Toohong

MCP73831/2

Miniature Single-Cell, Fully Integrated Li-Ion, Li-Polymer Charge Management Controllers

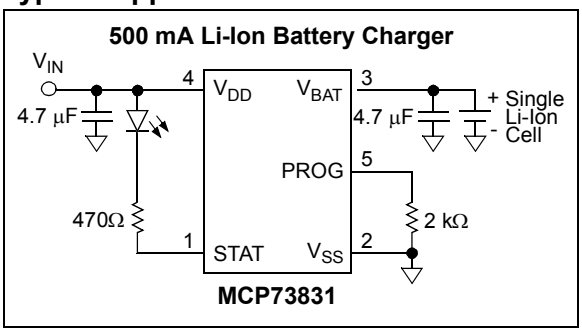
Features:

- Linear Charge Management Controller:
  - Integrated Pass Transistor
  - Integrated Current Sense
  - Reverse Discharge Protection
- High Accuracy Preset Voltage Regulation: ± 0.75%
- Four Voltage Regulation Options:
  - 4.20V, 4.35V, 4.40V, 4.50V
- Programmable Charge Current: 15 mA to 500 mA
- Selectable Preconditioning:
  - 10%, 20%, 40%, or Disable
- Selectable End-of-Charge Control:
  - 5%, 7.5%, 10%, or 20%
- Charge Status Output
  - Tri-State Output - MCP73831
  - Open-Drain Output - MCP73832
- Automatic Power-Down
- Thermal Regulation
- Temperature Range: -40°C to +85°C
- Packaging:
  - 8-Lead, 2 mm x 3 mm DFN
  - 5-Lead, SOT-23

Applications:

- Lithium-Ion/Lithium-Polymer Battery Chargers
- Personal Data Assistants
- Cellular Telephones
- Digital Cameras
- MP3 Players
- Bluetooth Headsets
- USB Chargers

Typical Application



Description:

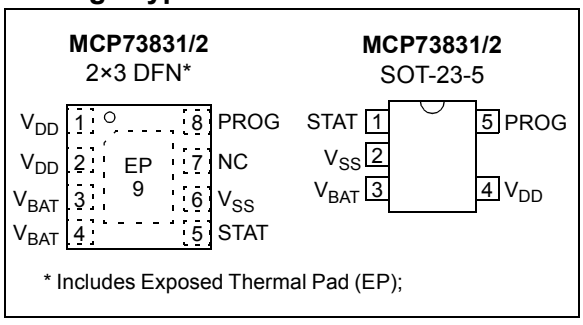
The MCP73831/2 devices are highly advanced linear charge management controllers for use in space-limited, cost-sensitive applications. The MCP73831/2 are available in an 8-Lead, 2 mm x 3 mm DFN package or a 5-Lead, SOT-23 package. Along with their small physical size, the low number of external components required make the MCP73831/2 ideally suited for portable applications. For applications charging from a USB port, the MCP73831/2 adhere to all the specifications governing the USB power bus.

The MCP73831/2 employ a constant-current/constant-voltage charge algorithm with selectable preconditioning and charge termination. The constant voltage regulation is fixed with four available options: 4.20V, 4.35V, 4.40V or 4.50V, to accommodate new, emerging battery charging requirements. The constant current value is set with one external resistor. The MCP73831/2 devices limit the charge current based on die temperature during high power or high ambient conditions. This thermal regulation optimizes the charge cycle time while maintaining device reliability.

Several options are available for the preconditioning threshold, preconditioning current value, charge termination value and automatic recharge threshold. The preconditioning value and charge termination value are set as a ratio or percentage of the programmed constant current value. Preconditioning can be disabled. Refer to **Section 1.0 "Electrical Characteristics"** for available options and the **Product Identification System** for standard options.T

