MPQ5884

80V, 4.5mΩ, E-Fuse and Smart High-Side Power Switch, AEC-Q100 Qualified

DESCRIPTION

The MPQ5884 is an automotive-grade, low-resistance e-fuse and smart high-side power switch with low quiescent current (I_Q) mode. It is designed for demanding applications such as high-current relay replacements and fuse replacements. Protection and diagnostic features improve system robustness and performance.

The MPQ5884 uses proprietary, fuse-like over-current protection (OCP), which can emulate the behavior of a passive fuse. Current-sensing and temperature-sensing allow the switch's status to be monitored. Open-load detection monitors the load's health. Low-I_Q mode can help prolong the battery life when the system is in sleep mode.

The MPQ5884 provides robust protections including OCP, short-circuit protection (SCP), loss of IC GND, loss of module GND, loss of power supply, over-temperature protection (OTP), reverse battery self-protection, and reverse load protection.

The device can survive under severe transient pulses. When a bidirectional TVS diode is applied in the system, the MPQ5884 can handle the tests defined in ISO7637-2, ISO16750-2, and ISO21780. The MPQ5884 turns on the MOSFET under a negative input voltage (V_{IN}) to achieve the same current capability under a positive V_{IN}. The MPQ5884 features a 4.5mΩ, rugged power N-channel MOSFET.

The MPQ5884 is available in a QFN-30 (5mmx6mm) package, and it is available in AEC-Q100 Grade 1.

FEATURES

- Built to Handle Tough Automotive Transients
  - Load Dump up to 80V
  - Cold Crank down to 6V
  - Reverse Battery Protection
  - Available in AEC-Q100 Grade 1
- Cooler Thermals
  - Integrated 4.5mΩ MOSFET
- Extends Vehicle Battery Life
  - Low Quiescent Current (I_Q) Mode
  - 1μA Extremely Low Shutdown Current (I_{OFF})
- Full Diagnostics and Robust Protections
  - Configurable, Fuse-Like Over-Current Protection (OCP)
  - Fast-Off Short-Circuit Protection (SCP)
  - Loss of Ground and Loss of Power Supply Protection
  - Switch-Off Negative Voltage Clamping
  - Self-Protection during Reverse Current
  - Thermal Monitor and Over-Temperature Protection (OTP)
  - High-Accuracy Current Sense
  - Off-State Open-Load Detection
  - Fault State Reporting
  - Compliant with AEC-Q100-012 Test Grade A
- Additional Features
  - 110mJ Repetitive Unclamped Inductive Switching (UIS) Energy
  - Available in a QFN-30 (5mmx6mm) Package with Wettable Flanks
- Functional Safety System Design Capable
  - MPSafe™ Compatible – Functional Safety Supporting Document Available

MPSafe™ FuSa Compatible

APPLICATIONS

- Relay Replacements
- Ignition, Heaters, and Motors
- Inductive, Capacitive, and Resistive Loads
- 24V and 48V Battery Systems

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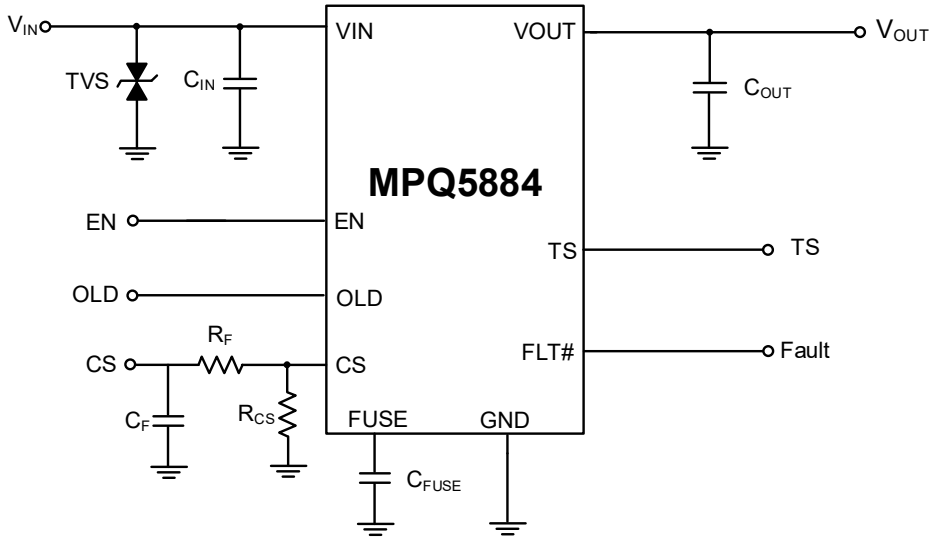
TYPICAL APPLICATION



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ORDERING INFORMATION

Part Number*	Package	Top Marking	MSL Rating**
MPQ5884GQJE-AEC1	QFN-30 (5mmx6mm)	*See Below*	3

* For Tape & Reel, add suffix -Z (e.g. MPQ5884GQJE-AEC1-Z).
* For Tray, add suffix -T (e.g., MPQ5884GQJE-AEC1-T).
** Moisture Sensitivity Level Rating

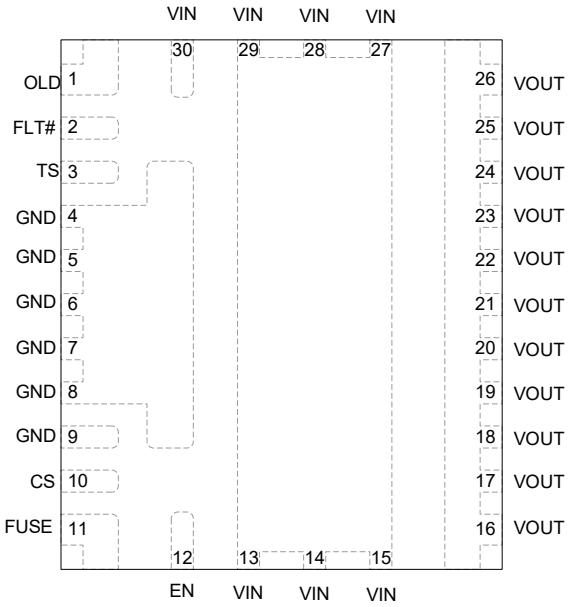
TOP MARKING

MPSYYWW
MP5884
LLLLLLL
E

MPS: MPS prefix
YY: Year code
WW: Week code
MP5884: Part number
LLLLLLL: Lot number
E: Wettable Flank

PACKAGE REFERENCE

TOP VIEW



QFN-30 (5mmx6mm)

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PIN FUNCTIONS

Pin #	Name	Description
1	OLD	**Open-load detection pin.** When the EN pin is low, drive this pin above 1.5V to enable open-load detection. When EN is high, drive this pin above 1.5V to enter low quiescent current (I_Q) mode. Pull this pin below 0.8V to exit low-I_Q mode. Do not leave this pin floating, and connect this pin to the GND pin if this function is not used.
2	FLT#	**Fault output.** The FLT# pin is an open drain. The pin is pulled low if a fault is detected.
3	TS	**Temperature sense.** The voltage on this pin reflects the MOSFET's temperature.
4, 5, 6, 7, 8, 9	GND	**Ground.** The GND pins are connected internally. Connect this pin to the board's ground plane.
10	CS	**Current sense.** This pin's output current is proportional to the load current. Connect a resistor from this pin to ground to set the initial fuse current limit. An RC filter is required to filter the noise. It is recommended to use a 10kΩ resistor and 100nF capacitor.
11	FUSE	**Timing pin for fuse current limit.** Connect a capacitor from the FUSE pin to ground to set the fuse timer. See the Fuse-Like Current Limit section on page 17 for more details. Short the FUSE pin to ground to use the 50A current limit.
12	EN	**Enable pin.** Pull EN below 0.8V to shut down the chip. Pull EN above 1.5V to enable the chip. Do not float the EN pin.
13, 14, 15, 27, 28, 29, 30	VIN	**Supply voltage.** The VIN pins are connected internally. Connect this pin to the battery.
16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26	VOUT	**Protected switch output.** The VOUT pins are connected internally. Connect this pin to the load.

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ABSOLUTE MAXIMUM RATINGS (1)

V_{IN} .....-60V to +80V
V_{IN} - V_{OUT}.....-1V to +80V
EN ..... -0.3V to V_{IN}
OLD .....-0.3V to +18V
FUSE .....-0.3V to +4.5V
All other pins .....-0.3V to +6.5V
Junction temperature (T_J) .....150°C
Lead temperature .....260°C
Continuous power dissipation (T_A = 25°C) (2) (9)
QFN-30 (5mmx6mm)..... 7.6W
Short circuit EN on (3)..... 1 million cycles
Repetitive pulse energy (4) 110mJ
Single-pulse energy (5) 400mJ

ESD Ratings

Human body model (HBM) .....Class 2 (6)
Charged-device model (CDM) ..... Class C2b (7)

Recommended Operating Conditions

Supply voltage (V_{IN})..... 6V to 60V
Nominal DC load current..... 15A
Operating junction temp (T_J).... -40°C to +150°C

Thermal Resistance	θ_{JA}	θ_{JC}	
QFN-30 (5mmx6mm)			
JESD51-7	23.1	0.6	°C/W (8)
EVQ5884-QJ-00A	16.5		°C/W (9)

	Ψ_{JT}	
JESD51-7	1.6	°C/W (8)
EVQ5884-QJ-00A	1.6	°C/W (9)

Notes:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature, T_J (MAX), the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable continuous power dissipation at any ambient temperature is calculated by P_D (MAX) = (T_J (MAX) - T_A) / θ_{JA}. Exceeding the maximum allowable power dissipation can cause excessive die temperature, and the regulator may go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
3) Test conditions: V_{IN} = 60V, set-up refers to AEC-Q100-012, L_{SHORT} = 1μH, R_{SHORT} = 20mΩ. Guaranteed by 3 lot data. Not tested in production.
4) Test conditions: I_{OUT} = 15A, L = 1mH, T_A = 25°C, 1 million cycles EN on/off for repetitive test. Guaranteed by 3 lot data. Not tested in production.
5) Test conditions: L = 1mH, T_A =25°C. Guaranteed by 3 lot data. Not tested in production.
6) Per AEC-Q100-002.
7) Per AEC-Q100-011.
8) Obtained based on a JESD51-7, 4 layer PCB. The values given in this table are only valid for comparison with other packages and cannot be used for design purposes. These values were calculated in accordance with JESD51-7, and simulated on a specified JEDEC board. They do not represent the performance obtained in an actual application. θ_{JC} shows the thermal resistance from junction-to-case bottom, and Ψ_{JT} shows the characterization parameter from junction-to-case top.
9) Measured on an MPS standard EVB, 4-layer PCB, 8.3cmx8.3cm, 2oz copper thickness.

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ELECTRICAL CHARACTERISTICS

V_{IN} = 48V, EN = 5V, T_J = -40°C to +150°C, typical values are at T_J = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply Voltage						
Normal operation voltage	V_{IN_NOR}		6		60	V
Input voltage (V_{IN}) under-voltage (UV) falling threshold	$V_{IN_UV_F}$	V_{IN} < $V_{IN_UV_F}$, V_{OUT} shutdown	1	1.7	2.2	V
V_{IN} under-voltage (UV) rising threshold	$V_{IN_UV_R}$	V_{IN} > $V_{IN_UV_R}$, V_{OUT} recovery	1.5	2.75	3.7	V
Operating Current						
Quiescent current	I_{Q_NOR}	Normal mode, V_{OLD} = 0V, I_{OUT} = 0A		1.5	1.7	mA
	I_{Q_LIQ}	Low-I_Q mode, V_{OLD} = 5V, I_{OUT} = 0A		25	40	µA
	I_{Q_OLD}	Open-load detection mode, V_{OLD} = 5V, V_{EN} = 0V		500	640	µA
Shutdown current	I_{OFF}	V_{EN} = V_{OLD} = 0V, T_J = 25°C		0.85	1	µA
		V_{EN} = V_{OLD} = 0V, T_J = -40°C to +150°C			30	µA
Power Stage (DC)						
On resistance (normal battery)	R_{ON}	I_{OUT} ≥ 0A		4.5	10	mΩ
On resistance (reverse load)	R_{ON_RL}	V_{EN} = 0V		4.8	12	mΩ
On resistance (reverse battery)	R_{ON_RB}	V_{IN} = -48V, V_{EN} = 0V		4.5	10	mΩ
On resistance (secondary MOSFET)	R_{ON_BB}	V_{OLD} = 5V		1.4	4	Ω
Output leakage	I_{LEAK}	V_{EN} = 0V, V_{OUT} = 0V, T_J = 25°C			100	nA
		V_{EN} = 0V, V_{OUT} = 0V, T_J = -40°C to +150°C			25	µA
Output leakage (loss of IC ground) (10)	I_{LEAK_DG}	V_{EN} = 0V, V_{OUT} = 0V, T_J = 25°C		1.3		mA
Output leakage (loss of module ground) (10)	I_{LEAK_DG}	V_{EN} = 0V, V_{OUT} = 0V, T_J = 25°C		1.3		mA
Power Stage (Switching)						
Turn-on delay (10)	t_{ON_DELAY}	V_{EN} = 5V to V_{OUT} = 10% V_{IN}, I_{OUT} = 15A (resistive load)		15		µs
Turn-on time (10)	t_{ON}	V_{OUT} = 10% of V_{IN} to 90% of V_{IN}, I_{OUT} = 15A (resistive load)		38		µs
Turn-on slew rate (10)	S_{ON}	I_{OUT} = 15A (resistive load)		1		V/µs
Turn-on energy (10)	E_{ON}	I_{OUT} = 15A (resistive load)		5.5		mJ
Turn-off delay (10)	t_{OFF_DELAY}	V_{EN} = 0V to V_{OUT} = 90% of V_{IN}, I_{OUT} = 15A (resistive load)		4		µs
Turn-off time (10)	t_{OFF}	V_{OUT} = 90% of V_{IN} to 10% of V_{IN}, I_{OUT} = 15A (resistive load)		10		µs
Turn-off slew rate (10)	S_{OFF}	I_{OUT} = 15A (resistive load)		3.8		V/µs
Turn-off energy (10)	E_{OFF}	I_{OUT} = 15A (resistive load)		3		mJ
Drain-to-source clamp (10)	V_{CLAMP}	I_{CLAMP} = 15A (resistive load)	85			V

