MAX77829 Companion PMIC for Smartphone and Tablet

General Description

The MAX77829 is a high-performance companion PMIC for latest 3G/4G smartphones and tablets. The PMIC includes a single-input 2.0A switched-mode charger with reverse-boost capability and adapter input protection up to 22V (DC) for one-cell Lithium-Ion (Li+) battery, a safeout LDO, and WLED backlight driver supporting up to 25mA/string, 35V output voltage. It also features a dual-channel 1.5A (combined, 750mA/CH) Flash LED driver (with Torch Mode included).

The typical 4MHz switched-mode battery charger with two integrated switches, providing the smallest L/C size, lowest heat and fastest programmable battery-charging current, is ideally suited for portable devices such as headsets and ultra-portable media players. The charger features single input, which works for adapter/USB type inputs. All the MAX77829 blocks connecting to the adapter/USB pin are protected from input overvoltage events. The DC pin is rated to 22V absolute maximum. The USB-OTG output provides true-load disconnect and is protected by an adjustable output current limit (default 900mA, other current limit is also available with different factory setting up to 900mA).

The battery charger drives an external p-channel MOSFET as power-path switch, and its I^2C-programmable settings can accommodate a wide range of battery sizes and system loads. When configured in reverse boost mode, the MAX77829 requires no additional inductor to power USB OTG accessories and/or provide illumination to the Flash LED.

The switching charger implements a special CC, CV, and die temperature regulation algorithm; the patented MaxFlash prevents overloading a weak battery, further extending battery life.

The MAX77829 features an I^2C 2.0-compatible serial interface consisting of a bidirectional serial data line (SDA) and a serial clock line (SCL).

Benefits and Features

- Highly Integrated Solution
  - Single Input Switched Mode Charger
  - Camera Flash and Torch LED Driver, Dual-Channel 750mA/ch
  - Two-String White LED Backlight Driver, 25mA/ch, 35V OVP
  - One Safeout LDO
- Single High Efficient Switched Mode Charger
  - Supporting Up to 2.0A Charging Current Capability
  - Input-Voltage-Based Automatic Input Current Limit (AICL) Power Management
  - System Voltage Regulator/Battery Charger with External Power Path
  - Various Charging Protection Features
- Single Input Accommodating Standard USB and High Input Voltage Adaptor
  - 22V Absolute Maximum Input Voltage Rating,
  - up to +9.4V Maximum Operating Input Voltage
- USB OTG Capability
  - Reverse Boost Support, Up to 900mA at +5V
  - Programmable Reverse Boost Output Voltage (Up to 5.8V)
- Flexible Programmability
  - I^2C 2.0 Serial Interface
- Compact Package
  - 3.64mm x 3.24mm WLP, 8 x 7 Array, 56-Bumps, 0.4mm Pitch

Applications

- Smartphone and Tablets
- Other Li-Ion Battery Power Handheld Devices

***Ordering Information* appears at end of data sheet.**

Absolute Maximum Ratings

DC, BYP to GND ....-0.3V to +22V
LX, BST to GND ....-0.3V to +12V
CS, SYSS, SYS, AVL, PVL, FET_DRV,
MBATT, IN_FLED, CHGIND to GND ....-0.3V to +6V
MBATSNSP, MBATSNSN, MBATDET,
THM to GND ....-0.3V to +6V
INOK to GND .... -0.3V to (V_{SYS} + 0.3V)
LX, CHGPG Continuous Current ....$2A_{RMS}$
DC, BYP Continuous Current ....$2A_{RMS}$
FLED to GND .... -0.3V to (V_{BYP} + 0.3V)
TORCHEN, FLASHEN to GND ....-0.3V to (V_{SYS_A} + 0.3V)
FLED1, FLED2 Current ....$0.8A_{RMS}$
SAFEOUT to GND .... -0.3V to (V_{DC} + 0.3V)
SAFEOUT Continuous Current 100mA
WLEDOUT, WLED1, WLED2 to GND .... -0.3V to +36V
WLEDGND, WLEDPGND to GND .... -0.3V to 0.3V
WLEDPWM to GND .... -0.3V to (V_{SYS} + 0.3V)
WLEDLX Continuous Current ....$1.2A_{RMS}$
VIO to GND ....-0.3V to +6V
SDA, SCL to GND .... -0.3V to (V_{VIO} + 0.3V)
MRST, RESET, INT to GND ....-0.3V to (V_{SYS_A} + 0.3V)
TEST_, VCCTEST, SYS_ to GND ....-0.3V to +6V
GND_ to GND ....-0.3V to +0.3V
Continuous Power Dissipation (T_A = +70°C)
WLP (derate 25mW/°C above 70°C)..........................2000mW
Operating Temperature .... -40°C to +85°C
Junction Temperature ....+150°C
Storage Temperature Range .... -65°C to +150°C
Soldering Temperature (reflow) ....+260°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Package Thermal Characteristics (Note 1)

WLP
Junction-to-Ambient Thermal Resistance (θ_{JA}) ....40°C/W

Note 1: Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to www.maximintegrated.com/thermal-tutorial.

Electrical Characteristics

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC INPUT						
DC Operating Voltage Range			3.5		V_{OVLO} (min)	V
DC Startup Voltage Range			4.0		V_{OVLO}	V
DC Undervoltage Lockout	V_{UVLO}	DC rising, 500mV hysteresis	3.6	3.8	4.0	V
DC Overvoltage Lockout	V_{OVLO}	DC rising, 3% hysteresis, contact factory for alternate thresholds (5.9V, 7.5V, 9.7V)	6.3	6.5	6.7	V
DC_V Threshold	V_{DC_V}	DC rising, 200mV hysteresis	5.7	5.8	5.95	V
DC Overvoltage Interrupt Delay				16		ms
DC Insertion Debounce Time	t_{DBDC}		100	120	150	ms
DC to SYS Shutdown Threshold		When charging stops, V_{DC} falling, 150mV hysteresis	0	50	100	mV

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DC Supply Current	I_{DC}	USB suspend, V_{DC} = 5.5V				0.5	mA
		Charger enabled, f = 4MHz, V_{DC} = 5.5V, V_{SYSMIN} = 3.55V, QBAT off, no load			2		
DC Current Limit	I_{DC_ILIM}	Programmed DCILMT[5:0], minimum			0.1		A
		Programmed DCILMT[5:0], typical			2		
Input Current Limit Accurancy		USB 100mA mode		90	95	100	mA
		USB 500mA mode		450	475	500	
		Programmed to 1.5A		1350	1500	1650	
Adaptive Input Current Limit (AICL) Voltage Threshold	V_{DC_AICL}	DC voltage where charging current is regulated, programmable from 4.0V to 4.6V in 100mV increments (4.5V setting)		4.410	4.5	4.635	V
		DC voltage where the charging current is reset to its minimum value (75mA), AICL_RESET=0			V_{DC_AICL} - 0.1		V
Input Limit Switch		V_{DC} = 5.5V, I_{BYP} = 100mA			50	100	mΩ
LEAKAGE CURRENT							
BST Leakage Current		V_{BST} = V_{LXCHG} = 5.5V, V_{DC}= $V_{PGCHG,}$ V_{SYS} = 3.7V	T_A = +25°C		0.01	10	µA
			T_A = -40°C to +85°C		0.1		
MBATT Reverse-Leakage Current		V_{MBAT} = 4.2V, V_{DC} = 0V	T_A = +25°C		0.01	10	µA
			T_A = -40°C to +85°C		0.1		
BUCK CONVERTER OPERATION							
Switching Frequency		V_{MBAT} = 3.7V			4		MHz
Max Duty Cycle						99.5	%
Minimum On-Time					35		ns
Maximum On-Time					10		µs
Minimum Off-Time					35		ns
Soft-Start Time					1.5		ms
High-Side Resistance		I_{LX} = 100mA, V_{DC} = 5.5V			130	250	mΩ
Low-Side Resistance		I_{LX} = 100mA, V_{DC} = 5.5V			150	220	mΩ
Thermal Regulation Temperature		Programmable-2 bits, see the REGTEMP[1:0]	Minimum		75		°C
			Maximum		120		
			Step size		15		
BATTERY CHARGER							
Pre-Charge Lower Threshold	V_{PQLTH}	V_{MBATT} rising, 125mV hysteresis, contact the factory for alternative selection for 2.1V, 2.2V, 2.3V, 2.4V, 2.5V, 2.6V, 2.7V, 2.8V			2.1		V
Dead-Battery Charge Current	I_{PQLTH}	0V ≤ V_{MBAT} ≤ V_{PQLTH}			40		mA

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Precharge Upper Threshold	V_{PQUTH}	V_{MBAT} rising, 150mV hysteresis, contact the factory for alternative settings			3.4		V
Precharge Current	I_{PRECHG}	Contact factory for alternative settings, 100mA, 200mA, 300mA, 400mA) with 200mA as default setting			200		mA
CONSTANT CURRENT MODE							
BATT Fast-Charge Current Range	I_{FCHG}	Programmable 50mA steps, RCS = 47mΩ	Minimum		250		mA
			Maximum		2000		
Fast-Charge Current Accuracy (Voltage Across R_{CS})		11.5mV < V_{RCS} < 70.5mV R_{CS} = 47mΩ, V_{RCS} = R_{CS} x I_{CHG}	T_A = +10°C to +45°C	-5		+5	%
			JEITA Safety Region	-65	-50	-35	
CONSTANT VOLTAGE MODE							
Battery Regulation Voltage Range		Programmable with MBATREG[3:0]	Minimum		3.55		V
			Maximum		4.4		
Battery Regulation Voltage Accuracy	V_{MBATT}	When the charger is regulating battery voltage (i.e. top-off mode or fast-charger constant voltage mode), then it will regulate based on MBATREG[3:0].	T_A = +25ºC	-0.5		+0.5	%
			T_A = -40ºC to +85ºC	-1		+1	
		Charger is regulating battery voltage , $V_{MBATREG}$ = 4.2V (MBATREG[3:0]=0b1011), $V_{MBATREG}$ = 4.35V (MBATREG[3:0]=0b1111)	When JEITA is enabled (JEITA_EN=1) and the battery temperature is in the "COOL" Region, the battery regulation voltage will be this much lower than the value programmed by MBATREG[3:0].		150		mV
Battery Refresh Threshold		$V_{MBATREG}$ = 4.2V (MBATREG[3:0]=0b1011), $V_{MBATREG}$ = 4.35V (MBATREG[3:0]=0b1111) After the charger enters the DONE state, it will restart when the battery falls this percentage below $V_{MBATREG}$ (MBATREG[3:0])	CHGRSTRT = 0	1	3	5	%
			CHGRSTRT = 1	2	4	6	
Battery Overvoltage Protection	V_{MBAT_OVP}	$V_{MBATREG}$ = 4.2V (MBATREG[3:0]=0b1011), $V_{MBATREG}$ = 4.35V (MBATREG[3:0]=0b1111) VMBATT threshold over regulation voltage, hysteresis 2.2% (V_{BAT} falling)		102	104	106	%

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Charge Current Termination Threshold Range	I_{DONE}	I²C programmable, see I_{TOPOFF}[2:0]. I_{DONE} current independent of JEITA functionality	Minimum		50		mA
			Maximum		400		
			Step size		50		
Charge Current Termination Deglitch Time		2mV overdrive			16		ms
Charge Current Termination Accuracy		I_{DONE} = 200mA		180		224	mA
		I_{DONE} = 50mA		35		70	
VICHG							
VICHG Output Voltage		V_{ICHG_GAIN} = 0, 1.41mV/mA	I_{OUT} = 50mA		70.5		mV
			I_{OUT} = 1000mA	1260	1410	1540	
			I_{OUT} = 1500mA		2150		
CHARGER TIMER							
Dead-Battery and Precharge Time	t_{PRECHG}	USB 500mA mode (t_{PRECHG_500})			14	16	min
		USB 100mA mode (t_{PRECHG_100})			39	45	
Fast-Charge Time Range	t_{FCHG}	I²C programmable, refer to FCHGTIME[2:0] for detailed values	Minimum		4		hour
			Maximum		16		
Fast-Charge Timer Accuracy		Default 5 hours setting			5	6	hour
Top-Off Time	t_{TOPOFF}	I²C programmable (See the T_{OPOFFT}[2:0])	Minimum		0		min
			Maximum		60		
			Step size		10		
Top-Off Timer Accuracy		Default 30 minute setting			20		%
Timer Extend Current Threshold		Percentage of fast-charge current below which the timer clock operates at half-speed (when JEITA is enabled)			50		%
REVERSE BOOST							
BYP Reverse Boost Voltage Adjustment Range		Programmable with RBOUT[3:0], 2.6V < V_{SYS} < V_{BYP} - 0.5V	Minimum		3.0		V
			Maximum		5.8		
			Step size		0.025		
Reverse Boost Quiescent Current		Switching			2.1		mA
Reverse Boost Voltage Accuracy		5.1V setting, 0mA < I_{LOAD} < 500mA		4.94	5.1	5.36	V
Reverse Boost Converter Maximum Output Current		V_{SYS} = 3.7V(minimum required SYS voltage to guarantee the boost output current)		1500			mA

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Reverse Boost Output Voltage Ripple		Discontinuous inductor current (i.e. skip mode)			±50		mV
		V_{BAT} = 3.6V, V_{BYP} = 5.5V, I_{BYP} = 100mA			±50		mV
DC Output Capacitor		Device included				22	µF
Maximum DC Output Current		V_{SYS} = 3.7V		900			mA
DC Output Current Limit	OTGILIM			1000		1970	mA
OTGILIM Interrupt Debounce					30		ms
Reverse Boost Output Voltage Ripple		When DC output current hits OTGILIM	Retry on-time		0.5		ms
			Retry off-time		330		
Inductor Peak Current Limit				3.49	3.9	4.40	A
BYP_UVLO		Falling		4.30	4.35	4.45	V
BYP_UVLO Hysteresis					150		mV
BAT-SYS-FET DRIVER							
FET_DRV Output High		I_{SOURCE} = -1mA		V_{PVL} - 0.2			V
FET_DRV Output Low		I_{SINK}= 1mA				0.2	V
Minimum V_{SYS} Regulation Voltage Range	V_{SYSMIN}	Programmable with V_{SYSREG}[2:0]	Minimum		3.0		V
			Maximum		3.6		
			Step size		0.1		
MBATT to SYS FET Turn-On Threshold		Turn-on threshold (V_{MBATT} rising)			V_{PQUTH}		V
		Turn-off threshold (V_{MBATT} falling)			V_{PQUTH} - 0.15		V
Supplement Mode Threshold Level		Entering supplement mode when V_{SYS} < V_{BAT}		25	40	50	mV
		Exiting supplement mode		10			mV
BATTERY OVERCURRENT THRESHOLD							
Battery Overcurrent Threshold Alarm		$R_{BATRSNS}$ = 5mΩ, BAT2SOC[1:0] = 4.0A setting, overcurrent from BAT to SYS sensed through the 5mΩ resistor, it does not shut off external FET, but provides an overcurrent interrupt through BAT_I to the processor		16	20	24	mV
Battery Overcurrent Debounce Time		4ms setting (programmable from 4ms to 10ms)		3.8	4.0	4.2	ms

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2µF, C_{PVL} = C_{AVL} = 10µF, C_{SYS} = 10µF, C_{MBAT} = 4.7µF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
BATTERY DETECTION							
Low-Cost Battery Presence Detection Voltage		V_{INI2C} = 1.8V, $V_{\overline{MBATDET}}$ rising, 60mV hysteresis		1.063	1.1	1.136	V
				59.1	61.1	63.1	% V_{INI2C}
High-Cost Battery Presence Detection Voltage		V_{INI2C} = 1.8V, $V_{\overline{MBATDET}}$ rising, 20mV hysteresis		1.454	1.5	1.536	V
		Turn off threshold (V_{MBATT} falling)		80.8	83.3	85.3	% V_{INI2C}
Battery Disconnect Detection Voltage		V_{INI2C} = 1.8V, $V_{\overline{MBATDET}}$ rising, 60Mv hysteresis		1.621	1.65	1.676	V
		Turn-off threshold (V_{MBATT} falling)		90.1	91.6	93.1	% V_{INI2C}
Battery Detection Debounce Timer (BAT_ REMOVED)		Programmable with TDEB_BATREM[4:0]	Minimum		0		µs
			Maximum		976		
			Step Size		30.5		
Strong Pullup Resistor		STRONGPUENB=0		2.4	4.7	9.4	kΩ
$\overline{MBATDET}$ Leakage Current		V_{INI2C} = 5.5V, $V_{\overline{MBATDET}}$ = 0V T_A = +25°C		-1	0.01	+1	µA
		V_{INI2C} = 5.5V, $V_{\overline{MBATDET}}$ = 0V T_A = +85°C			0.1		
THERMISTOR MONITOR (Thresholds are calculated for R25 = 100kΩ and β = 4050K)							
THM Threshold, Cold, No Charge (-7°C)	T1	V_{THM}/V_{AVL} rising, 2% hysteresis (thermistor temperature falling)		75.4	77.9	80.4	%
THM Cool Threshold (10°C)	T2	V_{THM}/V_{AVL} rising, 2% hysteresis (thermistor temperature falling), Disabled through JEITA_EN register		61.5	64	66.5	%
THM Warm Threshold (45°C)	T3	V_{THM}/V_{AVL} falling, 2% hysteresis (thermistor temperature rising) , Disabled through JEITA_EN register		30.47	32.97	35.47	%
THM Threshold, Hot, No Charge (56°C)	T4	V_{THM}/V_{AVL} falling, 2% hysteresis (thermistor temperature rising)		23.1	25.6	28.1	%
THM Leakage Current		V_{THM} = V_{AVL} or 0V	T_A = +25°C	-0.2	+0.01	+0.2	µA
			T_A = +85°C		0.1		

Electrical Characteristics (continued)

(V_{DC} = 5V, C_{BYP} = 2.2μF, C_{PVL} = C_{AVL} = 10μF, C_{SYS} = 10μF, C_{MBAT} = 4.7μF, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
PVL/AVL OUTPUTS							
Dropout Voltage	V_{DO}	V_{SYS} = 3.6V, I_{AVL} = 30mA, V_{DO} = V_{BYP} - V_{AVL}	V_{DC} = 4.5V		50		mV
			V_{DC} = 0V		18		
Current Limit					400		mA
Maximum Output Current	I_{AVLMAX}			100			mA
AVL/PVL POK Output Threshold		Threshold where internal power rails to charger turns on			2.7		V
AVL/PVL Regulated Output		I_{AVL} = 0V to I_{PVLMAX}, V_{DC} = 5.5V		4.75	5.00	5.25	V
INOK							
Output Low Voltage		I_{SINK} = 1mA				0.4	V
Output High Leakage		V_{SYS} = 5.5V	T_A = +25°C	-1	0	+1	μA
			T_A = +85°C		0.1		
CHGIND							
Output Low Voltage		I_{SINK} = 10mA				0.4	V
Output High Leakage		V_{SYS} = 5.5V	T_A = +25°C	-1	0	+1	μA
			T_A = +85°C		0.1		
THERMAL SHUTDOWN							
Thermal Shutdown Temperature					160		°C
Thermal Shutdown Hysteresis					15		°C
BYP to IN_FLED SWITCH							
IN_FLED Switch Resistance		V_{BYP} = 5.0V, loading = 150mA			160	320	mΩ

LED Flash Driver EC Characteristics

(V_{SYS} = 3.7V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
FLASH DC-DC STEP-UP CONVERTER (Shared with switch mode charger)						
Adaptive Control Range	V_{IN_FLED}	Adaptive controlled	3.3		5.5	V
Adaptive Output Voltage Regulation Threshold		$V_{IN\_FLED-VFLED\_}$, $I_{FLED\_}$ = 750mA		250		mV
Adaptive Regulation Step Size		Smallest step that the output will regulate to		25		mV

LED Flash Driver EC Characteristics (continued)

(V_{SYS} = 3.7V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
FLED CURRENT REGULATOR							
IN_FLED Supply Current					1.1		mA
Current Setting for FLED_ (i.e., FLED1 or FLED2)		Current range in Flash mode in 23.436mA/step, powered from IN_FLED (FLED1NUM=0)		23.436		750	mA
		Current range in Torch mode in 23.436mA/step		23.436		375	
Current Accuracy		93mA setting; V_{BYP} = 5V; $V_{FLED\_}$ = 4.2V	T_A = +25°C	-2.5		+2.5	%
			T_A = -40°C to +85°C	-4.5		+6.5	
Current Regulator Dropout		750mA setting, 10% drop in output current, V_{BYP} = 3.3V			220	350	mV
		750mA setting, 1% drop in output current, V_{BYP} = 3.3V			220		
Turn-Off Time		From FLASHEN falling edge or TORCHEN falling edge or timer expire until ramping of current on FLED1/FLED2				1.5	µs
FLED1/FLED2 Current Ramping Down		Time taken for ramping current from 750mA setting to OFF setting			2		µs
FLED1/FLED2 Leakage in Shutdown		V_{IN_FLED} = 5.5V, $V_{FLED\_}$ = 0V	T_A = +25°C		0.01	5	µA
			T_A = +85°C		0.1		µA
PROTECTION CIRCUITS							
Flash Duration Timer		In 62.5ms steps		62.5		1000	ms
Flash Duration Timer Accuracy				-10		+10	%
Flash Safety Timer Reset Inhibit Period		From falling edge of FLASHEN or TORCHEN or register bits until flash safety timer is reset		450		700	µs
Torch Timer Range (Can be Disabled via I²C Programming)		In 0.262s steps		0.262		1.049	s
		In 0.524s steps		1.048		3.146	
		In 1.049s steps		3.145		7.340	
		In 2.097s steps		7.340		15.729	
Torch Timer Accuracy				-10		+10	%
Open LED Protection Threshold		FLED1 enabled			V_{IN_FLED} – 30mV		mV
Shorted LED Protection Threshold		FLED				1.0	V
FLED_ Short Debounce Timer		From FLED_ short detected until FLED_ current regulator is disabled – FLED_ source is disabled after this timer to prevent excessive battery current			1		ms
FLED_ Open Debounce timer		From FLED_ open detected until FLED_ current regulator is disabled – IN_FLED voltage is limited to 5.8V max – FLED_ current source is disabled after this timer			8		ms

LED Flash Driver EC Characteristics (continued)

(V_{SYS} = 3.7V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
MAXFLASH						
Low SYS Detect Threshold Range		In 33mV steps	2.400		3.433	V
Low SYS Voltage Threshold Accuracy				± 2.5		%
Low SYS Voltage Hysteresis Programmable Range		In 100mV steps	100		300	mV
Low SYS Inhibit Timer			256		2048	ms
		Rising in 256µs steps	256		2048	
Low SYS Inhibit Time Accuracy			-10		+10	%
FLASHEN, TORCHEN INPUTS						
Pulldown Resistor			400	800	1600	kΩ
Input Capacitance		(Note 3)		10		pF
Input Low Voltage	V_{IL}				0.54	V
Input High Voltage	V_{IH}		1.26			V

Safeout LDO

(V_{DC} = 5V, V_{BATT} = 3.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SAFEOUT						
Output Voltage (Default ON)		5.0V < V_{DC} < 5.5V, $I_{SAFEOUT}$ = 10mA, SAFEOUT[1:0] = 01'b (default)	4.65	4.9	5.15	V
		SAFEOUT[1:0] = 00'b		4.85		V
		SAFEOUT[1:0] = 10'b		4.95		V
		SAFEOUT[1:0] = 11'b		3.3		V
Maximum Output Current			60			mA
Output Current Limit				150		mA
Dropout Voltage		V_{CHGIN} = 5V, I_{OUT} = 60mA		120		mV
Load Regulation		V_{CHGIN} = 5.5V, 30µA < I_{OUT} < 30mA		50		mV
Quiescent Supply Current		Not production tested		72		µA
Output Capacitor for Stable Operation (Note 3)		0µA < $I_{SAFEOUT}$ < 30mA, maximum ESR = 50mΩ	0.7	1		µF
Internal Off-Discharge Resistance				1200		Ω

White LED Backlight Driver

(V_{SYS} = 3.7V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
STEP-UP WLED DRIVER							
Input Voltage Range				2.5		V_{OVLO}	V
Step-Up Converter Quiescent Current		No switching, includes 20µA for each current source			200		µA
Step-Up Converter Shutdown Current		V_{SYS} = 5.2V, All current sources disabled				1	µA
Current Source Quiescent Current		$V_{WLEDOUT}$ = 20V, change in quiescent current when 1 current source is enabled or disabled			20		µA
Step-Up Converter Switching Frequency		BSTEN = 1, LEDPWM duty cycle > 0	WLEDFOSC = 00		0.667		MHz
			WLEDFOSC = 11		1		
Maximum Duty Cycle		WLEDFOSC[1:0] =11		93			%
Soft-Start Duration					10		V/ms
Output Voltage Range				V_{BAT}		35	V
Overvoltage Protection Threshold			WLEDOVP = 1	34.1			
WLEDOUT Leakage Current		$V_{WLEDOUT}$ = 5.5V, V_{SYS} = 5.2V, boost in shutdown (Note 3)	T_A = +25°C		0.12		µA
			T_A = +25°C		2		µA
		$V_{WLEDOUT}$ = 35V, V_{WLEDLX} = 35V, boost in shutdown			25		µA
Current Source Linear Output Range		8-bit linear dimming range (97.656µA/LSB)		0		25	mA
Current Source Dropout Voltage		$I_{WLED\_}$ = 25mA (programmed), ($V_{WLED\_}$ - $V_{WLEDGND}$) measured when $I_{LED\_}$ has dropped to 90% of full-scale programmed level, $V_{WLEDOOUT}$ = 20V, T_A = +25°C			100	180	mV
WLED Current Accuracy		$I_{WLED\_}$ = 25mA, $V_{WLED\_}$ = 0.5V above $V_{WLEDGND}$, $V_{WLEDOUT}$ = 20V, T_A = +25°C		-1		+1	%
WLED Current Matching		Mismatch between W_{LED1} and W_{LED2}, $I_{WLED\_}$ = 25mA, (V_{WLED} - $V_{WLEDGND}$) = 0.5V, $V_{WLEDOUT}$ = 20V, T_A = +25°C		-1		+1	%
WLED Leakage Current in shutdown		$V_{WLEDOUT}$ = 35V, $V_{WLED\_}$ = 35V	T_A = +25°C		0.1	1	µA
			T_A = +85°C		1		µA
WLEDLX Leakage Current		V_{WLEDLX} = 35V, $V_{WLEDOUT}$ = 35V	T_A = +25°C	-5	+0.1	+5	µA
			T_A = +85°C		1		µA
N-Channel On-Resistance		I_{WLEDLX} = 175mA			400		mΩ

White LED Backlight Driver (continued)

(V_{SYS} = 3.7V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
N-Channel Current Limit		Current regulation mode	935	1100	1265	mA
WLED_ Voltage Regulation Maximum		($V_{WLED\_}$ - $V_{WLEDGND}$) below dropout voltage level of highest string		50		mV
WLED_ Voltage Regulation Window		Nonskip mode		125		mV
		Skip mode		487.5		mV
WLEDPWM Input Frequency Range		External PWM input	5		60	kHz
WLEDPWM Input Duty Cycle Range			0		100	%
WLEDPWM Input Current Dimming Range		PWM Duty = 0% to 100%	0		25	mA
WLEDPWM Input Current		V_{SYS} = 2.5V to 5.2V, $V_{WLEDPWM}$ = 0V and 5.2V	-1		+1	µA
WLEDPWM Input Logic High		V_{SYS} = 2.5V and 5.2V	1.2			V
WLEDPWM Input Logic Low		V_{SYS} = 2.5V and 5.2V			0.4	V

General, I²C, Logic, and Thermal

(V_{SYS} = 3.7V, V_{IO} = 1.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Shutdown Supply Current	I_{SYS}	All circuits off		15	30	µA
SYS INPUT RANGE						
SYS Operating Voltage		Guaranteed by $V_{SYSUVLO}$ and $V_{SYSOVLO}$	2.8		5	V
SYS Undervoltage Lockout Threshold (SYS UVLO)		V_{SYS} falling, 200mV hysteresis	2.45	2.5	2.55	V
SYS Overvoltage Lockout Threshold (SYS OVLO)		V_{SYS} rising, 200mV hysteresis	5.2	5.36	5.52	V
Low SYS Thresholds		Range programmable via LSDAC register, V_{SYS} falling	2.60		3.35	V
Low SYS Hysteresis		Range programmable via LSHYST register	100		400	mV
THERMAL SHUTDOWN						
Thermal Shutdown Threshold		T_J rising		165		°C
Thermal Shutdown Hysteresis				15		°C
Thermal Interrupt 1				120		°C
Thermal Interrupt 2				140		°C

General, I²C, Logic, and Thermal (continued)

(V_{SYS} = 3.7V, V_{IO} = 1.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
LOGIC AND CONTROL INPUTS							
SCL, SDA Input Low Level		T_A = +25°C				0.3 x V_{IO}	V
SCL, SDA Input High Level		T_A = +25°C		0.7 x V_{IO}			V
SCL, SDA Input Hysteresis		T_A = +25°C			0.05 x V_{IO}		V
SCL, SDA Logic Input Current		V_{IO} = 3.6V		-10		+10	µA
SCL, SDA Input capacitance					10		pF
SDA Output Low Voltage		Sinking 20mA				0.4	V
Output Low Voltage $\overline{RESET}$, $\overline{INT}$		I_{SINK} = 1mA				0.4	V
$\overline{MRST}$ Input Low Level		T_A = +25°C				0.4	V
$\overline{MRST}$ Input High Level		T_A = +25°C		1.4			V
$\overline{MRST}$ Input Hysteresis		T_A = +25°C			0.1		V
$\overline{MRST}$ Input Current		V_{SYS} = 5.5V	T_A = +25°C	-2	0	+2	µA
			T_A = +85°C		0.1		
Output High Leakage $\overline{RESET}$, $\overline{INT}$		V_{SYS} = 5.5V	T_A = +25°C	-1	0	+1	µA
			T_A = +85°C		0.1		
Interrupt Debounce Filter Timer		LOWSYS			16		ms
$\overline{RESET}$ Deassert Delay					60		ms
Manual Reset Debounce Timer		The period between ($\overline{MRST}$ = Low) and automatic reboot start			3		s
					4		
					5		
					6		
					7 (default)		
					8		
					9		
					10		