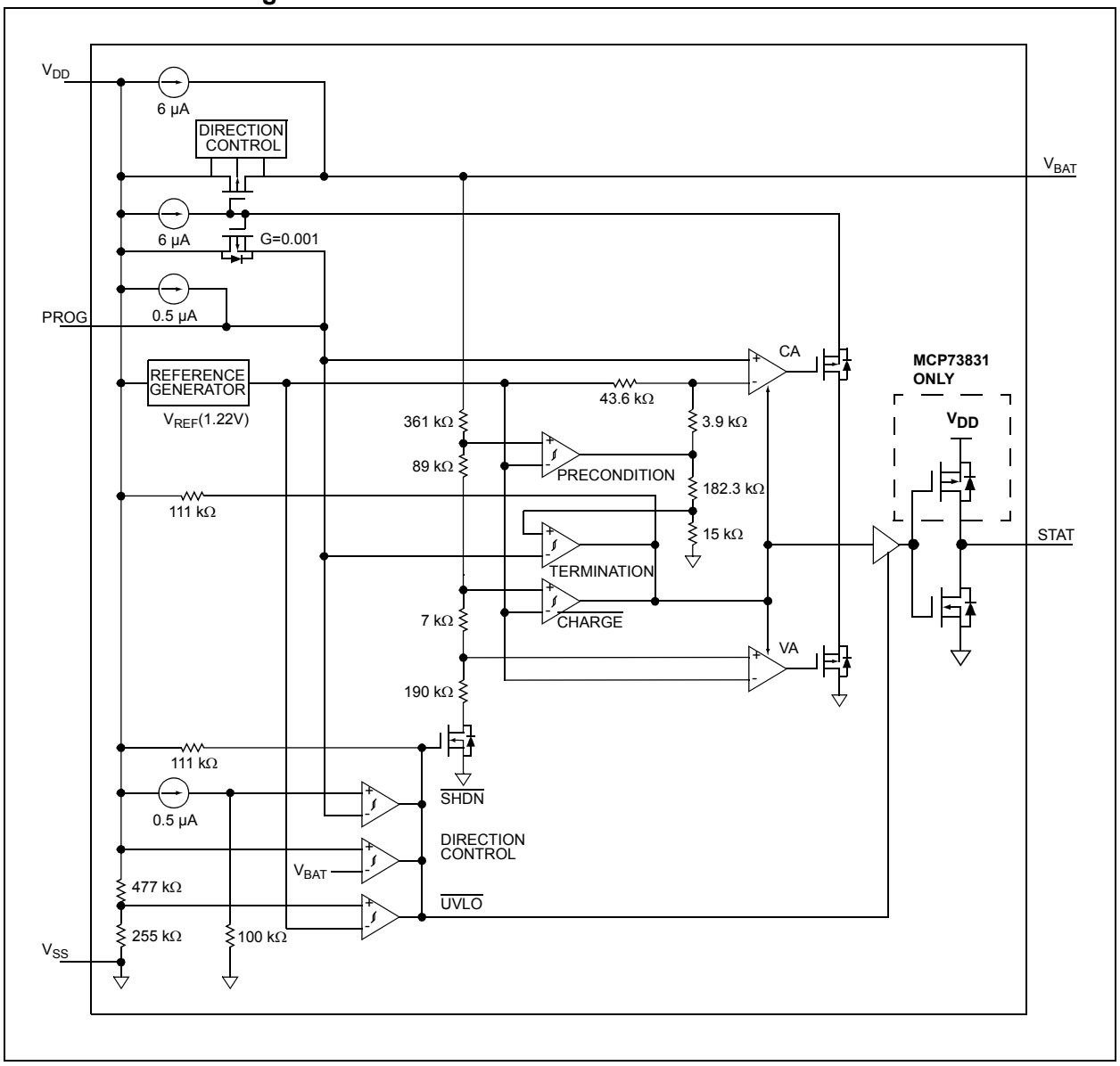
he MCP73831/2 devices are fully specified over the a mbient temperature range of -40°C to +85°C.

Package Types



* Includes Exposed Thermal Pad (EP);

Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

V_{DD}.....7.0V
All Inputs and Outputs w.r.t. V_{SS} ..... -0.3 to (V_{DD}+0.3)V
Maximum Junction Temperature, T_J .....Internally Limited
Storage temperature .....-65°C to +150°C
ESD protection on all pins:
Human Body Model (1.5 kΩ in Series with 100 pF).....≥ 4 kV
Machine Model (200 pF, No Series Resistance).....400V

† Notice: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, all limits apply for V_{DD}= [V_{REG}(typical) + 0.3V] to 6V, T_A = -40°C to +85°C. Typical values are at +25°C, V_{DD} = [V_{REG} (typical) + 1.0V]