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ELECTRICAL CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, T_J = -40°C to +150°C, typical values are at T_J = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Enable (EN)						
EN rising threshold	V_{EN_R}		1.1	1.25	1.45	V
EN falling threshold	V_{EN_L}		0.9	1.05	1.25	V
EN leakage current	V_{EN_LK}	V_{EN} = 5V	1.2	3.6	6.3	µA
Current Sense						
Current-sense gain	K_{CS}	I_{OUT} ≥ 5A	198	220	242	µA/A
		5A ≥ I_{OUT} ≥ 2A	176	220	264	µA/A
		2A ≥ I_{OUT} ≥ 1A	165	220	275	µA/A
Current-sense current accuracy	I_{SENSE}	I_{OUT} = 1A	165	220	275	µA
		I_{OUT} = 2A	352	440	528	µA
		I_{OUT} = 5A	0.99	1.1	1.21	mA
		I_{OUT} = 15A	2.97	3.3	3.63	mA
		I_{OUT} = 30A	5.84	6.6	7.26	mA
Low-I_Q Mode						
Low-I_Q mode V_{IN} range	V_{IN_LIQ}	V_{EN} = 5V, V_{OLD} = 5V	10		60	V
Exit low-I_Q mode current threshold	I_{LIQ_TH}	V_{EN} = 5V, V_{OLD} = 5V, T_J = 25°C	100	145	225	mA
		V_{EN} = 5V, V_{OLD} = 5V, T_J = -40°C to +150°C	90		225	mA
Thermal Sense						
Temperature-sense gain	K_{TS}			104.4		°C/V
Temperature-sense offset	V_{TS_OFST}	T_J = 25°C		0.81		V
Thermal shutdown temperature (10)	T_{SD}			168		°C
Thermal shutdown hysteresis (10)	T_{SD_HYS}			20		°C
Protection						
FLT# pin pull-down voltage	V_{FLT}	I_{FLT} = 1mA			0.2	V
Reverse battery protection threshold	V_{RB_TH}	V_{EN} = 0V, V_{IN} < -V_{RB_TH}, the main MOSFET turns on to protect the device	2.5	5.5	7.2	V
Reverse load protection threshold	V_{RL_TH}	V_{EN} = 0V, (V_{OUT} - V_{IN}) ≥ V_{RL_TH}, main MOSFET turns on	0.23	0.31	0.43	V
Fuse-Like Over-Current Protection (OCP) and Short-Circuit Protection (SCP)						
Fuse upper trip limit	V_{FUSE_H}		2.8	3	3.2	V
Fuse lower trip limit	V_{FUSE_L}		0.11	0.135	0.175	V
Fuse trip limit hysteresis	V_{FUSE_HYS}		2.65	2.875	3.1	V
Current limit threshold	V_{ILIM}		2.85	3.05	3.25	V
Short-circuit current threshold (10)	I_{SCP}	DC	45	50	55	A

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ELECTRICAL CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, T_J = -40°C to +150°C, typical values are at T_J = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Short-circuit V_{IN} limit (10)	V_{IN_SCP}	Test condition subject to AEC-100-012. (L_{SUPPLY} = 5μH; for short at module: L_{LOAD} = 1μH; for short at load, L_{LOAD} = 5μH)	6		60	V
Open-Load Detection (OLD)						
OLD rising threshold	V_{OLD_R}		1.1	1.25	1.45	V
OLD falling threshold	V_{OLD_F}		0.9	1.05	1.25	V
OLD leakage current	V_{OLD_LK}	V_{OLD} = 5V		1.5	3	μA
OLD current	I_{OLD}	V_{EN} = 0V, V_{OLD} = 5V, output current	120	165	210	μA
OLD threshold	V_{OLD_TH}	V_{EN} = 0V, V_{OLD} = 5V, V_{OUT} > V_{OLD_TH}, open load is detected	4.5	5.2	6	V
OLD hysteresis	V_{OLD_HYS}	V_{EN} = 0V, V_{OLD} = 5V, V_{OUT} < V_{OLD_TH} - V_{OLD_HYS}, open-load condition is removed		1.4		V

Note:

10) Not tested in production and guaranteed by over-temperature (OT) correlation.

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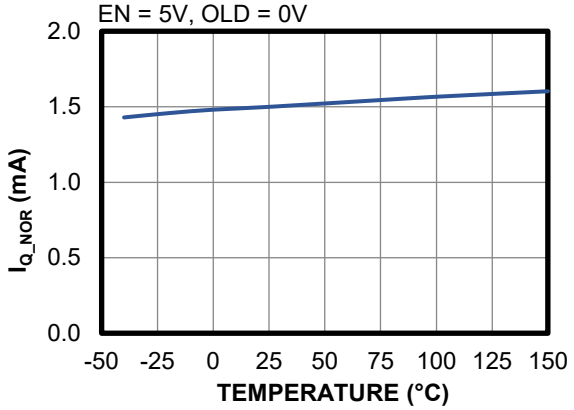
TYPICAL CHARACTERISTICS

V_{IN} = 48V, EN = 5V, unless otherwise noted.

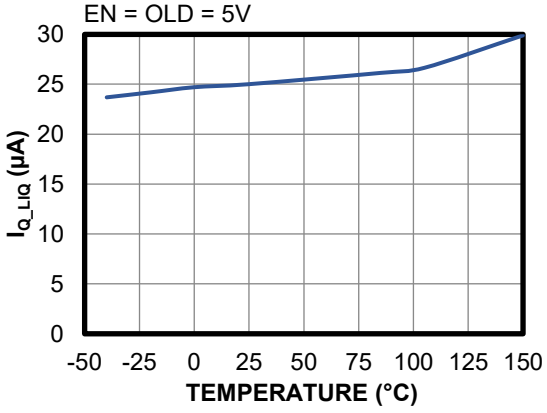
Normal Mode Quiescent Current vs. Temperature

EN = 5V, OLD = 0V



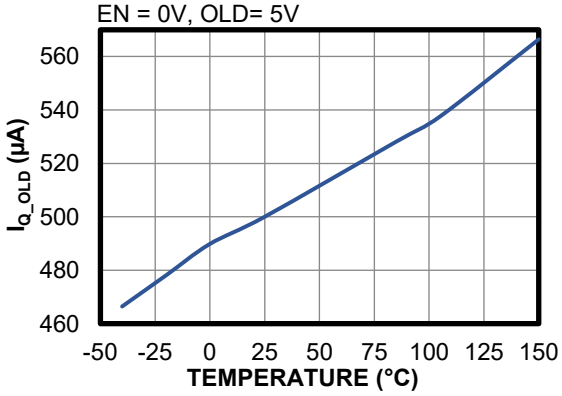
Low-I_Q Mode Quiescent Current vs. Temperature

EN = OLD = 5V



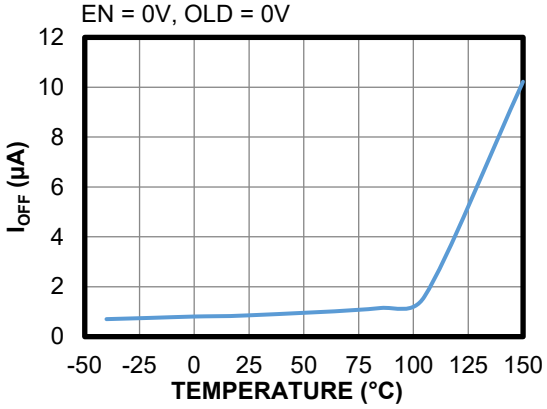
Open Load Detection Mode Quiescent Current vs. Temperature

EN = 0V, OLD= 5V

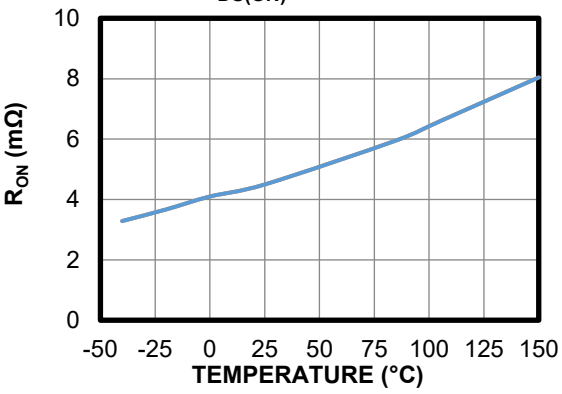


Shutdown Current vs. Temperature

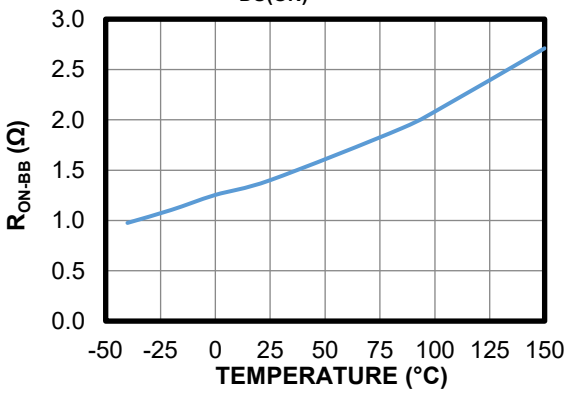
EN = 0V, OLD = 0V



M-FET $R_{DS(ON)}$ vs. Temperature



BB-FET $R_{DS(ON)}$ vs. Temperature



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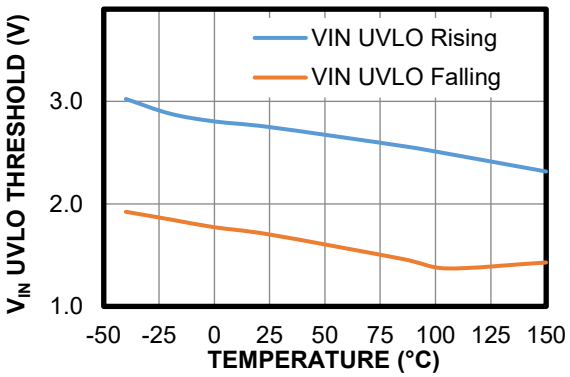
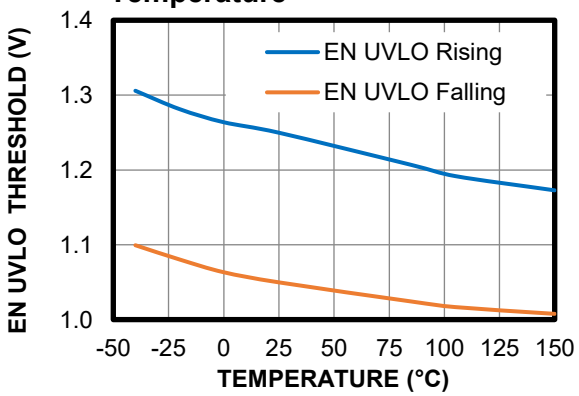
TYPICAL CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, unless otherwise noted.