General, I²C, Logic, and Thermal (continued)

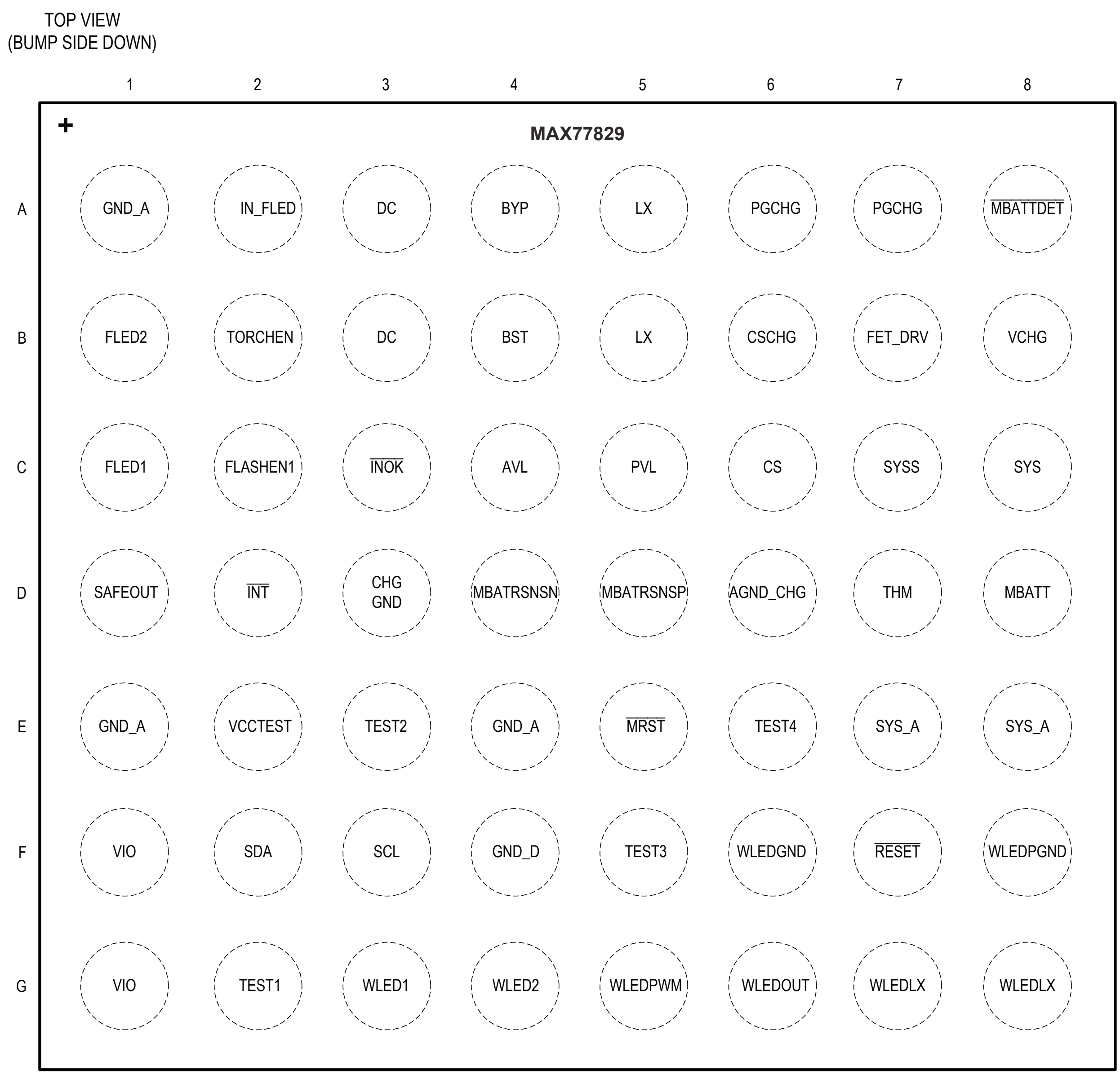
(V_{SYS} = 3.7V, V_{IO} = 1.8V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
I²C INTERFACE (Note 3)						
Clock Frequency			100		400	kHz
Bus-Free Time Between START and STOP			1.3			µs
Hold Time Repeated START Condition			0.6			µs
SCL Low Period			1.3			µs
SCL High Period			0.6			µs
Setup Time Repeated START Condition			0.6			µs
SDA Hold Time			0			µs
SDA Setup time			100			ns
Maximum Pulse Width of Spikes that Must be Suppressed by the Input Filter of Both SDA and SCL Signals				50		ns
Setup Time for STOP Condition			0.26			µs

Note 2: Limits are 100% tested at T_A = +25°C. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design and characterization.

Note 3: Note production tested. Guaranteed by design.

Bump Configuration



WLP
(0.4mm pitch)

N.C. PINS ARE FLOATING AND CAN BE CONNECTED AT BOARD-LEVEL IF NEEDED. GROUND ALL TEST PINS (TEST_ AND VCCTEST).

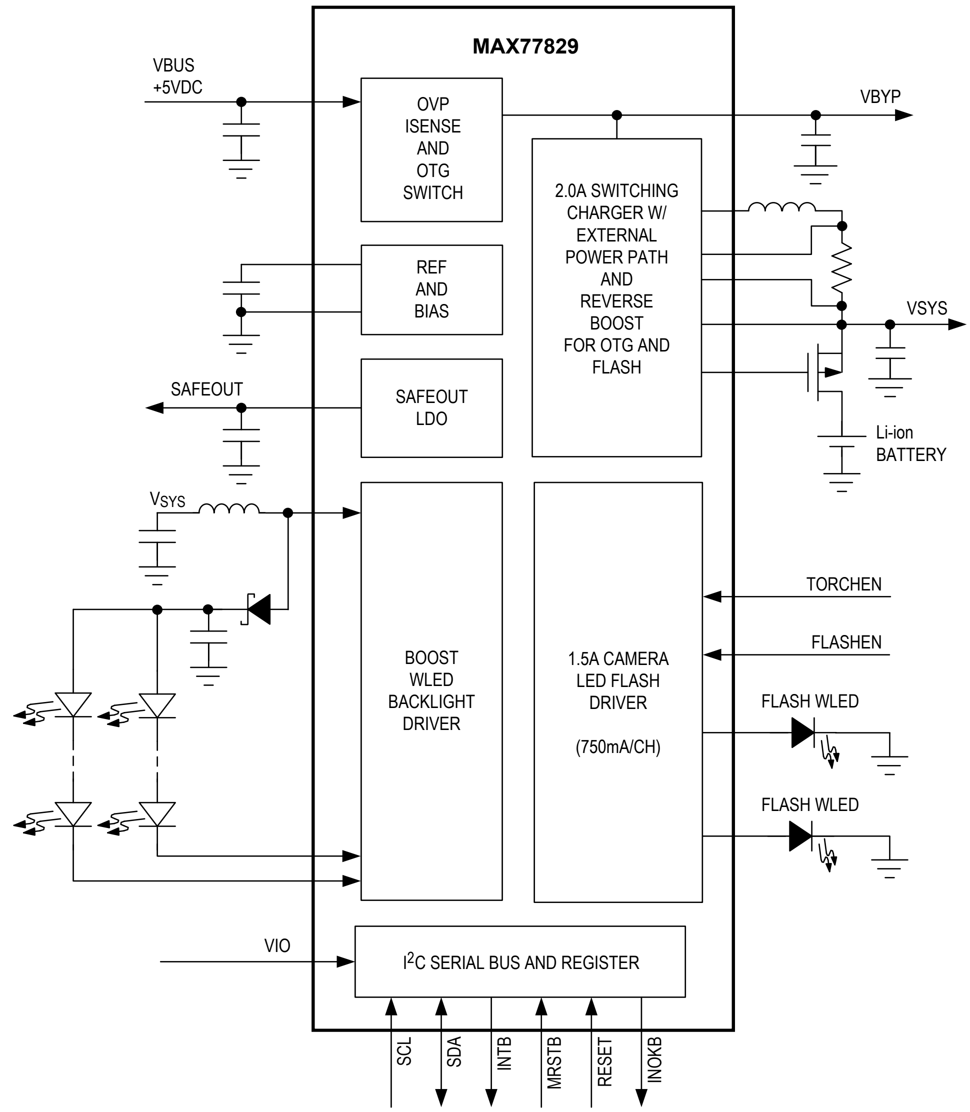
Bump Description

BUMP	NAME	FUNCTION
A3, B3	DC	High-Current Charger Input. Bypass to PGNDC with a 1μF/25V ceramic capacitor. Reverse Boost output.
A4	BYP	Connection Point Between Reverse Blocking MOSFET and High-Side Switching MOSFET. Bypass to PGND with a 4.7μF/25V ceramic capacitor. Reverse boost regulation node.
A5, B5	LX	Buck/Boost Inductor Connection. Connect the inductor between LXCHG and CS.
A6, A7	PGCHG	Power Ground for Charger Step-Down Low-Side FET.
A8	$\overline{\text{MBATDET}}$	Battery Detection Active-Low Input. Connect $\overline{\text{MBATDET}}$ to the ID pin on the battery pack. If $\overline{\text{MBATDET}}$ is pulled to ground, this indicates that the battery is present and the charger starts when valid DC power is present. $\overline{\text{MBATDET}}$ driven high or left unconnected indicates that the battery is not present and the charger will not start. $\overline{\text{MBATDET}}$ is pulled high to AVL through an internal 470kΩ resistor.
B4	BST	High-Side FET Driver Supply. Bypass BST to LXC with a 0.1μF ceramic capacitor.
B6	GSCHG	IC Substrate Ground
B7	FET_DRV	Battery FET Gate Driver
B8	VICHG	Charging Current Monitor
C3	$\overline{\text{INOK}}$	Charger Input Valid Logic Output Flag. Open-drain, active-low output that indicates when valid voltage is present at both CHGIN and SYS. This signal is often needed by the main PMIC or the applications processor.
C4	AVL	Internal Bias Regulator Quiet Analog Bypass Pin. Internal 10Ω connection between PVL and AVL forms LP filter with a 4.7μF external bypass capacitor to GNDCHG.
C5	PVL	Internal Bias Regulator High-Current Output Bypass Pin. Supports internal noisy and high-current gate drive loads. Bypass to PGNDCHG with a minimum 4.7μF ceramic capacitor.
C6	CS	Charger Current Sense Positive Terminal
C7	SYSS	Charger Current Sense Negative Terminal and System Voltage Sense Terminal
C8	SYS	System Power For Linear Charger. Boost supply during startup.
D3	CHGIND	Charging Status Indication. Open-drain, active-low output that indicates when the charging is active.
D4	MBATRSNSN	Battery Current Sense Negative Terminal
D5	MBATRSNSP	Battery Current Sense Positive Terminal
D6	AGND_CHG	Charger Analog Ground
D7	THM	Battery Thermistor Terminal/Battery Detection
D8	MBATT	Battery Positive Terminal. Bypass to AGND with a 4.7μF ceramic capacitor.
C1	FLED1	Flash LED Current Source Output 1. Connect FLED1 to the Anode of a high-brightness LED and Cathode tied to the ground plane. FLED1 has an internal TBDkΩ resistor to GND.
B1	FLED2	Flash LED Current Source Output 2. Connect FLED2 to the Anode of a high-brightness LED and Cathode tied to the ground plane. FLED2 has an internal TBDkΩ resistor to GND.

Bump Description (continued)

BUMP	NAME	FUNCTION
A2	IN_FLED	Flash LED Driver Input. Bypass to GND with 4.7µF ceramic capacitor.
B2	TORCHEN	Torch Mode Enable Active-High Logic Input. TORCHEN has on-chip 800kohm pull-down resistor.
C2	FLASHEN1	Flash Strobe #1 Enable Active-High Logic Input. FLASHEN1 has an internal 800kΩ pull-down resistor.
D1	SAFEOUT	Safeout LDO Output. Default 4.9V and on when CHGIN power is valid. Bypass with a 1µF ceramic capacitor to GND.
F6	WLEDGND	Ground for WLED Current Drivers
F8	WLEDPGND	Power Ground for WLED Boost Converter
G3	WLED1	Current Source Output for WLED1 Boost Converter String. When powering series LEDs, the anode of the LED string should connect to LED.
G4	WLED2	Current Source Output for WLED2 Boost Converter String. When powering series LEDs, the anode of the LED string should connect to LED.
G5	WLEDPWM	Content-Based Adaptive Brightness Control Input for LED Boost Converter. WLEDPWM accepts a logic-level PWM signal with a frequency range of 5kHz to 60kHz.
G6	WLEDOUT	Boost Converter Overvoltage Sense Input. Bypass WLEDOUT to WLEDPGND with a 1µF ceramic capacitor.
G7, G8	WLEDLX	WLED Switching Node
D2	$\overline{\text{INT}}$	Interrupt Output. Active-low open-drain output.
E5	$\overline{\text{MRST}}$	Manual Reset Input for Hardware Reset With Internal Timer
F1,G1	VIO	Digital I/O Supply Input for I^2C Interface
F2	SDA	I^2C Serial Data for MAX77829, Except the Fuel Gauge
F3	SCL	I^2C Serial Clock for MAX77829, Except the Fuel Gauge
F7	$\overline{\text{RESET}}$	Reset Output. Active-low open-drain output with timer. Provides manual reset capability to applications processors when the main PMIC is not already providing this function.
A1,E1 E4	GND_A	Analog Ground
E7, E8	SYS_A	Analog SYS Input. Share with SYS_Q
F4	GND_D	Digital Ground
E2	VCCTEST	Test Pin. Connect to ground.
E3	TEST2	Test Pin. Connect to ground.
E6	TEST4	Test Pin. Connect to ground.
F5	TEST3	Test Pin. Connect to ground.
G2	TEST1	Test Pin. Connect to ground.

Functional Diagram



Detailed Description

Main-Battery charger

The MAX77829 charger is a compact, high-frequency, high-efficiency switch-mode charger for a one-cell Lithium ion (Li+) battery with OTG capability and support to drive external p-channel MOSFET power-path. It delivers up to 2.0A of current to the battery from inputs up to 9.4V for DC and withstands transient inputs up to 22V. The typical 4MHz switch-mode charger is ideally suited for small portable devices such as headsets and ultra-portable media players because it minimizes component size and heat. The MAX77829 has programmable automatic input current limiting to protect upstream charging sources from collapsing. Upon request from the host processor, the MAX77829 can run its switching regulator in reverse to support USB 'On the Go' power, +5V at 500mA (default, up to 900mA with different factory setting).

The MAX77829 can manage two outputs independently, battery charging and system power. This allows immediate system operation under missing/deeply discharged battery conditions.

Battery protection features include low voltage prequalification, charge fault timer, die temperature monitoring, battery temperature monitoring and watchdog timer. The battery temperature monitoring adjusts the charge current and termination voltage for safe use of secondary lithium-ion batteries.

Features

- Efficient 4MHz (typ) Switch Mode Charger Supporting 2.0A Charging Current Capability
- USB OTG Supports 500mA at +5V DC (Default Setting, up to 900mA with Different Factory Setting)
- External Power-Path P-MOSFET Driver for No/Dead Battery Support
- Digital Programming via I^{2}C Interface:
  - Input Current Limit (Up to 2.0A)
  - Fast Charge Current (Up to 2.0A)
  - Termination Current
  - Restart Voltage
  - Safety Timer/Watchdog Timer
- High-Accuracy Voltage and Current Regulation
- Input Current Regulation: ±5%(100mA, 500mA), ±10%(≥ 1A), Default 500mA
- Charger Voltage Regulation: ±0.5% 250C, Adjustable from 3.55V to 4.4V
- Fast Charge Current Regulation: 0.25A to 2.0A ±5%, Default 500mA
- 22V Absolute Maximum Input Voltage Rating
- Up to +9.4V Maximum Operating Input Voltage
- Input Voltage Based Automatic Input Current Limit (AICL)
- Battery/System Load Current Sensing and Limiting
- JEITA Compliance Thermistor Monitoring of Battery Temperature and Adjust Charging Current and Voltage
- Battery Protection:
  - Reverse Leakage Protection Prevents Battery Drainage
  - Input/Output Overvoltage Protection
  - Battery Over Temperature Protection
  - Thermal Regulation and Shutdown
  - Battery Overcurrent Alarm
- System Voltage Regulator/Battery Charger with Power-Path:
  - External p-MOSFET Driver for Power-Path and Battery Charging
  - Supplement Mode to Delivery Current from Battery During Power -Path Operation
- Battery Presence Detection
- Interrupt Status Output
- Input/Output Overvoltage Protection
- Thermal Regulation Protection
- Charging Status Indicator

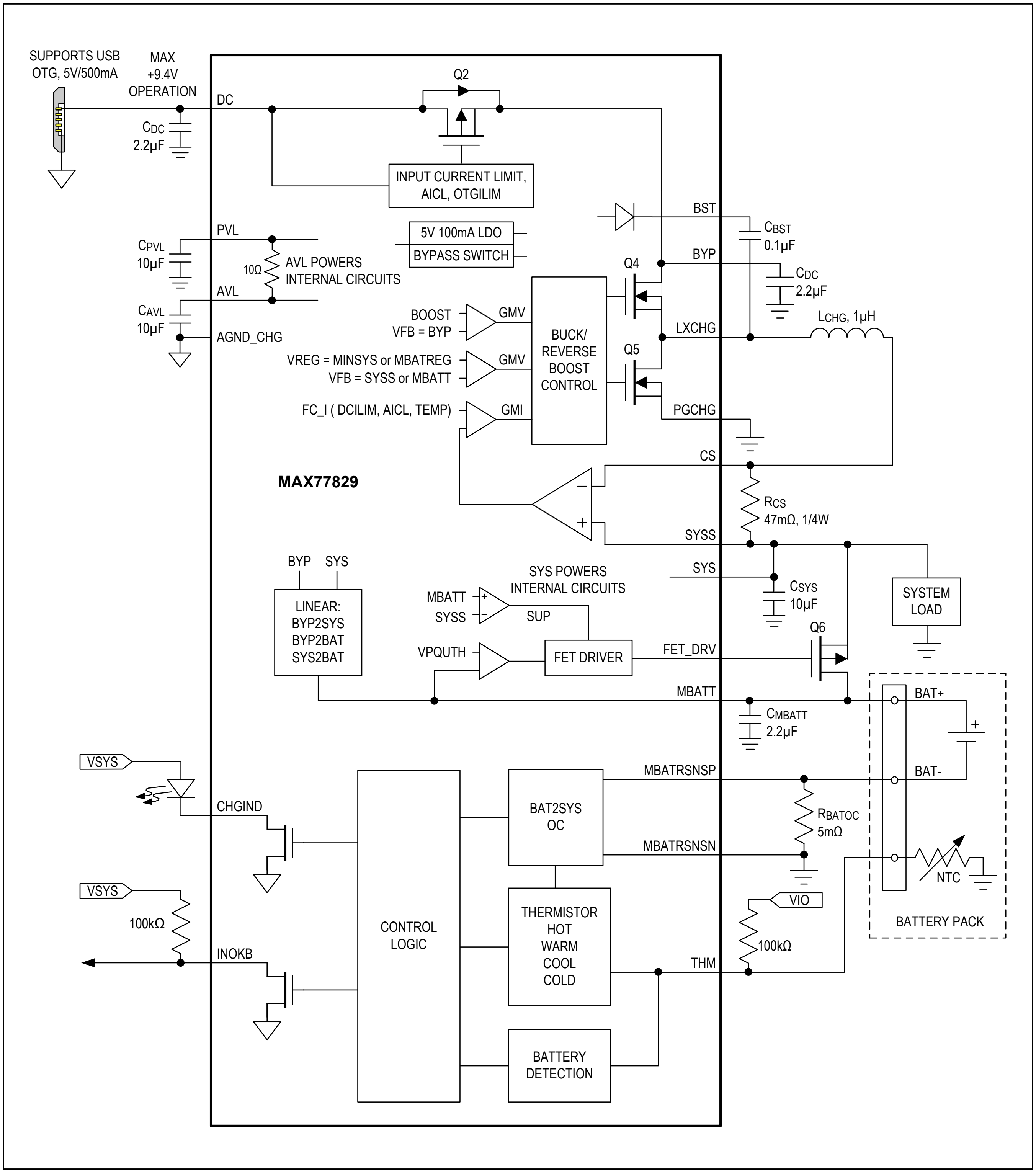


Figure 1. Main-Battery Charger Typical Application Circuit

Inductor Selection

The charger operates with a switching frequency of 4MHz and uses a 1μH or 2.2μH inductor. This operating frequency allows the use of physically small inductors while maintaining high efficiency. The inductor's DC current rating only needs to match the maximum load of the application because the MAX77829 features zero current overshoot during startup and load transients. For optimum transient response and high efficiency, choose an inductor with DC series resistance in the 40mΩ to 120mΩ range. See Table 1 below for suggested inductors and manufacturers.

MBAT Capacitor Selection (C_{MBATT})

Choose the nominal MBAT capacitance (C_{MBATT}) to be 2.2μF. The MBAT capacitor is required to keep the MBAT voltage ripple small and to ensure regulation loop stability. The MBAT capacitor must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectric are highly recommended due to their small size, low ESR, and small temperature coefficients. For optimum load-transient performance and very low output voltage ripple, the MBAT capacitor value can be increased above 2.2μF.

As the case sizes of ceramic surface-mount capacitors decreases, their capacitance vs. DC bias voltage characteristic becomes poor. Due to this characteristic, it is possible for 0603 capacitors to perform well while 0402 capacitors of the same value perform poorly. The recommended nominal MBAT capacitance is 2.2μF, however, after initial tolerance, bias voltage, aging, and temperature derating, the capacitance must be greater than 1.5μF. With the capacitor technology that is available at the time the MAX77829 was released to production, the MBAT capacitance is best achieved with a single ceramic capacitor (X5R or X7R) in a 0402 case size. The capacitor voltage ratings should be 6.3V or greater.

SYS Capacitor Selection (C_{SYS})

Choose the nominal SYS capacitance (C_{SYS}) to be 10μF. C_{SYS} is the output capacitor for the step-down converter when charging. Alternatively, C_{SYS} is the input capacitor for the stepup converter when it is operating in OTG mode. C_{SYS} is required to keep the SYS voltage ripple small and to ensure regulation loop stability. In a typical application, SYS also powers many other elements the MAX77829 Power-SoC as well as system elements. Although the sum total of capacitance on SYS may be ~50μF it is critical that a local C_{SYS} is provided to reduce the current loops created by the DC-DC.

C_{SYS} must have low impedance at the switching frequency. Ceramic capacitors with X5R or X7R dielectric are highly recommended due to their small size, low ESR, and small temperature coefficients. For optimum load-transient performance and very low output voltage ripple, the MBAT capacitor value can be increased above10μF.

As the case sizes of ceramic surface-mount capacitors decreases, their capacitance vs. DC bias voltage characteristic becomes poor. Due to this characteristic, it is possible for 0603 capacitors to perform well while 0402 capacitors of the same value perform poorly. The recommended nominal C_{SYS} is 10μF, however, after initial tolerance, bias voltage, aging, and temperature derating, the capacitance must be greater than 6μF. With the capacitor technology that is available at the time the MAX77829 was released to production, the SYS capacitance is best achieved with a single ceramic capacitor (X5R or X7R) in an 0603 case size. The capacitor voltage ratings should be 6.3V or greater.

Table 1. Suggested Inductors

MANUFACTURER	SERIES	INDUCTANCE (μH)	ESR (Ω)	CURRENT RATING (mA)	DIMENSIONS (mm)
Taiyo Yuden	MAKK2016	1	0.1	2500	2.0 x 1.6 x 1.0
TDK	TFA2016G	1	0.13	2500	2.0 x 1.6 x 1.0
TDK	MLP2520S	1.0	0.06	1500	2.0 x 2.5 x 1.0
TDK	VLS252012	1	0.105	2700	2.5 x 2.0 x 1.2
TOKO	MIPF2520	2.2	0.05	1500	2.5 x 2.0 x 1.0
TOKO	DFE252012C	1	0.06	2500	2.5 x 2.0 x 1.2
FDK	MIPSA2520D1R0	1.0	0.08	1500	2.5 x 2.0 x 1.2
Murata	LQM2HPN_G0	1.0	0.05	1600	2.5 x 2.0 x 0.6
Murata	LQM32PN1R0MG0	1	0.06	1800	3.2 x 2.5 x 0.9
Coilcraft	EPL2014	1.0	0.059	1600	2.0 x 2.0 x 1.4

BYP Capacitor Selection (C_{BYP})

Choose the nominal BYP capacitance (C_{BYP}) to be 2.2µF. C_{BYP} is the input capacitor for the step-down converter when charging. Alternatively, C_{BYP} is the output capacitor for the reverse boost converter. Larger value of C_{BYP} improves the decoupling for the DC-DC converter, but may cause high DC to BYP inrush currents when an input adapter is connected. To limit the inrush current, C_{BYP} must be no larger than 4.7µF.

C_{BYP} reduces the current peaks drawn from the input power source when charging. Similarly, C_{BYP} reduces the output voltage ripple of the stepup converter when it is operating in OTG mode. The impedance of the input capacitor at the switching frequency should be very low. Ceramic capacitors with X5R or X7R dielectric are highly recommended due to their small size, low ESR, and small temperature coefficients. To fully utilize the +22V input capability of the MAX77829, choose C_{BYP} to have a 25V or greater rating; many applications do not need to utilize the full input capability of the device and find that a 16V rating input capacitor is sufficient.

C_{BYP} is a critical discontinuous current path that requires careful bypassing. In the PCB layout, place C_{BYP} as close as possible to the power pins (BYP and PGCHG) to minimize parasitic inductance. If making connections to C_{BYP} through vias, ensure that the vias are rated for the expected input current so they do not contribute excess inductance and resistance between the bypass capacitor and the power pins. The expected C_{BYP} current is the same as the ISAT (see the *Inductor Selection* section).

C_{BYP} must meet the input ripple current requirement imposed by DC-DC converter. Ceramic capacitors are preferred due to their low ESR and resilience to surge currents. Choose the C_{BYP} capacitor so that its temperature rise due to ripple-current does not exceed approximately +10°C. For a step-down regulator, the maximum input ripple current is half of the output current. This maximum input ripple current occurs when the step-down converter operates as 50% duty cycle (V_{IN} = 2 x V_{BAT}).

BST Capacitor Selection (C_{BST})

Choose the nominal BST capacitance (C_{BST}) to be 0.1µF. C_{BST} is part of a charge pump that creates the high-side gate drive for the DC-DC. If larger values of larger values of C_{BST} are used, ensure that CPVL is always 10 times larger than C_{BST}. The maximum expected working voltage of C_{BST} is the same as the PVL regulation voltage (~5V). However, it is recommended that the C_{BST} has at least 10V rating. With the capacitor technology that is available at the time the MAX77829 was released to production, it is possible to find a 10V ceramic 0.1µF 0201 capacitor however these devices are pushing the limits, and a 10V ceramic 0.1µF 0402 may be more cost effective and readily available.

DC Input Capacitor Selection (C_{DC})

Choose the nominal DC capacitance (C_{DC}) to be 2.2µF. C_{DC} is intended to decouple a charge source and its parasitic impedance. Typically, the charger source at DC is a USB connector's V_{BUS}. Larger values of C_{DC} improve the decoupling of the charger source impedance; however, take care not to exceed the maximum capacitance allowed by the USB specification (i.e. 10µF and 50µC). Note that for the USB input capacitance specification, C_{DC} is effectively in parallel with C_{BYP} and therefore the sum of these two capacitances should be less than 10µF.

The impedance of the CDC at the DC-DC switching frequency should be very low. Ceramic capacitors with X5R or X7R dielectric are highly recommended due to their small size, low ESR, and small temperature coefficients. To fully utilize the +22V input capability of the MAX77829, choose CDC to have a 25V or greater rating; many applications don't need to utilize the full input capability of the device and find that a 16V or 10V rated input capacitor is sufficient.

Charge Current Resistor Selection

Both the top-off current range and fast charge current range depends on the sensing resistor (R_{SNS}). The recommended resistor value is 47mΩ 0.125W ±2%.

$$P_{RSNS} = I^2_{CHARGE} \times R_{SNS}$$
$$P_{RSNS} = (2.0A)^2 \times 0.047\Omega = 0.188W$$

Calculate the CC mode charge current step from the CHGCC voltage setting and sense resistor as follows:

$$I_{CHARGE\_CURRENT\_STEP} = \frac{V(CHGCC)}{R_{SNS}}$$

Table 2 below shows the charge current settings for two sensing resistors.

Table 2.Charge Current Settings for 47mΩ Sense Resistor

BIT	$V_{I(REG)}$(mV)	I_{CHARGE} (mA) R_{SNS} = 47mΩ
$V_{(CHGCC<11110>)}$	70.5	1500
$V_{(CHGCC<10100>)}$	47	1000
$V_{(CHGCC<01010>)}$	23.5	500

Calculate the top-off charge current step as follows:

$$I_{CHARGE\_CURRENT\_STEP} = \frac{V(TOP\_OFF)}{R_{SNS}}$$

Table 3 shows the top-off current settings for two sensing resistors.