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Supply Input						
Supply Voltage	V_{DD}	3.75	—	6	V	
Supply Current	I_{SS}	—	510	1500	µA	Charging
		—	53	200	µA	Charge Complete, No Battery
		—	25	50	µA	PROG Floating
		—	1	5	µA	$V_{DD} \leq (V_{BAT}$ - 50 mV)
		—	0.1	2	µA	$V_{DD} < V_{STOP}$
UVLO Start Threshold	V_{START}	3.3	3.45	3.6	V	V_{DD} Low-to-High
UVLO Stop Threshold	V_{STOP}	3.2	3.38	3.5	V	V_{DD} High-to-Low
UVLO Hysteresis	V_{HYS}	—	70	—	mV	
Voltage Regulation (Constant-Voltage Mode)						
Regulated Output Voltage	V_{REG}	4.168	4.20	4.232	V	MCP7383X-2
		4.317	4.35	4.383	V	MCP7383X-3
		4.367	4.40	4.433	V	MCP7383X-4
		4.466	4.50	4.534	V	MCP7383X-5
						V_{DD} = [V_{REG}(typical)+1V] I_{OUT} = 10 mA T_A = -5°C to +55°C
Line Regulation	$\lvert(\Delta V_{BAT}/V_{BAT})/\Delta V_{DD}\rvert$	—	0.09	0.30	%/V	V_{DD} = [V_{REG}(typical)+1V] to 6V, I_{OUT} = 10 mA
Load Regulation	$\lvert\Delta V_{BAT}/V_{BAT}\rvert$	—	0.05	0.30	%	I_{OUT} = 10 mA to 50 mA V_{DD} = [V_{REG}(typical)+1V]
Supply Ripple Attenuation	PSRR	—	52	—-	dB	I_{OUT}=10 mA, 10Hz to 1 kHz
		—	47	—	dB	I_{OUT}=10 mA, 10Hz to 10 kHz
		—	22	—	dB	I_{OUT}=10 mA, 10Hz to 1 MHz
Current Regulation (Fast Charge Constant-Current Mode)						
Fast Charge Current Regulation	I_{REG}	90	100	110	mA	PROG = 10 kΩ
		450	505	550	mA	PROG = 2.0 kΩ,
		12.5	14.5	16.5	mA	PROG = 67 kΩ
						T_A = -5°C to +55°C

Note 1: Not production tested. Ensured by design.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise indicated, all limits apply for V_{DD}= [V_{REG}(typical) + 0.3V] to 6V, T_A = -40°C to +85°C. Typical values are at +25°C, V_{DD} = [V_{REG} (typical) + 1.0V]

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Preconditioning Current Regulation (Trickle Charge Constant-Current Mode)						
Precondition Current Ratio	I_{PREG} / I_{REG}	7.5	10	12.5	%	PROG = 2.0 kΩ to 10 kΩ
		15	20	25	%	PROG = 2.0 kΩ to 10 kΩ
		30	40	50	%	PROG = 2.0 kΩ to 10 kΩ
		—	100	—	%	No Preconditioning
						T_A = -5°C to +55°C
Precondition Voltage Threshold Ratio	V_{PTH} / V_{REG}	64	66.5	69	%	V_{BAT} Low-to-High
		69	71.5	74	%	V_{BAT} Low-to-High
Precondition Hysteresis	V_{PHYS}	—	110	—	mV	V_{BAT} High-to-Low
Charge Termination						
Charge Termination Current Ratio	I_{TERM} / I_{REG}	3.75	5	6.25	%	PROG = 2.0 kΩ to 10 kΩ
		5.6	7.5	9.4	%	PROG = 2.0 kΩ to 10 kΩ
		8.5	10	11.5	%	PROG = 2.0 kΩ to 10 kΩ
		15	20	25	%	PROG = 2.0 kΩ to 10 kΩ
						T_A = -5°C to +55°C
Automatic Recharge						
Recharge Voltage Threshold Ratio	V_{RTH} / V_{REG}	91.5	94.0	96.5	%	V_{BAT} High-to-Low
		94	96.5	99	%	V_{BAT} High-to-Low
Pass Transistor ON-Resistance						
ON-Resistance	R_{DSON}	—	350	—	mΩ	V_{DD} = 3.75V, T_J = 105°C
Battery Detection						
Battery Detection Current	I_{BAT_DET}	—	6	—	µA	V_{BAT} Source Current
No-Battery-Present Threshold	V_{NO_BAT}	—	V_{REG} + 100 mV	—	V	V_{BAT} Voltage ≥ V_{NO_BAT} for No Battery condition
No-Battery-Present Impedance	Z_{NO_BAT}	2	—	—	MΩ	V_{BAT} Impedance ≥ Z_{NO_BAT} for No Battery condition,
Battery Discharge Current						
Output Reverse Leakage Current	$I_{DISCHARGE}$	—	0.15	2	µA	PROG Floating
		—	0.25	2	µA	V_{DD} Floating
		—	0.15	2	µA	V_{DD} < V_{STOP}
		—	-5.5	-15	µA	Charge Complete
Status Indicator – STAT						
Sink Current	I_{SINK}	—	—	25	mA	
Low Output Voltage	V_{OL}	—	0.4	1	V	I_{SINK} = 4 mA
Source Current	I_{SOURCE}	—	—	35	mA	
High Output Voltage	V_{OH}	—	V_{DD}-0.4	V_{DD} - 1	V	I_{SOURCE} = 4 mA (MCP73831)
Input Leakage Current	I_{LK}	—	0.03	1	µA	High-Impedance
PROG Input						
Charge Impedance Range	R_{PROG}	2	—	67	kΩ	
Minimum Shutdown Impedance	R_{PROG}	70	—	200	kΩ	
Automatic Power Down						
Automatic Power Down Entry Threshold	$V_{PDENTER}$	V_{DD}<(V_{BAT} +20 mV)	V_{DD}<(V_{BAT} +50 mV)	—		3.5V ≤ V_{BAT} ≤ V_{REG} V_{DD} Falling

