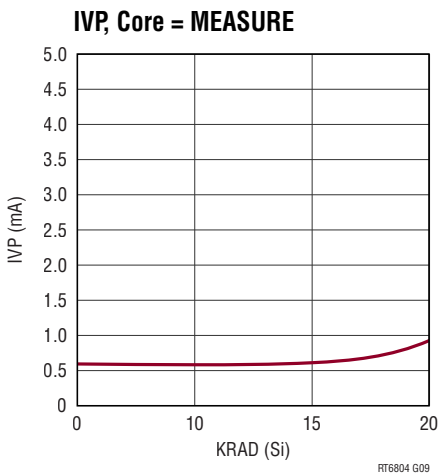
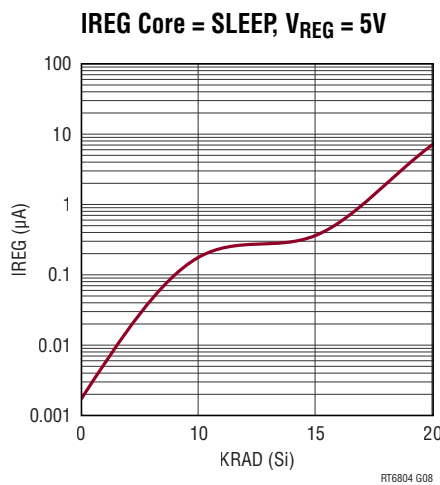
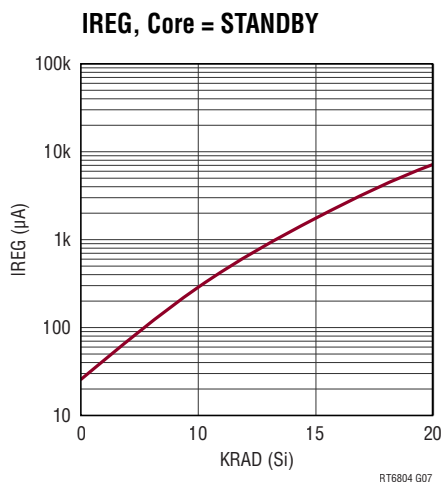
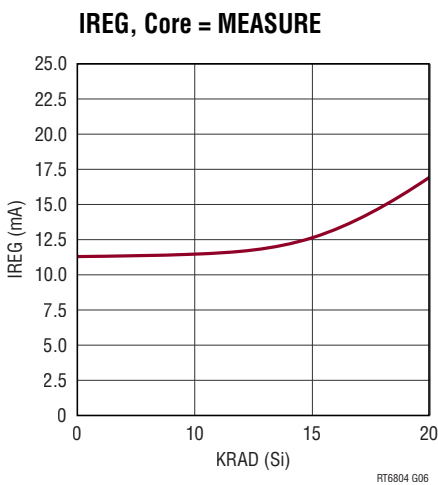
Reference Voltage 2, V_{REF2} ,
 $V_{REG} = 5V$



Reference Voltage 1, V_{REF1} ,
 $V_{REG} = 5V$



TYPICAL PERFORMANCE CHARACTERISTICS

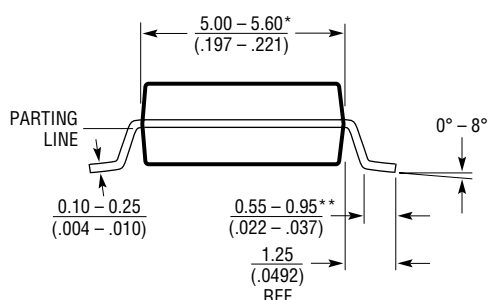
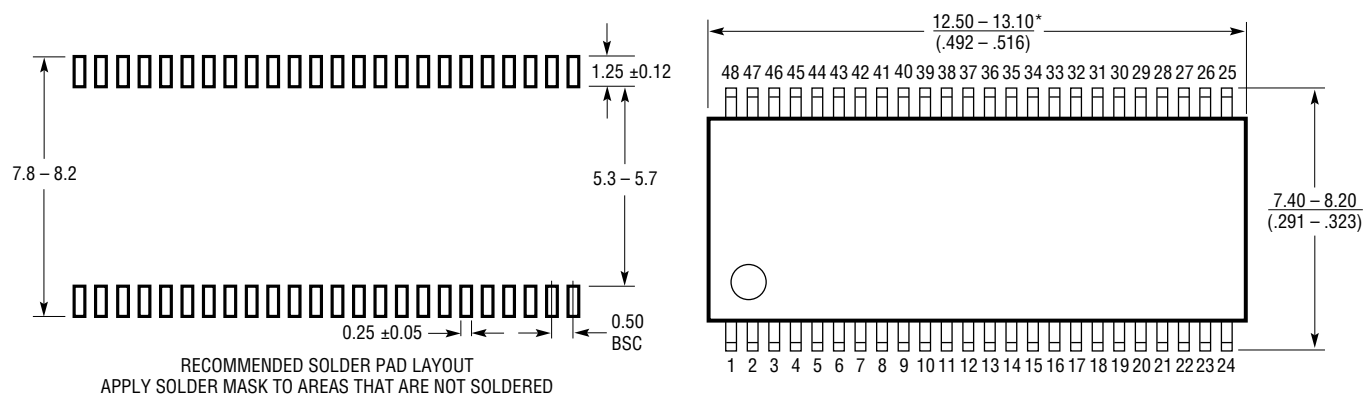


REVISION HISTORY

REV	DATE	DESCRIPTION	PAGE NUMBER
A	05/20	Increased Post 15kRad (Si) V ⁺ Supply Current State: Core = SLEEP, isoSPI = IDLE V _{REG} = 5V to 100 µA	4

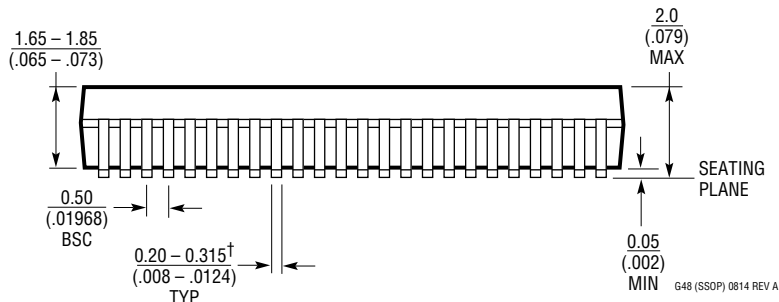
PACKAGE DESCRIPTION

G Package 48-Lead Plastic SSOP (5.3mm) (Reference LTC DWG # 05-08-1887 Rev A)



NOTE:

1. DRAWING IS NOT A JEDEC OUTLINE
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS ARE IN $\frac{\text{MILLIMETERS}}{(\text{INCHES})}$
4. DRAWING NOT TO SCALE
5. FORMED LEADS SHALL BE PLANAR WITH RESPECT TO ONE ANOTHER WITHIN 0.08mm AT SEATING PLANE



*DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS, BUT DO INCLUDE MOLD MISMATCH AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH SHALL NOT EXCEED .15mm PER SIDE

**LENGTH OF LEAD FOR SOLDERING TO A SUBSTRATE

†THE MAXIMUM DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSIONS. DAMBAR PROTRUSIONS DO NOT EXCEED 0.13mm PER SIDE

G48 (SSOP) 0814 REV A