DC Input – Fast Hysteretic Step-Down Regulator

When a valid DC input is present, battery charging is supplied by the high-frequency step-down regulator from DC. The step-down regulation point is then controlled by three feedback signals: maximum step-down output current programmed by the input current limit, maximum charger current programmed for the fast charge current and maximum die temperature. The feedback signal requiring the smallest current controls the average output current in the inductor. This scheme minimizes total power dissipation for battery charging and allows the battery to absorb any load transients with minimum voltage disturbance.

A proprietary hysteretic current PWM control scheme ensures fast switching and physically tiny external components. The feedback control signal that requires the smallest input current controls the center of the peak and valley currents in the inductor. The ripple current is internally set to provide 4MHz operation. When the input voltage decreases near the output voltage, very high duty cycle occurs and, due to minimum off-time, 4MHz operation is not achievable. The controller then provides minimum off-time, peak current regulation. Similarly, when the input voltage is too high to allow 4MHz operation due to the minimum off-time, the controller becomes a minimum on-time, valley current regulator. In this way, ripple current in the inductor is always as small as possible to reduce ripple voltage on Battery for a given capacitance. The ripple current is made to vary with input voltage and output voltage in a way that reduces frequency variation. However, the frequency still varies somewhat with operating conditions.

Soft-Start

To prevent input current transients, the rate of change of the input current (di/dt) and charge current is limited. When the input is valid, the charge current ramps from 0mA to the fast-charge current value in 1.5ms. Charge current also soft-starts when transitioning from the prequalification state to the fast-charge state. There is no di/dt limiting when transitioning from the done state to the fast-charge state.

PVL and AVL

As shown in Figure 1, AVL is the output of a 5V/100mA linear regulator when power from BYP is available. If only power from SYS is available, then PVL is connected to SYS with a bypass switch. When AVL is greater than 2.7V the internal control circuits for the charger are enabled. Connect a 10μF ceramic capacitor from AVL to AGND (CAVL). Powering external loads from AVL is acceptable, provided that they do not consume more than 100mA.

PVL powers the gate drivers and BST for the main-battery charger's step-down regulator, it also charges the BST capacitor. PVL is the filtered version of AVL. The filter consists of an internal 10Ω resistor and the PVL external bypass capacitor (10μF). This filter creates a 100kHz lowpass filter that cleans the 4MHz switching noise from the analog portion of the MAX77829. Connect a 10μF ceramic capacitor from PVL to PGCHG (CPVL). Powering external loads from PVL is NOT recommended.

Thermistor Input (THM)

The THM input connects to an external negative temperature coefficient (NTC) thermistor to monitor battery or system temperature. Charging is suspended when the thermistor temperature is out of range. The charge timers are suspended and hold their state but no fault is indicated. When the thermistor comes back into range, charging resumes and the charge timer continues from where it left. Connecting THM to GND disables the thermistor monitoring function.

Table 3. Top-off Current Settings for 47mΩ Sense Resistor

BIT	$V_{(TOP\text{-}OFF)}$	$I_{(TOP\text{-}OFF)}$(mA) R_{SNS} = 47mΩ
$V_{(Top\text{-}off<>)}$	9.4	200
$V_{(Top\text{-}off<>)}$	4.7	100
$V_{(Top\text{-}off<>)}$	2.35	50

Table 4. Suggested P-Channel MOSFET

MANUFACTURER	PART NUMBER	PART DESCRIPTION	DIMENSIONS
Vishay	SiA443DJ	PFET, 20V, SC70 Power Pak	2.05mm x 2.05mm x 1.0mm = 4.2mm3
	Si4435DDY	PFET, 30V, SO-8	6.2mm x 5.0mm x 1.75mm
Fairchild	FDMA905P	PFET, 20V, SC70	2mm x 2mm x 1mm = 4mm3

Since the thermistor monitoring circuit employs an external bias resistor from THM to AVL, the thermistor is not limited only to 10kΩ (at 25ºC). Any resistance thermistor can be used as long as the value is equivalent to the thermistors +25°C resistance. For example, with a 10kΩ at RTB resistor, the charger enters a temperature suspend state when the thermistor resistance falls below 3.97kΩ (too hot) or rises above 28.7kΩ (too cold). This corresponds to 0°C to +50°C range when using a 10kΩ NTC thermistor with a beta of 3500K. The general relation of thermistor resistance to temperature is defined by the following equation:

$$R_{THRM} = R_{25} \times e^{\left(\beta\left(\frac{1}{T+273} - \frac{1}{298}\right)\right)}$$

Where:

R_{THRM} = resistance in Ω of the thermistor at temperature T in °C.

R_{25} = resistance in Ω of the thermistor at +25ºC.

β = material constant of the thermistor, which typically ranges from 3000K to 5000K.

T = temperature of the thermistor in °C.

Some designs might prefer other thermistor temperature limits. Threshold adjustment can be accommodated by charging R_{TB}, connecting a resistor in series and/or in parallel with the thermistor, or using a thermistor with different B. For example, a +45ºC hot threshold and 0°C cold threshold can be realized by using a thermistor with a B to 4250K and connecting 120kΩ in parallel. Since the thermistor resistance near 0°C is much higher than it is near +50°C, a large parallel resistance lowers the cold threshold, while only slightly lowering the hot threshold. Conversely, a small series resistance raises the cold threshold, while only slightly raising the hot threshold. Raising R_{TB}, lowers both the hot and cold threshold, while lowering R_{TB} raises both thresholds.

Note that since AVL is active whenever valid input power is connected at DC, thermistor bias current flows at all times, even when charging is disabled. With a 10kΩ thermistor and a 10kΩ pullup to AVL, this results in an additional 250µA load. This load can be reduced to 25µA by instead using a 100kΩ thermistor and 100kΩ pull-up resistor.

Thermal Foldback

Thermal foldback maximizes the battery charge current while regulating the MAX77829 junction temperature. When the die temperature exceeds TREG, a thermal limiting circuit reduces the battery charge-current target until the charge current reaches 25% of the fast-charge current setting. The charger maintains 25% of the fast-charge current until the die temperature reaches TSHDN. Please note that the MAX77829 is rated for a maximum ambient temperature of +85°C. Furthermore, although the maximum die temperature of the MAX77829 is +150°C, it is common industry practice to design systems in such a way that the die temperature never exceeds +125°C. Limiting the maximum die temperature to +125°C extends long-term reliability.

Boost Mode

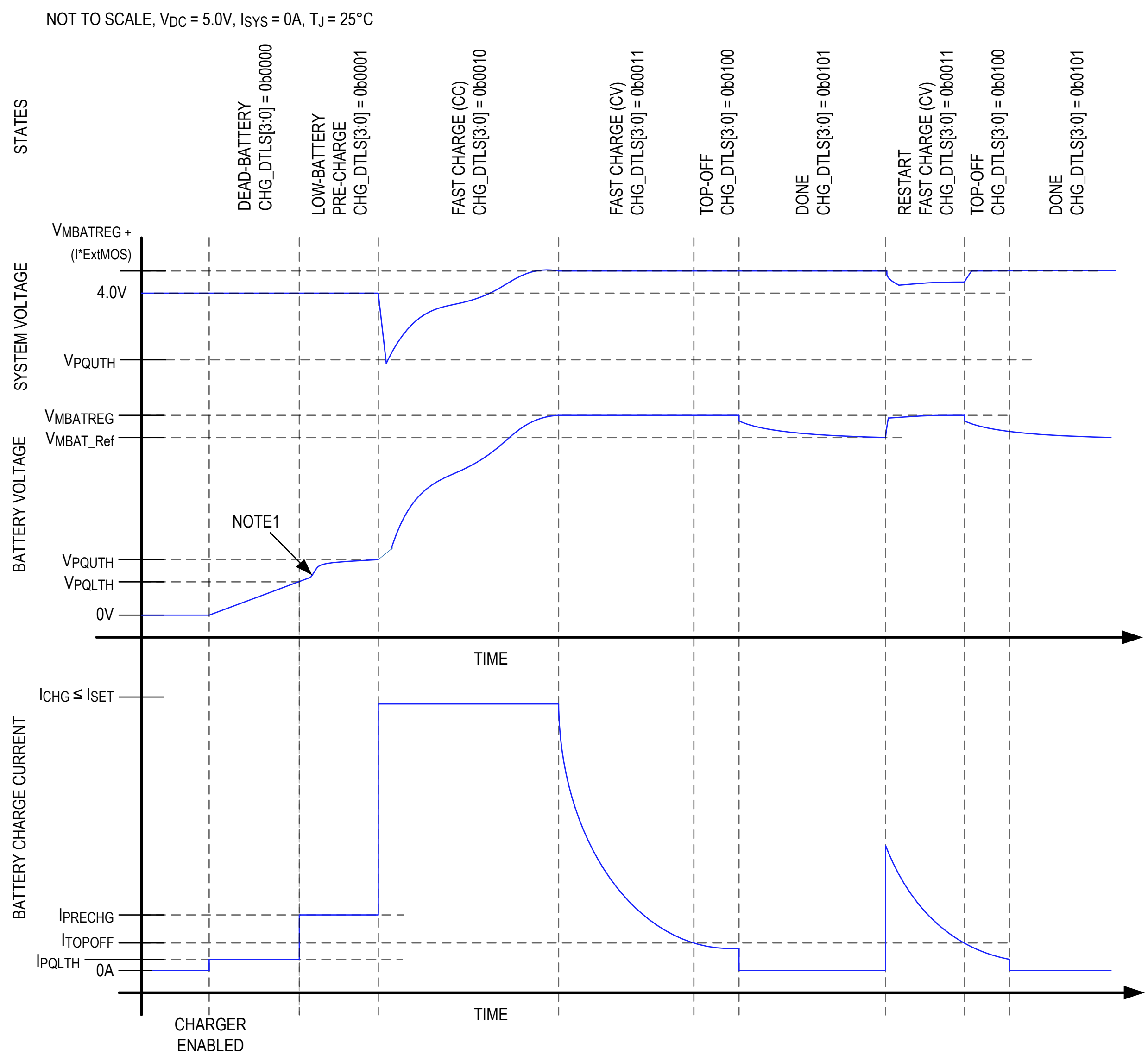
When enabled as a boost converter, in the absence of a valid charger input, the DC-DC converter is allowed to operate as a boost converter. The boost output voltage is regulated to 5.1V. The boost switches at 4MHz and is capable of delivering up to 500mA. The processor must enabled OTG mode by software via OTGEN bit. The reverse blocking switch allows the delivery of power to the charger input.

Table 5. Calculated Values for Different Thermistors

PARAMETER	VALUE						
R_{THM} at T_A = +25°C	10,000	10,000	10,000	47,000	47,000	100,000	100,000
Thermistor Beta (βΩ)	3380	3940	3940	4050	4050	4250	4250
$R_{TB(\Omega)}$	10,000	10,000	10,000	47,000	47,000	100,000	100,000
$R_{TP(\Omega)}$	OPEN	OPEN	301,000	OPEN	1,200,000	OPEN	1,800,000
$R_{TS(\Omega)}$	SHORT	SHORT	499	SHORT	2,400	SHORT	6,800
Resistance at T1_n15(Ω)	61,788	61,788	77,248	290,410	380,716	617,913	934,027
Resistance at T1_0(Ω)	29,308	29,308	31,971	137,750	153,211	293,090	343,283

Charger States

The MAX77829 utilizes several charging states to safely and quickly charge batteries. Figure 2 shows an exaggerated view of a Li+/Li-Poly battery progressing through the following charge states when the die and battery are close to room temperature: dead-battery → precharge → fast-charge → top-off → done.



NOTE1: A TYPICAL LI+/LI-POLY HAS AN INTERNAL BATTERY PACK PROTECTION CIRCUIT THAT WILL OPEN THE BATTERY CONNECTION WHEN THE BATTERY'S CELL VOLTAGE IS LOWER THAN A DEAD BATTERY THRESHOLD ($V_{PQLTH.FALLING}$~2.5V). TO GET THE PACK PROTECTION TO CLOSE AGAIN, THE CL12 CHARGES THE BATTERY CAPACITOR WITH I_{DBAT} UNTIL THE VOLTAGE EXCEEDS V_{PQLTH}. THEN THE CL12 CHARGES THE BATTERY CAPACITOR WITH I_{PRECHG}. WHEN THE BATTERY CAPACITOR'S VOLTAGE EXCEEDS $V_{PQUTH.RISING}$, THEN THE POWER-PATH FET CLOSES WHICH CONNECTS THE CELL TO THE CL12 CHARGER.

Figure 2. Li+/Li-Poly/LiFePO4 Charge Profile

Charger Disabled State

When DC is low or the input voltage is out of range, the MAX77829 disables the charger. To exit this state, the input voltage must be within its valid range.

Dead-Battery State

When a deeply discharged battery is inserted with a voltage of less than V_{PQLTH}, the MAX77829 disabled the switching charger and linearly charges with I_{PQLTH}. Once V_{BAT} increases beyond V_{PQLTH}, the MAX77829 transitions to the precharge state. This state prevents the MAX77829 from dissipating excessive power in the event of a shorted battery.

Precharge State

The precharge state occurs when the battery voltage is greater than V_{PQLTH} and less than V_{PQUTH}.

In this state, the dead-battery linear and system to battery linear charger turns on to provide I_{PRECHG} current to SYS. If the MAX77829 remains in this state for longer than t_{PRECHG}, then the MAX77829 transitions to the timer fault state. A normal battery typically stays in the prequalification state for several minutes or less and when the battery voltage rises above V_{PQUTH}, the MAX77829 transitions to the fast-charge constant current state.

Fast Charge Constant Current State

The fast-charge constant current state occurs when the battery voltage is greater than V_{PQUTH} and less than V_{BATREG}. In this state, the switching charger is on and delivering current to the battery. The total battery current is IFC. If the MAX77829 remains in this state and the fast-charge constant voltage state for longer than t_{FC}, then the MAX77829 transitions to the timer fault state. When the battery voltage rises to V_{BATREG}, the MAX77829 transitions to the fast-charge constant voltage state. When JEITA is enabled (JEITA_EN = 1), the fast-charge constant current is set to 50% of programmed value when -10°C < THM <15°C, and 100% of programmed value when 15°C < THM < 60°C.

The MAX77829 dissipates the most power in the fast-charge constant current state. This power dissipation causes the internal die temperature to rise. If the die temperature exceeds T_{REG}, I_{FC} is reduced.

If there is low input voltage headroom (V_{DC} – V_{MBAT}), then I_{FCHG} decreases due to the impedance from IN to BAT.

Fast Charge Constant Voltage State

The fast-charge constant voltage state occurs when the battery voltage is at the VMBATREG[3:0] and the charge current is greater than I_{DONE}. In this state, the switching charge is on and delivering current to the battery. The MAX77829 maintains V_{BATREG} and monitors the charge current to detect when the battery consumes less than the DONE current. When the charge current decreases below the I_{DONE} threshold, the MAX77829 transitions to the top-off state. If the MAX77829 remains in the fast-charge constant current state for longer than t_{FCHG}, then the MAX77829 transitions to the timer fault state.

Top-Off State

The top-off state occurs when the battery voltage is at V_{BATREG} and the battery current decreases below I_{DONE} current. In this state, the switching charger is on and delivers current to the battery. The MAX77829 maintains V_{BATREG} for a specified time. When this time expires, the MAX77829 transitions to the DONE state. If the charging current increases to I_{DONE} + 200mA before this time expires, then the charge reenters the fast-charge constant voltage state.

Done State

The MAX77829 enters its done state after the charge has been in the top-off state for topoff. In this state, the switching charger is off and no current is delivered to the battery. If the system load presented to the battery is low << 10μA, then a typical system can remain in the done state for many days. If left in the done state long enough, the battery voltage decays below the restart threshold (V_{MBAT_REF}) and the MAX77829 transitions back into the fast-charge state. There is no soft-start (di/dt limiting) during the done-to-fast-charge state transition.

Timer Fault State

The timer fault state occurs when either the prequalification or fast-charge timers expire. In this state, the charger is off. The charger can exit this timer fault state by cycling input power.

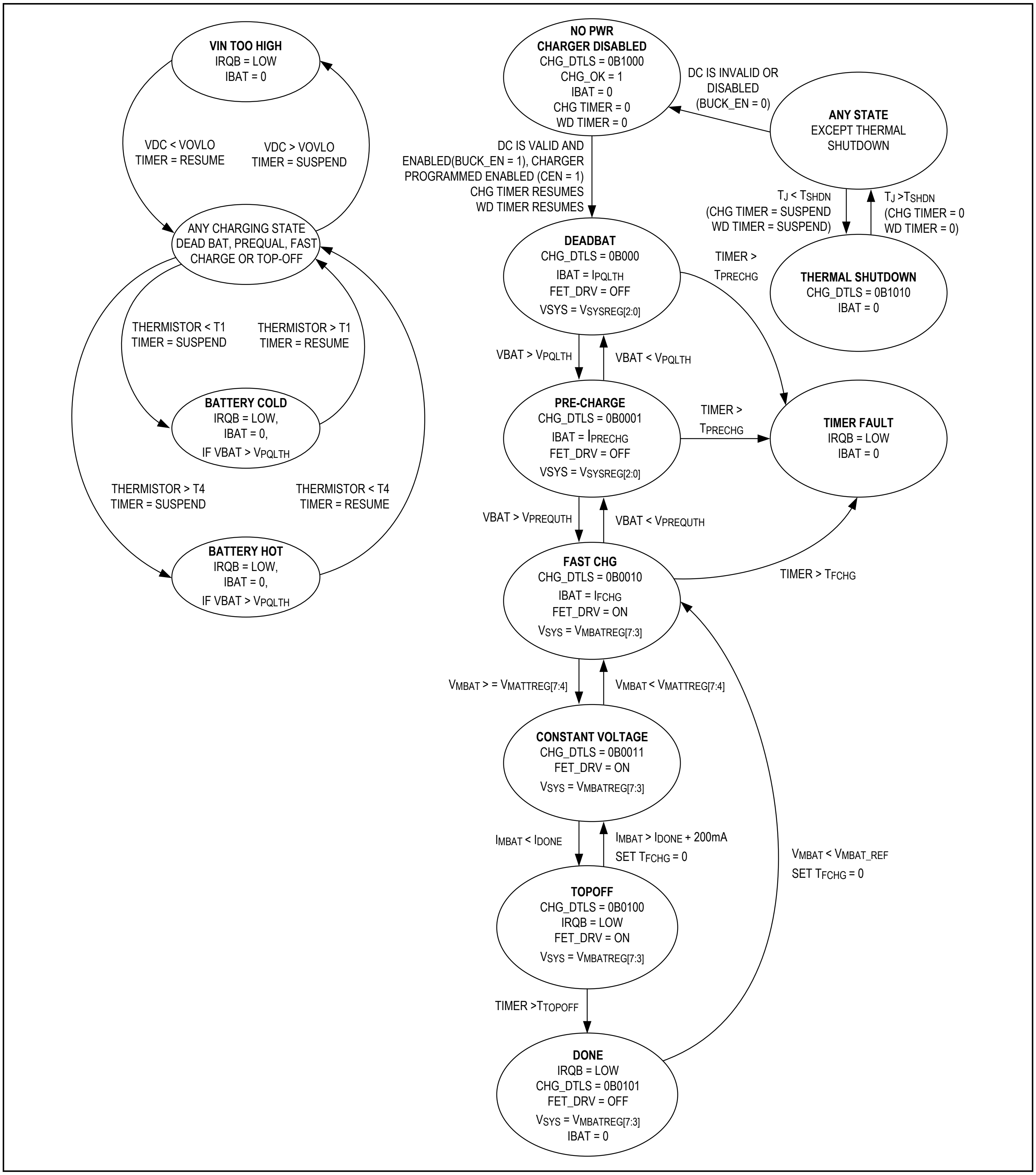


Figure 3. Charging State Diagram

Input Current Limit

The default settings of the I_{DC_ILIM} control bits are such that when a charge source is applied to DC, the MAX77829 will turn on its DC-DC converter in BUCK mode, limit V_{SYS} to V_{SYSMIN}, and limit the charge source current to 500mA. All control bits are reset on global shutdown.

Automatic Input Current Limit (AICL)

The MAX77829 includes the Automatic Input Current Limit (AICL) feature for the DC input. The amplifiers required for sensing the currents and associated logic circuitry for making decisions and changing the battery-charger current are fully integrated in the ICs. This not only helps in reducing cost but also improves the speed of system response.

The MAX77829 AICL works by monitoring the current being drawn from DC and comparing it to the programmed current limit. The current limit is set based on the current-handling capability of the USB. Generally, this limit is chosen to optimally fulfill the system power requirements while achieving a satisfactory charging time for the batteries. If the AC-adapter current exceeds the set threshold, the charger responds by cutting back on the charger current, thereby keeping the current drawn from the AC adapter within the set limit. This AICL feature allows for reducing the AC adapter size and cost. The input current limit has two control inputs, one based on voltage and one based on current. The voltage input monitors the input voltage, and when it drops below the desired input (VDC_AICL), it generates a flag (AICL) to decrement the fast-charge current.

When the voltage comparator initially trips at VDC_AICL, fast-charge current decrements at a slow rate, allowing the charger output to settle until the voltage on DC returns above this voltage threshold. Once the DC voltage resolves itself, the current delivery of the adapter is maximized. In the event of a limited input current source, an example being a 500mA adaptor plugged into a 1A input current limit setting, a second voltage comparator set at VDC_AICL - 100mV triggers and throttles the fast-charge current to a minimum of 75mA. Once the DC voltage corrects itself to above VDC_AICL, the fast-charge level is checked every 16ms to allow the system to recover if the available input power increases.

The current-limit input monitors the current through the input FET and generates a flag (DC_I) to decrement the fast-charge current when the input limit is exceeded. The fast-charge current is slowly decremented until the input-limit condition is cleared. At this point, the fast-charge current is maintained for 16ms and is then sampled again.

Battery Detection

The MAX77829 charger detects insertion and removal of battery packs under various conditions. When a valid power source is detected on DC pin, the battery detection state machine is enabled. The first task is to determine the type of detection method used for predicting battery present condition. The voltage level on the $\overline{\text{MBATDET}}$ pin is used to determine the presence of either a low-cost battery or a smart battery.

JEITA Description

The MAX77829 safely charges a single Li+ cell in accordance with JEITA specifications. The MAX77829 monitors the battery temperature while charging and automatically adjusts the fast-charge current and/or charge termination voltage as the battery temperature varies.

In safety region 1, the MAX77829 automatically reduces the fast-charging current for T_{MBATT} < +10°C and reduces the charge termination voltage from 4.200V (±25mV) to 4.075V (±25mV) for T_{MBATT} > +45°C. The fast-charge current is reduced to 50% of the nominal fast-charge current. When battery charge current is reduced by 50%, the timer is doubled.

In safety region 2, the IC automatically reduces the charge termination voltage from 4.200V (±25mV) to 4.075V (±25mV) for T_{MBATT} < +10°C and for T_{MBATT} > +45°C. The fast-charge current is not changed in safety region 2.

The customer can disable T2 and T3 temperature scaling for voltage and current by programming JEITA_EN bit to disable (JEITA_EN=0). In this case, only T1 and T4 temperature region will be enabled.

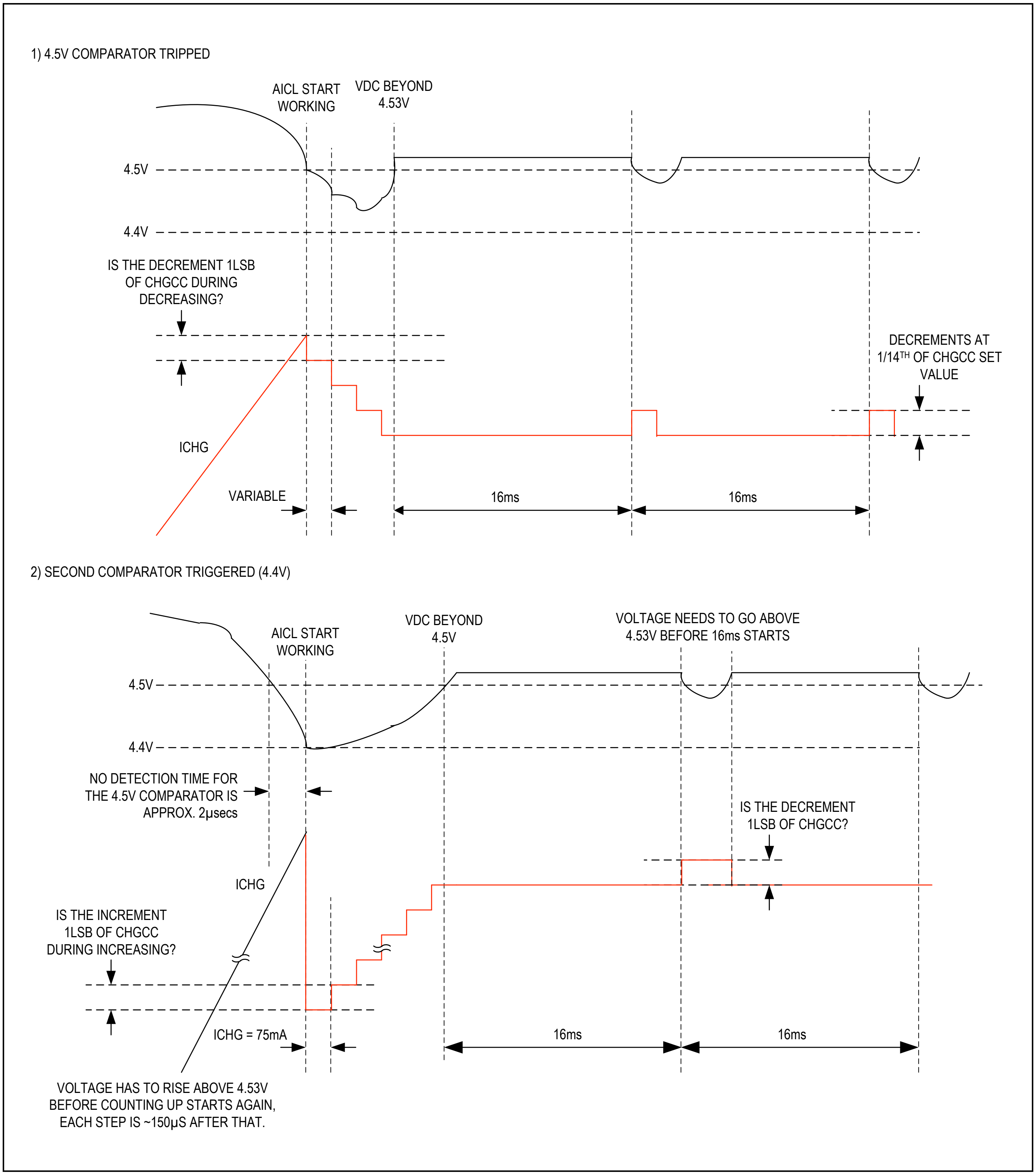


Figure 4. Automatic Input Current Limit Diagram

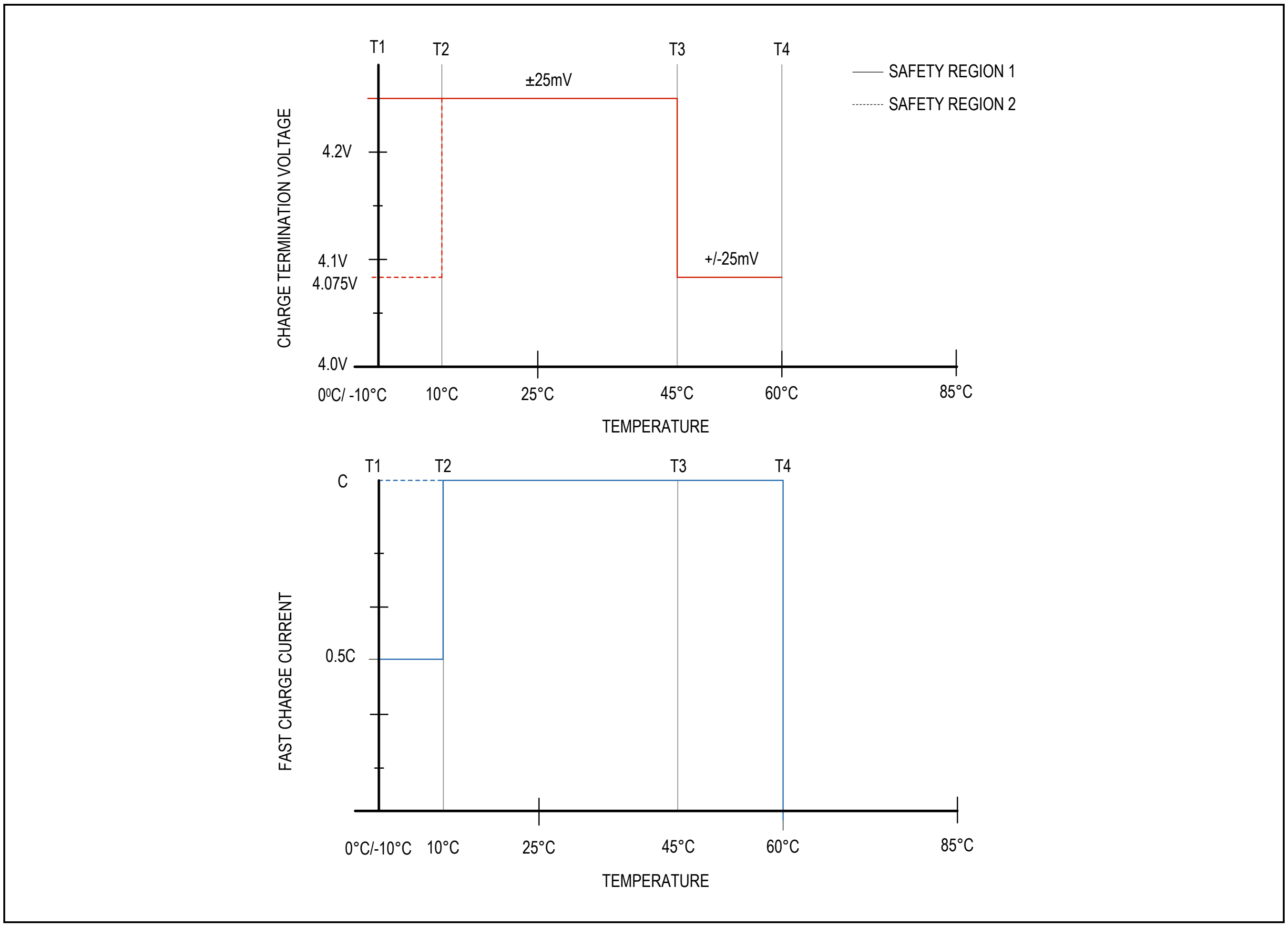


Figure 5. JEITA Safety Region

LED Flash Driver

Description

The flash driver integrates an adaptive PWM step-up DC-DC converter (shared with switch-mode charger module) and two high-side current regulators cable of delivering up to 750mA/ch for flash applications and 187.5mA/ch for torch mode. A serial interface controls the step-up output voltage setting, the torch/flash current, and the torch/flash timers. When valid V_{DC} is present, flash LED driver operates only when $V_{DC} < V_{DC\_V}$.