Note 1: Not production tested. Ensured by design.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise indicated, all limits apply for V_{DD}= [V_{REG}(typical) + 0.3V] to 6V, T_A = -40°C to +85°C. Typical values are at +25°C, V_{DD} = [V_{REG} (typical) + 1.0V]

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Automatic Power Down Exit Threshold	V_{PDEXIT}	—	V_{DD}<(V_{BAT} +150 mV)	V_{DD}<(V_{BAT} +200 mV)		3.5V ≤ V_{BAT} ≤ V_{REG} V_{DD} Rising
Thermal Shutdown						
Die Temperature	T_{SD}	—	150	—	°C	
Die Temperature Hysteresis	T_{SDHYS}	—	10	—	°C	

Note 1: Not production tested. Ensured by design.

AC CHARACTERISTICS

Electrical Specifications: Unless otherwise indicated, all limits apply for V_{DD} = [V_{REG} (typical) + 0.3V] to 12V, T_A = -40°C to +85°C. Typical values are at +25°C, V_{DD} = [V_{REG} (typical) + 1.0V]

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
UVLO Start Delay	t_{START}	—	—	5	ms	V_{DD} Low-to-High
Constant-Current Regulation						
Transition Time Out of Preconditioning	t_{DELAY}	—	—	1	ms	V_{BAT} < V_{PTH} to V_{BAT} > V_{PTH}
Current Rise Time Out of Preconditioning	t_{RISE}	—	—	1	ms	I_{OUT} Rising to 90% of I_{REG}
Termination Comparator Filter	t_{TERM}	0.4	1.3	3.2	ms	Average I_{OUT} Falling
$\overline{\text{Charge}}$ Comparator Filter	t_{CHARGE}	0.4	1.3	3.2	ms	Average V_{BAT}
Status Indicator						
Status Output turn-off	t_{OFF}	—	—	200	µs	I_{SINK} = 1 mA to 0 mA
Status Output turn-on	t_{ON}	—	—	200	µs	I_{SINK} = 0 mA to 1 mA

TEMPERATURE SPECIFICATIONS

Electrical Specifications: Unless otherwise indicated, all limits apply for V_{DD} = [V_{REG} (typical) + 0.3V] to 12V. Typical values are at +25°C, V_{DD} = [V_{REG} (typical) + 1.0V]

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Specified Temperature Range	T_A	-40	—	+85	°C	
Operating Temperature Range	T_J	-40	—	+125	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
5-Lead, SOT-23	θ_{JA}	—	230	—	°C/W	4-Layer JC51-7 Standard Board, Natural Convection
8-Lead, 2 mm x 3 mm, DFN	θ_{JA}	—	76	—	°C/W	4-Layer JC51-7 Standard Board, Natural Convection

Note 1: This represents the minimum copper condition on the PCB (Printed Circuit Board).