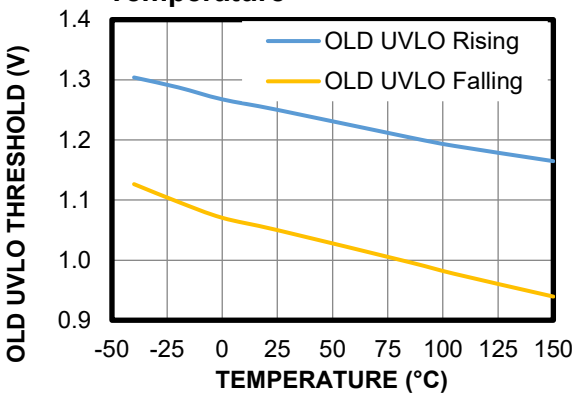
V_{IN} UVLO Threshold vs. Temperature



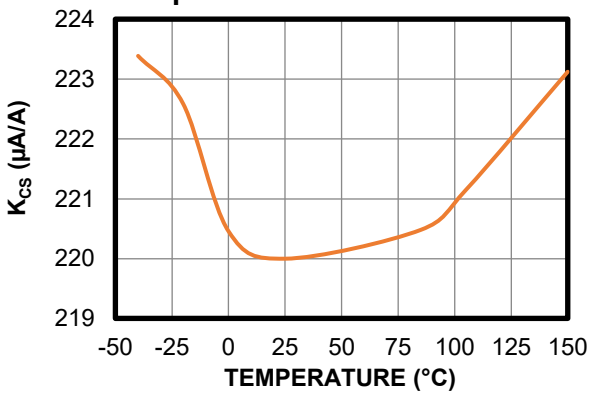
EN UVLO Threshold vs. Temperature



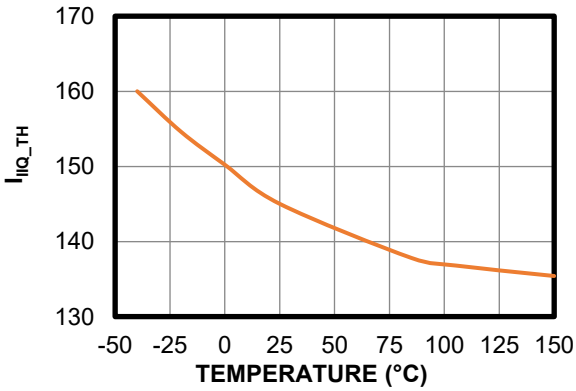
OLD UVLO Threshold vs. Temperature



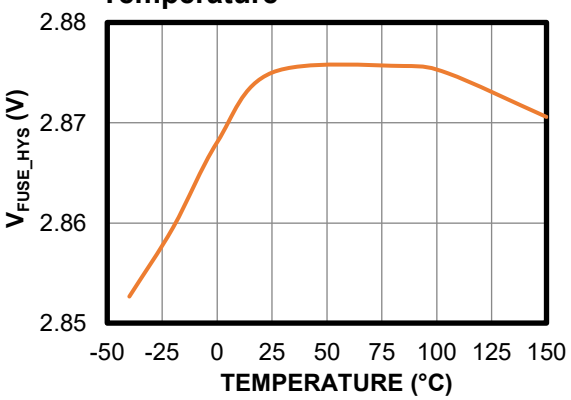
Current-Sense Ratio vs. Temperature



Exit Low-I_Q Mode Current Threshold vs. Temperature



FUSE Trip Limit Hysteresis vs. Temperature



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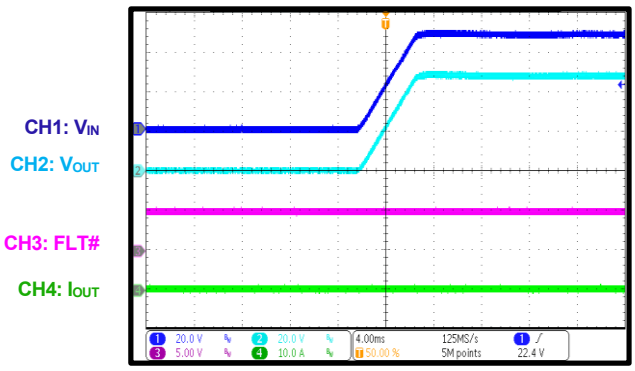
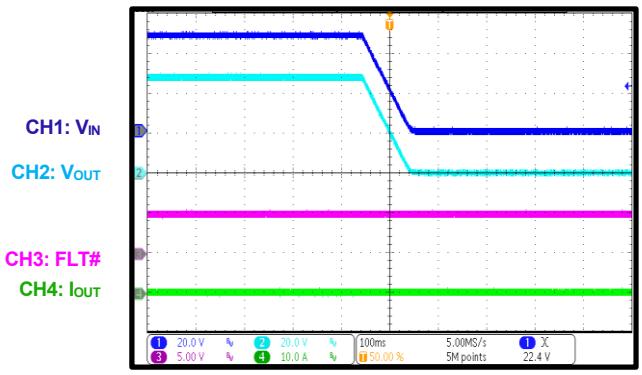
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 48V, EN = 5V, T_A = 25°C, unless otherwise noted.

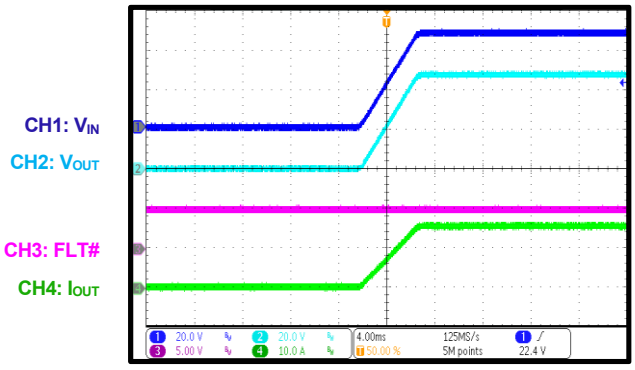
Start-Up through VIN
I_{OUT} = 0A



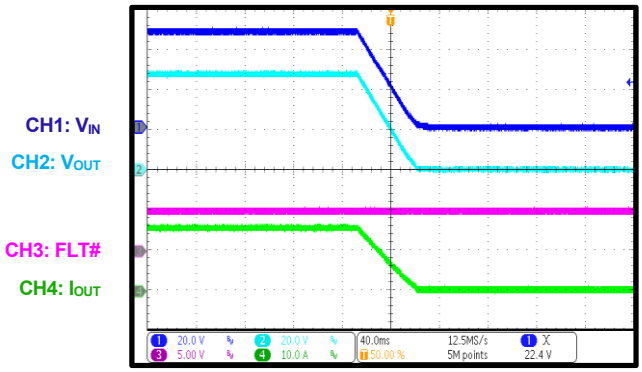
Shutdown through VIN
I_{OUT} = 0A



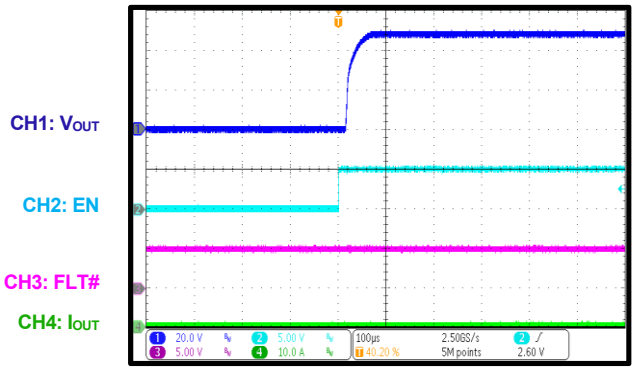
Start-Up through VIN
I_{OUT} = 15A



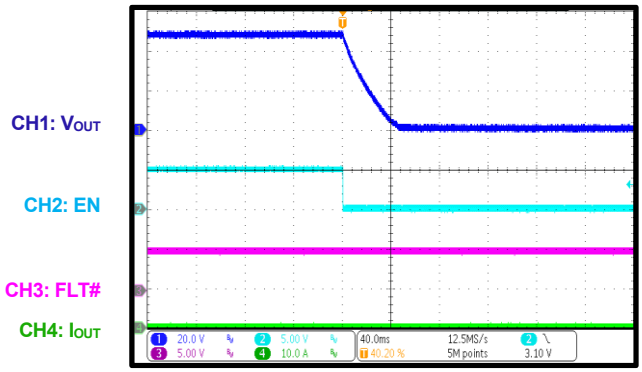
Shutdown through VIN
I_{OUT} = 15A



Start-Up through EN
I_{OUT} = 0A



Shutdown through EN
I_{OUT} = 0A



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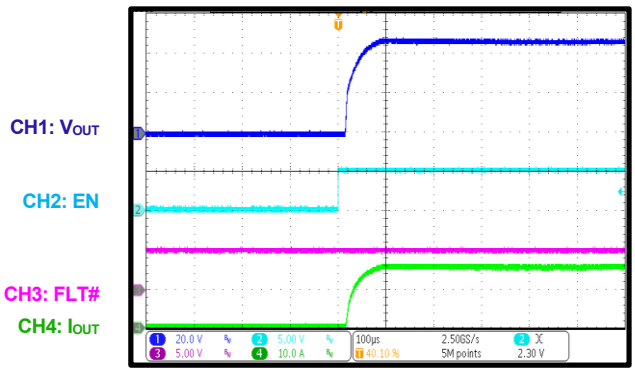
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, T_A = 25°C, unless otherwise noted.

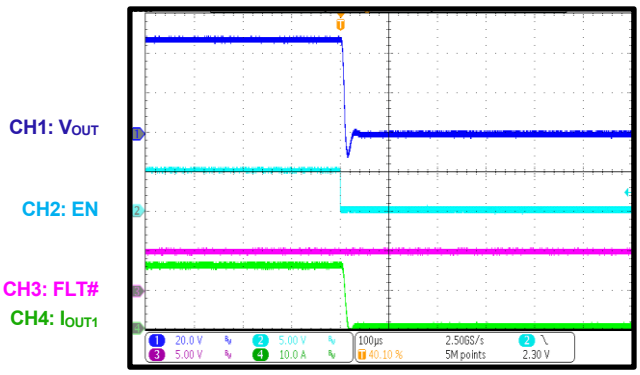
Start-Up through EN

I_{OUT} = 15A



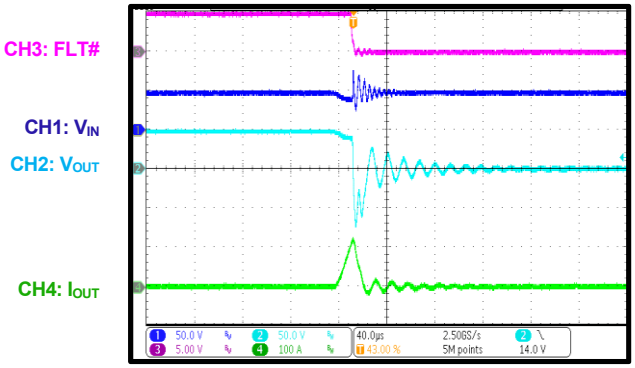
Shutdown through EN

I_{OUT} = 15A



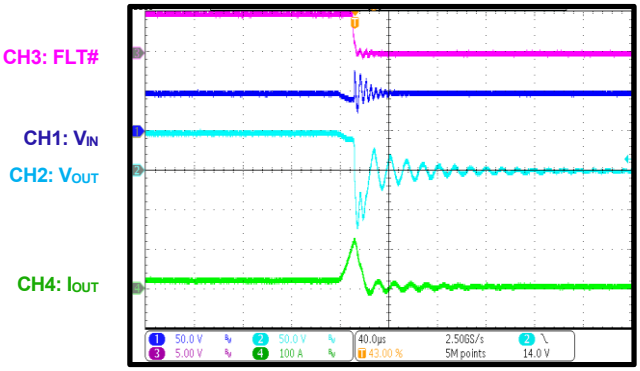
SCP Entry

I_{OUT} = 0A, L_{IN} < 5µH, L_{SHORT} = 1µH, R_{SHORT} = 20mΩ



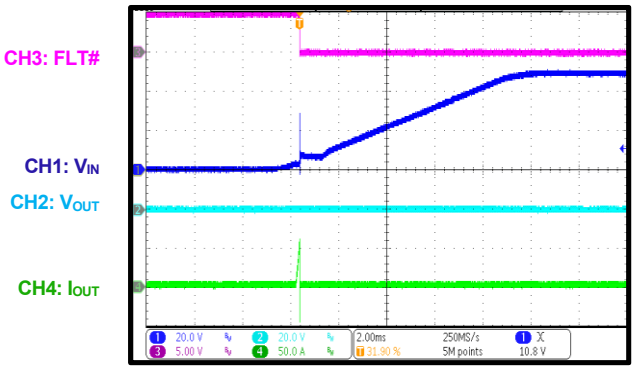
SCP Entry

I_{OUT} = 15A, L_{IN} < 5µH, L_{SHORT} = 1µH, R_{SHORT} = 20mΩ



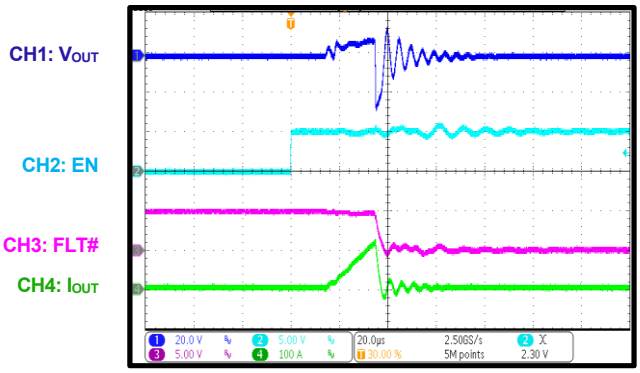
SCP Power On

I_{OUT} = 0A, L_{IN} < 5µH, L_{SHORT} = 1µH, R_{SHORT} = 20mΩ



SCP (EN On)

I_{OUT} = 0A, L_{IN} < 5µH, L_{SHORT} = 1µH, R_{SHORT} = 20mΩ



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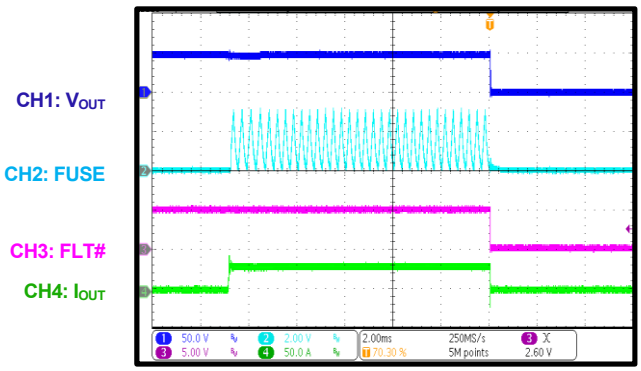
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, T_A = 25°C, unless otherwise noted.