Features

- Step-Up DC-DC Converter
  - Adaptive Regulation for Driving The LED Directly
  - See the Charger Section for Feature List
- FLASH Current Regulator
  - 2x High-Side Current Regulators Simplifies PCB Heat Sinking
  - Low Dropout Specification 160mV (typ) at 750mA
  - I2C Programmable Flash Output Current (11.72mA to 750mA in 64 steps) Per Channel
  - I2C Programmable Torch Output Current (11.72mA to 187.5mA in 16 steps) Per Channel
- Programmable Flash Safety Timer (62.5ms to 1000ms in 16 steps) – This Timer Cannot Be Disabled
- Programmable Torch Timer (262ms to 15.728s in 16 steps) – or Continuous Torch Current (Disable Option On The Torch Timer)
- MaxFlash System Lock-up Protection
- Open/Short LED Protection
- Dedicated FLASHEN and TORCHEN Inputs

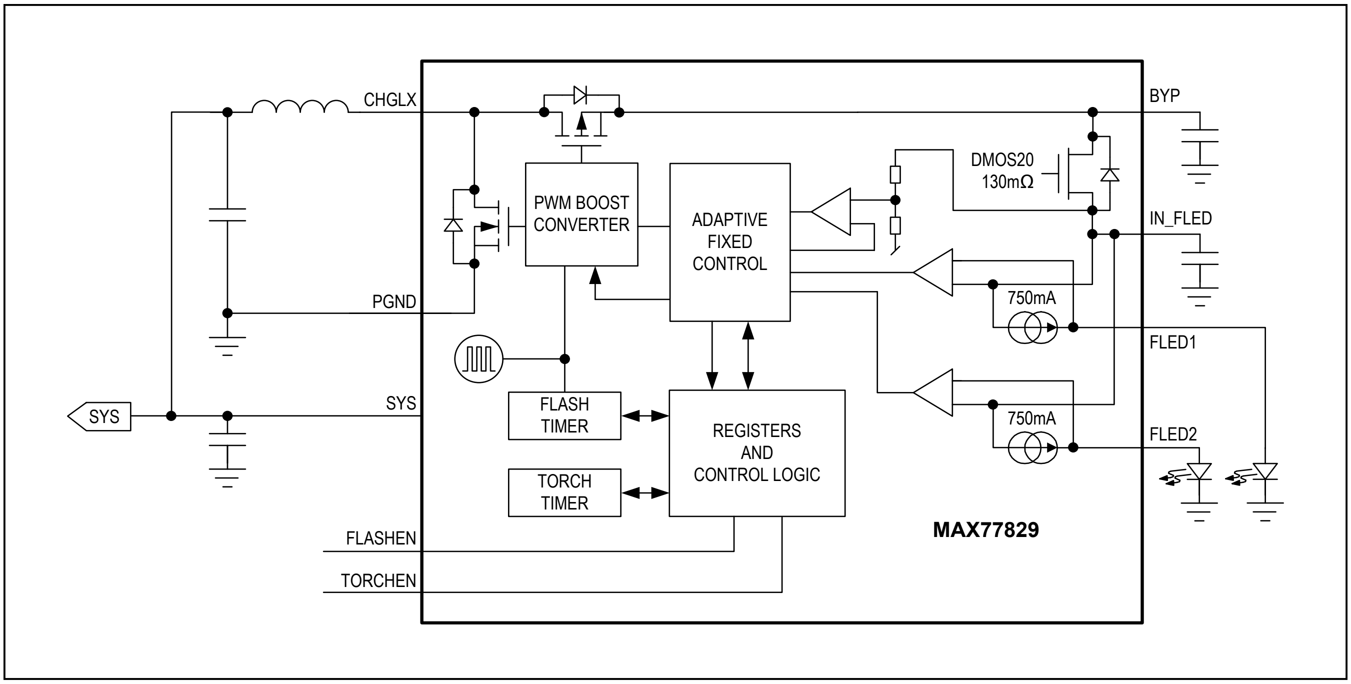


Figure 6. Functional Diagram for Charger Reverse Boost Converter and Current Sources

Boost Converter

The MAX77829 flash driver integrates an adaptive PWM step-up DC-DC converter (shared with switched mode charger module) and two high-side current regulators capable of delivering up to 750mA each, for flash applications. The serial interface controls individual output on/off, the step-up output voltage setting, the torch/flash current, and the torch/flash timer duration settings.

Current Source (FLED1 and FLED2)

The MAX77829 provides two high-side, low-dropout, linear current regulators. The LED current regulators can operate in either Torch or Flash mode. Each current source is programmable and regulated up to 375mA in Torch mode and up to 750mA in Flash mode. FLED current is programmable with 23.436mA/LSB resolution in Torch and Flash modes.

Torch mode can be enabled either using the serial interface or by logic control using the TORCHEN or FLASHEN inputs. See the description of the FLASH_EN register for more information about programming the FLED enable behavior. Torch mode provides continuous lighting when enabled. The time duration is controlled through the Torch timer, enabling the user to limit the duration of torch light from 0.262s to 15.73s, or enabled indefinitely, allowing the user to keep the LED on as long as a movie is being recorded.

Flash mode can also be enabled either using the serial interface or by logic control using the TORCHEN or FLASHEN inputs. See the description of the FLASH_EN register for more information about programming the FLED enable behavior. Flash mode provides a limited-duration light pulse for camera functions. In Flash mode, the time duration is limited by an internal timer (FLASH_TMR_DUR[3:0]). See the *Flash Safety Timer* section for greater detail on this function. The output current in Flash mode is programmable from 23.436mA to 750mA. The settings above 625mA are allowed only if FLEDNUM = 0.

If both Flash and Torch modes are enabled at the same time, Flash mode is assigned with higher priority. Once the flash event is done, the current regulator will then return to torch mode, if this mode is still enabled via software.

When the flash LED current ramps up via (1) toggle FLASHEN or TORCHEN pins; (2) set TORCH_FLED_EN or FLASH_FLED_EN bits; (3) set TORCH_I or FLASH_I register values from a lower value to a higher value; atypical 12.5mA/μs of di/dt rate is applied on the flash LED current during the current transition.

Flash Mode

In Flash mode, each LED current source provides from 23.436mA to 750mA of output current. Flash mode can be enabled by driving FLASHEN or TORCHEN high or through the serial interface, depending on register settings. Flash duration is also programmable through the serial interface.

FLASHEN/TORCHEN

The FLASHEN or TORCHEN logic inputs or the serial interface can enable/disable the FLED_ current regulator in Flash Mode and in Torch Mode.

If the FLED is enabled for both Torch and Flash mode at the same time, Flash mode has priority. Once the Flash safety timer expires, the current regulator then returns to Torch mode. If the safety timer is disabled, Torch mode current continues until disabled through the serial interface.

Configuring how the LED responds to FLASHEN or TORCHEN is accomplished by setting bits in the FLASH_EN register.

Flash Safety Timer

The Flash safety timer is activated any time Flash mode is enabled. The Flash safety timer, programmable from 62.5ms to 1000ms via serial interface, limits the duration of Flash mode to the programmed Flash safety timer duration. This timer can be configured to operate either as a one-shot timer or maximum flash duration timer. In one-shot mode, the flash function is initiated on the rising edge of FLASHEN, TORCHEN, or the serial register bits and terminated based on the programmed value of the safety timer (see Figure 7). In maximum flash timer mode, flash function remains enabled as long as FLASHEN, TORCHEN, or the serial register command is high, unless the pre-programmed safety timer times out (see Figure 8).

Once Flash mode is disabled, by the FLASHEN or TORCHEN logic inputs, register command, or Flash safety timer, the flash must be off for a minimum flash debounce timer (500µs – 600µs), before it can be reinitiated (see Figure 11). This prevents spurious events from re-enabling Flash mode. This time is described in the *Electrical Characteristics* table as the Flash Safety Timer Reset Inhibit Period.

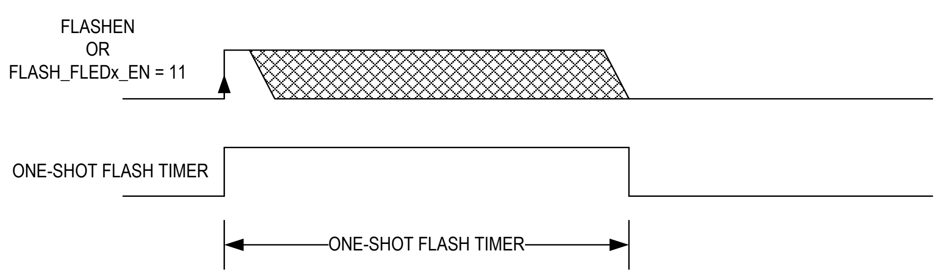


Figure 7. One Shot Flash Timer Mode

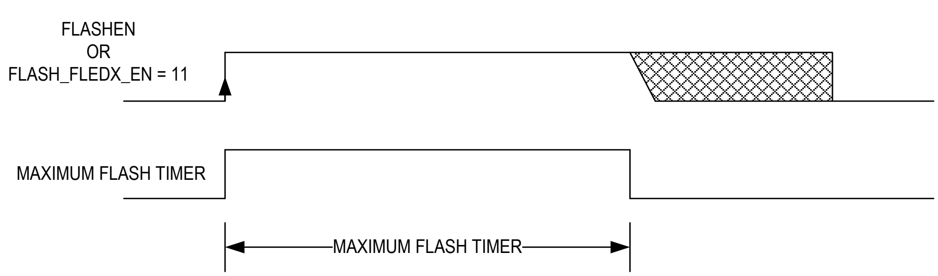


Figure 8. Maximum Flash Timer Mode

Torch Mode

In Torch mode, the LED current source provides from 11.72mA to 187.5mA of output current for each channel. Torch mode is enabled through the TORCHEN or FLASHEN inputs or through the serial interface. Torch mode duration is programmable through the serial interface, and can be programmed to remain on indefinitely.

Enabling Torch Mode

The current sources in Torch mode is independently enabled either through the TORCHEN or FLASHEN inputs or through the serial interface as programmed by the TORCH_FLED_EN bits in the FLASH_EN register. If Flash mode and Torch mode are enabled at the same time, Flash mode is given the higher priority.

Torch Safety Timer

The Torch safety timer is activated any time Torch mode is enabled and the Torch Safety Timer Disable bit is set to 0.

The torch safety timer, programmable from 262ms to 15.7s via the serial interface, limits the duration of Torch mode to the programmed Torch safety timer duration. This timer can be configured to operate either in one-shot timer or maximum torch duration timer. In one-shot mode, the torch function is initiated on the rising edge of the TORCH_FLED_EN register bit or TORCHEN or FLASHEN inputs and terminated based on the programmed value of the safety timer (see Figure 10). In maximum torch timer mode, torch function remains enabled as long as TORCH_FLED_EN is a ‘11’ or TORCHEN or FLASHEN is held high, unless the preprogrammed safety timer times out (see Figure 11).

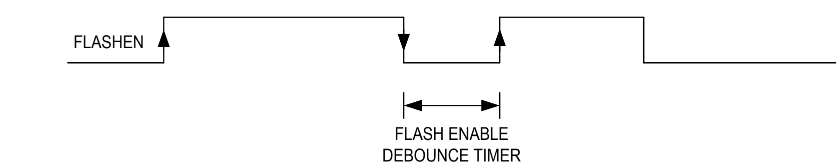


Figure 9. Flash Debounce Timer

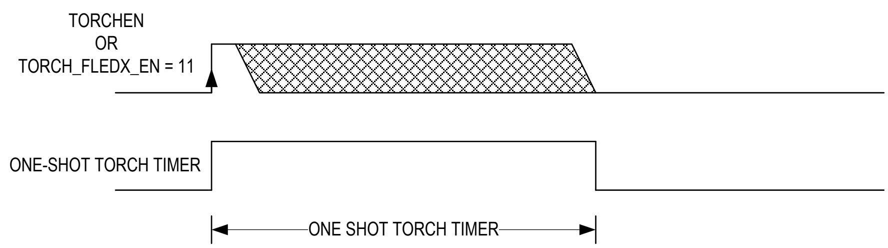


Figure 10. One Shot torch Timer Mode

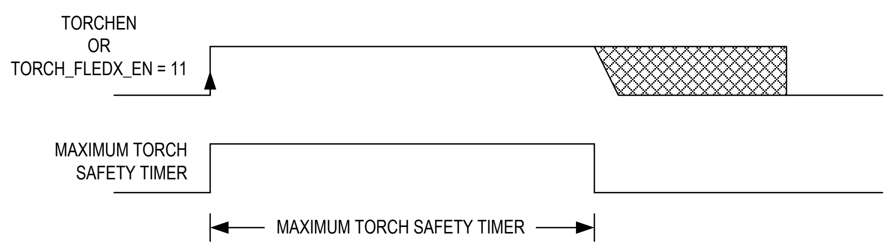


Figure 11. Maximum torch Timer Mode

The Torch safety timer can be disabled by setting the Torch safety timer disable bit to 1. In this case, the FLEDs will stay lit in Torch mode until the enable command (TORCHEN, FLASHEN, or serial interface) is deasserted, or Flash mode is initiated (since Flash mode has higher priority than Torch mode).

MAXFLASH Function

Note that MAXFLASH will detect a drop on V_{SYS} and not V_{BATT}.

During high load currents of a battery cell, the voltage will momentarily drop due to internal ESR of the battery, together with serial impendence form the battery to the load. For equipment requiring a minimum voltage for stable operation, the ESR of the battery needs to be calculated in order to estimate maximum current that can be drawn from the battery without making the cell voltage drop below this critical threshold. If this is not done, the power-down voltage will have to be set artificial high, reducing run time of the battery-operated equipment.

For applications like camera flash, movie light, or torch light the ESR of the system needs to be measured to calculate the maximum current that can be consumed by the flash to insure that at the end of the flash the battery voltage has not dropped below the minimum required battery voltage for the remaining system.

Since the ESR of a battery cell is dependent on load current, temperature, age of cell, and other parameters this ESR measurement has to be done during the start of each event in order to ensure that the current ESR of the battery cell is correct.

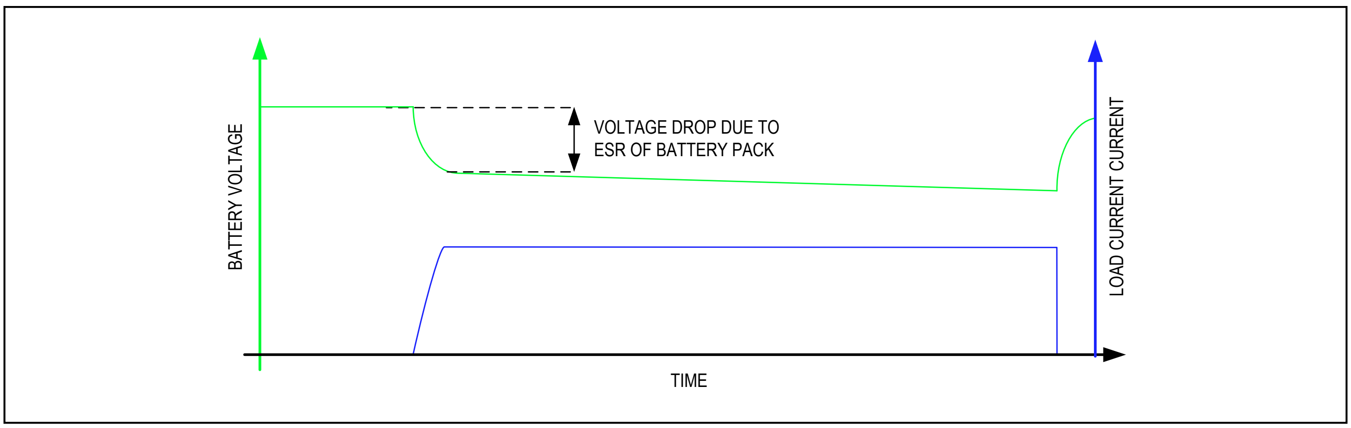


Figure 12. Voltage Drop Due to Battery ESR

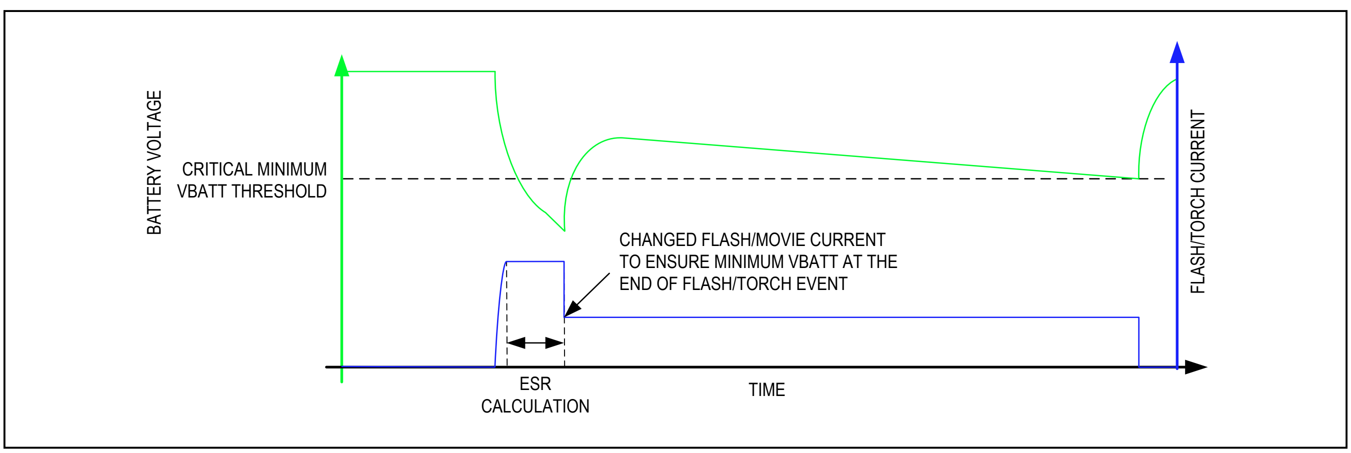


Figure 13. Using ESR Calculation to Insure Minimum Battery Voltage at the End of FLASH/TORCH Event Normal Case

In most cases, the camera flash is triggered by the camera module itself. Therefore, the ESR measurement of the battery has to be measured in real time during the initial flash event.

Since most systems contain many complex functions that are operated independent of each other, the current load might change during the FLASH/TORCH duration.

If another application within the system starts significantly drawing more current during the FLASH/TORCH duration, this can cause the battery voltage to drop below the minimum required battery voltage for the system, hence causing spurious events.

On the other hand, if an application is going from a high-current mode to a lower current mode during the FLASH/TORCH event, the battery voltage at the end of the FLASH/TORCH duration will be above the minimum battery voltage. This means that the actual FLASH/TORCH current could have been set higher for the remaining duration, allowing highest possible output current to be utilized.

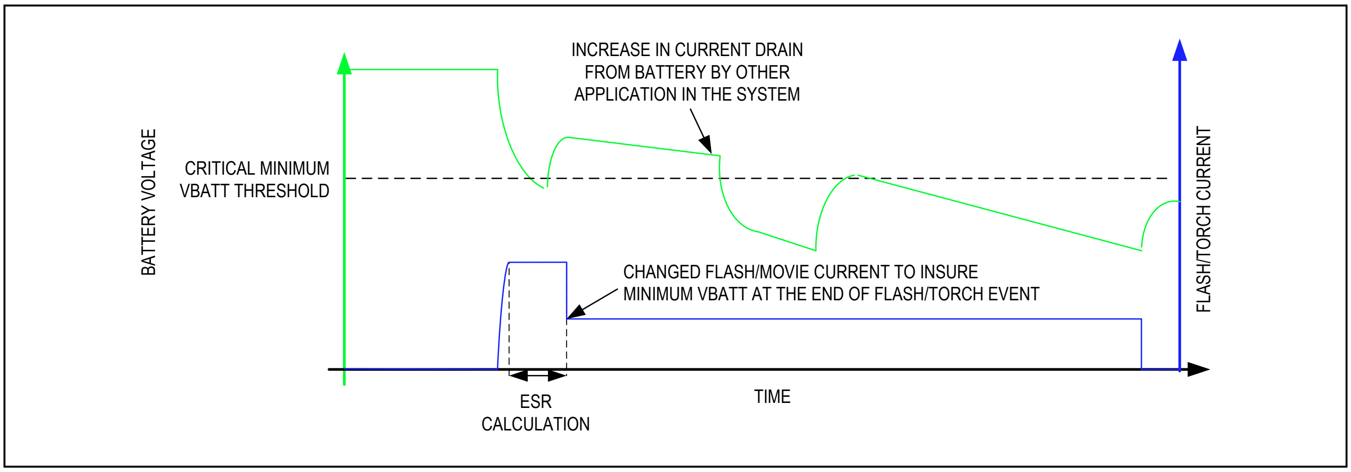


Figure 14. Using ESR Calculation to Ensure Minimum Battery Voltage at the End of FLASH/TORCH Event, with an Additional Load Event During the FLASH/TORCH Event

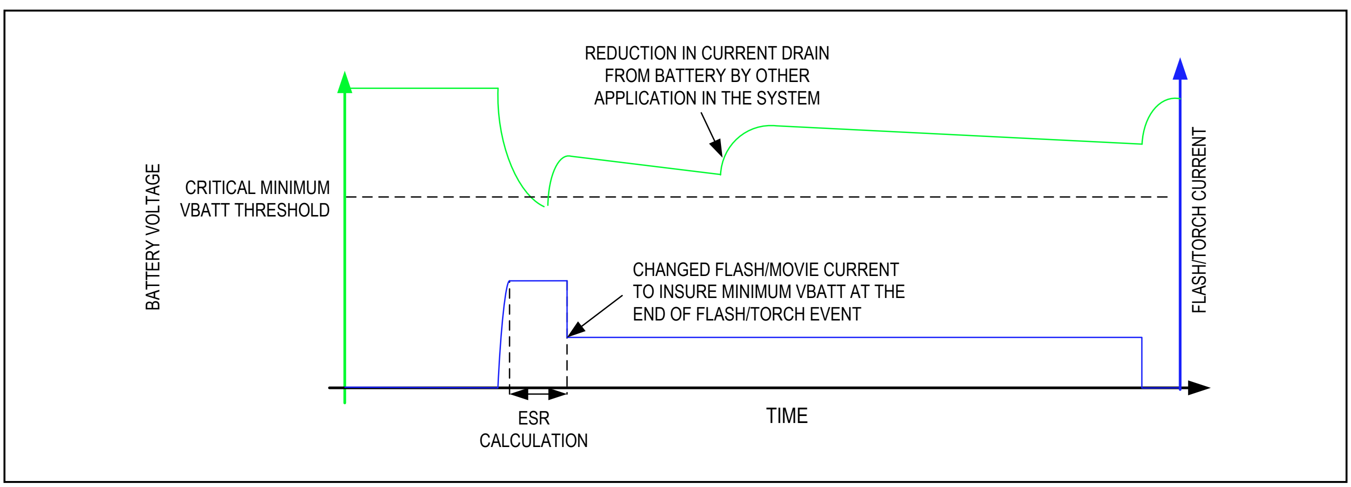


Figure 15. Using ESR Calculation to Ensure Minimum Battery Voltage at the end of FLASH/MOVIE Event with Load Release During FLASH/MOVIE Event

To avoid having to measure the ESR of the battery cell and still achieve the goal of insuring that the battery voltage does not drop below a predefined threshold, an alternative circuit can be used.

During a FLASH/TORCH event, the input voltage of the device is monitored (input Kelvin-connected to the battery cell, referred to as V_{BATT}). If the input voltage drops below a predefined threshold, referred to as MAXFLASH_TH, this is an indication that the FLASH/TORCH event is drawing more current than the battery can support.

As a reaction to this event, the current regulator driving the FLASH/TORCH will reduce output current in one step. This will reduce the input current, hence reducing the current drawn from the battery. Since the battery current is now reduced, V_{BATT} will start to rise due to the internal ESR of the battery cell.

The current regulator will then implement a user-defined delay, referred to as $t_{LB\_TMR\_F}$, for falling edge detection and $t_{LB\_TMR\_R}$ for rising edge detection. The V_{BATT} is then sampled again and compared to the MAXFLASH_TH. If V_{BATT} is still below this MAXFLASH_TH threshold the current regulator will reduce output current once again to insure that minimum V_{BATT} is available for the remaining of the system. If V_{BATT} is above the MAXFLASH_TH threshold plus a user-defined hysteresis, referred to as MAXFLASH_HYS, the current regulator will increase the output current one step, only if present output current is less than user-defined output current. If the MAXFLASH_HYS event is set to “000” then the flash current will only be reduced as a result of the low system voltage regardless if the voltage recovers again. The LED current is not allowed to increase again.

This will continue for the entire duration of the FLASH/TORCH event, ensuring that the FLASH/TORCH output current is always maximized for the specific operation conditions.

Open/Short Protection

The flash module monitors the FLED voltage to detect any open or short LEDs. An open fault is detected when the voltage on FLED rises above V_{BYP} – 30mV (typ) for 8ms (typ), and short fault is detected when the voltage on FLED drops below 1.0V (max) (referenced to GND) for 1ms (typ). The fault detection provides a continuous monitor of the current regulator’s status. Once a fault is detected, the current regulator is disabled and the status is latched into the interrupt register bit. This allows the processor to determine the operating condition of the MAX77829. Depending on the state of the interrupt mask bits, the MAX77829 can pull down on the $\overline{INT}$ pin when the flash open/short interrupt occurs.

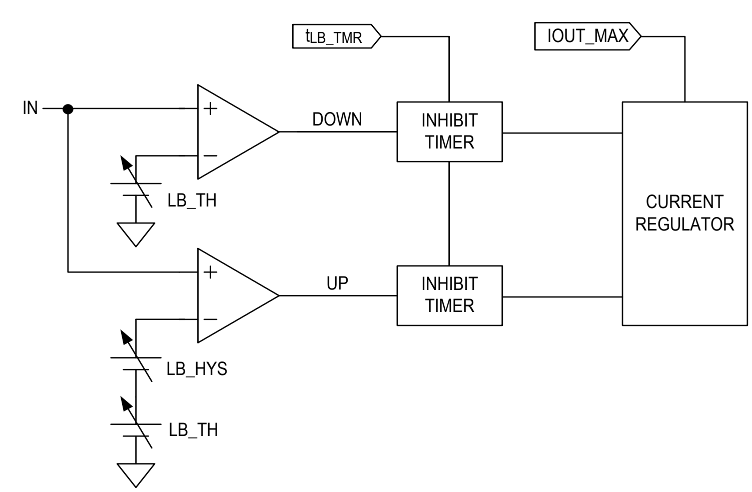


Figure 16. Block Diagram of MAXFLASH Function

Safeout LDO

The safeout LDO is a linear regulator that provides an output voltage of 3.3V, 4.85V, 4.9V, or 4.95V and can be used to supply low voltage-rated USB systems. The SAFEOUT linear regulator turns on when $V_{CHGIN} \geq 3.2V$ and SFOUT_EN = logic high (from MUIC), regardless of Charger Enable or $\overline{DETBAT}$. SAFEOUT is disabled when CHGIN is greater than the overvoltage threshold (5.90V typ). The safeout LDO integrate high-voltage MOSFET to provide 20V protection at their inputs, which are internally connected to the charger input at CHGIN.

SAFEOUT is default ON at 4.9V.