2: With large copper area on the PCB, the SOT-23-5 thermal resistance (θ_{JA}) can reach a typical value of 130°C/W or better.

2.0 TYPICAL PERFORMANCE CURVES

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Note: Unless otherwise indicated, V_{DD} = [V_{REG}(typical) + 1V], I_{OUT} = 10 mA and T_A= +25°C, Constant-Voltage mode.

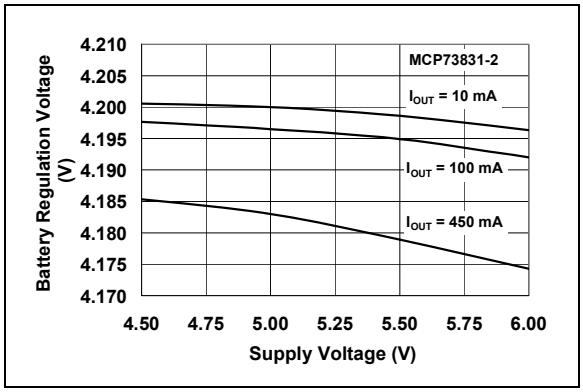


FIGURE 2-1: *Battery Regulation Voltage (V_{BAT}) vs. Supply Voltage (V_{DD}).*

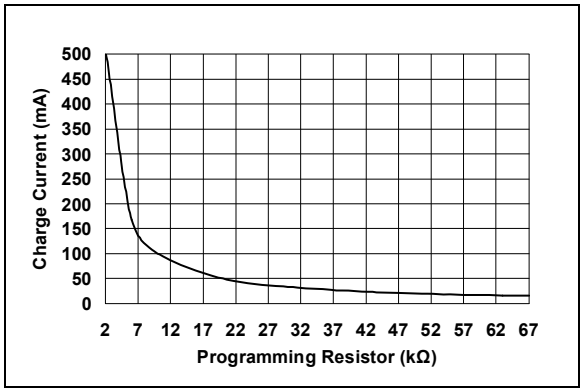


FIGURE 2-4: *Charge Current (I_{OUT}) vs. Programming Resistor (R_{PROG}).*

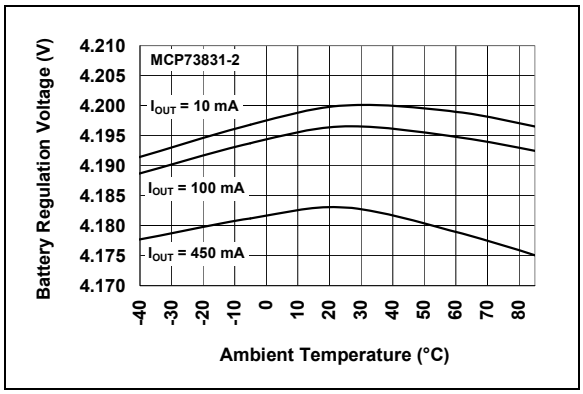


FIGURE 2-2: *Battery Regulation Voltage (V_{BAT}) vs. Ambient Temperature (T_A).*