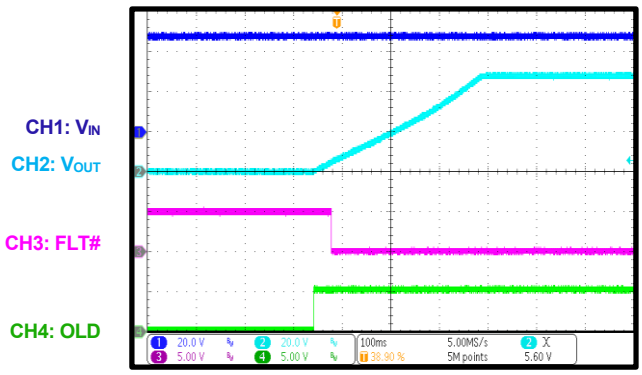
Fuse-Like Over-Current Protection

OC limit = 20A, I_{OUT} = 30A



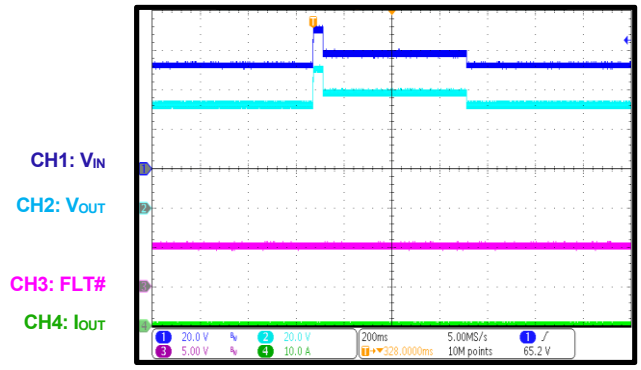
Open-Load Detection

EN = 0V



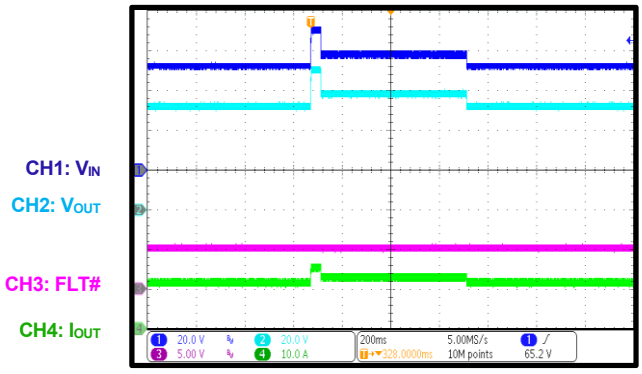
Load Dump

I_{OUT} = 0A



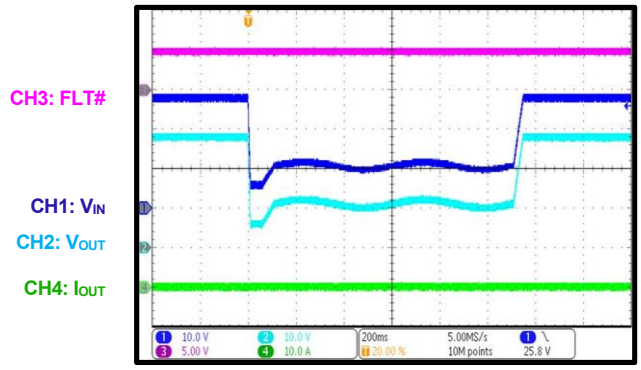
Load Dump

I_{OUT} = 15A



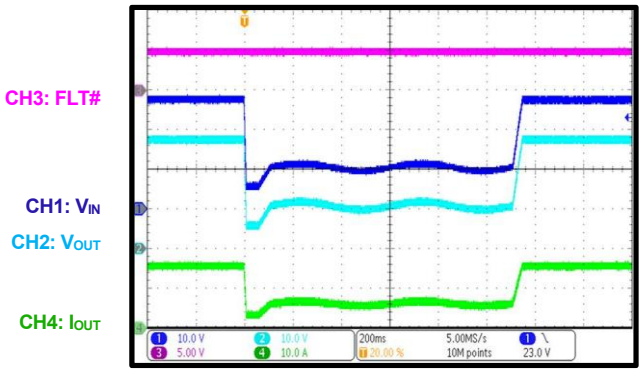
Cold Crank

I_{OUT} = 0A



Cold Crank

I_{OUT} = 15A



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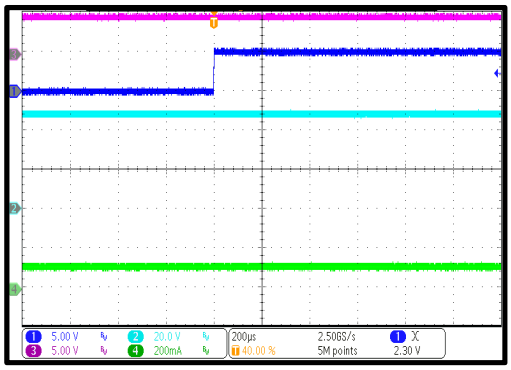
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 48V, EN = 5V, T_A = 25°C, unless otherwise noted.

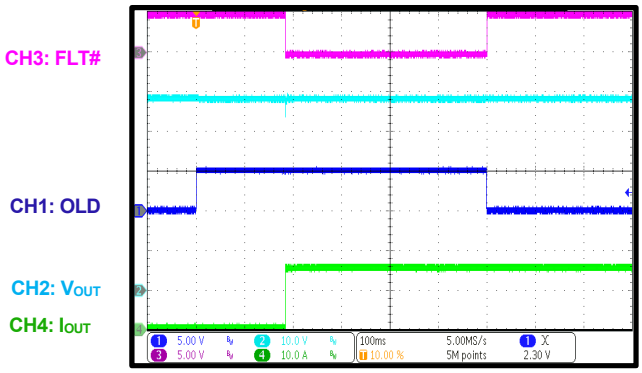
Enter Low-I_Q Mode

I_{OUT} = 100mA



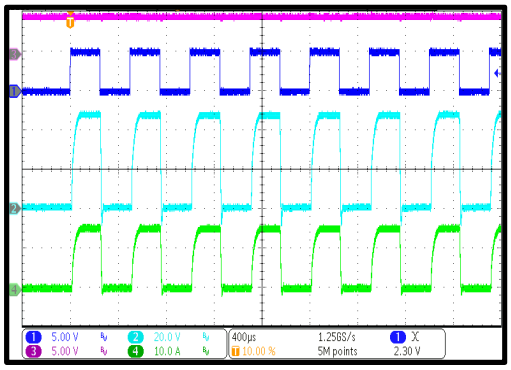
Exit Low-I_Q Mode when Load Increases

I_{OUT} rises from 0.1A to 15A



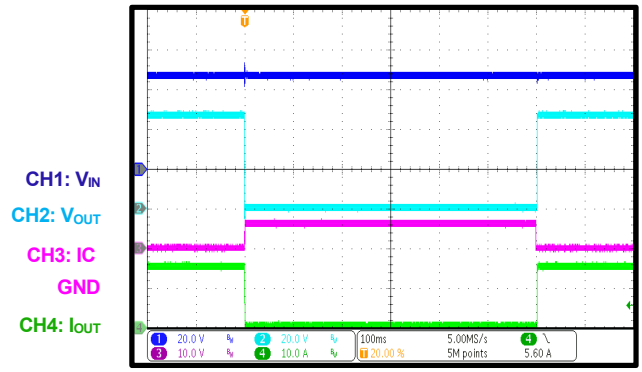
EN PWM Switching with Resistive Load

Period = 500µs, duty cycle = 50%, I_{OUT} = 15A



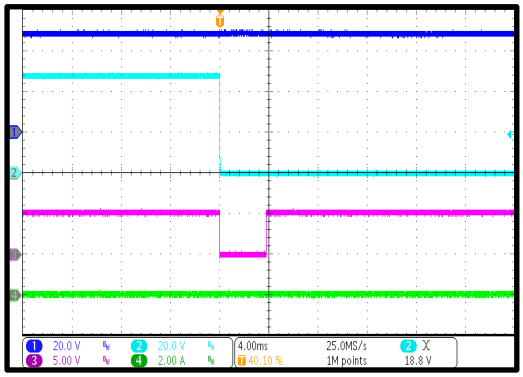
Loss of IC GND

I_{OUT} = 15A



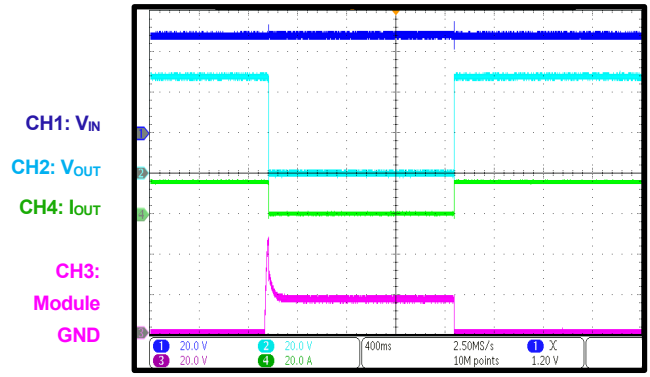
Thermal Shutdown

I_{OUT} = 0A



Loss of Module GND

I_{OUT} = 15A, EN's GND connected to module's GND



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FUNCTIONAL BLOCK DIAGRAM

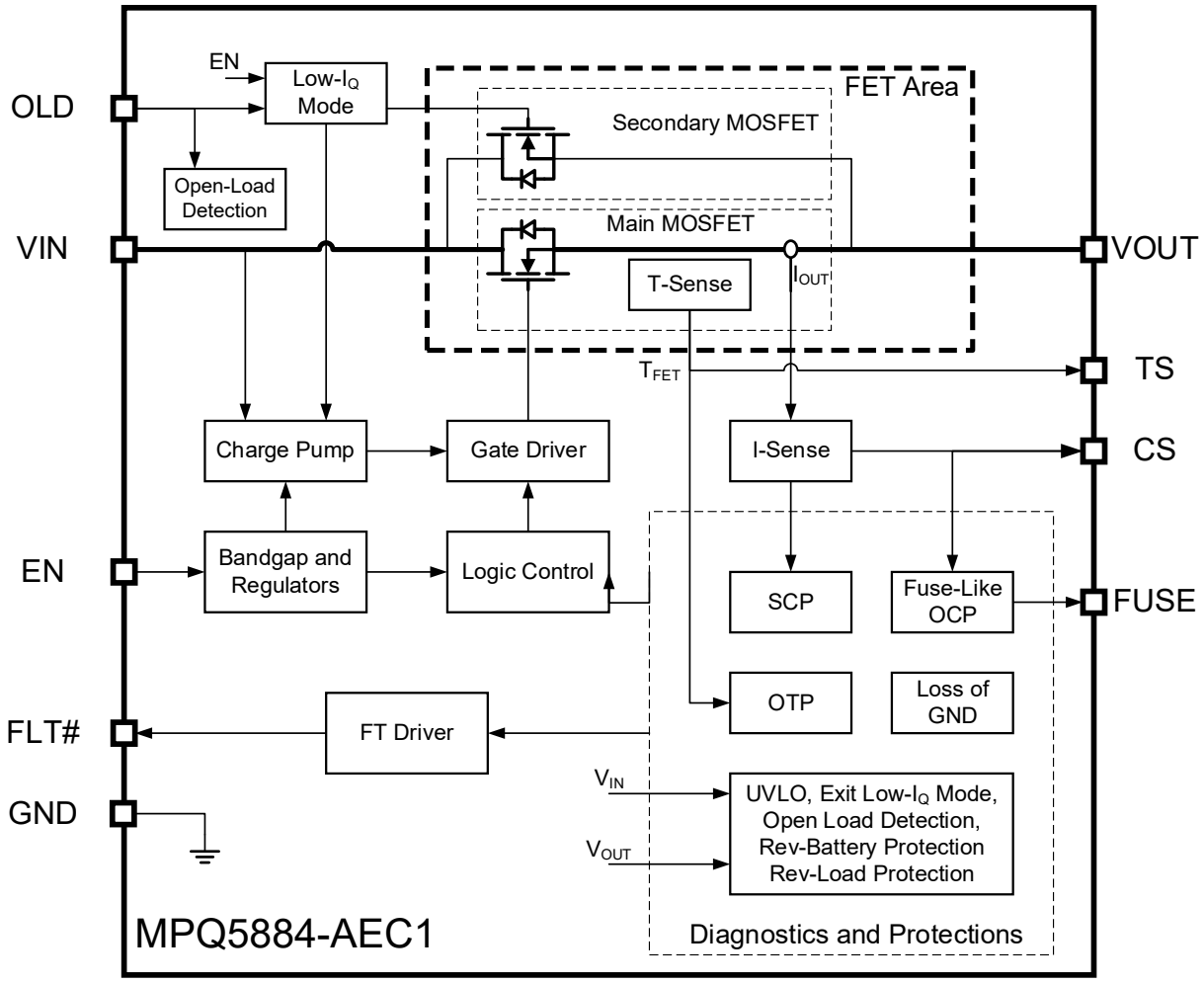

Figure 1: Functional Block Diagram

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OPERATION

The MPQ5884 is a robust, self-protected e-fuse and smart high-side switch. It is designed to drive high-current loads with minimal loss. The device's built-in protection features enable it to survive harsh automotive conditions with minimal external components. Integrated current and temperature monitoring provide information about the power device and load. Fuse-like over-current protection (OCP) enables the device to protect the wire and replace the passive fuse in a junction box.