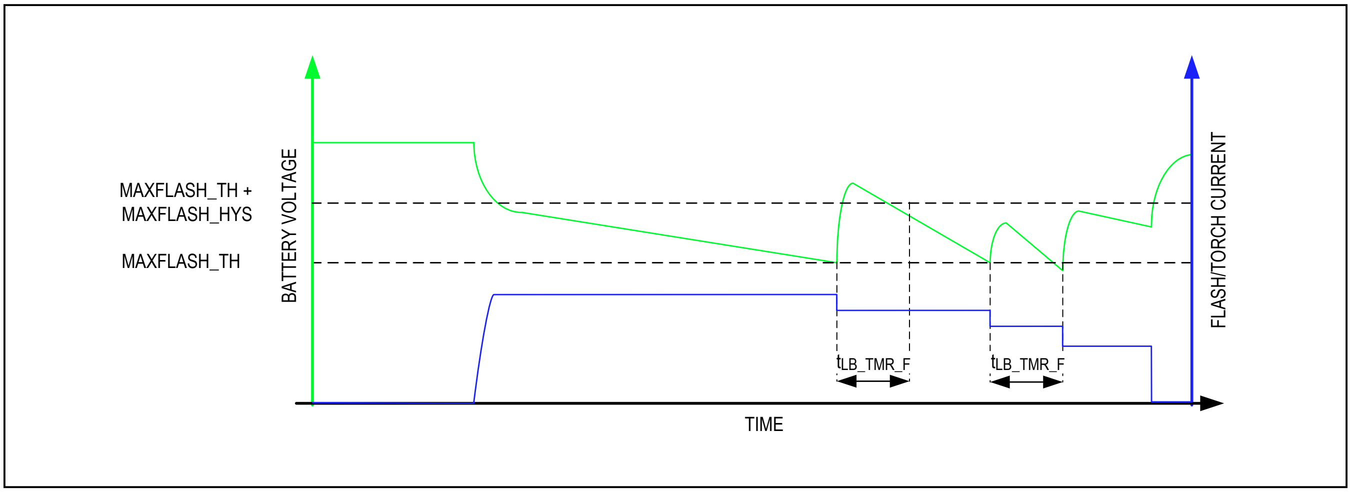


Figure 17. Example 1 of MAXFLASH Function Operation

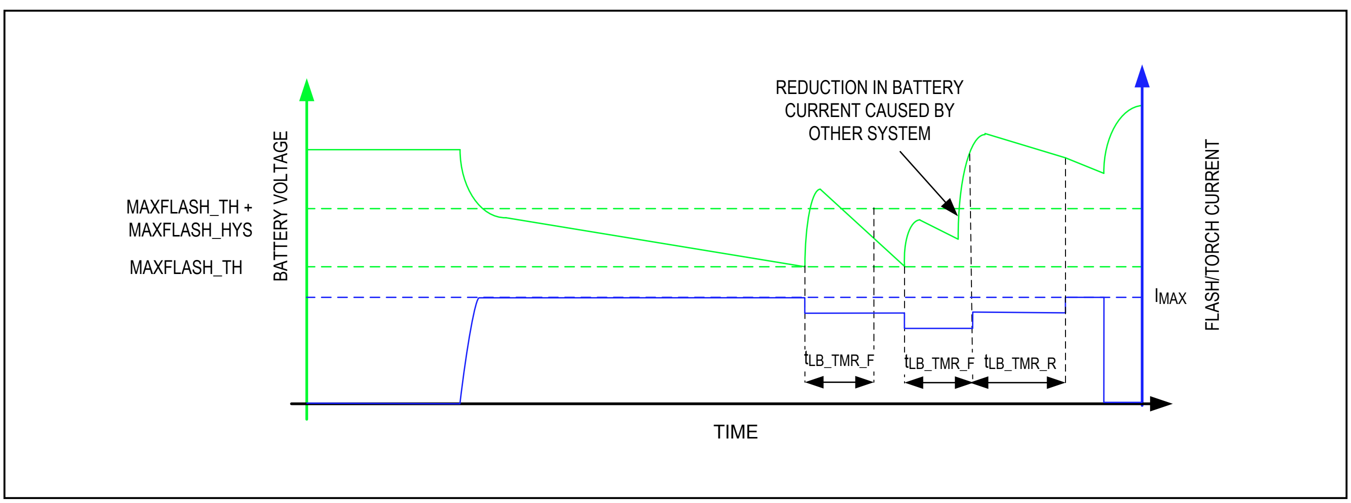


Figure 18. Example 2 of MAXFLASH Function Operation

WLED Backlight Driver

Step-Up Converter

The MAX77829 LED boost converter operates from a 2.5V to $V_{SYSOVLO}$ input supply. Due to duty-cycle limitations, full output power is only available for input voltages > 2.8V. For low input voltages (2.5V to 2.8V), maximum LED output current is available as shown in Table 6.

The MAX77829 LED boost converter utilizes a peak-current limited architecture. In the event of a serious overload, where the converter is operating at its current limit for 16ms, an interrupt is generated, and the processor can determine the appropriate course of action.

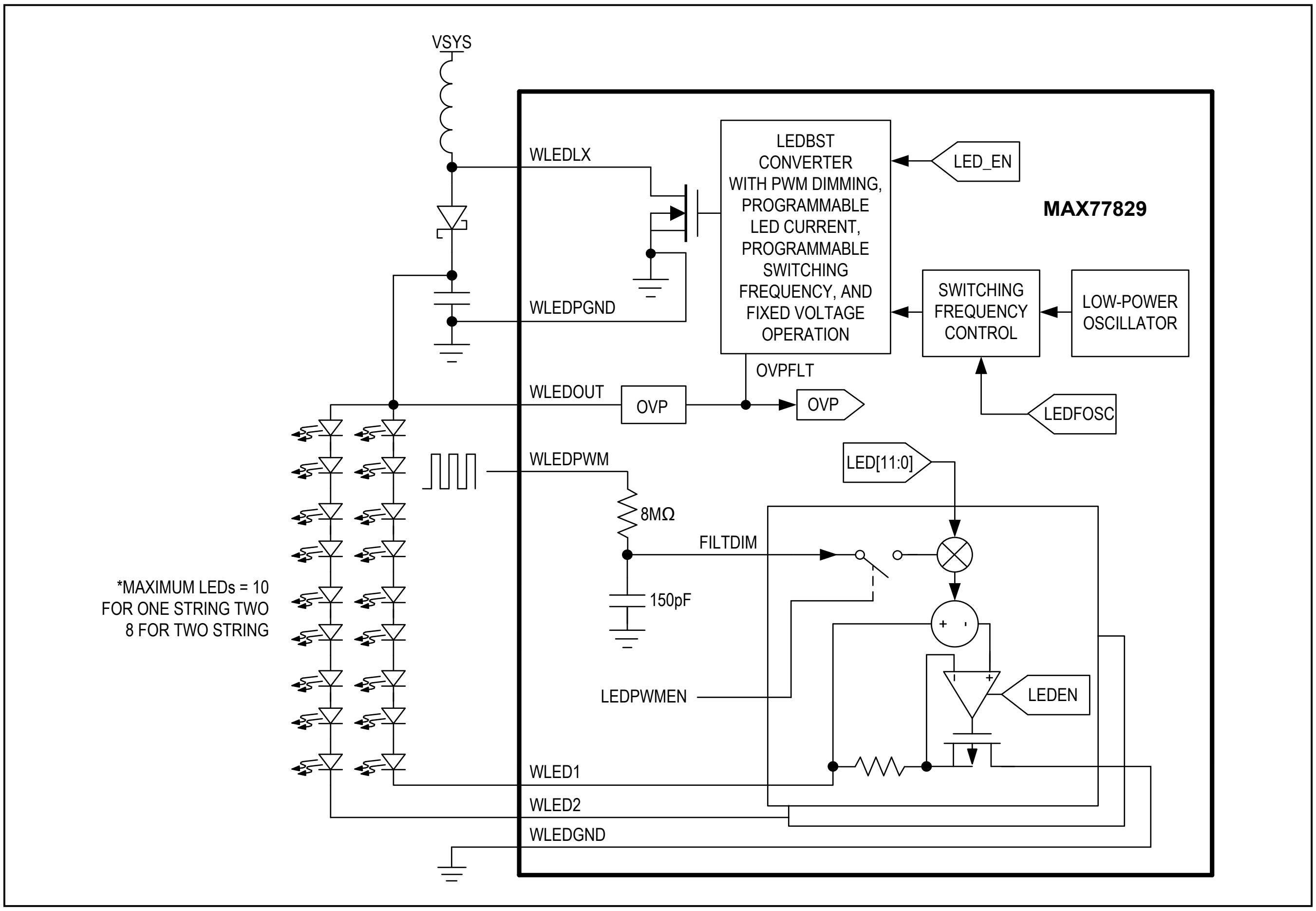


Figure 19. Functional Diagram for WLED Boost Converter and Current Source

Table 6. Maximum LED Output Current

V_{SYS}	2 STRINGS OF 8		2 STRINGS OF 6		1 STRING OF 10	
	1.47MHz	**2.2MHz**	**1.47MHz**	**2.2MHz**	**1.10MHz**	**733kHz**
3.0V	24.9mA	24.9mA	24.9mA	24.9mA	**TBD**	**TBD**
2.9V	24.9mA	21mA	24.9mA	24.9mA	**TBD**	**TBD**
2.8V	24.9mA	17mA	24.9mA	24.9mA	**TBD**	**TBD**
2.7V	23mA	14mA	24.9mA	24.9mA	**TBD**	**TBD**
2.6V	20mA	11mA	24.9mA	24.9mA	**TBD**	**TBD**
2.5V	18mA	8mA	24.9mA	21mA	**TBD**	**TBD**

The step-up converter switches at a fixed frequency of 2.2MHz to allow the use of small external components. Lower switching frequency can be selected through the serial interface to provide higher efficiency and/or avoid noise-sensitive frequency bands.

Overvoltage Protection

The MAX77829 is protected against open-circuited LED strings. In the event that the LED string is open, and the step-up converter is enabled, the WLEDOUT pin senses the output voltage of the step-up converter, and regulates the step-up output voltage at the OVP threshold. An interrupt (if unmasked) is generated when the step-up converter reaches the OVP threshold.

To optimize efficiency for the number of WLEDs used, the OVP threshold is programmable via WLEDOVP bit in WLEDBSTCNTL1 register. 28V (max) OVP setting is ideal for supporting up to 8 WLEDs in series while the 35V (max) OVP setting is needed for supporting up to 10 WLEDs in series.

Current Sources

The MAX77829 provides a low-side current source with 8-bit resolution for programming the LED current. A single register programs the output current in both sources. Both current sources can be programmed to respond to, or ignore, the WLEDPWM dimming input with a single bit.

The MAX77829 current source features a low-dropout voltage, increasing overall efficiency. When driving the maximum number of series LEDs, the current sources may enter dropout when the LED current is programmed near the maximum value. In this case, the current sources regulates with a 100mV (typ) voltage drop, and provide as much current as allowed by the forward voltage of the LEDs.

Setting the Current Limit

The two WLED Strings feature linear dimming with 8-bit resolution (97.656μA per LSB).

In addition to the internal LED current control offered through the MAX77829 step-up converter, an external PWM signal may be applied to the WLEDPWM input for content-adaptive brightness control. The WLEDPWM input accepts signals with frequency between 5kHz and 60kHz, although optimal performance (minimized LED current ripple) is attained with PWM frequencies ≥ 15kHz. The WLEDPWM input linearly decreases the LED current in strings 1 and 2 and is enabled through the serial interface.

WLED1 and WLED2 each have individual current sources, and both strings or any individual string may be enabled at any time. WLED1 and WLED2 share a common current setting register, so strings 1 and 2 always have the same LED current, if enabled.

Mismatched LED strings can also be supported by the MAX77829. In the event that LED strings with different LED count are being powered at the same time, the string with the fewest number of LEDs will see a higher voltage drop across the current driver causing higher power consumption.

The WLED_ current sources provide up to 24.9mA for powering the LED backlight. Under certain operating conditions, such as when powering the maximum number of LEDs in series, the WLED_ current sources operates in a dropout condition, in which 24.9mA may no longer be provided to the LED string.

Enabling CABC Dimming (WLEDPWM Input)

The MAX77829 supports a CABC dimming signal from the processor to linearly decrease the backlight intensity based on the video signal content. The WLEDPWM input accepts a PWM signal in the 5kHz to 60kHz range, with optimal performance (minimized LED current ripple) attained for PWM dimming frequency > 15kHz. The WLEDPWM signal is internally RC filtered (corner frequency 500Hz), and is then used to decrease the reference voltage to the current DAC for strings 1 and 2. Two bits in Boost Converter Control Register 1 (LEDPWM1EN and LEDPWM2EN) independently program strings 1 and 2 to respond to or ignore the WLEDPWM signal. If one of the current sources (WLED1 or WLED2) is disabled, this current source ignores the WLEDPWM signal.

In the event that a 0% duty cycle is applied to the WLEDPWM input, the converter does not shut down, but instead continues to regulate the WLEDOUT voltage. The output current at the WLED_ pins is close to zero.

Top System Management

Main Bias

The main bias includes voltage and current references for all circuitry that runs from the V_{SYS} node. It includes a 0.3% accurate voltage reference that is used by various blocks. The current bias is generated from the reference voltage and trimmed to be within 1.5% and is zero-TC. The current bias is converted to a voltage to route to other blocks.

The V_{REF} block generates a 1.25V zero-TC reference voltage. I_{BIAS} takes V_{REF} as input and generates a V_{IBIAS} voltage that will track RPH variation and TC. Instead of generating a current output, a bias voltage for current is generated to be distributed to different blocks.

It saves the number of top level routing lines for bias current at the expense of requiring a bias current generation circuit, generating current as V_{IBIAS}/RPH.

System Faults

The MAX77829 monitors the system for the following faults:

- SYS Undervoltage Lockout
- SYS Overvoltage Lockout
- SYS Low Threshold Detection
- Thermal Shutdown

SYS Faults

The system monitors the SYS node for undervoltage, overvoltage, and low threshold events. The following describes the IC behavior if any of these events is to occur. The SYS Low Threshold Detection is configurable via registers.

SYS undervoltage lockout prevents the regulators from being used when the input voltage is below the operating range. When the voltage from SYS to GND (V_{SYS}) is less than the undervoltage lockout threshold ($V_{SYSUVLO}$), the MAX77829 enters its global shutdown state.

SYS overvoltage lockout is a fail-safe mechanism and prevents the regulators from being used when the input voltage is above the operating range. The absolute maximum ratings state that the SYS node withstands is up to 6V. The SYS OVLO threshold is set to 5.3V (typ) – ideally V_{SYS} should not exceed the battery charge termination threshold. Systems must be designed such that V_{SYS} never exceeds 4.8V (transient and stead-state). If the V_{SYS} should exceed $V_{SYSOVLO}$ during a fault, the MAX77829 enters its global shutdown state.

When V_{SYS} voltage falls below its low threshold (V_{SYSL}), the MAX77829 initiates a LOWSYS interrupt. The low-SYS detection circuitry is enabled by default but can be disabled using the LSEN bit to reduce current consumption. V_{SYSL} is configurable using LSDAC register bits. Choose V_{SYSL} based on the system requirements and battery capacity.

The V_{SYSL} hysteresis (V_{LSHYST}) is configurable using LHYST register bits. Choose V_{LSHYST} based on your system peak currents and battery impedance. V_{LSHYST} should be set sufficiently high to avoid oscillation in and out of the low-SYS state due to system peak currents.

Since the main battery is typically connected to the SYS node (through the internal BATT to SYS switch), this circuit also functions as a low BATT comparator.

Thermal Fault

The MAX77829 has one centralized thermal circuit for sensing die temperature. If temperature increases above 165°C (T_{SHDN}) a thermal shutdown event occurs and the MAX77829 enters its global shutdown state.

In addition to the 165°C threshold, interrupts are generated when the die temperature reaches 120°C and 140°C.

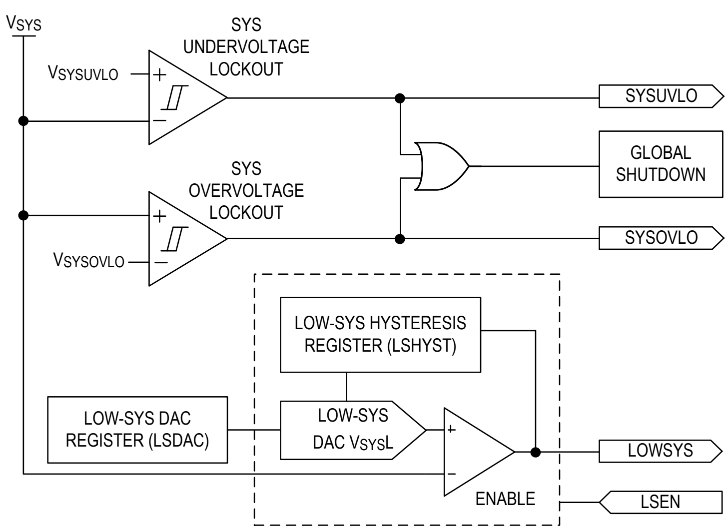


Figure 20. V_{SYS} Fault Monitor Functional Block Diagram

There is a 15°C thermal hysteresis. After thermal shutdown, if the die temperature cools by 15°C, the thermal shutdown bus is deasserted and DVDD LDO can be enabled again.

The main battery charger has an independent thermal control loop which will not cause thermal shutdown. In the event that the charger thermal overload occurs, only the charger will turn OFF.

Shutdown Events

The MAX77829 has a POR bus that goes to all blocks except the fuel gauge. The POR signal turns off these blocks and resets their registers to a default state under the following conditions:

- SYS Undervoltage Lockout
- SYS Overvoltage Lockout
- Overtemperature Fault (165°C) - This signal has hysteresis, if the die temperature hits 150°C, this signal is deasserted. This should not cause a turn-on event; turn-on events are listed in the Thermal Fault section. In other words, this signal is latched.
- Manual Reset (MRST pulled low for 7s default).

I²C Interface

The I²C serial bus consists of a bidirectional serial-data line (SDA) and a serial-clock input (SCL). The IC is a slave-only device, relying upon a master to generate a clock signal. The master initiates data transfer to and from the IC and generates SCL to synchronize the data transfer.

I²C is an open-drain bus. Both SDA and SCL are bidirectional lines, connected to a positive supply voltage through a pullup resistor. They both have Schmitt triggers and filter circuits to suppress noise spikes on the bus to assure proper device operation. A bus master initiates communication with the IC as a slave device by issuing a START condition followed by the IC address. The IC address byte consists of 7 address bits and a read/write bit (R/$\overline{W}$). After receiving the proper address, the IC issues an acknowledge bit by pulling SDA low during the ninth clock cycle. Figure 21 shows the I²C slave addresses for each functional block.

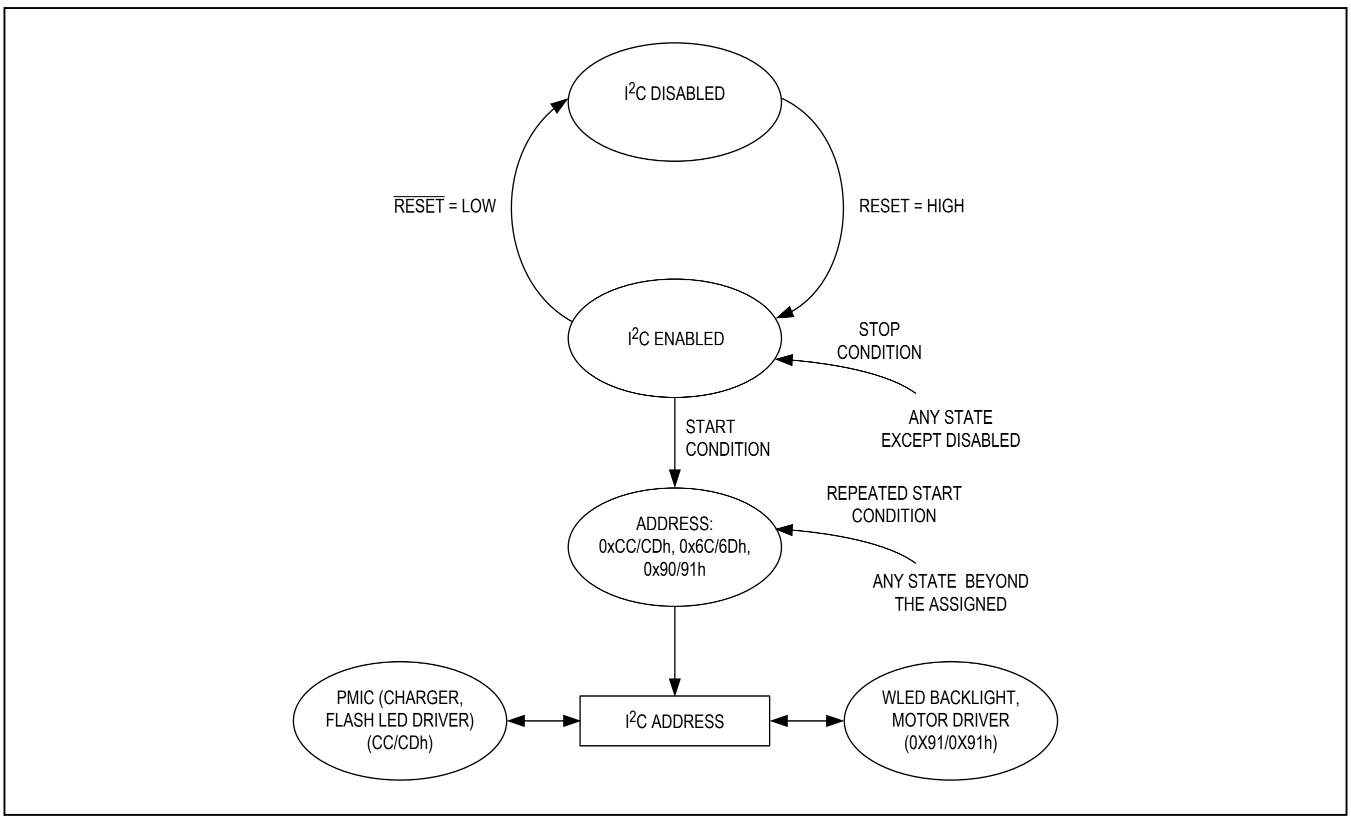


Figure 21. I²C State Diagram

I²C Bit Transfer

Each data bit, from the most significant bit to the least significant bit, is transferred one by one during each clock cycle. During data transfer, the SDA signal is allowed to change only during the low period of the SCL clock and it must remain stable during the high period of the SCL clock (Figure 22).

I²C Start And Stop Conditions

Both SCL and SDA remain high when the bus is not busy. The master signals the beginning of a transmission with a START (S) condition by transitioning SDA from high to low while SCL is high. When the master has finished communicating with the IC, it issues a STOP (P) condition by transitioning SDA from low to high while SCL is high. The bus is then free for another transmission (Figure 23). Both START and STOP conditions are generated by the bus master.

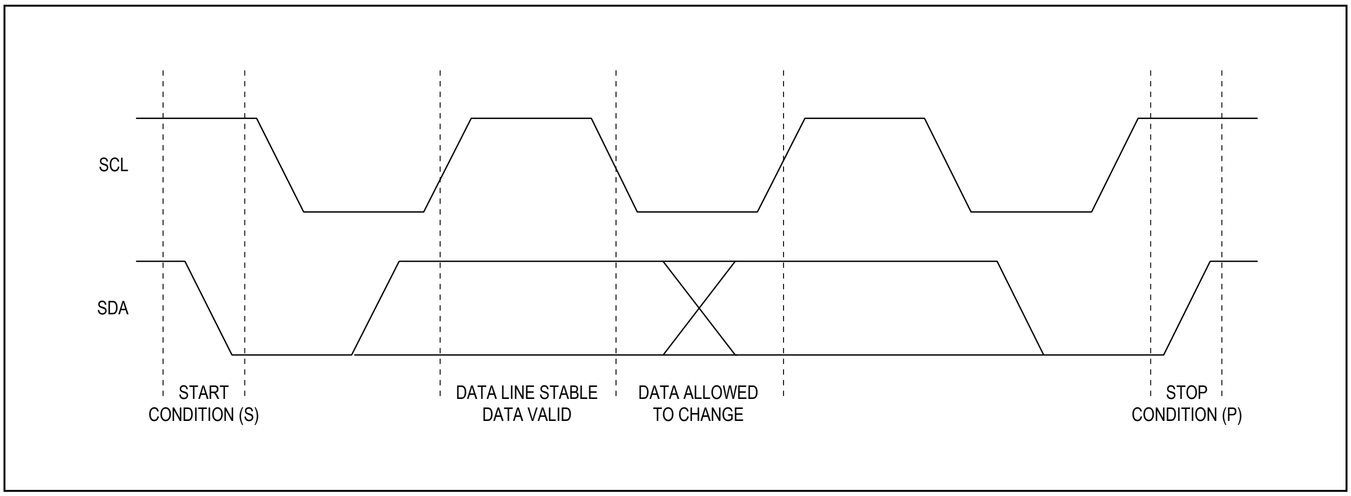


Figure 22. I²C Bit Transfer

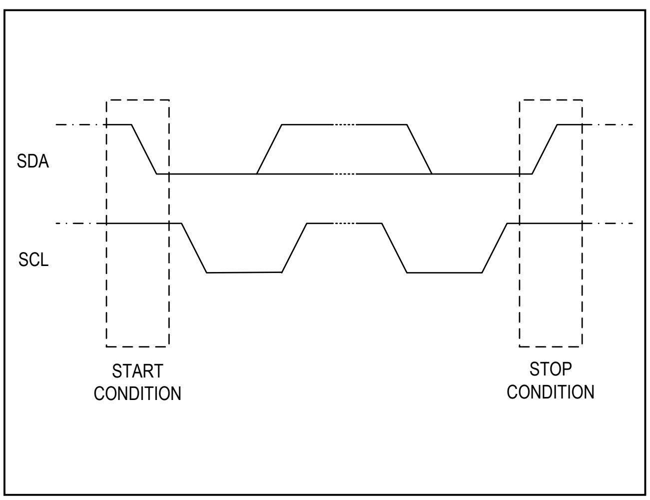


Figure 23. I²C Start and Stop Conditions

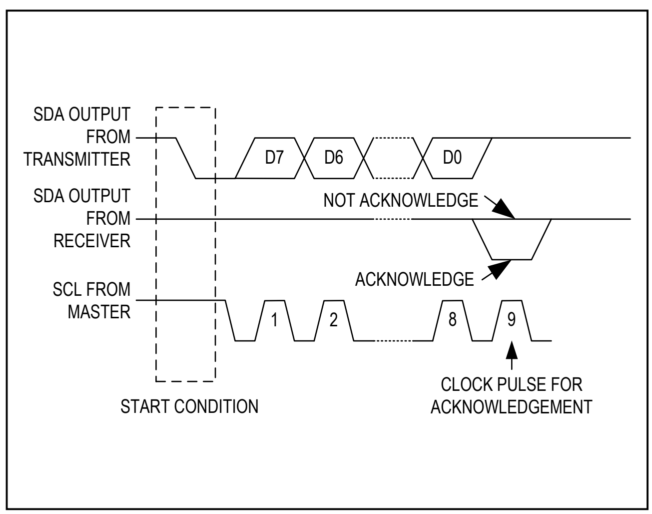


Figure 24. I²C Acknowledge

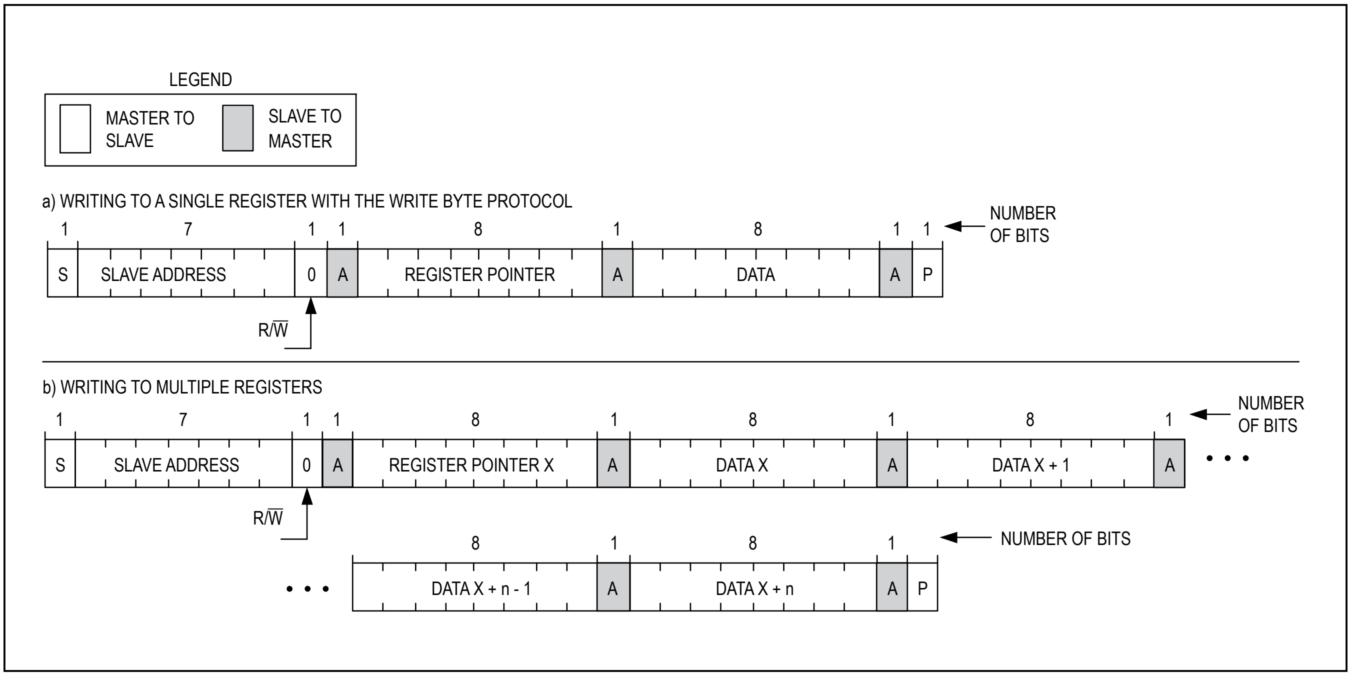


Figure 25. Master Transmits (Write Mode)

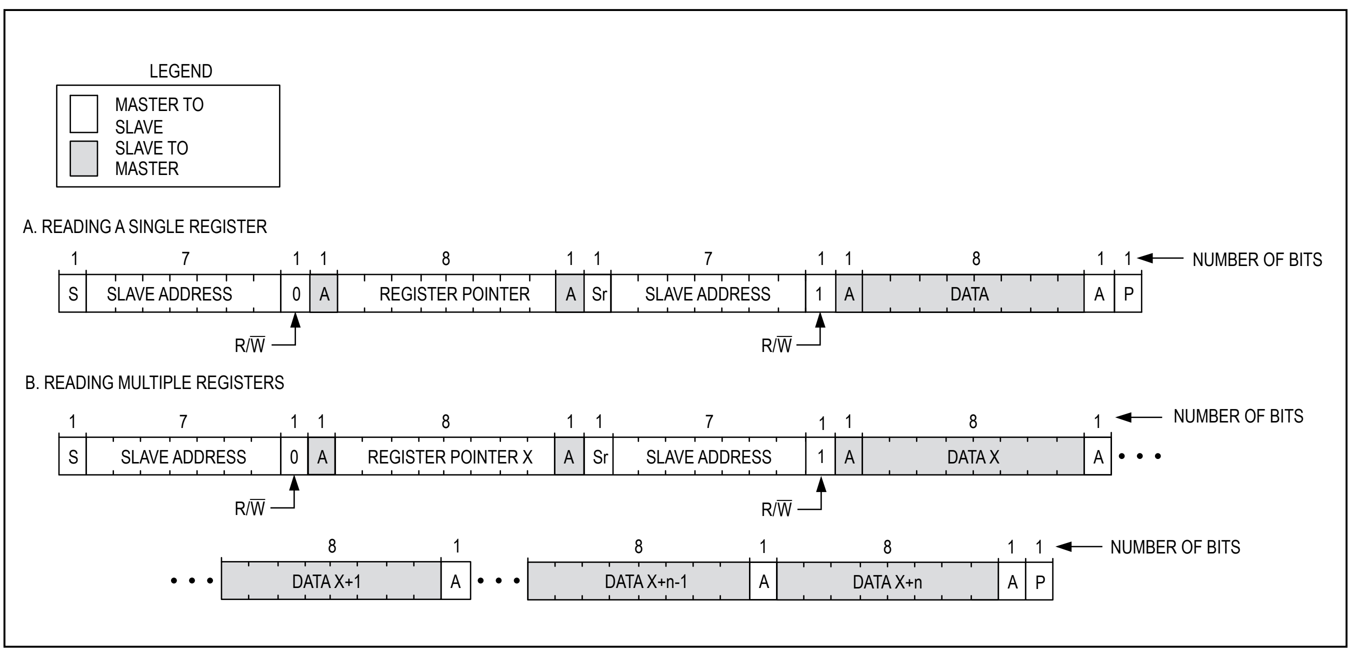


Figure 26. Master Reads Register Data Without Setting Register Address (Read Mode)

I2C Acknowledge

The number of data bytes between the Start and Stop conditions for the Transmitter and Receiver are unlimited. Each 8-bit byte is followed by an acknowledge bit. The acknowledge bit is a high-level signal put on SDA by the transmitter during which time the master generates an extra acknowledge related clock pulse. A slave receiver which is addressed must generate an acknowledge after each byte it receives. Also a master receiver must generate an acknowledge after each byte it receives that has been clocked out of the slave transmitter.

