

**SLG59M1707V**

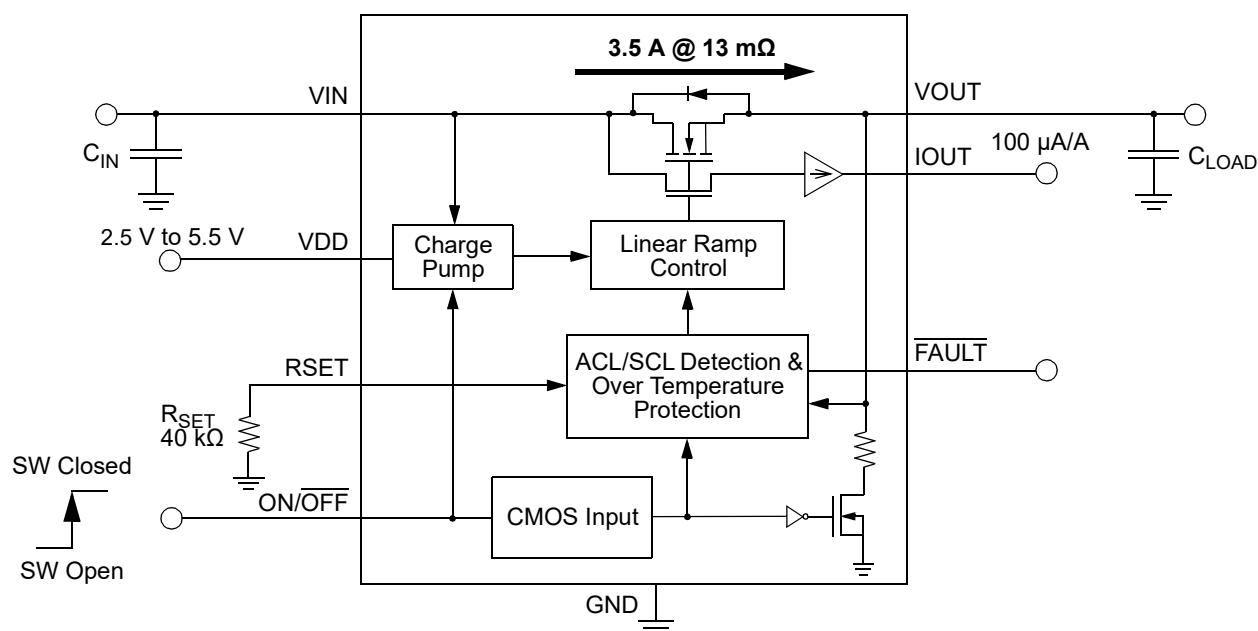
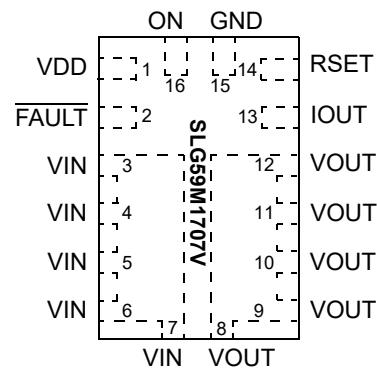
A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

**General Description**

Operating from a 2.5 V to 5.5 V power supply and fully specified over the -40 °C to 125 °C extended industrial temperature range, the SLG59M1707V is a high-performance 13 mΩ, 3.5 A single-channel nFET load switch designed for all 0.8 V to 5.5 V power rail applications. With a fixed  $V_{OUT}$  slew rate of 3 V/ms, inrush current is internally limited. Using a proprietary MOSFET design, the SLG59M1707V achieves a stable 13 mΩ  $R_{DS\text{ON}}$  across a wide input/supply voltage range. The SLG59M1707V also incorporates resistor-adjustable current limiting as well as thermal protection. Using Renesas's proprietary CuFET™ technology for high-current operation, the SLG59M1707V is packaged in a space-efficient, low thermal resistance, RoHS-compliant 1.6 mm x 2.5 mm STQFN package.