Off-state open-load detection can monitor the load status when EN is low. Low quiescent current (I_Q) mode provides a solution to extend the battery life when whole system is in standby.

Modes of Operation

The MPQ5884 has four modes of operation: normal mode, open-load detection mode, low-I_Q mode, and shutdown mode.

In addition, the MPQ5884 has two internal power switches: a main MOSFET (M-FET) and a secondary MOSFET (BB-FET). M-FET and BB-FET are N-channel MOSFETs.

In normal mode, the M-FET and BB-FET conduct. In low-I_Q mode, the MOSFET that conducts depends on the load current range.

Table 1 shows the set-up for the EN and OLD pins for each mode's steady state.

Table 1: EN and OLD Settings

EN	OLD	Operation Mode
High	Low	Normal mode
	High	Low-I_Q mode
Low	Low	Shutdown mode
	High	Open-load detection

Figure 2 shows the MPQ5884's mode transitions, which shows the sequences to follow when switching between the four modes. It is recommended to pull EN and OLD high after the input voltage (V_{IN}) exceeds the under-voltage lockout (UVLO) threshold.

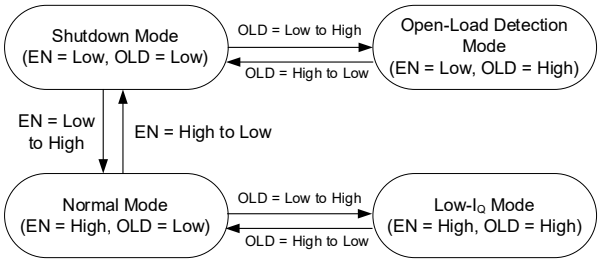

Figure 2: Operation State Machine

Enable (EN) Input

The EN pin is a digital input that turns the MPQ5884's power switch on/off. If the enable voltage exceeds 1.5V, the device turns on. If the enable voltage is below 0.8V, the device turns off. Do not leave the EN pin floating.

Normal Mode

In normal mode, the M-FET and BB-FET turn on when EN reaches the enable high threshold. The MPQ5884 has an internal charge pump to generate a high voltage, which is necessary to drive the N-channel MOSFET. The charge pump is operational when M-FET and BB-FET conduct.

Low Quiescent Current (I_Q) Mode

The MPQ5884 has a low-I_Q mode, where I_Q is typically reduced to 25μA. This mode can effectively extend the battery life. In normal mode, the M-FET and BB-FET conduct. The MPQ5884 switches to low-I_Q mode by pulling the OLD pin high when EN is high. In low-I_Q mode, the BB-FET stays on while the M-FET turns off.

In low-I_Q mode, the MPQ5884 monitors the BB-FET's drain-to-source voltage (V_{DS}). If V_{DS} exceeds the voltage threshold (V_{LIQ_TH}, typically 0.2V), the MPQ5884 turns on the M-FET automatically, and the BB-FET stays on. The current threshold in low-I_Q mode can be calculated with Equation (1):

$$I_{LIQ_TH} = \frac{V_{LIQ_TH}}{R_{ON_BB}} \quad (1)$$

Note that R_{ON_BB} is larger at high temperatures, which means that I_{LIQ_TH} is smaller. I_{LIQ_TH} exceeds 90mA across the full temperature range.

If $I_{OUT} < I_{LIQ_TH}$ in low-I_Q mode, only the BB-FET is conducting. Current-sensing and temperature-sensing are disabled.

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If V_{DS} exceeds V_{LIQ_TH}, the M-FET turns on and the BB-FET is also on. Current-sensing and temperature-sensing are enabled when the M-FET turns on. Meanwhile, FLT# is pulled low. Under this condition, the M-FET does not turn off, even if the output current (I_{OUT}) falls below I_{LIQ_TH} again. The OLD pin must be pulled down to reset the FLT# pin. Afterward, OLD can be pulled up to enter low-I_Q mode again.

To exit low-I_Q mode, the user can actively pull the OLD pin low. After OLD turns to logic low, the M-FET and BB-FET turn on.

If there is a short circuit in low-I_Q mode, the device first exits low-I_Q mode automatically, and both M-FET and BB-FET turn off since I_{OUT} rises quickly. Then the M-FET begins to turn on in 100µs, and the current-sense and temperature-sense functions are enabled at the same time. If I_{OUT} exceeds the short-circuit protection (SCP) threshold, the device shuts down again and latches off.

Figure 3 shows the entry and exit flowchart for low-I_Q mode.

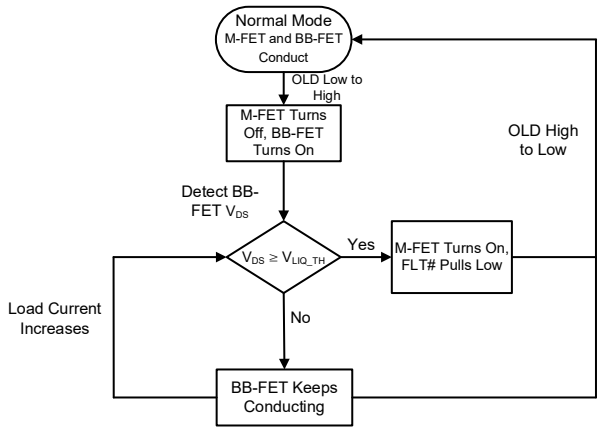

Figure 3: Low-I_Q Mode Entry and Exit

Open-Load Detection

The MPQ5884 has off-state open-load detection. When EN is low and OLD is driven to logic high, the device attempts to detect an open load. A current source then sources a current (I_{OLD}, typically 165µA) to the output pin. If the output voltage (V_{OUT}) exceeds the open-load detection threshold (V_{OLD_TH}, typically 5.2V), the FLT# pin asserts to low.

Current Monitor

The MPQ5884's current monitor function is enabled during normal mode. The CS pin outputs a current proportional to the power device's I_{OUT}. The CS pin's voltage can be estimated with Equation (2).

$$V_{CS} = I_{CS} \times R_{CS} = K_{CS} \times I_{OUT} \times R_{CS} \quad (2)$$

Where I_{CS} is CS pin's output current, R_{CS} is the resistance between the CS pin and GND, and K_{CS} is the current-sense gain ($K_{CS} = I_{CS} / I_{OUT}$), which is typically 220µA/A.

V_{CS} is clamped to the current-limit threshold (V_{ILIM}) even if I_{OUT} keeps rising, as the additional current is used for the fuse-like current limit.

To eliminate the CS noise, an RC filter is required when sampling V_{CS}. It is recommended to use a 10kΩ resistor and 100nF capacitor.

Current Limit

There are two levels for integrated current-limit protection: the fuse-like current limit and short-circuit current limit. If the fuse-like current limit is triggered, the device shuts down following an adjustable I-t curve (see Figure 4 on page 18). If the FUSE pin is shorted to GND, there is only the short-circuit current limit. If SCP is triggered, the device turns off as quickly as possible. Both current limit protections assert the FLT# flag. The device remains off until the EN pin is toggled.

Fuse-Like Current Limit

The fuse-like current limit provides a protection similar to regular, disposable fuses. The MPQ5884 does not shut down immediately after triggering the fuse-like current limit. The higher the current, the shorter the shutdown deglitch time.

When V_{CS} is clamped to V_{ILIM}, if I_{OUT} continues increasing after V_{CS} reaches V_{ILIM}, the fuse-like current limit is triggered. The fuse-like current limit can be calculated with Equation (3):

$$I_{FUSE_CL}(A) = \frac{V_{ILIM}}{K_{CS} \times R_{CS}(\Omega)}(A) \quad (3)$$

Where I_{FUSE_CL} is the fuse-like current limit.

A fuse capacitor is connected between the FUSE pin and GND. When I_{OUT} exceeds I_{FUSE_CL}, a current (I_{FUSE+}) charges the FUSE capacitor, and I_{FUSE+} increases as ΔI_{OUT} rises.

ΔI_{OUT} can be estimated with Equation (4):

$$\Delta I_{OUT} = I_{OUT} - I_{FUSE_CL} \quad (4)$$

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The capacitor voltage (V_{FUSE}) is charged to the fuse's upper trip limit (V_{FUSE_H}) by I_{FUSE+}, then V_{FUSE} is discharged to the fuse's lower trip limit (V_{FUSE_L}) with I_{FUSE+}. Once V_{FUSE} drops to V_{FUSE_L} and $I_{OUT} > I_{FUSE_CL}$, the internal FUSE counter adds 1. When the counter reaches 32, the MPQ5884 shuts down and FLT# is pulled low.

When $\Delta I_{OUT} < 1.5A$, the deglitch time (t_{FUSE}) depends on different ΔI_{OUT} values following Equation (5). In this scenario, t_{FUSE} can be calculated with Equation (5):

$$t_{FUSE}(s)=C_{FUSE}(nF)\times(0.2 - \Delta I_{OUT}(A)\times 0.128) \quad (5)$$

When $1.5A < \Delta I_{OUT} < 8A$, t_{FUSE} depends on different ΔI_{OUT} values following Equation (6). In this scenario, t_{FUSE} can be estimated with Equation (6):

$$t_{FUSE}(s) = C_{FUSE}(nF) \times 0.067 \times \Delta I_{OUT}(A)^{-3.2} \quad (6)$$

When $\Delta I_{OUT} > 8A$, I_{FUSE+} is close to its maximum value, so the deglitch time does not decrease as significantly while I_{OUT} increases. When C_{FUSE} = 100nF, the longest deglitch time is about 15s, and the shortest deglitch time is about 10ms. Figure 4 shows the FUSE deglitch time vs. I_{OUT} with fuse-like current limit of 15A while C_{FUSE} = 100nF.

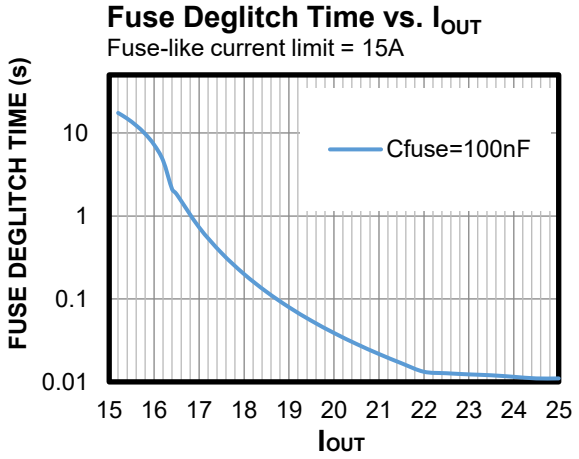

Figure 4: Load Current vs. Fuse Time When Fuse-Like Current Limit = 15A

Note that K_{CS} and V_{FUSE_HYS} might have variations. The variation of K_{CS} and accuracy of R_{CS} influence the designed I_{FUSE_CL} value and ΔI_{OUT}, which then influence the deglitch time. V_{FUSE_HYS} is the difference between V_{FUSE_H} and V_{FUSE_L}, which means that V_{FUSE_HYS} is the voltage range for C_{FUSE}.

This means that the V_{FUSE_HYS} variations and the C_{FUSE} accuracy directly influence the deglitch time. These parameters should be taken into consideration when calculating the deglitch time.

If I_{OUT} decreases and V_{CS} drops below V_{ILIM} before counting to 32, the internal FUSE counter starts to decrease. While the FUSE counter decreases, the fuse capacitor is charged and discharged by a current (I_{FUSE-}), which can be calculated with Equation (7):

$$I_{FUSE-}(\mu A) = 64.7 \times (1 - I_{OUT} / I_{FUSE_CL})(A) + 9\mu A \quad (7)$$

The maximum value for I_{FUSE-} is 40μA. If the FUSE capacitor discharges to V_{FUSE_L} and $I_{OUT} < I_{FUSE_CL}$, the FUSE counter is subtracted by 1 until it reaches 0.