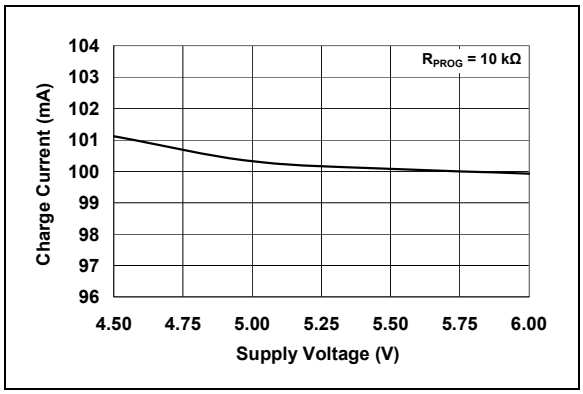


FIGURE 2-5: *Charge Current (I_{OUT}) vs. Supply Voltage (V_{DD}).*

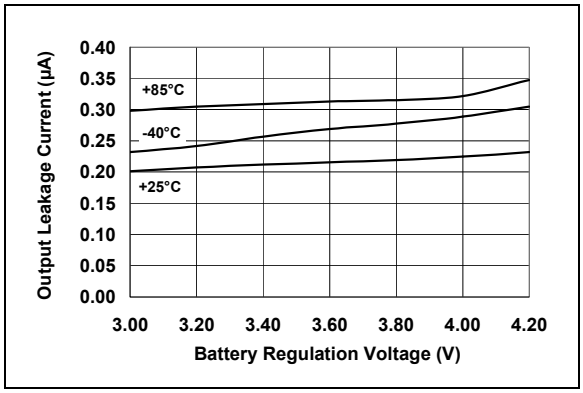


FIGURE 2-3: *Output Leakage Current ($I_{DISCHARGE}$) vs. Battery Regulation Voltage (V_{BAT}).*

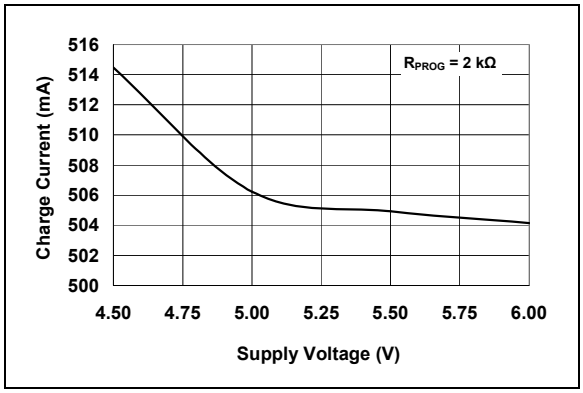


FIGURE 2-6: *Charge Current (I_{OUT}) vs. Supply Voltage (V_{DD}).*

TYPICAL PERFORMANCE CURVES (CONTINUED)

Note: Unless otherwise indicated, V_{DD} = [V_{REG}(typical) + 1V], I_{OUT} = 10 mA and T_A= +25°C, Constant-Voltage mode.