The device that acknowledges must pull down the SDA line during the acknowledge clock pulse, so that the SDA line is stable low during the high period of the acknowledge clock pulse (setup and hold times must also be met). A master receiver must signal an end of data to the transmitter by not generating an acknowledge on the last byte that has been clocked out of the slave. In this case, the transmitter must leave SDA high to enable the master to generate a Stop condition.

Multibutton Manual Reset

$\overline{\text{MRST}}$ is the manual reset input for hardware reset. Falling edge of $\overline{\text{MRST}}$ and minimum 7s (default) low initiate the automatic power reboot. The debouncing time is programmable ranging from 3s to 10s (with 1s per step). After the debouncing timer expires, the $\overline{\text{RESET}}$ output asserts and all the MAX77829 registers return to their default values. The $\overline{\text{RESET}}$ output is intended to reset the host system's main PMIC and/or applications processor in case they do not already have manual reset inputs of their own. When the manual reset feature is not required, pull $\overline{\text{MRST}}$ above logic-high input.

$\overline{\text{INT}}$

The MAX77829 interrupts indicate to the application processor that the status of the MAX77829 has changed. $\overline{\text{INT}}$ asserts low whenever one or more interrupts are toggled, and those interrupts are not masked. The application processor may read the interrupts in two steps. First, the AP reads the INTSRC register. This is a read-only register indicating which functional block is generating the interrupt, i.e. charger, flash, or other blocks. Depending on the result of the read, the next step is to read the actual interrupt registers pertaining to the functional block.

For example, if the application processor reads 0x02 from INTSRC register, it means the top-level PMIC block has an interrupt generated. The next step is to read the INT1 register of the PMIC functional block.

$\overline{\text{INT}}$ becomes high (cleared) as soon as the read sequence of the last INT_ register that contains an active interrupt starts. All interrupts can be masked to prevent $\overline{\text{INT}}$ from being asserted for masked interrupts. A mask bit in the INTM register implements masking. The INTSRC register can still provide the actual interrupt status of the masked interrupts, but $\overline{\text{INT}}$ is not asserted.

Register Map

I2C Slave Address (W/R): 0xCC/0xCD

ADDR	REGISTER NAME	RESET TYPE	MODE	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	RESET VALUE
0x00	IFLASH1	O	R/W	RESERVED			FLASH1_I[4:0]					0x00
0x01	IFLASH2	O	R/W	RESERVED			FLASH2_I[4:0]					0x00
0x02	ITORCH	O	R/W	RESERVED				TORCH_IOUT[3:0]				0x00
0x03	TORCH_TMR	O	R/W	TORCH_ TMR_MODE	DIS_TORCH_ TMR	RESERVED		TORCH_TMR_DUR[3:0]				0x00
0x04	FLASH_TMR	O	R/W	FLASH_ TMR_MODE	RESERVED			FLASH_TMR_DUR[3:0]				0x00
0x05	FLASH_EN	O	R/W	FLASH_FLED1_EN[1:0]		FLASH_FLED2_EN[1:0]		TORCH_FLED1_EN[1:0]		TORCH_FLED2_EN[1:0]		0x00
0x06	MAX_FLASH1	O	R/W	MAX_FL_EN	MAX_FLASH_TH[4:0]					MAX_FLASH_HYS[1:0]		0x00
0x07	MAX_FLASH2	O	R/W	RESERVED		LB_TMR_R[2:0]			LB_TMR_F[2:0]			0x00
0x08	MAX_FLASH3	O	R/W	FLED1_ MIN_MODE	RESERVED	FLED1_MIN_OUT[5:0]						0x00

I²C Slave Address (W/R): 0xCC/0xCD (continued)

ADDR	REGISTER NAME	RESET TYPE	MODE	BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0	RESET VALUE
0x09	MAX_FLASH4	O	R/W	FLED2_ MIN_MODE	RESERVED	FLED2_MIN_OUT[5:0]						0x00
0x0A	VOUT_CNTL	O	R/W	FLEDNUM	RESERVED				BOOST_FLASH_MODE[2:0]			0x00
0x0B	VOUT_FLASH	O	R/W	RESERVED	BOOST_VOUT_FLASH[6:0]							0x00
0x0E	FLASH_INT	S1	R/C	RESERVED		FLED_FAIL	MAX_FLASH	FLED1_ SHORT	FLED1_ OPEN	FLED2_ SHORT	FLED2_ OPEN	0x00
0x0F	FLASH_INT_ MASK	S1	R/W	RESERVED		FLED_ FAIL_m	MAX_ FLASH_m	FLED1_ SHORT_m	FLED1_ OPEN_m	FLED2_ SHORT_m	FLED2_ OPEN_m	0xFF
0x10	FLASH_ STATUS	S1	R	RESERVED				FLASH_ ON_STAT	TORCH_ ON_STAT	RESERVED		0x00
0x20	PMICID	O	R	ID[7:0]								0x29
0x21	PMICREV	O	R	VERSION[7:3]					REV[2:0]			0x01
0x22	INTSRC	S1	R/C	RESERVED			WLED_INT	RESERVED	FLASH_INT	TOP_INT	CHGR_INT	0x00
0x23	INTSRC_ MASK	S1	R/W	RESERVED			WLED_ INT_MASK	RESERVED	FLASH_ INT_MASK	TOP_ INT_MASK	CHGR_ INT_MASK	0xFF
0x24	TOPSYS_INT	S1	R/C	RESERVED				LOWSYS_ INT	RESERVED	T140C	T120C	0x00
0x26	TOPSYS_INT_ MASK	S1	R/W	RESERVED				LOWSYS_ INT_m	RESERVED	T140C_m	T120C_m	0xFF
0x28	TOPSYS_ STAT	O	R	RESERVED				LOWSYS_ STAT	MRSTB_ STAT	T140C_ STAT	T120C_ STAT	0x00
0x2A	MAINCTRL1	O	R/W	RESERVED				MREN	MRDBTMER[2:0]			0x0C
0x2B	LSCONFIG	S1	R/W	LSEN	LSHYST[1:0]		LSDAC[3:0]				RESERVED	0x2A
0x30	CHGINT1	O	R/C	AICLOTG_I	TOPOFF_I	OVP_I	DC_UVP_I	CHG_I	BAT_I	THM_I	RESERVED	0x00
0x31	CHGINTM1	O	R/W	AICLOTG_M	TOPOFF_M	OVPM	DC_UVPM	CHG_M	BAT_M	THM_M	RESERVED	0xCE
0x32	CHGSTAT	O	R	AICL_NOK	DCI_NOK	OVP_NOK	DC_UVP_ NOK	CHG_NOK	BAT_NOK	THM_NOK	DC_V	0x00
0x33	DC_BATT_ DTLS	O	R	DC_AICL	DC_I	DC_OVP	DC_UVP	BAT_DTLS[1:0]		BATDET_DTLS[1:0]		0x00
0x34	CHG_DTLS	O	R	THM_DTLS[2:0]			TOPOFF	CHG_DTLS[3:0]				0x68
0x35	BAT2SYS_ DTLS	O	R	RESERVED			BAT2SYS	VPQUTH	RESERVED			0x00
0x36	BAT2SOC_ CTL	O	R/W	RESERVED		OTG_EN	BAT2SOC[1:0]		BAT2SOCEN	TBAT2SOC[1:0]		0x00
0x37	CHGCNTL1	C	R/W	SFO_DEBOUNCE_TMR[1:0]		SFO_ DEBOUNCE_ EN	THM_DIS	JEITA_EN	BUCK_EN	CHGPROT[1:0]		0x44
0x38	FCHGCRNT	C	R/W	FCHGTIME[2:0]			CHGCC[4:0]					0x46
0x39	TOPOFF	C	R/W	TOPOFFTIME[2:0]			RESERVED		ITOPOFF[2:0]			0x63
0x3A	BATREG	C	R/W	REGTEMP[1:0]		CHGRSTRT	MBATREG[3:0]				VICHG_ GAIN	0x16

I²C Slave Address (W/R): 0xCC/0xCD (continued)

<table>
<tr><th>ADDR</th><th>REGISTER NAME</th><th>RESET TYPE</th><th>MODE</th><th>BIT 7</th><th>BIT 6</th><th>BIT 5</th><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>BIT 1</th><th>BIT 0</th><th>RESET VALUE</th></tr>
<tr><td>0x3B</td><td>DCCRNT</td><td>C</td><td>R/W</td><td colspan="2">RESERVED</td><td colspan="6">DCILMT[5:0]</td><td>0x0C</td></tr>
<tr><td>0x3C</td><td>AICLCNTL</td><td>C</td><td>R/W</td><td>RESERVED</td><td>AICLVTH</td><td>AICL_ RESET</td><td colspan="4">AICL[3:0]</td><td>DCMON_ DIS</td><td>0x0C</td></tr>
<tr><td>0x3D</td><td>RBOOST_ CTL1</td><td>D</td><td>R/W</td><td colspan="3">BSTSOFTSLEWRATE[2:0]</td><td>RBFORCEPWM</td><td colspan="3">RESERVED</td><td>RBOOSTEN</td><td>0x20</td></tr>
<tr><td>0x3E</td><td>CHGCNTL2</td><td>C</td><td>R/W</td><td>DCILIM_EN</td><td colspan="2">PREQCUR[1:0]</td><td>CEN</td><td>QBATEN</td><td colspan="3">VSYSREG[2:0]</td><td>0x36</td></tr>
<tr><td>0x3F</td><td>BATDET</td><td>O</td><td>R/W</td><td>STRONPUEN</td><td>BATDETENB</td><td colspan="5">TDEB_BATREM</td><td>BAT_SIM_ DEB</td><td>0x6E</td></tr>
<tr><td>0x40</td><td>USBCHGCTL</td><td>C</td><td>R/W</td><td>DISTIMER</td><td colspan="3">RESERVED</td><td>USB_ HICURRENT</td><td>USB_ SUSPEND</td><td>RESERVED</td><td>LOW_BAT</td><td>0x00</td></tr>
<tr><td>0x41</td><td>MBATREGMAX</td><td>O</td><td>R/W</td><td colspan="4">RESERVED</td><td colspan="4">MBATMAX[3:0]</td><td>0x0F</td></tr>
<tr><td>0x42</td><td>CHGCCMAX</td><td>O</td><td>R/W</td><td colspan="3">RESERVED</td><td colspan="5">CHGCCMAX[4:0]</td><td>0x1F</td></tr>
<tr><td>0x43</td><td>RBOOST_CTL2</td><td>D</td><td>R/W</td><td>RESERVED</td><td colspan="7">VBYPSET[6:0]</td><td>0x00</td></tr>
<tr><td>0x44</td><td>CHGINT2</td><td>O</td><td>R/C</td><td>DC_V_I</td><td colspan="2">RESERVED</td><td>CHG_ WDT_I</td><td colspan="3">RESERVED</td><td>CHG_WDT_ WRN_I</td><td>0x00</td></tr>
<tr><td>0x45</td><td>CHGINTMSK2</td><td>O</td><td>R/W</td><td>DC_V_M</td><td colspan="2">RESERVED</td><td>CHG_ WDT_M</td><td colspan="3">RESERVED</td><td>CHG_WDT_ WRN_M</td><td>0x00</td></tr>
<tr><td>0x46</td><td>CHG_WDTC</td><td>O</td><td>R/W</td><td colspan="6">RESERVED</td><td colspan="2">CHG_WDTC[1:0]</td><td>0x00</td></tr>
<tr><td>0x47</td><td>CHG_WDT_ CTL</td><td>O</td><td>R/W</td><td colspan="2">CHG_WDT[1:0]</td><td colspan="5">RESERVED</td><td>CHG_ WDT_EN</td><td>0x40</td></tr>
<tr><td>0x48</td><td>CHG_WDT_ DTLS</td><td>O</td><td>R</td><td colspan="3">RESERVED</td><td>CHG_WDT_ STAT</td><td colspan="3">RESERVED</td><td>CHG_WDT_ WRN_STAT</td><td>0x00</td></tr>
<tr><td>0x4B</td><td>SAFEOUTCTL</td><td>O</td><td>R/W</td><td>RESERVED</td><td>SAFEOUT_ EN</td><td>RESERVED</td><td>ACTDISSAFEO1</td><td colspan="2">RESERVED</td><td colspan="2">SAFEOUT[1:0]</td><td>0x51</td></tr>
</table>

** R/W: Read and Write*
R: Read Only
R/C: Read and Clear
W/C: Write and Clear

I²C Slave Address (W/R): 0x90/0x91

<table>
<tr><th>ADDR</th><th>REGISTER NAME</th><th>RESET TYPE</th><th>MODE</th><th>BIT 7</th><th>BIT 6</th><th>BIT 5</th><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>BIT 1</th><th>BIT 0</th><th>RESET VALUE</th></tr>
<tr><td>0x98</td><td>WLEDBST CNTL1</td><td>O</td><td>R/W</td><td>WLED1EN</td><td>WLED2EN</td><td>WLEDPWM1EN</td><td>WLEDPWM2EN</td><td colspan="2">WLEDFOSC</td><td>WLEDOVP</td><td>RESERVED</td><td>0x00</td></tr>
<tr><td>0x99</td><td>IWLED</td><td>O</td><td>R/W</td><td colspan="8">IWLED</td><td>0x00</td></tr>
<tr><td>0x9B</td><td>WLED_INT</td><td>S1</td><td>R/C</td><td>WLEDOVP</td><td colspan="2">RESERVED</td><td>WLEDOL</td><td colspan="4">RESERVED</td><td>0x00</td></tr>
<tr><td>0x9C</td><td>WLED_INT_M</td><td>S1</td><td>R/W</td><td>WLED OVP_M</td><td colspan="2">RESERVED</td><td>WLEDOL_M</td><td colspan="4">RESERVED</td><td>0x90</td></tr>
</table>

** R/W: Read and Write*
R/C: Read and Clear

Register Introduction

I^2C Address:

The MAX77829 has 2 slave addresses. The least significant bit is the read/$\overline{\text{write}}$ indicator

- PMIC (Charger, Flash LED Driver): 0xCC/0xCD
- WLED Backlight Driver: 0x90/0x91

Register Reset Conditions:

- Type S1: Registers are reset each time when SYS < POR
- Type O: Registers are reset each time when SYS < SYS UVLO or MAX77829 transitions from on to off state (global shutdown) or MRSTB is logic level low

PMIC Register Details

PMIC ID Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
PMICID		PMIC ID	0x20	O	0x29
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R	ID	1001	ID information	
7:4	R	ID	0010		

PMIC Version/Rev Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
PMICREV		PMIC Revision	0x21	O	0x01
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R	REV	001	Chip revision history	
7:3	R	VERSION	00000	Version information	

Interrupt Source Mask Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
INTSRC_MASK		Interrupt Source Mask	0x23	S1	0xFF
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	CHGR_INT_MASK	1	1: Charger interrupt is masked. 0: Charger interrupt is unmasked.	
1	R/W	TOP_INT_MASK	1	1: Top interrupt is masked. 0: Top interrupt is unmasked.	
2	R/W	FLASH_INT_MASK	1	1: Flash interrupt is masked. 0: Flash interrupt is unmasked.	
3	R/W	RESERVED	1	Reserved	
4	R/W	WLED_INT_MASK	1	1: WLED interrupt is masked. 0: WLED interrupt is unmasked.	
5	R/W	RESERVED	1	Reserved	
6	R/W	RESERVED	1	Reserved	
7	R/W	RESERVED	1	Reserved	

Top SYS Interrupt Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
TOPSYS_INT		Top SYS Interrupts	0x24	S1	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/C	T120C	0	+120°C Thermal Interrupt This interrupt is set when TDIE > +120°C. 1 = Detected 0 = Not detected	
1	R/C	T140C	0	+140°C Thermal Interrupt This interrupt is set when TDIE > +140°C. 1 = Detected 0 = Not detected	
2	R/C	RESERVED	0	Reserved	
3	R/C	LOWSYS_INT	0	Low SYS Interrupt 1 = Detected 0 = Not detected	
4	R/C	RESERVED	0	Reserved	
5	R/C	RESERVED	0	Reserved	
6	R/C	RESERVED	0	Reserved	
7	R/C	RESERVED	0	Reserved	

Top SYS Interrupt Mask Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
TOPSYS_INT_ MASK		Top SYS Interrupt Mask	0x26	S1	0xFF
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	T120C_m	1	+120°C Thermal Interrupt Mask 0 = Not masked 1 = Masked	
1	R/W	T140C_m	1	+140°C Thermal Interrupt Mask 0 = Not masked 1 = Masked	
2	R/W	RESERVED	1	Reserved	
3	R/W	LOWSYS_INT_m	1	LOWSYS Event 0 = Not masked 1 = Masked	
4	R/W	RESERVED	1	Reserved	
5	R/W	RESERVED	1	Reserved	
6	R/W	RESERVED	1	Reserved	
7	R/W	RESERVED	1	Reserved	

Top SYS Status Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
TOPSYS_STAT		Status 1	0x28	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R	T120C_STAT	0	+120°C Thermal Status 0 = T_{die} < +120°C 1 = T_{die} > +140°C	
1	R	T140C_STAT	0	+140°C Thermal Status 0 = T_{die} < +140°C 1 = T_{die} > +140°C	
2	R	MRSTB_STAT	0	Instantaneous Status on MRSTB Pin Without Debounce Timer 0: MRSTB is Low 1: MRSTB is High	
3	R	LOWSYS_STAT	0	0: SYS is below the Low SYS threshold. 1: SYS is above the Low SYS threshold.	
4	R	RESERVED	0	Reserved	
5	R	RESERVED	0	Reserved	
6	R	RESERVED	0	Reserved	
7	R	RESERVED	0	Reserved	

Main Control 1 Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MAINCTRL1		Main Control 1	0x2A	O	0x0C
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R/W	MRDBTMER	100	Manual Reset Debounce Timer When MRSTB = Logic Low 000: 3s 001: 4s 010: 5s 011: 6s 100: 7s 101: 8s 110: 9s 111: 10s	
3	R/W	MREN	1	Manual Reset Enable Bit 0: Manual reset function is disabled. 1: Manual reset function is enabled.	
4	R/W	RESERVED	0	Reserved	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	RESERVED	0	Reserved	

Low SYS Detection Configuration 1 Register

<table>
<tr><th colspan="2">NAME</th><th>FUNCTION</th><th>ADDRESS</th><th colspan="2">TYPE</th><th colspan="2">RESET</th></tr>
<tr><td colspan="2">LSCNFG</td><td>Low SYS Detect Configuration</td><td>0x2B</td><td colspan="2">S1</td><td colspan="2">0x2A</td></tr>
<tr><th>BIT</th><th>MODE</th><th>NAME</th><th>RESET</th><th colspan="4">DESCRIPTION</th></tr>
<tr><td>0</td><td>R/W</td><td>RESERVED</td><td>0</td><td colspan="4">Reserved</td></tr>
<tr><td rowspan="9">4:1</td><td rowspan="9">R/W</td><td rowspan="9">LSDAC</td><td rowspan="9">0101</td><td colspan="4">Low SYS DAC voltage that sets the V_{SYS} falling threshold.
Programmed in 50mV steps from 2.6V to 3.35V.</td></tr>
<tr><td>0000</td><td>2.60V</td><td>1000</td><td>3.00V</td></tr>
<tr><td>0001</td><td>2.65V</td><td>1001</td><td>3.05V</td></tr>
<tr><td>0010</td><td>2.70V</td><td>1010</td><td>3.10V</td></tr>
<tr><td>0011</td><td>2.75V</td><td>1011</td><td>3.15V</td></tr>
<tr><td>0100</td><td>2.80V</td><td>1100</td><td>3.20V</td></tr>
<tr><td>0101</td><td>2.85V</td><td>1101</td><td>3.25V</td></tr>
<tr><td>0110</td><td>2.90V</td><td>1110</td><td>3.30V</td></tr>
<tr><td>0111</td><td>2.95V</td><td>1111</td><td>3.35V</td></tr>
<tr><td>6:5</td><td>R/W</td><td>LSHYST</td><td>01</td><td colspan="4">Low SYS Comparator Hysteresis
00 = 100mV
01 = 200mV (default)
10 = 300mV
11 = 400mV</td></tr>
<tr><td>7</td><td>R/W</td><td>LSEN</td><td>0</td><td colspan="4">Low SYS DAC Enable
With LSEN = 1, the low SYS DAC output is available as an interrupt.
0 = DAC disabled (reduce supply current).
1 = DAC enabled.</td></tr>
</table>

Charger Register Details

Charger Interrupt Register

NAME	FUNCTION	ADDRESS	TYPE	RESET
CHGINT1	Charger Interrupt	0x30	O	0x00

BIT	MODE	NAME	RESET	DESCRIPTION
0	R/C	RESERVED	0	Reserved
1	R/C	THM_I	0	Thermistor Interrupt 0 = The THM_NOK status has not changed since the last time this bit was read. 1 = The THM_NOK status has changed since the last time this bit was read.
2	R/C	BAT_I	0	Battery Interrupt 0 = The BAT_NOK status or BATDET_DTLS<1:0>, or BAT2SYS or VPQUTH battery details has not changed since the last time this bit was read. 1 = The BAT_NOK status or BATDET_DTLS<1:0, or BAT2SYS or VPQUTH battery details has changed since the last time this bit was read.
3	R/C	CHG_I	0	Charge Current Interrupt 0 = The CHG_NOK status has not changed since the last time this bit was read. 1 = The CHG_NOK status has changed since the last time this bit was read.
4	R/C	DC_UVP_I	0	DC Undervoltage Interrupt 0 =The DCUVP_NOK status has not changed since the last time this bit was read. 1 = The DCUVP_NOK status has changed since the last time this bit was read.
5	R/C	OVP_I	0	DC Overvoltage Interrupt 0 = The OVP_NOK status has not changed since the last time this bit was read. 1 = The OVP_NOK status has changed since the last time this bit was read.
6	R/C	TOPOFF_I	0	Topoff Interrupt 0 = The topoff status has not changed since the last time this bit was read. 1 = The charger has entered topoff state.
7	R/C	AICLOTG_I	0	AICL interrupt when buck and charger enabled. OTGILIM interrupt when reverse boost enabled. 0 = The AICL_NOK or DCI_NOK status has not changed since the last time this bit was read (charger enabled). The OTGILIM status has not changed since the last time this bit was read (reverse boost enabled). 1 = The AICL_NOK or DCI_NOK status has changed since the last time this bit was read (charger enabled). The OTGILIM status has changed since the last time this bit was read (reverse boost enabled).

Charger Interrupt Masks Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGINTM1		Charger INT MASK	0x31	O	0xCE
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	RESERVED	0	Reserved	
1	R/W	THM_M	1	Thermistor Interrupt Mask 0 = Unmask 1 = Mask	
2	R/W	BAT_M	1	Battery Interrupt Mask 0 = Unmask 1 = Mask	
3	R/W	CHG_M	1	Charger Interrupt Mask 0 = Unmask 1 = Mask	
4	R/W	DC_UVPM	0	DC Undervoltage Interrupt Mask 0 = Unmask 1 = Mask	
5	R/W	OVPM	0	DC Overvoltage Interrupt Mask 0 = Unmask 1 = Mask	
6	R/W	TOPOFF_M	1	Topoff Interrupt Mask 0 = Unmask 1 = Mask	
7	R/W	AICLOTG_M	1	AICL/OTG Interrupt Mask 0 = Unmask 1 = Mask	

Charger Status Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGSTAT		Charger Status	0x32	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R	DC_V	0	DC Voltage Status 1 = V_{DC} > 5.9V 0 = V_{DC} ≤ 5.9V	
1	R	THM_NOK	0	Thermistor Status Indicator. See the THM_DTLS [2:0] for more information. A change in status issues an interrupt to THM_I. 1 = The thermistor temperature is outside of the allowable range for charging. THM_DTLS [2:0] = 0b001 or 0b101 0 = The thermistor temperature is inside of the allowable range for charging (i.e., okay). THM_DTLS [2:0] ≠ 0b001 or 0b101	
2	R	BAT_NOK	0	Single-Bit Battery Status Indicator. See BAT_DTLS [1:0] for more information. A change in status issues an interrupt to BAT_I. 1 = The battery has an issue and the charger has been suspended. BAT_DTLS [1:0] = 0b01 or 0b11 0 = The battery is okay. BAT_DTLS [1:0] = 0b10 or 0b00	
3	R	CHG_NOK	0	Single-Bit Charger Status Indicator. See CHG_DTLS [3:0] for more information. A change in status issues an interrupt CHG_I. 1 = The charger has suspended charging. CHG_DTLS [3:0] = 0b0101 or 0b0110 or 0b0111 or 0b1001 or 0b1010 0 = The charger is okay. All other CHG_DTLS [3:0] states.	
4	R	DC_UVP_NOK	0	A change in status issues an interrupt to DC_UVP_I. 1 = The DC UVP is invalid. DC_UVP = 0 0 = The DC UVP input is valid. DC_UVP =1	
5	R	OVP_NOK	0	A change in status issues an interrupt to OVP_I. 1 = The DC input is invalid. DC_OVP 0 = The DC input is valid. DC_OVP = 0	
6	R	DCI_NOK	0	A change in status issues an interrupt to AICL_I. 1 = The DC input current limit is invalid. DC_I = 1 0 = The DC input is valid. DCI = 0	
7	R	AICL_NOK	0	AICL Input Status Indicator. See DC Details for more information. A change in status issues an interrupt to AICL_I. 1 = The part is operating in AICL mode. 0 = The part is not operating in AICL mode.	

DC and BATT Details Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
DC_BATT_DTLS		Details 1	0x33	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R	BATDET_DTLS [1:0]	00	BATDET_DTLS generates an interrupt to the processor BAT_I. Battery Detect Details: 01,10 = Battery detected 11 = BAT_REMOVED detected 00 = CONTACT_BREAK	
3:2	R	BAT_DTLS [1:0]	00	Battery Details 00 = V_{MBATT} < V_{PQLTH}. This condition is also reported in the CHG_ DTLS [3:0] as 0000. 01 = The battery is taking longer than expected to charge. This could be due to high system currents, an old battery, a damaged battery or something else. Charging has suspended and the charger is in its timer fault mode. This condition is also reported in the CHG_DTLS [3:0] as 0110. 10 = The battery is okay. 11 = The battery voltage is greater than the battery overvoltage flag threshold (VBAT_OVP), VBAT_OVP is set to a fixed LSB value above battery regulation target. Note that this flag is only generated when there is a valid DC input.	
4	R	DC_UVP	0	DC Details. An invalid condition indicates adapter removed/ unplugged. A valid condition indicates adapter inserted. 1 = V_{DC} is valid. V_{DC} > VDC_UVLO 0 = V_{DC} is invalid. V_{DC} < VDC_UVLO	
5	R	DC_OVP	0	DC Details 0 = V_{DC} is valid. V_{DC} < VDC_OVLO 1 = V_{DC} is invalid. V_{DC} > VDC_ OVLO	
6	R	DC_I	0	DC Details 0 = IDC is valid. IDC < Input Current Limit 1 = IDC is invalid. IDC > Input Current Limit	
7	R	DC_AICL	0	DC AICL Details 0 = V_{DC} > AICL threshold. 1 = V_{DC} < AICL threshold.	