To enhance the FUSE counter's stability, it is recommended that the FUSE capacitance exceed 10nF. Figure 5 shows the principles of the fuse-like current limit.

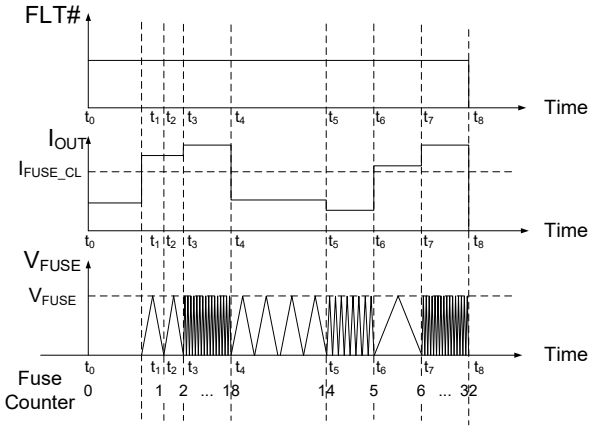

Figure 5: Fuse-Like Current Limit

Short-Circuit Current Limit

The short-circuit current limit is developed for SCP. If a short circuit occurs, the inrush current rises sharply, which might violate the internal MOSFET's safe operating area. The MPQ5884 integrates an SCP threshold (I_{SCP}) to handle this condition.

If the load current reaches I_{SCP}, the device shuts down immediately to protect the M-FET, and the FLT# pin asserts to low. A voltage spike occurs on VIN when the device shuts down, so it is recommended to add a TVS diode on the VIN pin. The clamping voltage must be selected such that the absolute maximum for the MPQ5884 is not exceeded.

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The MPQ5884 short-circuit capability is tested with the set-up according to AEC-Q100-012. For shorts at the module (short-circuit inductance = 1μH, resistance = 20mΩ) and shorts at the load (short-circuit inductance = 5μH, resistance = 50mΩ), the device can survive when V_{IN} ≤ 60V.

Fault Indicator

The MPQ5884 has a fault indicator function via the FLT# pin. The FLT# pin is an open drain. It is recommended to pull FLT# up by a 3.3V or 5V external source through a 10kΩ resistance, which can effectively reduce the FLT# pin's input current if a fault occurs.

Reverse Battery Protection

If a reverse battery connection occurs, there is a large current from VOUT to VIN through the M-FET's internal reverse diode. This results in IC damage. To protect itself, the MPQ5884 provides reverse battery protection. If the MPQ5884 detects a reverse battery protection condition and the reverse voltage is below $-V_{RB_TH}$, the M-FET turns on immediately and VOUT is pulled to VIN. This results in very low power dissipation on the MPQ5884.

Reverse Load Protection

If the output voltage (V_{OUT}) > V_{IN}, there is a current flowing from VOUT to VIN through the integrated diode if the device is off. This produces significant heat and power loss. To reduce power loss and heat, when V_{OUT} - V_{IN} exceeds V_{RL_TH}, the MPQ5884's M-FET turns on, and FLT# is pulled to low. After the M-FET turns on, V_{IN} is pulled to V_{OUT} and the MPQ5884 continuously monitors the current from VIN to VOUT. When the VIN-to-VOUT current exceeds 30mA, the M-FET turns off, and FLT# is pulled to high.

Loss of Power Supply Protection

If the power supply is lost, then the device shuts down, regardless of EN. For resistive or capacitive loads, the device can easily handle power supply loss. However, for an inductive load, a current is absorbed from the microcontroller unit's (MCU) general-purpose input/outputs (GPIOs), which might damage the device and the MCU. Therefore, for proper protection against this status, it is recommended to connect a 10kΩ resistor between the MCU GPIO and the MPQ5884's pins.

Loss of Ground Protection

If the IC ground or module ground is lost, the power switch turns off when it is the on state; if the switch is in the off state, it stays in the off state. To protect any device that is interfacing with the MPQ5884, add a 10kΩ resistor between the MPQ5884's logic pins and the MCU's GPIOs. Figure 6 shows the loss of IC GND.

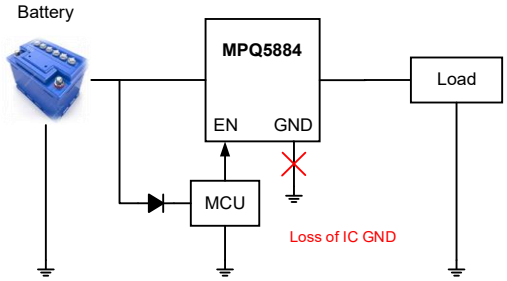

Figure 6: Loss of IC GND

Figure 7 shows the loss of module GND.

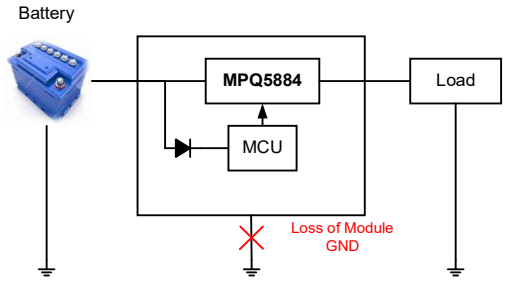

Figure 7: Loss of Module GND

Cold Crank

Under cold-crank conditions, the battery's voltage drops rapidly. This may result in the device shutting down. The MPQ5884 provides a low-V_{IN} solution to maintain its output even if the battery voltage drops to 6V.

Temperature Sensor

The MPQ5884 has an internal temperature sensor that is close to the M-FET. The temperature sensor can monitor the M-FET's junction temperature and output a voltage through the TS pin. The junction temperature (T_J) can be estimated with Equation (8):

$$T_J(^\circ C) = 104.4^\circ C/V \times V_{TS}(V) - 59.3^\circ C \quad (8)$$

Where T_J is the M-FET's junction temperature, and V_{TS} is the TS pin's voltage. The temperature sensor provides a way to monitor the M-FET's T_J with ±15°C accuracy. It is recommended to limit T_J within 150°C during normal operation.

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Thermal Shutdown

The MPQ5884's internal controller detects the power switch's junction temperature. If the junction temperature exceeds the thermal shutdown threshold (168°C, typically), the FLT# pin is pulled low for about 4ms, and the device stays off until the temperature falls to its lower threshold (148°C, typically).

Full Protection and Diagnostics

The MPQ5884 provides flexible protections and diagnostic functions. Table 2 shows the fault statuses and related trigger conditions, where "H" is high and "L" is low.

Table 2: Fault Table

IC Status	Fault Condition	EN	OLD	OUT	FT	Recover
Normal mode	N/A	H	L	H	H	N/A
Low-I_Q mode	N/A (V_{DS} < V_{LIQ_TH})	H	H	H	H	N/A
Shutdown mode	N/A	L	L	L	H	N/A
Open-load detection mode	N/A	L	H	L	H	N/A
Low I_Q mode auto-exit	V_{DS} >= V_{LIQ_TH}	H	H	H	L	Pull down OLD pin
Open load detected	V_{OUT} > V_{OLD_TH}	L	H	H	L	V_{OUT} < V_{OLD_TH} - V_{OLD_HYS}
I_{OUT} exceed fuse-like current limit	I_{OUT} > I_{FUSE_CL}, part shuts down after t_{FUSE}	H	N/A	L	H within t_{FUSE}, L after shutdown	Toggle EN pin
I_{OUT} exceeds short-circuit threshold	SCP is triggered, device shuts down immediately	H	N/A	L	L	Toggle EN pin
Reverse battery self-protection	V_{IN} < -V_{RB_TH}	L	N/A	L	H	Auto-recover if fault condition removed
Reverse load protection	V_{OUT} - V_{IN} > V_{RL_TH}	L	N/A	H	L	I_{OUT} > 30mA.
Thermal shutdown	T > T_{SD}	H	N/A	L	L (4ms)	T < T_{SD} - T_{SD_HYS}
Loss of GND	IC or module GND loss	N/A	N/A	L	H	Auto-recover if fault condition removed

AEC Q100-012 Test Grade A Certification

Short-circuit reliability is critical for smart high-side power switch devices. The AEC-Q100-012 standard is used to determine the reliability of the devices when operating under a continuous short-circuit condition. Different grade levels are specified according to the pass cycles. This device is qualified with the highest level, Grade A, which is a short-to-GND certification after being tested 1 million times.

There applicable test modes are listed below:

1. Cold repetitive short-circuit test (long pulse)
2. Cold repetitive short-circuit test (short pulse)

Transient Disturbances Tests

The MPQ5884 meets requirements specified in ISO7637-2, ISO16750-2, and ISO 21780 standards based on the application circuit.

Table 3 shows the ISO7637-2 and ISO16750-2 tests in a 12V system. Table 4 on page 21 shows the ISO7637-2 and ISO16750-2 tests for a 24V system. Table 5 on page 21 shows the ISO21780 tests for a 48V system.

Table 3: Tests in ISO7637-2 and ISO16750-2 for 12V System

Standard	Test Item	Level	Description
7637-2	1	IV	-150V/2ms
	2a	IV	112V/50µs
	2b	IV	10V/R_{IN} = 0Ω
	3a	IV	-220V/0.1µs
	3b	IV	150V/0.1µs
16750-2	Load Dump Test B		U_{S*} = 42V $t_R \leqslant$ 5ms
	Reverse Polarity Voltage		U_S = - 30V t < 60s

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Table 4: Tests in ISO7637-2 and ISO16750-2 for 24V System

Standard	Test Item	Level	Description
7637-2	1	IV	-600V/1ms
	2a	IV	112V/50µs
	2b	IV	20V/ R_{IN} = 0Ω
	3a	IV	-300V/0.1µs
	3b	IV	300V/0.1µs
16750-2	Load Dump Test B		U_{S*} = 58V $t_R \leqslant$ 5ms
	Reverse Polarity Voltage		U_S = - 30V t < 60s

Table 5: Tests in ISO21780 for 48V System

Standard	Test Item	Description
21780	Test 02 Case 1	31V / 2s
	Test 02 Case 2	54V / 120s
	Test 06	60V / 60min
	Test 04 Load Dump	70V / 40ms, t_R = 0.7ms
	Test 05 Starting Profile	24V / 10s, t_F = 5ms

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APPLICATION INFORMATION

Figure 8 shows the MPQ5884's typical application circuit. Table 6 shows the design guide index.

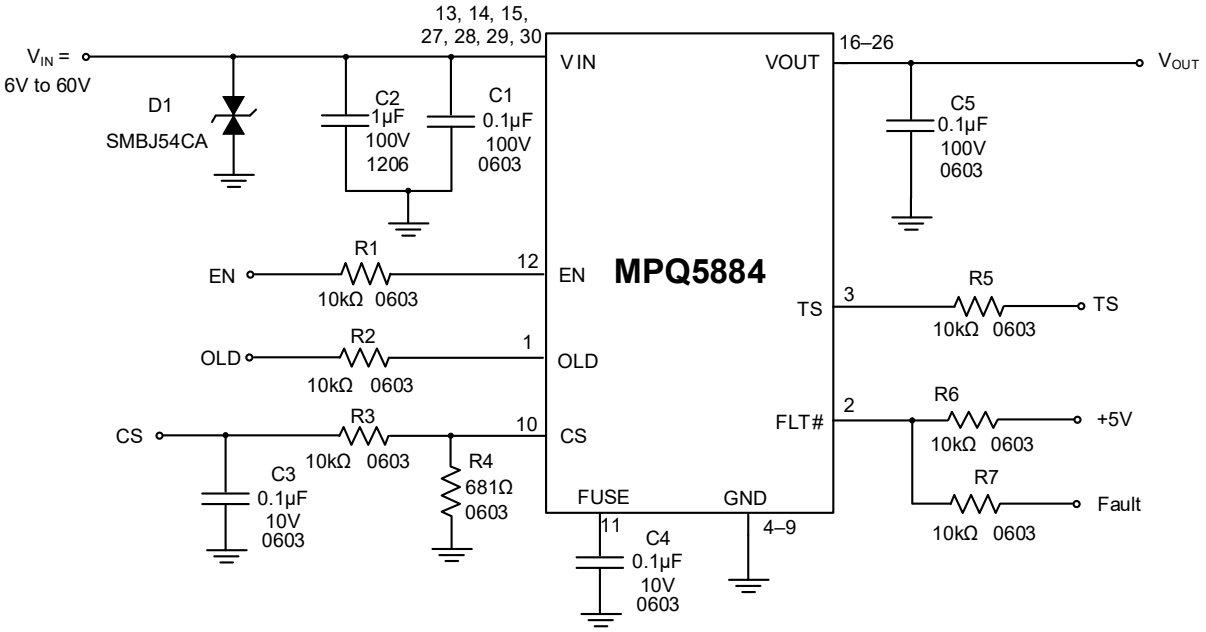

Figure 8: Typical Application Circuit

Table 6: Design Guide Index

Pin #	Pin Name	Component	Design Guide Index
13, 14, 15, 27, 28, 29, 30	VIN	C1, C2, D1	Selecting the Input Capacitor (VIN, Pins 13–15, 27–30) Selecting the Input TVS Diode (VIN, Pins 13–15, 27–30)
16–26	VOUT	C5	Selecting the Output Capacitor (VOUT, Pins 16–26)
11	FUSE	C4	Selecting the FUSE Capacitor (FUSE, Pin 11)
10	CS	R4, R5, C3	Selecting the CS Resistor and Capacitor (CS, Pin 10)
1	OLD	R2	Enable Low-I_Q Mode or Open-Load Detection (OLD, Pin 1)
2	FLT#	R6, R7	Fault Report (FLT#, Pin 2)
3	TS	R5	Temperature-Sense Output (TS, Pin 3)
4-9	GND	-	Ground Connection (GND, Pins 4–9)
12	EN	R1	Enable Power Output (EN, Pin 12)

Selecting the Input Capacitor (VIN, Pins 13–15, 27–30)

For the best performance, a minimum 1µF ceramic capacitor with X5R or X7R dielectrics is highly recommended due to its low ESR and small temperature coefficients. It is recommended to use another lower-value capacitor (e.g. 0.1µF) with a small package size (0603) to absorb high-frequency switching noise. Place the smaller capacitor as close to VIN and GND as possible.