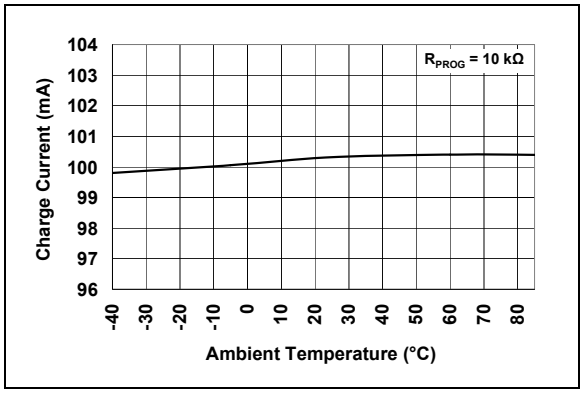


FIGURE 2-7: *Charge Current (I_{OUT}) vs. Ambient Temperature (T_A).*

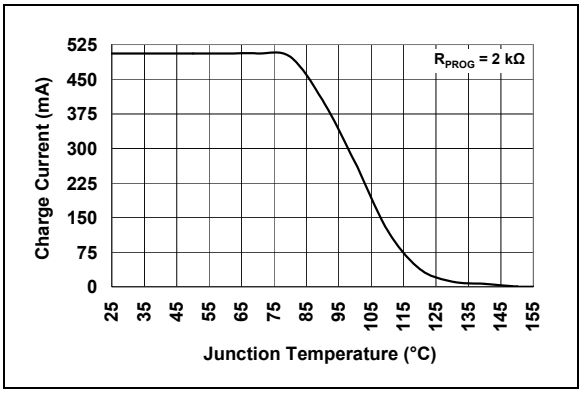


FIGURE 2-10: *Charge Current (I_{OUT}) vs. Junction Temperature (T_J).*

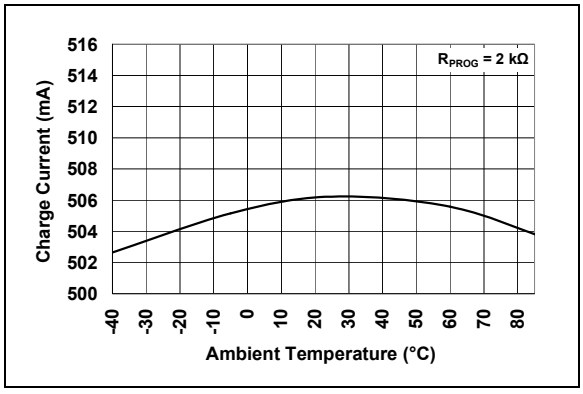


FIGURE 2-8: *Charge Current (I_{OUT}) vs. Ambient Temperature (T_A).*

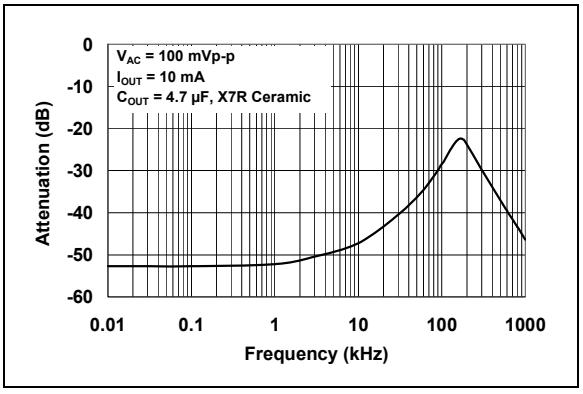


FIGURE 2-11: *Power Supply Ripple Rejection (PSRR).*

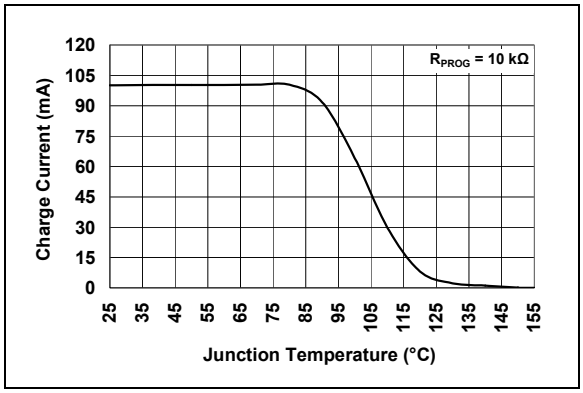


FIGURE 2-9: *Charge Current (I_{OUT}) vs. Junction Temperature (T_J).*

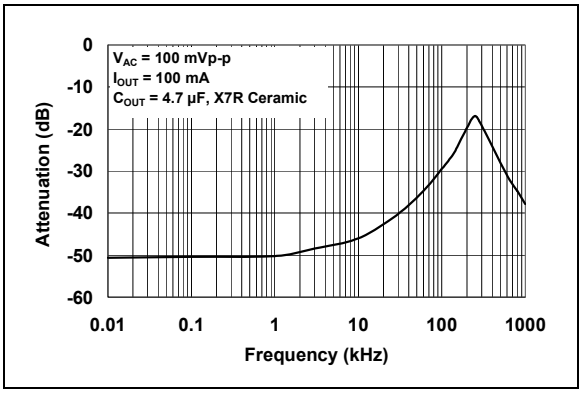


FIGURE 2-12: *Power Supply Ripple Rejection (PSRR).*

TYPICAL PERFORMANCE CURVES (CONTINUED)

Note: Unless otherwise indicated, V_{DD} = [V_{REG}(typical) + 1V], I_{OUT} = 10 mA and T_A= +25°C, Constant-Voltage mode.