Charger Details Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHG_DTLS		Details 2	0x34	O	0x68
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R	CHG_DTLS [3:0]	1000	Charger Details 0000 = Charger is in dead-battery region, V_{BAT} < V_{PQLTH}, T_J < T_{JREG}, T_J < T_{JSHDN}, 0001 = Charger is in precharge mode, V_{BAT} < V_{PQUTH}, T_J < T_{JREG}, T_J < T_{JSHDN}, 0010 = Charger is in fast-charge constant current mode, V_{BAT} > V_{PQUTH}, T_J < T_{JREG}, T_J < T_{JSHDN}, 0011 = Charger is in fast-charge constant voltage mode, V_{BAT} = V_{BATREG}, T_J < T_{JREG}, T_J < T_{JSHDN} 0100 = Charger is in top-off mode, V_{BAT} ≥ V_{BATREG}, T_J < T_{JREG}, T_J < T_{JSHDN} 0101 = Charger is in done mode, V_{BAT} > V_{BATREG} and T > T_{TOPOFF} + 16s, T_J < T_{JREG}, T_J < T_{JSHDN} 0110 = Charger is in timer fault mode, V_{BAT} < V_{MBATOV}, T T_J < T_{JSHDN} 0111 = Charger is in temperature suspend mode, see THM_DTLS [2:0] 1000 = Buck off, charger off 1001 = Charger is in precharge, fast-charge or top-off modes and is operating with its thermal loop active (i.e., the junction temperature is greater than the value set by REGTEMP [1:0]). 1010 = Charger is off and junction temperature is > T_{SHDN} 1011 = Buck on, charger off 1100 = Charger OTG current limit is exceeded longer than debounce time 1101 = USB suspend	
4	R	TOPOFF	0	TOPOFF Details A change in details entering topoff issues an interrupt to TOPOFF_I but not exiting. 0 = TOPOFF is not reached; I_{FCHG} > IDONE 1 = TOPOFF is reached; I_{FCHG} < IDONE	
7:5	R	THM_DTLS [2:0]	011	Thermistor Details 001 = Low temperature and charging suspended (cold, <T1) 010 = Low temperature charging (cool, > T1 and < T2) 011 = Standard temperature charging (normal, >T2 and <T3) 100 = High temperature charging (warm, >T3 and <T4) 101 = High temperature and charging suspended (>T4)	

Battery Overcurrent, Prequal Details Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
BAT2SYS_DTLS		Details 3	0x35	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R	RESERVED	0	Reserved	
3	R	VPQUTH	0	Prequal Upper Threshold Detail 0 = MBATT< V_{PQUTH} 1 = MBATT> V_{PQUTH}, or no valid charger.	
4	R	BAT2SYS	0	Battery Overcurrent Detail 0 = The battery current does not exceed overcurrent threshold. 1 = The battery has been overcurrent for at least $t_{BAT2SOC}$.	
7:5	R	RESERVED	000	Reserved	

Battery-to-System Overcurrent Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
BAT2SOC_CTL		BAT2SYS OC Control	0x36	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	TBAT2SOC [1:0]	00	Battery Overcurrent Debounce Time 00 = 4ms 01 = 6ms 10 = 8ms 11 = 10ms	
2	R/W	BAT2SOCEN	0	Battery to System Overcurrent Enable 0 = Disable 1 = Enable	
4:3	R/W	BAT2SOC [1:0]	00	Battery Overcurrent Threshold 00 = 3.0A (20mV) 01 = 3.5A (25mV) 10 = 4.0A (27.5mV) 11 = 5.0A (30mV)	
5	R/W	OTG_EN	0	OTG Enabled Control 0 = OTG disabled 1 = OTG enabled	
7:6	R/W	RESERVED	000	Reserved	

Charger Control 1 Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGCNTL1		Charger Control 1	0x37	C	0x44
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	CHGPROT [1:0]	0	Charger Settings Protection Bits. Writing “11” to these bits unlocks the settings for the above registers. Writing any value besides “11” locks these registers. 00 = Locked 01 = Locked 10 = Locked 11 = Unlocked	
2	R/W	BUCK_EN	1	Buck Enable/Disable Bit 0 = Buck disabled 1 = Buck enabled	
3	R/W	JEITA_EN	0	JEITA Enable Configuration, JEITA enable bit does not affect T1 and T4 temperature sensing. 0 = JEITA is enabled 1 = JEITA is disabled	
4	R/W	THM_DIS	0	Thermistor Enable/Disable 0 = Thermistor is enabled 1 = Thermistor is disabled	
5	R/W	SFO_ DEBOUNCE_EN	0	SAFEOUT LDO Debounce Timer Enable/Disable 0 = Disabled (default) 1 = Enabled	
7:6	R/W	SFO_ DEBOUNCE_ TMR [1:0]	01	SAFEOUT LDO Debounce Timer. If CHGIN voltage falls below its UVLO- and recovers above its UVLO+ threshold within the debounce timer, SAFEOUT LDO output is not disabled. Note this timer, when enabled, only applies on the CHGIN falling edge. When CHGIN rises, the SAFEOUT LDO output is enabled as soon as the CHGIN input is valid, no debounce time in such case. 00 = 50ms 01 = 100ms (default) 10 = 150ms 11 = 200ms	

Fast Charge Current and Timer Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
FCHGCRNT		Fast Charge Current	0x38	C (Protected with CHGPROT)	0x46
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
4:0	R/W	CHGCC [4:0]	00110	Fast-Charge Current Selection. When the charger is enabled, the charge current limit is set by these bits. These bits range from 250mA to 2.0A. See the *CHGCC[4:0] Code Table* for more details.	
7:5	R/W	FCHGTIME [2:0]	010	Fast-Charge Timer Duration (t_{FC}) 000 = Disable 001 = 4hrs 010 = 5hrs 011 = 6hrs 100 = 7hrs 101 = 8hrs 110 = 9hrs 111 = 16hrs	

CHGCC[4:0] Code Table

(Current values are shown for a 47mΩ sense resistor)

0x00 = 0b00000 = 0A	0x10 = 0b10000 = 1.000A
0x01 = 0b00001 = 0.250A	0x11 = 0b10001 = 1.050A
0x02 = 0b00010 = 0.300A	0x12 = 0b10010 = 1.100A
0x03 = 0b00011 = 0.350A	0x13 = 0b10011 = 1.150A
0x04 = 0b00100 = 0.400A	0x14 = 0b10100 = 1.200A
0x05 = 0b00101 = 0.450A	0x15 = 0b10101 = 1.250A
0x06 = 0b00110 = 0.500A	0x16 = 0b10110 = 1.300A
0x07 = 0b00111 = 0.550A	0x17 = 0b10111 = 1.350A
0x08 = 0b01000 = 0.600A	0x18 = 0b11000 = 1.400A
0x09 = 0b01001 = 0.650A	0x19 = 0b11001 = 1.450A
0x0A = 0b01010 = 0.700A	0x1A = 0b11010 = 1.500A
0x0B = 0b01011 = 0.750A	0x1B = 0b11011 = 1.550A
0x0C = 0b01100 = 0.800A	0x1C = 0b11100 = 1.80A
0x0D = 0b01101 = 0.850A	0x1D = 0b11101 = 1.867A
0x0E = 0b01110 = 0.900A	0x1E = 0b11110 = 1.933A
0x0F = 0b01111 = 0.950A	0x1F = 0b11111 = 2.000A

Topoff and Temperature Regulation Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
TOPOFF		Top off/TEMP Control	0x39	C (Protected with CHGPROT)	0x63
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R/W	ITOPOFF [2:0]	011	Topoff Current Threshold (Topoff timer starts when ICHG reaches this current setting) 0x00 = 0b000 = 50mA 0x01 = 0b001 = 100mA 0x02 = 0b010 = 150mA 0x03 = 0b011 = 200mA 0x04 = 0b100 = 250mA 0x05 = 0b101 = 300mA 0x06 = 0b110 = 350mA 0x0 7 = 0b111 = 400mA	
3	R/W	RESERVED	0	Reserved	
4	R/W	RESERVED	0	Reserved	
7:5	R/W	TOPOFFTIME [2:0]	011	Top Off Timer Setting 0x00 = 0b00 0 = 0min 0x01 = 0b00 1 = 10min 0x02 = 0b010 = 20min 0x03 = 0b011 = 30min 0x04 = 0b100 = 40min 0x05 = 0b101 = 50min 0x06 = 0b110 = 60min 0x07 = 0b111 = Disable (charger never enters DONE state)	

Battery Regulation Control Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
BATREG		Battery Regulation	0x3A	C (Protected with CHGPROT)	0x16
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	VICHG_GAIN	0	VICHG Gain. I2V gain between charge current and ADC input 0 = 1.41mV/mA 1 = 8.46mV/mA (6x)	
4:1	R/W	MBATREG [3:0]	1011	MBATT Charger Regulation Voltage. See the *MBATREG[3:0] Code Table* for more details.	
5	R/W	CHGRSTRT	0	Fast Charge Restart Threshold (VMBAT_Ref) 0 = -150mV 1 = -200mV	
7:6	R/W	REGTEMP [1:0]	00	Die Temperature Thermal Regulation Loop Set Point 00 = +105°C 01 = +90°C 10 = +120°C 11 = +75°C	

MBATREG[3:0] Code Table

0x00 = 0b0000 = 3.55V	0x08 = 0b1000 = 4.05V
0x01 = 0b0001 = 3.70V	0x09 = 0b1001 = 4.10V
0x02 = 0b0010 = 3.75V	0x0A = 0b1010 = 4.15V
0x03 = 0b0011 = 3.80V	0x0B = 0b1011 = 4.20V
0x04 = 0b0100 = 3.85V	0x0C = 0b1100 = 4.25V
0x05 = 0b0101 = 3.90V	0x0D = 0b1101 = 4.30V
0x06 = 0b0110 = 3.95V	0x0E = 0b1110 = 4.35V
0x07 = 0b0111 = 4.00V	0x0F = 0b1111 = 4.40V

DC Current Limit Control Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
DCCRNT		Input Current Limit	0x3B	C (Protected with CHGPROT)	0x0C
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
5:0	R/W	DCILMT [5:0]	001100	DC Input Current Limit Selection. When the DC-DC converter is on and DCILIM_EN = 1, the DC input current limit is set by DCILIM as shown in the *DCILMT[5:0] Code Table*. DCILIM target is always at 95% of programmed value.	
7:6	R/W	RESERVED	00	Reserved	

DCILMT[5:0] Code Table

0x00 = 0b000000 = 0.100A	0x10 = 0b010000 = 0.600A	0x20 = 0b100000 = 1.000A	0x30 = 0b110000 = 1.400A
0x00 = 0b000001 = 0.100A	0x11 = 0b010001 = 0.625A	0x21 = 0b100001 = 1.025A	0x31 = 0b110001 = 1.425A
0x00 = 0b000010 = 0.100A	0x12 = 0b010010 = 0.650A	0x22 = 0b100010 = 1.050A	0x32 = 0b110010 = 1.450A
0x03 = 0b000011 = 0.275A	0x13 = 0b010011 = 0.675A	0x23 = 0b100011 = 1.075A	0x33 = 0b110011 = 1.475A
0x04 = 0b000100 = 0.300A	0x14 = 0b010100 = 0.700A	0x24 = 0b100100 = 1.100A	0x34 = 0b110100 = 1.500A
0x05 = 0b000101 = 0.325A	0x15 = 0b010101 = 0.725A	0x25 = 0b100101 = 1.125A	0x35 = 0b110101 = 1.709A
0x06 = 0b000110 = 0.350A	0x16 = 0b010110 = 0.750A	0x26 = 0b100110 = 1.150A	0x36 = 0b110110 = 1.750A
0x07 = 0b000111 = 0.375A	0x17 = 0b010111 = 0.775A	0x27 = 0b100111 = 1.175A	0x37 = 0b110111 = 1.792A
0x08 = 0b001000 = 0.400A	0x18 = 0b011000 = 0.800A	0x28 = 0b101000 = 1.200A	0x38 = 0b111000 = 1.834A
0x09 = 0b001001 = 0.425A	0x19 = 0b011001 = 0.825A	0x29 = 0b101001 = 1.225A	0x39 = 0b111001 = 1.875A
0x0A = 0b001010 = 0.450A	0x1A = 0b011010 = 0.850A	0x2A = 0b101010 = 1.250A	0x3A = 0b111010 = 1.917A
0x0B = 0b001011 = 0.475A	0x1B = 0b011011 = 0.875A	0x2B = 0b101011 = 1.275A	0x3B = 0b111011 = 1.959A
0x0C = 0b001100 = 0.500A	0x1C = 0b011100 = 0.900A	0x2C = 0b101100 = 1.300A	0x3C = 0b111100 = 2.000A
0x0D = 0b001101 = 0.525A	0x1D = 0b011101 = 0.925A	0x2D = 0b101101 = 1.325A	0x3D = 0b111101 = 2.042A
0x0E = 0b001110 = 0.550A	0x1E = 0b011110 = 0.950A	0x2E = 0b101110 = 1.350A	0x3E = 0b111110 = 2.084A
0x0F = 0b001111 = 0.575A	0x1F = 0b011111 = 0.975A	0x2F = 0b101111 = 1.375A	0x3F = 0b111111 = No LIMIT

AICL Control Register

NAME		FUNCTION	ADDRESS	TYPE
AICLCNTL		AICL	0x3C	C (Protected with CHGPROT)

NAME	FUNCTION	ADDRESS	TYPE	RESET
AICLCNTL	AICL	0x3C	C (Protected with CHGPROT)	0x0C

BIT	MODE	NAME	RESET	DESCRIPTION
0	R/W	DCMON_DIS	0	DCMON_DIS, disable the monitoring of input voltage by the dynamic input power limited. 0 = AICL enabled 1 = AICL disabled
4:1	R/W	AICL [3:0]	0110	AICL Detection Voltage Setting. See the *AICL [3:0] Code Table* for more details.
5	R/W	AICL_RESET	0	AICL Reset Threshold Below AICL Voltage Setting 0 = 100mV 1 = 200mV
6	R/W	AICLVTH	0	AICL Threshold Dependency on OVP Threshold 0 = AICL threshold is independent with the OVP threshold (i.e., the AICL threshold does not change with different OVP voltage setting) 1 = AICL threshold is dependent with the OVP threshold (i.e., the AICL threshold changes with different OVP voltage setting accordingly)
7	R/W	RESERVED	0	Reserved

AICL [3:0] Code Table

0x0 = 0b0000 = 3.9V	0x7 = 0b0111 = 4.6V
0x1 = 0b0001 = 4.0V	0x8 = 0b1000 = 4.7V
0x2 = 0b0010 = 4.1V	0x9 = 0b1001 = 4.8V
0x3 = 0b0011 = 4.2V	0x10 = 0b1010 = 4.8V
0x4 = 0b0100 = 4.3V	0x11 = 0b1011 = 4.8V
0x5 = 0b0101 = 4.4V	0x12 = 0b1100 = 4.8V
0x6 = 0b0110 = 4.5V	0x13 = 0b11xx = 4.8V

Reverse Boost Control 1 Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
RBOOST_CTL1		Reverse Boost Control #1	0x3D	D	0x20
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	RBOOSTEN	0	0 = Reverse boost disabled 1 = Reverse boost enabled	
3:1	R/W	RESERVED	000	Reserved	
4	R/W	RBFORCEPWM	0	Force Boost PWM Enable/Disable 0 = Force boost PWM disabled 1 = Force reverse boost to operate in PWM mode for better transient response	
7:5	R/W	BSTSOFTSLEW RATE [2:0]	001	Soft Slew Rate Control 000 = Bypass mode 001 = 1 code (25mV) each T100K*1 period 010 = 1 code (25mV) each T100K*2 period 011 = 1 code (25mV) each T100k*4 period 100 = 1 code (25mV) each T100k*8 period 101 = 1 code (25mV) each T100k*16 period 110 = 1 code (25mV) each T100k*32 period 111 = 1 code (25mV) each T100k*64 period	

System Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGCNTL2		SYS Control	0x3E	C (Protected with CHGPROT)	0x36
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R/W	VSYSREG [2:0]	110	Minimum V_{SYS} Regulation Voltage. See the *VSYSREG [2:0] Code Table* for more details.	
3	R/W	QBATEN	0	External pMOSFET Control. This bit allows the user to short SYS and BAT through SW. Under default conditions, QBAT switch is controlled through hardware state diagram during pre-charge to fast-charge conditions and in DONE state. However, this bit could provide flexibility to customers who intend to do SW charging instead of smart battery charging. 0 = Off 1 = On	
4	R/W	CEN	1	Charging Control. This bit allows the user to control when to enable charging. 0 = Off 1 = On	
6:5	R/W	PREQCUR [1:0]	01	Prequal Current: 00 = 100mA 01 = 200mA 10 = 300mA 11 = 400mA	
7	R/W	DCILIM_EN	0	Input Current Limit Control Enables the DC input current limit register to be controlled. 0 = The input current limit is controlled through USB_HICURRENT register bit. 1 = The input current limit is controlled through DCILMT [5:0] register bits.	

VSYSREG [2:0] Code Table

0x0 = 0b000 = 3.0V
0x1 = 0b001 = 3.1V
0x2 = 0b010 = 3.2V
0x3 = 0b011 = 3.3V
0x4 = 0b100 = 3.4V
0x5 = 0b101 = 3.5V
0x6 = 0b110 = 3.6V
0x7 = 0b111 = 4.0V

Battery Insertion/Removal Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
BATDET		Battery Detection	0x3F	O	0x6E
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	BAT_SIM_DEB	0	0 = The SIM card battery removal signal (BAT_REMOVED_SIM) is derived from a debounced timer that uses 3 cycle of 100kHz oscillator. The debounce time is between 30μs and 40μs. 1 = The SIM card battery removal signal (BAT_REMOVED_SIM) is the same signal as BAT_REMOVED which is programmed by TDEB_BATREM [4:0].	
5:1	R/W	TDEB_BATREM [4:0]	10111	Battery Removal Debounce Timer Count (BAT_REMOVED). This timer is driven from divide by 1 tap of the 100kHz oscillator. t_{MIN} = COUNT x 1/100kHz $t_{MAX} = t_{MIN}$+1/100kHz	
6	R/W	BATDETENB	1	Battery Detection Enable/Disable Bit 0 = Battery detection enable 1 = Battery detection disable	
7	R/W	STRONGPUENB	0	Battery Detection Strong Pullup Enable/Disable Bit 0 = Pullup enable 1 = Pullup disable	

USB Charger Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
USBCHGCTL		USB Charger Control	0x40	C	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	LOW_BAT	0	Low Battery Output 0 = The battery voltage level, $V_{MBATT} > V_{PQUTH}$ and V_{DC} or VWC is valid. 1 = The battery voltage level, $V_{MBATT} < V_{PQUTH}$ and V_{DC} is valid and VWC is invalid.	
1	R/W	RESERVED	0	Reserved	
2	R/W	USB_SUSPEND	0	USB Suspend Input 0 = Set DC input current limit based on USB_HICURRENT, DCILMT [5:0], and DCILM_EN configuration bits. 1 = Disable the DC input	
3	R/W	USB_HICURRENT	0	USB_HICURRENT Input. USB_HICURRENT controls the input current limit of the main-battery charger's DC input when DCILMT_EN = 0. When DCILMT_EN = 1, the DC input current limit is controlled by DCILMT [5:0]. 0 = Set the DC input current limit to 100mA 1 = Set the DC input current limit to 500mA	
4	R/W	RESERVED	0	Reserved	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	DISTIMER	0	Charging Timer Control 0 = Enable Timer 0 1 = Disable Timer 0	

Maximum Charge Termination Voltage Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MBATREGMAX		Max Charge Voltage	0x41	O	0x0F
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/W	MBATMAX [3:0]	1111	Maximum Charge Termination Voltage. The effective termination charge voltage is clamped by MBATMAX [3:0]. MBATMAX follows the same code table as MBATREG	
7:4	R/W	RESERVED	0000	Reserved	

Maximum Charge Current Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGCCMAX		Max Charge Current	0x42	O	0x1F
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
4:0	R/W	CHGCCMAX [4:0]	11111	Maximum Charge Current. The effective charge current is clamped by CHGCCMAX [4:0].	
7:5	R/W	RESERVED	000	Reserved	

BYP Target Output Voltage in Boost Mode Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
RBOOST_CTL2		BYP Target Output Voltage in Boost Mode	0x43	D	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
6:0	R/W	VBYPSET	0x00 (3V)	Bypass Target Output Voltage in Boost Mode. 3V (0x00) to 5.8V (0x70) in 0.025V steps. This setting is compared to the setting coming from the camera flash controller's adaptive circuit and the boost target voltage is the higher of the two.	
7	R/W	RESERVED	0	Reserved	

VBYPSET [6:0] Setting

(Note the presence of redundant codes)

0x00 = 3.000V	0x10 = 3.400V	0x20 = 3.800V	0x30 = 4.200V	0x40 = 4.600V	0x50 = 5.000V	0x60 = 5.400V	0x70 = 5.800V
0x01 = 3.025V	0x11 = 3.425V	0x21 = 3.825V	0x31 = 4.225V	0x41 = 4.625V	0x51 = 5.025V	0x61 = 5.425V	0x71 = 5.800V
0x02 = 3.050V	0x12 = 3.450V	0x22 = 3.850V	0x32 = 4.250V	0x42 = 4.650V	0x52 = 5.050V	0x62 = 5.450V	0x72 = 5.800V
0x03 = 3.075V	0x13 = 3.475V	0x23 = 3.875V	0x33 = 4.275V	0x43 = 4.675V	0x53 = 5.075V	0x63 = 5.475V	0x73 = 5.800V
0x04 = 3.100V	0x14 = 3.500V	0x24 = 3.900V	0x34 = 4.300V	0x44 = 4.700V	0x54 = 5.100V	0x64 = 5.500V	0x74 = 5.800V
0x05 = 3.125V	0x15 = 3.525V	0x25 = 3.925V	0x35 = 4.325V	0x45 = 4.725V	0x55 = 5.125V	0x65 = 5.525V	0x75 = 5.800V
0x06 = 3.150V	0x16 = 3.550V	0x26 = 3.950V	0x36 = 4.350V	0x46 = 4.750V	0x56 = 5.150V	0x66 = 5.550V	0x76 = 5.800V
0x07 = 3.175V	0x17 = 3.575V	0x27 = 3.975V	0x37 = 4.375V	0x47 = 4.775V	0x57 = 5.175V	0x67 = 5.575V	0x77 = 5.800V
0x08 = 3.200V	0x18 = 3.600V	0x28 = 4.000V	0x38 = 4.400V	0x48 = 4.800V	0x58 = 5.200V	0x68 = 5.600V	0x78 = 5.800V
0x09 = 3.225V	0x19 = 3.625V	0x29 = 4.025V	0x39 = 4.425V	0x49 = 4.825V	0x59 = 5.225V	0x69 = 5.625V	0x79 = 5.800V
0x0A = 3.250V	0x1A = 3.650V	0x2A = 4.050V	0x3A = 4.450V	0x4A = 4.850V	0x5A = 5.250V	0x6A = 5.650V	0x7A = 5.800V
0x0B = 3.275V	0x1B = 3.675V	0x2B = 4.075V	0x3B = 4.475V	0x4B = 4.875V	0x5B = 5.275V	0x6B = 5.675V	0x7B = 5.800V
0x0C = 3.300V	0x1C = 3.700V	0x2C = 4.100V	0x3C = 4.500V	0x4C = 4.900V	0x5C = 5.300V	0x6C = 5.700V	0x7C = 5.800V
0x0D = 3.325V	0x1D = 3.725V	0x2D = 4.125V	0x3D = 4.525V	0x4D = 4.925V	0x5D = 5.325V	0x6D = 5.725V	0x7D = 5.800V
0x0E = 3.350V	0x1E = 3.750V	0x2E = 4.150V	0x3E = 4.550V	0x4E = 4.950V	0x5E = 5.350V	0x6E = 5.750V	0x7E = 5.800V
0x0F = 3.375V	0x1F = 3.775V	0x2F = 4.175V	0x3F = 4.575V	0x4F = 4.975V	0x5F = 5.375V	0x6F = 5.775V	0x7F = 5.800V

Charger Interrupt 2 Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGINT2		Charger Watchdog Timer Interrupt	0x44	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/C	CHG_WDT_WRN_I	0	Charger Watchdog Timer Warning Interrupt 0 = The charger watchdog timer has not come within 2s of expiring since the last time this bit was read. 1 = The charge watchdog timer has come within 2s of expiring since the last time this bit was read.	
3:1	R/C	RESERVED	0	Reserved	
4	R/C	CHG_WDT_I	0	Charger Watchdog Timer Expire Interrupt 0 = The charger watchdog timer is not expired since the last time this bit was read. 1 = The charger watchdog timer is expired since the last time this bit was read.	
6:5	R/C	RESERVED	0	Reserved	
7	R/C	DC_V_I	0	DC_V Interrupt 0 = DC_V voltage is equal or less than 5.9V 1 = DC_V voltage is higher than 5.9V	

Charger Watchdog Timer Interrupt Masks Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHGINTMASK2		Charger Watchdog Timer Interrupt Mask	0x45	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	CHG_WDT_ WRN_M	0	Charger Watchdog Timer Warning Mask 0 = Unmask 1 = Mask	
3:1	R/W	RESERVED	0	Reserved	
4	R/W	CHG_WDT_M	0	Charger Watchdog Timer Expire Mask 0 = Unmask 1 = Mask	
6:5	R/W	RESERVED	0	Reserved	
7	R/W	DC_V_M	0	DC_V Interrupt Mask 0 = Unmask 1 = Mask	

Charger Watchdog Timer Clear Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHG_WDTC		Charger Watchdog Timer Clear	0x46	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	CHG_WDTC [1:0]	00	Charger Watchdog Timer Clear. Writing 0b01 to these bits clears the watchdog timer. These bits automatically reset to 0b00 after they are written to 0b01. 0b00 = The system watchdog timer is not cleared. 0b01 = The system watchdog timer is cleared. 0b10 = The system watchdog timer is not cleared. 0b11 = The system watchdog timer is not cleared.	
7:2	R/W	RESERVED	0	Reserved	

Charger Watchdog Timer Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHG_WDT_CTL		Charger Watchdog Timer Control	0x47	O	0x40
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	CHG_WDT_EN	0	Charger Watchdog Timer Enable Bit 0 = Disabled 1 = Enabled	
5:1	R/W	RESERVED	0	Reserved	
7:6	R/W	CHG_WDT [1:0]	01	Charger Watchdog Timer Period 0b00 = 16s 0b01 = 32s 0b10 = 64s 0b11 = 128s The charger watchdog timer period may be changed at any time, however the new value is not implemented until the watchdog timer is cleared (CHG_WDTC [1:0] = 0b01). It is recommended that software clears the timer shortly after any watchdog timer period change.	