**Features**

- Low  $R_{DS\text{ON}}$  nFET Block: 13 mΩ
- Steady-state Operating Current: Up to 3.5 A
- Supply Voltage: 2.5 V ≤  $V_{DD}$  ≤ 5.5 V
- Wide Input Voltage Range: 0.8 V ≤  $V_{IN}$  ≤  $V_{DD}$
- Fixed  $V_{OUT}$  Slew Rate: 3 V/ms
- Two-stage Overcurrent Protection:
  - Resistor-adjustable Active Current Limit
  - Fixed 0.5 A Short-circuit Current Limit
- Thermal Shutdown Protection
- Analog MOSFET Current Monitor Output: 100 μA/A
- Open-drain FAULT Signaling
- Operating Temperature: -40 °C to 125 °C
- Low  $\theta_{JA}$ , 16-pin 1.6 mm x 2.5 mm STQFN
  - Pb-Free / Halogen-Free / RoHS compliant

**Block Diagram****Pin Configuration**

**16-pin FC-STQFN  
(Top View)**

**Applications**

- Notebook Power Rail Switching
- Tablet Power Rail Switching
- Smartphone Power Rail Switching

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## Pin Description

Pin #	Pin Name	Type	Pin Description
1	VDD	PWR	With an internal 1.9 V V <sub>DD(UVLO)</sub> threshold, VDD supplies the power for the operation of the load switch and internal control circuitry where its range is 2.5 V ≤ V <sub>DD</sub> ≤ 5.5 V. Bypass the VDD pin to GND with a 0.1 µF (or larger) capacitor
2	FAULT	Output	An open drain output, FAULT is asserted within 8ms when a current-limit or an over-temperature condition is detected. FAULT is deasserted within 8 ms when the fault condition is removed. Connect an external 10 kΩ resistor from the FAULT pin to local system logic supply.
3-7	VIN	MOSFET	Drain terminal of Power MOSFET (Pins 3-7 fused together). Connect a 10 µF (or larger) low ESR capacitor from this pin to GND. Capacitors used at VIN should be rated at 10 V or higher.
8-12	VOUT	MOSFET	Source terminal of Power MOSFET (Pins 8-12 fused together). Connect a low ESR capacitor (up to 100 µF) from this pin to GND. Capacitors used at VOUT should be rated at 10 V or higher.
13	IOUT	Output	MOSFET Load Current Monitor Output. As an analog current output, this signal when applied to a ground-reference resistor generates a voltage proportional to the current through the n-channel MOSFET. The I <sub>OUT</sub> transfer characteristic is typically 100 µA/A with a voltage compliance range of 0.5 V ≤ V <sub>IOUT</sub> ≤ V <sub>DD</sub> - 1 V. Optimal I <sub>OUT</sub> linearity is exhibited for 0.5 A ≤ I <sub>DS</sub> ≤ 3.5 A. Bypass the IOUT pin to GND with a 0.01 µF capacitor.
14	RSET	Input	A 1%-tolerance, metal-film resistor between 20 kΩ and 80 kΩ sets the load switch's active current limit. A 20 kΩ resistor sets the SLG59M1707V's active current limit to 4 A and a 80 kΩ resistor sets the active current limit to 1 A.
15	GND	GND	Ground
16	ON	Input	A low-to-high transition on this pin closes the load switch. ON is an asserted-HIGH, level-sensitive CMOS input with ON <sub>V<sub>IL</sub></sub> < 0.3 V and ON <sub>V<sub>IH</sub></sub> > 0.85 V. While there is an internal pull down circuit to ground (~4 MΩ), connect this pin to the output of a general-purpose output (GPO) from a microcontroller or other application processor. To ensure proper operation, ON pin needs to be toggled from low to high after V <sub>DD</sub> and V <sub>IN</sub> have reached their steady-state values.