Selecting the Input TVS Diode (VIN, Pins 13–15, 27–30)

To prevent the voltage on VIN from exceeding the absolute maximum value, it is recommended to add a bidirectional TVS diode (SMBJ54CA) to protect the device. Place the TVS diode as close to VIN and GND as possible.

Selecting the Output Capacitor (VOUT, Pins 16–26)

For the best performance, it is recommended to use 0.1µF (0603) ceramic capacitors with X5R or X7R dielectrics to absorb high-frequency noise. Place the smaller capacitor as close to VOUT and GND as possible.

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Selecting the FUSE Capacitor (FUSE, Pin 11)

To enhance the FUSE counter's stability, it is recommended for the FUSE capacitance to exceed 10nF. It is recommended to use small package size (0603) ceramic capacitors with C0G or NP0 dielectrics to ensure a consistent capacitance across the full temperature range. Place the smaller capacitor as close to FUSE and GND as possible.

Selecting the CS Resistor and Capacitor (CS, Pin 10)

The fuse-like current limit is set by a resistor connected from the CS pin to ground. Select the CS resistor (R_{CS}) appropriately. R_{CS} can be calculated with Equation (9):

$$R_{CS}(\Omega) = \frac{1}{k_{CS}} \times \frac{3V}{I_{FUSE_{CL}}(A)} \quad (9)$$

For example, the fuse-like current limit is about 20A when R_{CS} = 681Ω.

Place a minimum 10kΩ resistor between the MCU's GPIO and the MPQ5884's CS pin. In addition, place a 100nF capacitor at GPIO to filter the noise. Do not place a capacitor directly at the CS pin, because this capacitor would impact the internal close loop's stability.

Enable Low-I_Q Mode or Open-Load Detection (OLD, Pin 1)

The MPQ5884 switches to low-I_Q mode by pulling the OLD pin high when the EN is high. The MPQ5884 switches to open-load detection mode by pulling the OLD pin high when EN is low.

Fault Report (FLT#, Pin 2)

The FT pin is an open-drain output. If using the FT pin, connect it to a 3.3V or 5V power supply via a pull-up resistor (R6, which is recommended to be about 10kΩ). FT asserts low if a fault occurs.

Temperature-Sense Output (TS, Pin 3)

The TS pin voltage reflects the M-FET's junction temperature. See Equation (8) on page 19 for the detailed calculation method.

Ground Connection (GND, Pins 4–9)

See the PCB Layout Guidelines section on page 26 for more details.

Enable Power Output (EN, Pin 12)

EN is a digital control pin that turns the device on and off. When the EN pin voltage exceeds 1.5V, the MPQ5884 turns on.

Pulse-Width Modulation (PWM) Switching

The MPQ5884 can be used for PWM switching. To ensure that the die temperature does not exceed the maximum rating, consider the turn-on and turn-off energy.

Figure 9 shows the typical waveforms of EN, V_{OUT}, and I_{OUT} when the MPQ5884 executes PWM switching with a resistance load.

At t_0, EN turns from low to high, and MPQ5884 starts up.

At t_2, EN turns from high to low; the MPQ5884 shuts down, and V_{OUT} and I_{OUT} begin to drop.

At t_3, V_{OUT} and I_{OUT} drop to zero.

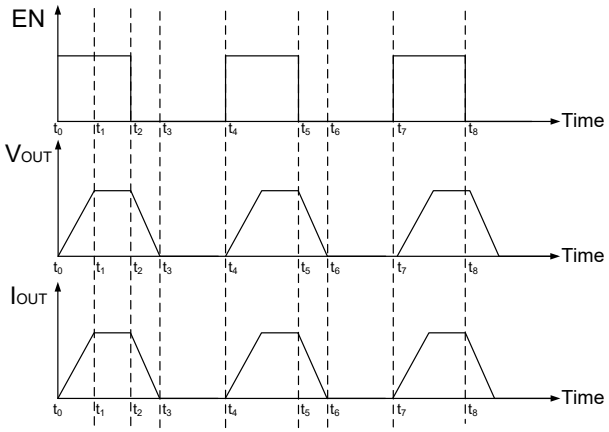

Figure 9: PWM Switching

The heat dissipation on the MPQ5884 during one PWM switching cycle (t_0 to t_4) can be calculated with the equations below.

The MPQ5884's heat dissipation during one PWM cycle (Q_{DISS}) can be estimated with Equation (10):

$$Q_{DISS} = \int_{t_0}^{t_4} V_{OUT(t)} \times I_{OUT(t)} dt \quad (10)$$

The MPQ5884's dispassion power during PWM switching (P_{DISS}) can be calculated with Equation (11):

$$P_{DISS} = f_{PWM} \times Q_{DISS} = \frac{1}{t_4 - t_0} \times Q_{DISS} \quad (11)$$

Where f_{PWM} is the frequency during PWM switching.

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The rising junction temperature (T_{JA}) can be estimated with Equation (12):

$$T_{JA} = \theta_{JA} \times P_{DISS} \quad (12)$$

Where θ_{JA} is the MPQ5884's thermal resistance (see the Electrical Characteristics section on page 5). The MPQ5884's junction temperature (T_J) can be calculated with Equation (13):

$$T_J = T_{JA} + T_A \quad (13)$$

Where T_A is ambient temperature.

It is recommended to limit the MPQ5884's junction temperature below 150°C. Considering the EN on delay and EN on time, it is recommended to set the PWM on time to be longer than 100μs. When the duty cycle = 50%, the maximum PWM frequency for the resistive load is about 5kHz.

Driving Capacitive Loads

When driving a capacitive load, there is an inrush current with a high input voltage due to the MPQ5884's fast turn-on. In this scenario, SCP might be triggered by the inrush current. The MPQ5884 can drive a 60μF capacitor directly under the full temperature and full operation voltage without triggering SCP. If the capacitive load exceeds 60μF, it is recommended to apply a PWM signal on EN during start-up. Note that after SCP is triggered, the MPQ5884 latches off for about 1ms; the MPQ5884 cannot recover during this period, even if EN is reset.

It is recommended to apply 500Hz with a duty cycle = 50% or a lower PWM frequency signal on EN.

Switching-Off Inductive Loads

When switching off an inductive load, a large amount of unclamped inductive switching (UIS) energy dissipates on the internal MOSFET. The load current should be limited with different inductive loads subject to the M-FET's UIS limitation (see Figure 10).

Figure 10 shows the MPQ5884's schematic when driving an inductor load. The output voltage (V_{OUT}) is negative as the load switch turns off.

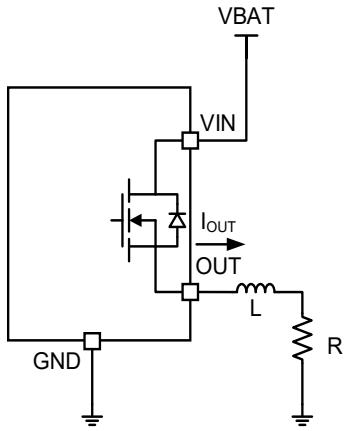

Figure 10: Driving an Inductive Load

Figure 11 shows the typical inductive load's switching off waveform.

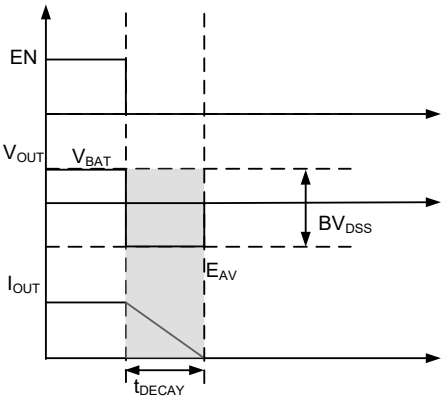

Figure 11: Inductive Load Switching-Off Waveform

During switching, the drain-to-source voltage is clamped by the power FET's drain-to-source breakdown voltage (BV_{DSS}). During the current decay period (t_{DECAY}), the energy dissipated on the high-side load switch (E_{DISS}) can be calculated with Equation (14) through Equation (18):

$$E_{DISS} = \int_0^{t_{DECAY}} BV_{DSS} \times I_{OUT}(t)\, dt \quad (14)$$

Where BV_{DSS} can be calculated with Equation (15):

$$V_{OUT} = V_{BAT} - BV_{DSS} \quad (15)$$

I_{OUT} can be estimated with Equation (16):

$$I_{OUT}(t) = \frac{V_{OUT}}{R} + \left(I_{OFF} - \frac{V_{OUT}}{R}\right) e^{-\frac{R}{L}t},\ t<t_{DECAY} \quad (16)$$

t_{DECAY} can be calculated with Equation (17):

$$t_{DECAY} = \frac{L}{R} \times \ln\left(\frac{I_{OFF} \times R + |V_{OUT}|}{|V_{OUT}|}\right) \quad (17)$$

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For simplification, E_{DISS} can be estimated with E quation (18):

$$E_{DISS} = \frac{L(V_{BAT} + |V_{OUT}|)}{R^2}\left[I_{OFF} \times R - |V_{OUT}| \ln\left(\frac{I_{OFF} \times R + |V_{OUT}|}{|V_{OUT}|}\right)\right] \quad (18)$$

When the load is a pure inductor (or *R* can be ignored), E_{DISS} can be calculated with Equation (19):

$$E_{DISS} = \frac{L \times I_{OFF}^2}{2} \times \frac{V_{BAT} + |V_{OUT}|}{|V_{OUT}|} \quad (19)$$

To prevent the device from damage, E_{DISS} should not exceed the single-pulse energy value (see the Absolute Maximum Ratings section on page 5). Repetitive pulse energy means that the MPQ5884 can handle this energy for one million cycles, and MPQ5884 does not experience any degeneration.

Figure 12 shows the maximum allowable current for an inductive load.

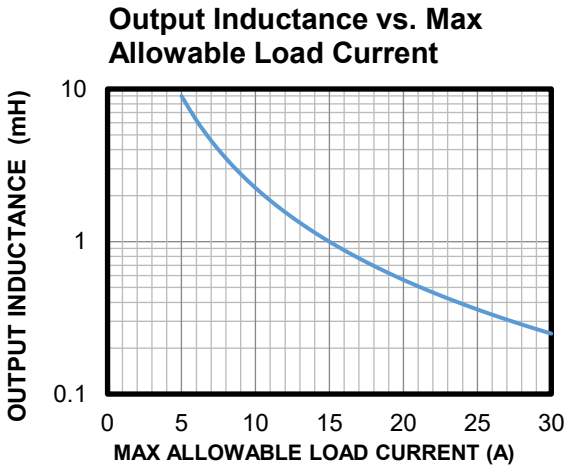

Figure 12: Maximum Allowable Output Current with Various Load Inductance

If the MPQ5884 is used to switch an inductive load, the unclamped inductance can cause the power switch to break down. The energy ratings in the Absolute Maximum Ratings section on page 5 should not be exceeded. If additional inductive energy handling is required, a TVS diode can be used to absorb the entirety of the inductive energy. The anode should be connected to ground, and the cathode should be connected to VOUT.

Loss of Input Supply or Load

If the input supply is lost, the output cable's inductance can cause a negative transient on VOUT. If the load is lost, the supply cable's inductance can cause a positive transient voltage on VIN. To suppress both transients, it is recommended to place two TVS diodes in a back-to-back configuration on the VIN pin. The clamping voltage must be selected such that the absolute maximum for the MPQ5884 is not exceeded. Figure 13 shows this schematic.