Charger Watchdog Timer Status Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
CHG_WDT_DTLS		Charger Watchdog Timer Status	0x48	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R	CHG_WDT_WRN_STAT	0	Charger Watchdog Warning 0 = The charger watchdog timer has not come within 2s of expiring. 1 = The charger watchdog timer has come within 2s of expiring.	
3:1	R	RESERVED	0	Reserved	
4	R	CHG_WDT_STAT	0	Charger Watchdog Timer 0 = Timer not expires 1 = Timer expires	
7:5	R	RESERVED	0	Reserved	

SAFEOUT LDO Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
SAFEOUTCTL		SAFEOUT Linear Regulator Control	0x4B	O	0x51
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	SAFEOUT [1:0]	01	SAFEOUT Output Voltage 00 = 4.85V 01 = 4.90V (default) 10 = 4.95V 11 = 3.3V	
3:2	R/W	RESERVED	00	Reserved	
4	R/W	ACTDISSAFEO1	1	0 = No active discharge 1 = Active discharge	
5	R/W	RESERVED	0	Reserved	
6	R/W	SAFEOUT_EN	1	SAFEOUTLDO Enable Bit 0 = Disable SAFEOUT 1 = Enable SAFEOUT	
7	R/W	RESERVED	0	Reserved	

Flash Register Details

FLED1 Flash Current Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
IFLASH1		FLED1 Flash Current Setting	0x00	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
4:0	R/W	FLASH1_I	000000	Sets the FLED1 Current in FLASH Mode. Adjustable from 23.436mA–750mA in 5-bits, 32 steps, 23.436mA per step	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	RESERVED	0	Reserved	

FLED2 Flash Current Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
IFLASH2		FLED2 Flash Current Setting	0x01	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
4:0	R/W	FLASH2_I	00000	Sets the FLED2 Current in FLASH Mode. Adjustable from 23.436mA–750mA in 5-bits, 32 steps, 23.436mA per step	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	RESERVED	0	Reserved	

IFlash_1/IFLASH_2[4:0] Value Table

IFIASH_x [4:0]	FLEDxFlash Current (mA)	IFIASH_x [4:0]	FLEDxFlash Current (mA)	IFIASH_x [4:0]	FLEDxFlash Current (mA)	IFIASH_x [4:0]	FLEDxFlash Current (mA)
0x00	23.436	0x08	210.924	0x10	398.412	0x18	585.9
0x01	46.872	0x09	234.36	0x11	421.848	0x19	609.336
0x02	70.308	0x0A	257.796	0x12	445.284	0x1A	632.772
0x03	93.744	0x0B	281.232	0x13	468.72	0x1B	656.208
0x04	117.18	0x0C	304.668	0x14	492.156	0x1C	679.644
0x05	140.616	0x0D	328.104	0x15	515.592	0x1D	703.08
0x06	164.052	0x0E	351.54	0x16	539.028	0x1E	726.516
0x07	187.488	0x0F	374.976	0x17	562.464	0x1F	749.952

FLED Torch Currents Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
ITORCH		FLED Torch Current Settings	0x02	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/W	TORCH_IOUT	0000	Sets FLED1 and FLED2 Total Current in TORCH Mode Adjustable from 23.436mA to 375mA in 4-bits, 16 steps, 23.436mA/step (11.72mA to 187.5mA per channel).	
7:4	R/W	RESERVED	0000	Reserved	

Torch_IOUT[3:0] Value Table

Torch_IOUT [3:0]	FLEDxTorch Current (mA)	Torch_IOUT [3:0]	FLEDxTorch Current (mA)	Torch_IOUT [3:0]	FLEDxTorch Current (mA)	Torch_IOUT [3:0]	FLEDxTorch Current (mA)
0x00	23.436	0x04	117.18	0x08	210.924	0x0C	304.668
0x01	46.872	0x05	140.616	0x09	234.36	0x0D	328.104
0x02	70.308	0x06	164.052	0x0A	257.796	0x0E	351.54
0x03	93.744	0x07	187.488	0x0B	281.232	0x0F	374.976

Torch Timer Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
TORCH_TMR		Torch Timer Settings	0x03	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/W	TORCH_TMR_DUR	0000	Torch Safety Timer setting 0x00 = 262ms 0x01 = 524ms 0x02 = 786ms 0x03 = 1.048s 0x04 = 1.572s 0x05 = 2.096s 0x06 = 2.62s 0x07 = 3.144s 0x08 = 4.193s 0x09 = 5.242s 0x0A = 6.291s 0x0B = 7.34s 0x0C = 9.437s 0x0D = 11.534s 0x0E = 13.631s 0x0F = 15.728s	
4	R/W	RESERVED	0	Reserved	
5	R/W	RESERVED	0	Reserved	
6	R/W	DIS_TORCH_TMR	0	Torch Safety Timer Enable Control 0 = Torch safety timer enabled. 1 = Torch safety timer disabled.	
7	R/W	TORCH_TMR_MODE	0	Torch Mode Timer Control 0 = ONE SHOT 1 = Run for MAX timer	

Flash Timer Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
FLASH_TMR		Flash Timer Settings	0x04	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/W	FLASH_TMR_DUR	0000	Flash Safety Timer Setting 62.5ms to 1000ms adjustable in 62.5ms steps.	
4	R/W	RESERVED	0	Reserved	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	FLASH_TMR_MODE	0	FLASH Mode Timer Control 0 = ONE SHOT 1 = Run for MAX timer	

FLED Enable Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
FLASH_EN		FLED Enable Settings	0x05	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	TORCH_ FLED2_EN	00	Enable/Disable Control for Torch Mode on FLED2 0x00 = Torch OFF 0x01 = Torch triggered by FLASHEN 0x02 = Torch triggered by TORCHEN 0x03 = Torch triggered through serial interface	
3:2	R/W	TORCH_FLED1_EN	00	Enable/Disable Control for Torch Mode on FLED1 0x00 = Torch OFF 0x01 = Torch triggered by FLASHEN 0x02 = Torch triggered by TORCHEN 0x03 = Torch triggered through serial interface	
5:4	R/W	FLASH_ FLED2_EN	00	Enable/Disable Control for Flash Mode on FLED2 00 = Flash OFF 01 = Flash triggered by FLASHEN 10 = Torch triggered by TORCHEN 11 = Flash triggered through serial interface	
7:6	R/W	FLASH_FLED1_EN	00	Enable/Disable Control for Flash Mode on FLED1 00 = Flash OFF 01 = Flash triggered by FLASHEN 10 = Torch triggered by TORCHEN 11 = Flash triggered through serial interface	

Note: *Flash has higher priority always over Torch. If user tried to simultaneously start FLASH and TORCH, the FLED will Flash to completion, then initiate Torch.*

MAXFLASH Voltage Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MAX_FLASH1		MAXFLASH Voltage Settings	0x06	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
1:0	R/W	MAX_FLASH_HYS	00	Low Battery Detection Hysteresis 0x00 = 100mV 0x01 = 200mV 0x02 = 300mV 0x03 = Hysteresis disabled. Flash current is only reduced.	
6:2	R/W	MAX_FLASH_TH	00000	MAXFLASH Function, Low Battery Detection Threshold 0x00 = 0x1F = 2.4V to 3.4V adjustable in 33mV steps 0x00 = 2.4V 0x1E = 0x1F = 3.4V	
7	R/W	MAX_FL_EN	0	MAXFLASH Function Enable/Disable 0 = MAXFLASH disabled 1 = MAXFLASH enabled	

MAXFLASH Timer Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MAX_FLASH2		MAXFLASH Timer Settings	0x07	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R/W	LB_TMR_F	000	Low Battery Mask Timer for Falling Edge of Battery Adjustable from 256µs to 2048µs in 256µs steps.	
5:3	R/W	LB_TMR_R	000	Low Battery Mask Timer for Rising Edge of Battery Adjustable from 256µs to 2048µs in 256µs steps.	
6	R/W	RESERVED	0	Reserved	
7	R/W	RESERVED	0	Reserved	

MAXFLASH FLED1 Status Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MAX_FLASH3		MAXFLASH Status – FLED1	0x08	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
5:0	R/W	FLED1_MIN_OUT	000000	Minimum Output Current During a MAXFLASH Event for FLED1 Status of the current level for a MAXFLASH event on FLED1. In flash mode, this number is lower than FLASH_IOUT1, in torch mode, it is lower than TORCH_IOUT1. Reading from 11.72mA–750mA in 11.72mA steps.	
6	R/W	RESERVED	0	Reserved	
7	R/W	FLED1_MIN_MODE	0	MAX_FLASH Triggered on FLED1, Triggered In 0 = Torch mode 1 = Flash mode	

MAXFLASH FLED2 Status Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
MAX_FLASH4		MAXFLASH Status – FLED2	0x09	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
5:0	R/W	FLED2_MIN_OUT	000000	Minimum output current during a MAXFLASH event for FLED2 status of the current level for a MAXFLASH event on FLED2. In flash mode, this number is lower than FLASH_IOUT2, in torch mode, it is lower than TORCH_IOUT2. Reading from 11.72mA–750mA in 11.72mA steps.	
6	R/W	RESERVED	0	Reserved	
7	R/W	FLED2_MIN_MODE	0	MAX_FLASH Triggered on FLED2, Triggered In 0 = Torch mode 1 = Flash mode	

Boost Control Mode Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
VOUT_CNTL		Boost Control Settings	0x0A	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
2:0	R/W	BOOST_FLASH_MODE	000	Mode of Operation for the Flash 000 = Flash is OFF 001 = FLED1 in adaptive mode 010 = FLED2 in adaptive mode 011 = FLED1 and FLED2 in adaptive mode 100 = Fixed Mode 101–111 = Reserved	
3	R/W	RESERVED	0	Reserved	
4	R/W	RESERVED	0	Reserved	
5	R/W	RESERVED	0	Reserved	
6	R/W	RESERVED	0	Reserved	
7	R/W	FLEDNUM	0	0 = Only 1 FLED source is used. Current for FLED powered from boost is limited to 1A. 1 = Both FLED1 and FLED2 are used. Current in FLED powered from boost is limited to 625mA/FLED source. This bit must be enabled only when both FLED sources are used.	

Boost Voltage Settings Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
VOUT_FLASH		Boost Voltage Settings	0x0B	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
6:0	R/W	BOOST_VOUT_FLASH	0000000	3.3V to 5.5V adjustable in 25mV steps. If Adaptive mode is selected, this register contents are ignored. If fixed mode is selected, this register represents the BYP voltage (as long as BYP voltage in this register is > BYP voltage set in the charger and reverse boost is ON). See the *BOOST_VOUT_FLASH [6:0] Setting* table for more details. Note the presence of redundant codes	
7	R/W	RESERVED	0	Reserved	

BOOST_VOUT_FLASH [6:0] Setting

(Note the presence of redundant codes)

0x00 = 3.300V	0x10 = 3.400V	0x20 = 3.800V	0x30 = 4.200V	0x40 = 4.600V	0x50 = 5.000V	0x60 = 5.400V	0x70 = 5.500V
0x01 = 3.300V	0x11 = 3.425V	0x21 = 3.825V	0x31 = 4.225V	0x41 = 4.625V	0x51 = 5.025V	0x61 = 5.425V	0x71 = 5.500V
0x02 = 3.300V	0x12 = 3.450V	0x22 = 3.850V	0x32 = 4.250V	0x42 = 4.650V	0x52 = 5.050V	0x62 = 5.450V	0x72 = 5.500V
0x03 = 3.300V	0x13 = 3.475V	0x23 = 3.875V	0x33 = 4.275V	0x43 = 4.675V	0x53 = 5.075V	0x63 = 5.475V	0x73 = 5.500V
0x04 = 3.300V	0x14 = 3.500V	0x24 = 3.900V	0x34 = 4.300V	0x44 = 4.700V	0x54 = 5.100V	0x64 = 5.500V	0x74 = 5.500V
0x05 = 3.300V	0x15 = 3.525V	0x25 = 3.925V	0x35 = 4.325V	0x45 = 4.725V	0x55 = 5.125V	0x65 = 5.500V	0x75 = 5.500V
0x06 = 3.300V	0x16 = 3.550V	0x26 = 3.950V	0x36 = 4.350V	0x46 = 4.750V	0x56 = 5.150V	0x66 = 5.500V	0x76 = 5.500V
0x07 = 3.300V	0x17 = 3.575V	0x27 = 3.975V	0x37 = 4.375V	0x47 = 4.775V	0x57 = 5.175V	0x67 = 5.500V	0x77 = 5.500V
0x08 = 3.300V	0x18 = 3.600V	0x28 = 4.000V	0x38 = 4.400V	0x48 = 4.800V	0x58 = 5.200V	0x68 = 5.500V	0x78 = 5.500V
0x09 = 3.300V	0x19 = 3.625V	0x29 = 4.025V	0x39 = 4.425V	0x49 = 4.825V	0x59 = 5.225V	0x69 = 5.500V	0x79 = 5.500V
0x0A = 3.300V	0x1A = 3.650V	0x2A = 4.050V	0x3A = 4.450V	0x4A = 4.850V	0x5A = 5.250V	0x6A = 5.500V	0x7A = 5.500V
0x0B = 3.300V	0x1B = 3.675V	0x2B = 4.075V	0x3B = 4.475V	0x4B = 4.875V	0x5B = 5.275V	0x6B = 5.500V	0x7B = 5.500V
0x0C = 3.300V	0x1C = 3.700V	0x2C = 4.100V	0x3C = 4.500V	0x4C = 4.900V	0x5C = 5.300V	0x6C = 5.500V	0x7C = 5.500V
0x0D = 3.325V	0x1D = 3.725V	0x2D = 4.125V	0x3D = 4.525V	0x4D = 4.925V	0x5D = 5.325V	0x6D = 5.500V	0x7D = 5.500V
0x0E = 3.350V	0x1E = 3.750V	0x2E = 4.150V	0x3E = 4.550V	0x4E = 4.950V	0x5E = 5.350V	0x6E = 5.500V	0x7E = 5.500V
0x0F = 3.375V	0x1F = 3.775V	0x2F = 4.175V	0x3F = 4.575V	0x4F = 4.975V	0x5F = 5.375V	0x6F = 5.500V	0x7F = 5.500V

Flash Interrupts Register

NAME	FUNCTION	ADDRESS	TYPE	RESET
FLASH_INT	Flash Interrupts	0x0E	S1	0x00

BIT	MODE	NAME	RESET	DESCRIPTION
0	R/C	FLED2_OPEN	0	Interrupt indicating that an FLED1 open has been detected. 0 = FLED2 open not detected 1 = FLED2 open occurred
1	R/C	FLED2_SHORT	0	Interrupt indicating that an FLED2 short has been detected. 0 = FLED2 short not detected 1 = FLED2 short occurred
2	R/C	FLED1_OPEN	0	Interrupt indicating that an FLED1 open has been detected. 0 = FLED1 open not detected 1 = FLED1 open occurred
3	R/C	FLED1_SHORT	0	Interrupt indicating that an FLED1 short has been detected. 0 = FLED1 short not detected 1 = FLED1 short occurred
4	R/C	MAX_FLASH	0	MAXFLASH Interrupt 0 = MAXFLASH not triggered 1 = MAXFLASH triggered during a flash event
5	R/C	FLED_FAIL	0	Interrupt indicating the FLED current is not maintained. 0 = FLED current was maintained for flash/torch period. 1 = FLED current was not maintained for flash/torch period.
6	R/C	RESERVED	0	Reserved
7	R/C	RESERVED	0	Reserved

Flash Interrupt Masks Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
FLASH_INT_MASK		Flash Interrupt Masks	0x0F	S1	0xFF
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	FLED2_OPEN_m	1	Mask for FLED2 Open Interrupt 0 = Interrupt is not masked 1 = Interrupt is masked	
1	R/W	FLED2_SHORT_m	1	Mask for FLED2 Short Interrupt 0 = Interrupt is not masked 1 = Interrupt is masked	
2	R/W	FLED1_OPEN_m	1	Mask for FLED1 Open Interrupt 0 = Interrupt is not masked 1 = Interrupt is masked	
3	R/W	FLED1_SHORT_m	1	Mask for FLED1 Short Interrupt 0 = Interrupt is not masked 1 = Interrupt is masked	
4	R/W	MAX_FLASH_m	1	MAXFLASH Interrupt Mask 0 = MAXFLASH_IRQ interrupt is masked 1 = MAXFLASH_IRQ interrupt is not masked	
5	R/W	FLED_FAIL_m	1	Mask for FLED Current is Not Maintained 0 = Interrupt is masked 1 = Interrupt is not masked	
6	R/W	RESERVED	1	Reserved	
7	R/W	RESERVED	1	Reserved	

FLASH_STATUS Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
FLASH_STATUS		Flash Interrupt Masks	0x10	S1	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R	RESERVED	0	Reserved	
1	R	RESERVED	0	Reserved	
2	R	TORCH_ON_STAT	0	Torch Mode in Progress 0 = No torch mode in progress. 1 = Torch mode in progress.	
3	R	FLASH_ON_STAT	0	Flash Mode in Progress Interrupt 0 = No flash mode in progress. 1 = Flash mode in progress.	
4	R	RESERVED	0	Reserved	
5	R	RESERVED	0	Reserved	
6	R	RESERVED	0	Reserved	
7	R	RESERVED	0	Reserved	

WLED Backlight Driver Register Details

WLED Driver Control Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
WLEDBSTCNTL1		Control Register	0x98	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
0	R/W	RESERVED	0	Reserved	
1	R/W	WLEDOVP	0	WLED Boost OVP Threshold Setting 0 = 28V (max) 1 = 35V (max)	
3:2	R/W	WLEDFOSC	00	WLEDBST Converter Switching Frequency Select 0x00 = WLEDBST converter switches at 733kHz. 0x01 = WLEDBST converter switches at 1.1MHz. 0x02 = WLEDBST converter switches at 1.47MHz. 0x03 = WLEDBST converter switches at 2.2MHz.	
4	R/W	WLEDPWM2EN	0	Content-Adaptive Brightness Control Enable for Current Source 2 0 = WLEDPWM signal does not affect current source 2 output current. 1 = WLEDPWM signal linearly decreases current source 2 output current with duty cycle.	
5	R/W	WLEDPWM1EN	0	Content-Adaptive Brightness Control Enable for Current Source 1 0 = WLEDPWM signal does not affect current source 1 output current. 1 = WLEDPWM signal linearly decreases current source 1 output current with duty cycle.	
6	R/W	WLED2EN	0	Current Source 2 Enable 0 = Current source 2 is disabled. 1 = Current source 2 is enabled. Enabling any current source automatically enables the boost converter as well.	
7	R/W	WLED1EN	0	Current Source 1 Enable 0 = Current source 1 is disabled. 1 = Current source 1 is enabled. Enabling any current source automatically enables the boost converter as well.	

WLED Currents Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
IWLED		WLED Current	0x99	O	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
7:0	R/W	IWLED	00000000	Sets the WLED current in both strings from 0mA to 24.9024mA in 97.6563μA.	

WLED Current [7:0]

0x00 = 0.0000mA	0x20 = 3.1250mA	0x40 = 6.2500mA	0x60 = 9.3750mA
0x01 = 0.0977mA	0x21 = 3.2227mA	0x41 = 6.3477mA	0x61 = 9.4727mA
0x02 = 0.1953mA	0x22 = 3.3203mA	0x42 = 6.4453mA	0x62 = 9.5703mA
0x03 = 0.2930mA	0x23 = 3.4180mA	0x43 = 6.5430mA	0x63 = 9.6680mA
0x04 = 0.3906mA	0x24 = 3.5156mA	0x44 = 6.6406mA	0x64 = 9.7656mA
0x05 = 0.4883mA	0x25 = 3.6133mA	0x45 = 6.7383mA	0x65 = 9.8633mA
0x06 = 0.5859mA	0x26 = 3.7109mA	0x46 = 6.8359mA	0x66 = 9.9609mA
0x07 = 0.6836mA	0x27 = 3.8086mA	0x47 = 6.9336mA	0x67 = 10.0586mA
0x08 = 0.7813mA	0x28 = 3.9063mA	0x48 = 7.0313mA	0x68 = 10.1563mA
0x09 = 0.8789mA	0x29 = 4.0039mA	0x49 = 7.1289mA	0x69 = 10.2539mA
0xA = 0.9766mA	0x2A = 4.1016mA	0x4A = 7.2266mA	0x6A = 10.3516mA
0xB = 1.0742mA	0x2B = 4.1992mA	0x4B = 7.3242mA	0x6B = 10.4492mA
0xC = 1.1719mA	0x2C = 4.2969mA	0x4C = 7.4219mA	0x6C = 10.5469mA
0xD = 1.2695mA	0x2D = 4.3945mA	0x4D = 7.5195mA	0x6D = 10.6445mA
0xE = 1.3672mA	0x2E = 4.4922mA	0x4E = 7.6172mA	0x6E = 10.7422mA
0xF = 1.4648mA	0x2F = 4.5898mA	0x4F = 7.7148mA	0x6F = 10.8398mA
0x10 = 1.5625mA	0x30 = 4.6875mA	0x50 = 7.8125mA	0x70 = 10.9375mA
0x11 = 1.6602mA	0x31 = 4.7852mA	0x51 = 7.9102mA	0x71 = 11.0352mA
0x12 = 1.7578mA	0x32 = 4.8828mA	0x52 = 8.0078mA	0x72 = 11.1328mA
0x13 = 1.8555mA	0x33 = 4.9805mA	0x53 = 8.1055mA	0x73 = 11.2305mA
0x14 = 1.9531mA	0x34 = 5.0781mA	0x54 = 8.2031mA	0x74 = 11.3281mA
0x15 = 2.0508mA	0x35 = 5.1758mA	0x55 = 8.3008mA	0x75 = 11.4258mA
0x16 = 2.1484mA	0x36 = 5.2734mA	0x56 = 8.3984mA	0x76 = 11.5234mA
0x17 = 2.2461mA	0x37 = 5.3711mA	0x57 = 8.4961mA	0x77 = 11.6211mA
0x18 = 2.3438mA	0x38 = 5.4688mA	0x58 = 8.5938mA	0x78 = 11.7188mA
0x19 = 2.4414mA	0x39 = 5.5664mA	0x59 = 8.6914mA	0x79 = 11.8164mA
0x1A = 2.5391mA	0x3A = 5.6641mA	0x5A = 8.7891mA	0x7A = 11.9141mA
0x1B = 2.6367mA	0x3B = 5.7617mA	0x5B = 8.8867mA	0x7B = 12.0117mA

WLED Current [7:0] (continued)

0x1C = 2.7344mA	0x3C = 5.8594mA	0x5C = 8.9844mA	0x7C = 12.1094mA
0x1D = 2.8320mA	0x3D = 5.9570mA	0x5D = 9.0820mA	0x7D = 12.2070mA
0x1E = 2.9297mA	0x3E = 6.0547mA	0x5E = 9.1797mA	0x7E = 12.3047mA
0x1F = 3.0273mA	0x3F = 6.1523mA	0x5F = 9.2773mA	0x7F = 12.4024mA
0x80 = 12.5000mA	0xA0 = 15.6250mA	0xC0 = 18.7500mA	0xE0 = 21.8750mA
0x81 = 12.5977mA	0xA1 = 15.7227mA	0xC1 = 18.8477mA	0xE1 = 21.9727mA
0x82 = 12.6953mA	0xA2 = 15.8203mA	0xC2 = 18.9453mA	0xE2 = 22.0703mA
0x83 = 12.7930mA	0xA3 = 15.9180mA	0xC3 = 19.0430mA	0xE3 = 22.1680mA
0x84 = 12.8906mA	0xA4 = 16.0156mA	0xC4 = 19.1406mA	0xE4 = 22.2656mA
0x85 = 12.9883mA	0xA5 = 16.1133mA	0xC5 = 19.2383mA	0xE5 = 22.3633mA
0x86 = 13.0859mA	0xA6 = 16.2109mA	0xC6 = 19.3359mA	0xE6 = 22.4609mA
0x87 = 13.1836mA	0xA7 = 16.3086mA	0xC7 = 19.4336mA	0xE7 = 22.5586mA
0x88 = 13.2813mA	0xA8 = 16.4063mA	0xC8 = 19.5313mA	0xE8 = 22.6563mA
0x89 = 13.3789mA	0xA9 = 16.5039mA	0xC9 = 19.6289mA	0xE9 = 22.7539mA
0x8A = 13.4766mA	0xAA = 16.6016mA	0xCA = 19.7266mA	0xEA = 22.8516mA
0x8B = 13.5742mA	0xAB = 16.6992mA	0xCB = 19.8242mA	0xEB = 22.9492mA
0x8C = 13.6719mA	0xAC = 16.7969mA	0xCC = 19.9219mA	0xEC = 23.0469mA
0x8D = 13.7695mA	0xAD = 16.8945mA	0xCD = 20.0195mA	0xED = 23.1445mA
0x8E = 13.8672mA	0xAE = 16.9922mA	0xCE = 20.1172mA	0xEE = 23.2422mA
0x8F = 13.9649mA	0xAF = 17.0899mA	0xCF = 20.2149mA	0xEF = 23.3399mA
0x90 = 14.0625mA	0xB0 = 17.1875mA	0xD0 = 20.3125mA	0xF0 = 23.4375mA
0x91 = 14.1602mA	0xB1 = 17.2852mA	0xD1 = 20.4102mA	0xF1 = 23.5352mA
0x92 = 14.2578mA	0xB2 = 17.3828mA	0xD2 = 20.5078mA	0xF2 = 23.6328mA
0x93 = 14.3555mA	0xB3 = 17.4805mA	0xD3 = 20.6055mA	0xF3 = 23.7305mA
0x94 = 14.4531mA	0xB4 = 17.5781mA	0xD4 = 20.7031mA	0xF4 = 23.8281mA
0x95 = 14.5508mA	0xB5 = 17.6758mA	0xD5 = 20.8008mA	0xF5 = 23.9258mA
0x96 = 14.6484mA	0xB6 = 17.7734mA	0xD6 = 20.8984mA	0xF6 = 24.0234mA
0x97 = 14.7461mA	0xB7 = 17.8711mA	0xD7 = 20.9961mA	0xF7 = 24.1211mA
0x98 = 14.8438mA	0xB8 = 17.9688mA	0xD8 = 21.0938mA	0xF8 = 24.2188mA
0x99 = 14.9414mA	0xB9 = 18.0664mA	0xD9 = 21.1914mA	0xF9 = 24.3164mA
0x9A = 15.0391mA	0xBA = 18.1641mA	0xDA = 21.2891mA	0xFA = 24.4141mA
0x9B = 15.1367mA	0xBB = 18.2617mA	0xDB = 21.3867mA	0xFB = 24.5117mA
0x9C = 15.2344mA	0xBC = 18.3594mA	0xDC = 21.4844mA	0xFC = 24.6094mA
0x9D = 15.3320mA	0xBD = 18.4570mA	0xDD = 21.5820mA	0xFD = 24.7070mA
0x9E = 15.4297mA	0xBE = 18.5547mA	0xDE = 21.6797mA	0xFE = 24.8047mA
0x9F = 15.5274mA	0xBF = 18.6524mA	0xDF = 21.7774mA	0xFF = 24.9024mA

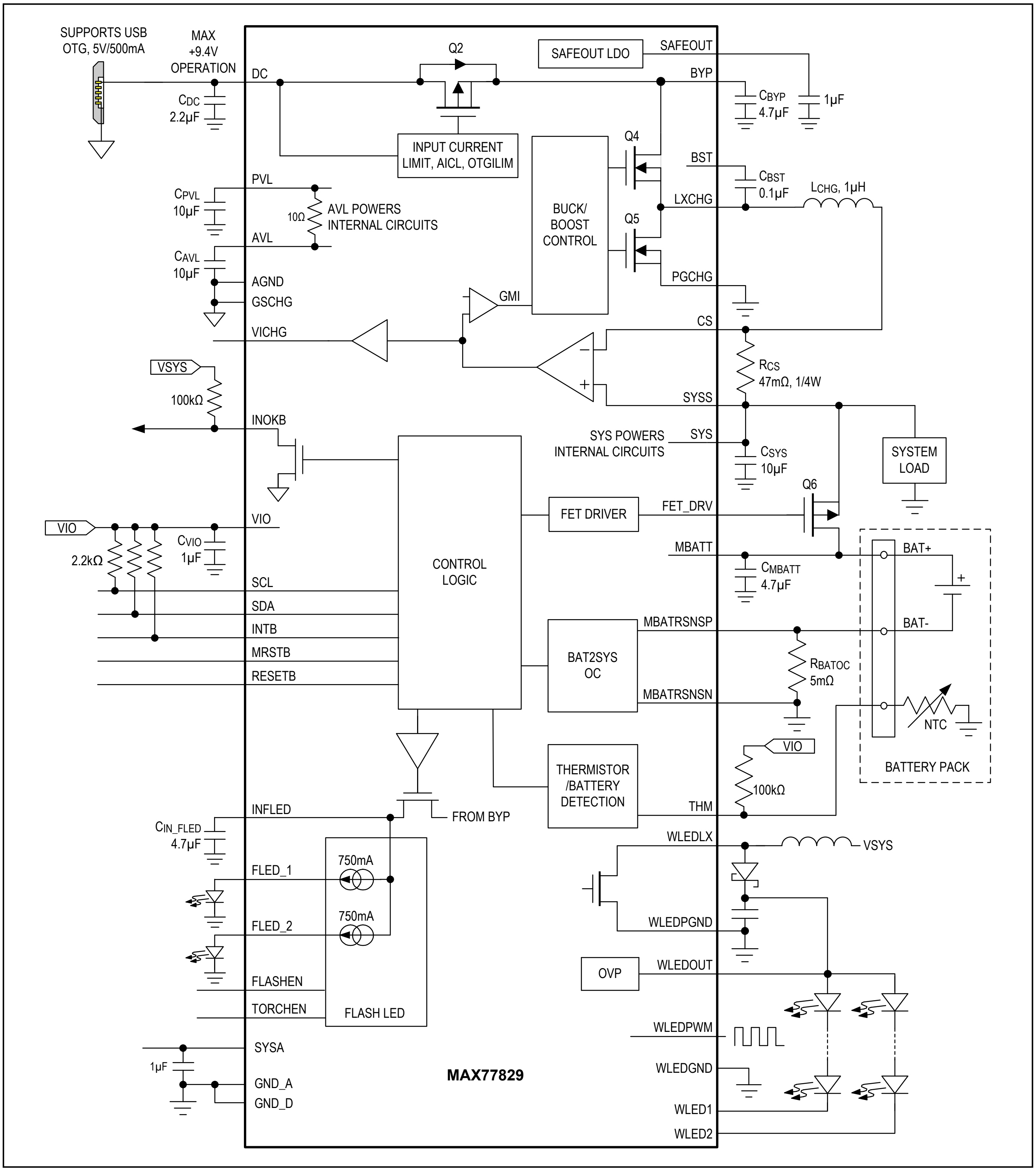
WLED Interrupt Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
WLED_INT		Interrupt Source	0x9B	S1	0x00
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/C	RESERVED	0000	Reserved	
4	R/C	WLEDOL	0	WLED Converter Current Limit Interrupt 0 = No interrupt pending. 1 = WLED converter has reached the current limit.	
6:5	R/C	RESERVED	00	Reserved	
7	R/C	WLEDOVP	0	WLED Converter has reached the OVP Threshold (Open WLED String) 0 = No interrupt pending. 1 = WLED converter has reached the OVP threshold (open LED string).	

WLED Interrupt Mask Register

NAME		FUNCTION	ADDRESS	TYPE	RESET
WLED_INT_M		Interrupt Mask	0x9C	S1	0x90
BIT	**MODE**	**NAME**	**RESET**	**DESCRIPTION**	
3:0	R/W	RESERVED	0000	Reserved	
4	R/W	WLEDOL_M	1	WLED Converter Current Limit Interrupt Mask 0 = Not masked 1 = Masked	
6:5	R/W	RESERVED	00	Reserved	
7	R/W	WLEDOVP_M	1	WLED Converter has reached the OVP Threshold (Open WLED String) Mask 0 = Not masked 1 = Masked	

Typical Application Circuit



Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX77829EWN+	-40°C to +85°C	56 WLP 0.4mm pitch, 3.64mm x 3.24mm

Chip Information

PROCESS: CMOS

Package Information

For the latest package outline information and land patterns (footprints), go to www.maximintegrated.com/packages. Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
56 WLP	W563F3+1	21-1038	Refer to Application Note 1891

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/15	Initial Release	—
1	10/16	Corrected typo; added *Register Map* and register tables	33, 44–81