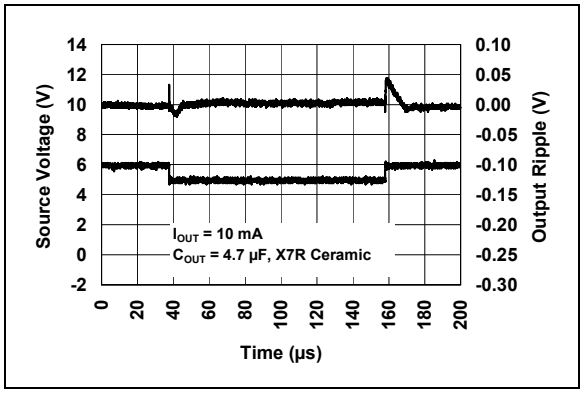


FIGURE 2-13: *Line Transient Response.*

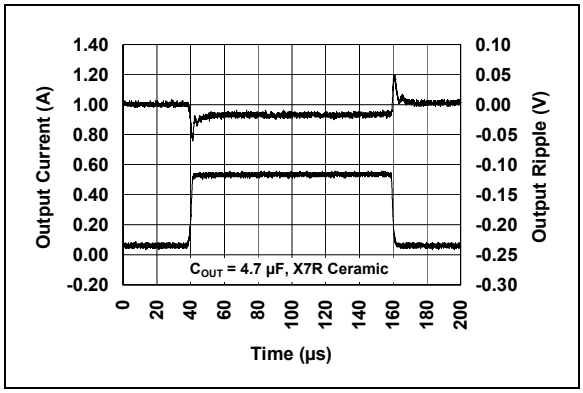


FIGURE 2-16: *Load Transient Response.*

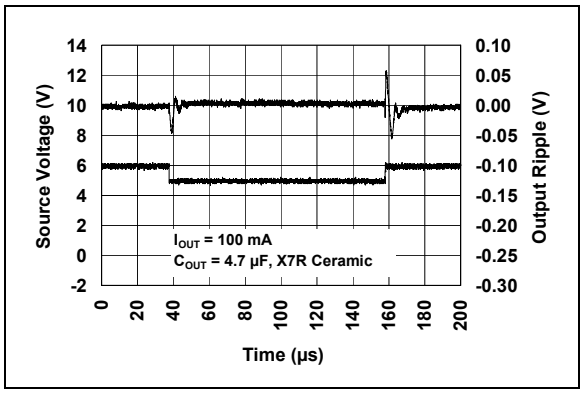


FIGURE 2-14: *Line Transient Response.*

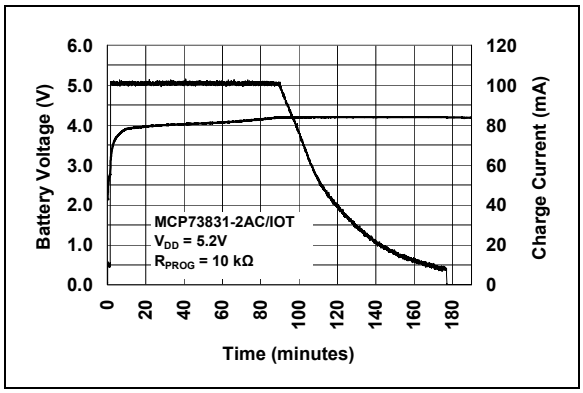


FIGURE 2-17: *Complete Charge Cycle (180 mAh Li-Ion Battery).*

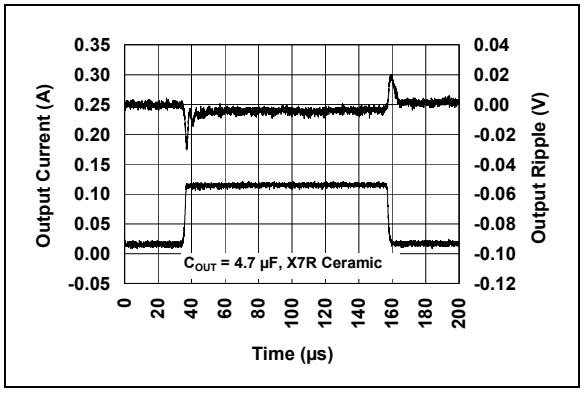


FIGURE 2-15: *Load Transient Response.*

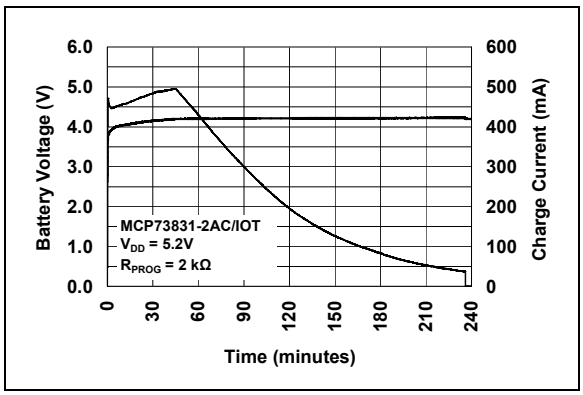


FIGURE 2-18: *Complete Charge Cycle (1000 mAh Li-Ion Battery).*