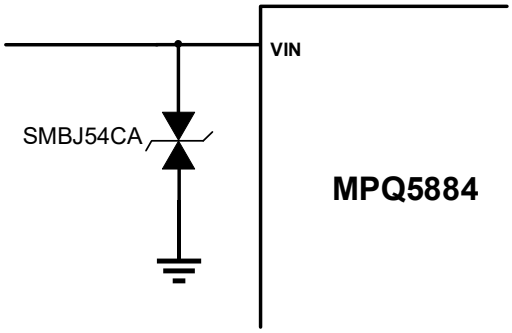

Figure 13: Loss of Input Supply or Load with External Components

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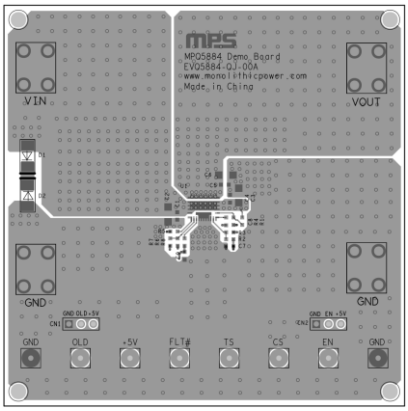
PCB Layout Guidelines (11)

An optimized PCB layout is very important for proper operation. A 4-layer layout is strongly recommended to improve thermal performance. For the best results, refer to Figure 14 and follow the guidelines below:

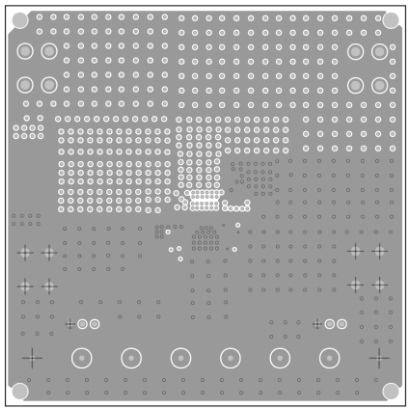
1. Use a large plane to connect to VIN, VOUT, and GND directly.
2. Place the ceramic input capacitor and output bypass capacitor as close to VIN and VOUT as possible to minimize noise.
3. Place the FUSE capacitor as close to the FUSE pin as possible to minimize noise.
4. Place the CS resistor as close to the CS pin as possible to minimize noise.
5. Use large copper areas to minimize conduction loss and thermal stress.
6. Use multiple vias to connect the power planes to the internal layer.

Note:

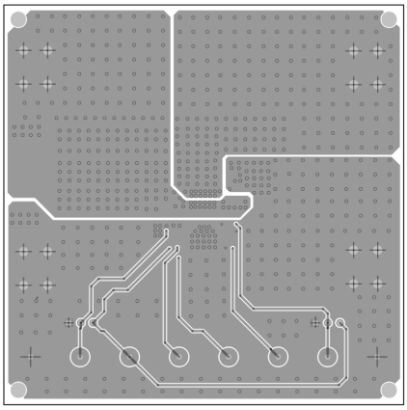
11) The recommended PCB layout is based on the circuit in Figure 15 on page 27.



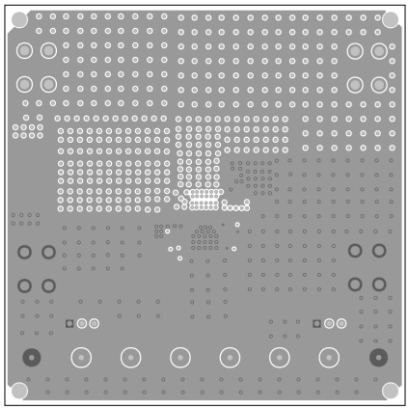
Top Silk and Top Layer



Mid-Layer 1



Mid-Layer 2



Bottom Layer and Bottom Silk

Figure 14: Recommended PCB Layout

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TYPICAL APPLICATION CIRCUIT

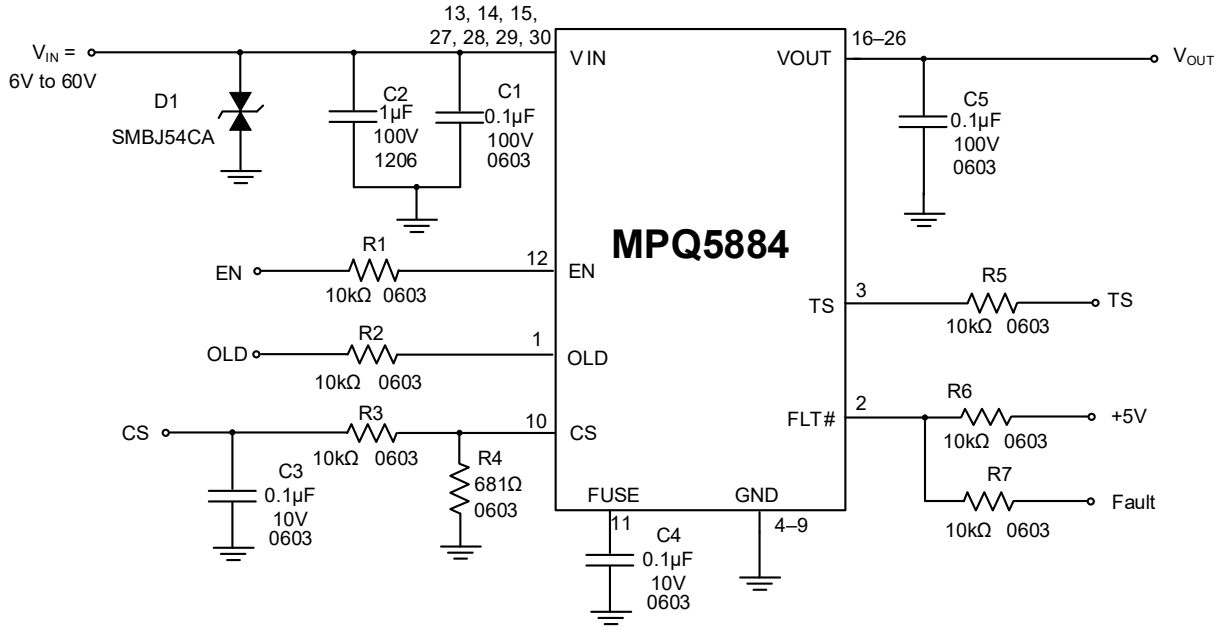

Figure 15: Typical Application Circuit

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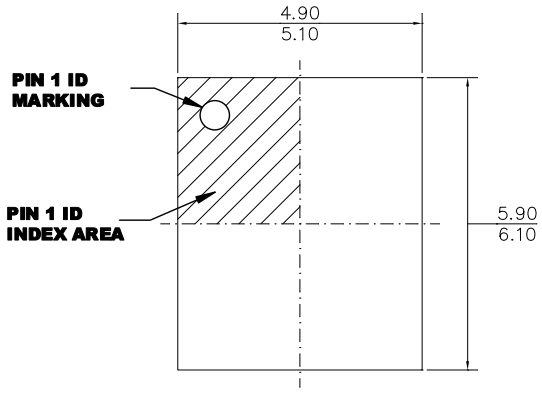
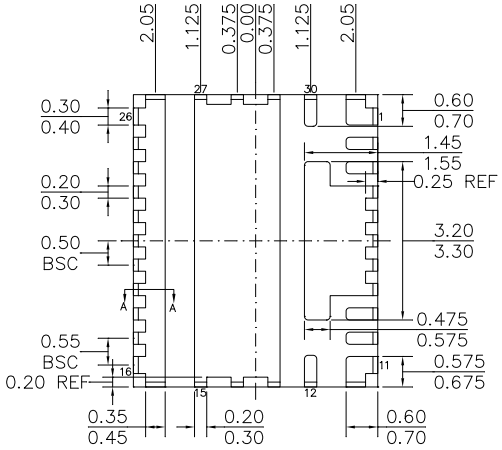
PACKAGE INFORMATION

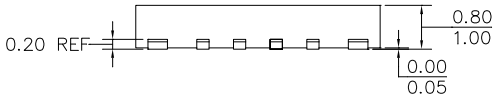
QFN-30 (5mmx6mm)



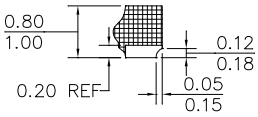
TOP VIEW



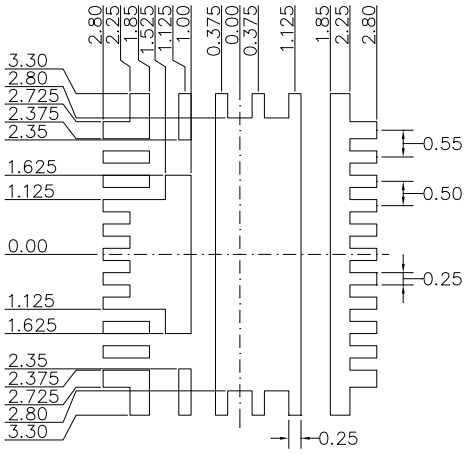
BOTTOM VIEW



SIDE VIEW



SECTION A-A



RECOMMENDED LAND PATTERN

NOTE:

1) THE LEAD SIDE IS WETTABLE.
2) ALL DIMENSIONS ARE IN MILLIMETERS.
3) EXPOSED PADDLE SIZE DOES NOT INCLUDE MOLD FLASH.
4) LEAD COPLANARITY SHALL BE 0.08 MILLIMETERS MAX.
5) JEDEC REFERENCE IS MO-220.
6) DRAWING IS NOT TO SCALE.

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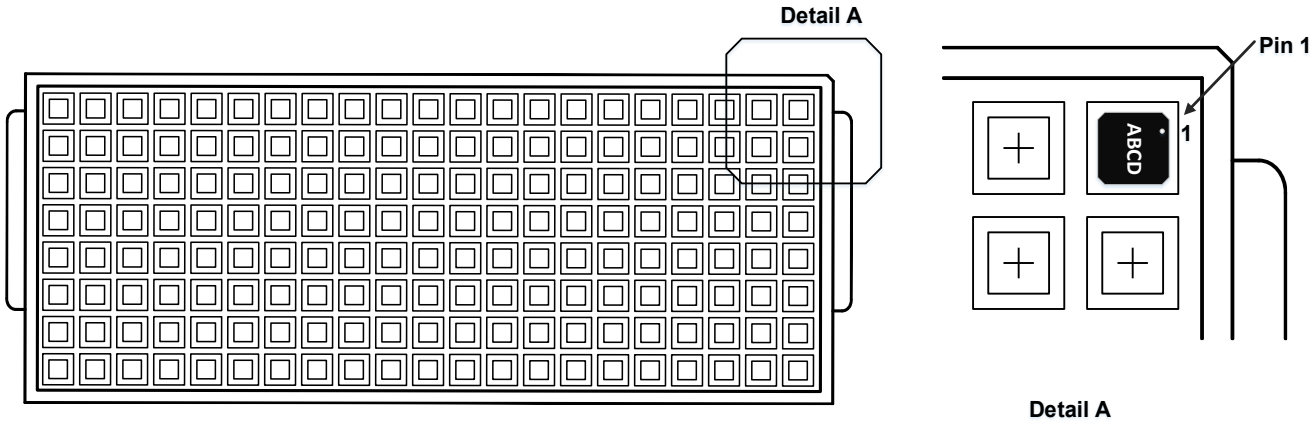
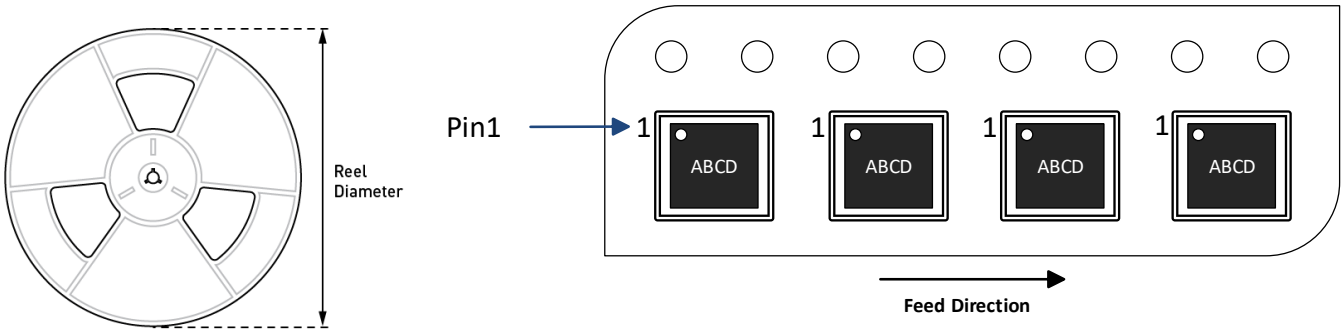
CARRIER INFORMATION



Part Number	Package Description	Quantity/ Reel	Quantity/ Tube	Quantity/ Tray	Reel Diameter	Carrier Tape Width	Carrier Tape Pitch
MPQ5884GQJE-AEC1-T	QFN-30 (5mmx6mm)	N/A	N/A	364	N/A	N/A	N/A



Part Number	Package Description	Quantity/ Reel	Quantity/ Tube	Quantity/ Tray	Reel Diameter	Carrier Tape Width	Carrier Tape Pitch
MPQ5884GQJE-AEC1-Z	QFN-30 (5mmx6mm)	5000	N/A	N/A	13in	12mm	8mm

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REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/23/2025	Initial Release	-

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