## Ordering Information

Part Number	Type	Production Flow
SLG59M1707V	STQFN 16L	Extended Industrial, -40 °C to 125 °C
SLG59M1707VTR	STQFN 16L (Tape and Reel)	Extended Industrial, -40 °C to 125 °C

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### Absolute Maximum Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Power Supply Pin Voltage to GND		--	--	6	V
V <sub>IN</sub> to GND	Load Switch Input Voltage to GND		-0.3	--	6	V
V <sub>OUT</sub> to GND	Load Switch Output Voltage to GND		-0.3	--	V <sub>IN</sub>	V
ON, RSET, I <sub>OUT</sub> , and FAULT to GND	ON, RSET, I <sub>OUT</sub> , and FAULT Pin Voltages to GND		-0.3	--	6	V
T <sub>S</sub>	Storage Temperature		-65	--	150	°C
ESD <sub>HBM</sub>	ESD Protection	Human Body Model	2000	--	--	V
ESD <sub>CDM</sub>	ESD Protection	Charged Device Model	500	--	--	V
MSL	Moisture Sensitivity Level				1	
θ <sub>JA</sub>	Package Thermal Resistance, Junction-to-Ambient	1.6 mm x 2.5 mm STQFN; Determined using 1 in <sup>2</sup> , 1.2 oz. copper pads under V <sub>IN</sub> and V <sub>OUT</sub> on FR4 pcb material	--	35	--	°C/W
W <sub>DIS</sub>	Package Power Dissipation		--	--	1.2	W
MOSFET I <sub>DS</sub> <sub>PK</sub>	Peak Current from Drain to Source	Maximum pulsed switch current, pulse width < 1 ms, 1% duty cycle	--	--	4.5	A
Note: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.						

### Electrical Characteristics

T<sub>A</sub> = -40 °C to 125 °C (unless otherwise stated). Typical values are at T<sub>A</sub> = 25 °C

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	Power Supply Voltage		2.5	--	5.5	V
V <sub>DD</sub> (UVLO)	V <sub>DD</sub> Undervoltage Lockout Threshold	V <sub>DD</sub> ↑	1.6	1.9	2.2	V
		V <sub>DD</sub> ↓	1.5	1.8	2.2	V
I <sub>DD</sub>	Power Supply Current, when OFF	V <sub>DD</sub> = V <sub>IN</sub> = 5.5 V; ON = 0 V	--	--	1	µA
	Power Supply Current, when ON	V <sub>DD</sub> = V <sub>IN</sub> = ON = 5.5 V; No Load; R <sub>SET</sub> = 80 kΩ	--	170	230	µA
R <sub>DS</sub> <sub>ON</sub>	ON Resistance	T <sub>A</sub> = 25 °C; I <sub>DS</sub> = 100 mA; V <sub>DD</sub> = V <sub>IN</sub> = 5 V	--	13	15.5	mΩ
		T <sub>A</sub> = 85 °C; I <sub>DS</sub> = 100 mA; V <sub>DD</sub> = V <sub>IN</sub> = 5 V		16	19.5	mΩ
		T <sub>A</sub> = 125 °C; I <sub>DS</sub> = 100 mA; V <sub>DD</sub> = V <sub>IN</sub> = 5 V		20	25	mΩ
MOSFET I <sub>DS</sub>	Current from VIN to VOUT	Continuous	--	--	3.5	A
I <sub>FET</sub> <sub>_OFF</sub>	MOSFET OFF Leakage Current	V <sub>DD</sub> = V <sub>IN</sub> = 5.5 V; V <sub>OUT</sub> = 0 V; ON = 0 V	--	0.004	7.2	µA
I <sub>OUT</sub>	MOSFET Load Current Monitor Output	0.5 V ≤ V <sub>OUT</sub> ≤ V <sub>DD</sub> - 1 V; I <sub>DS</sub> = 1 A	90	100	125	µA
V <sub>IN</sub>	Drain Voltage		0.8	--	V <sub>DD</sub>	V

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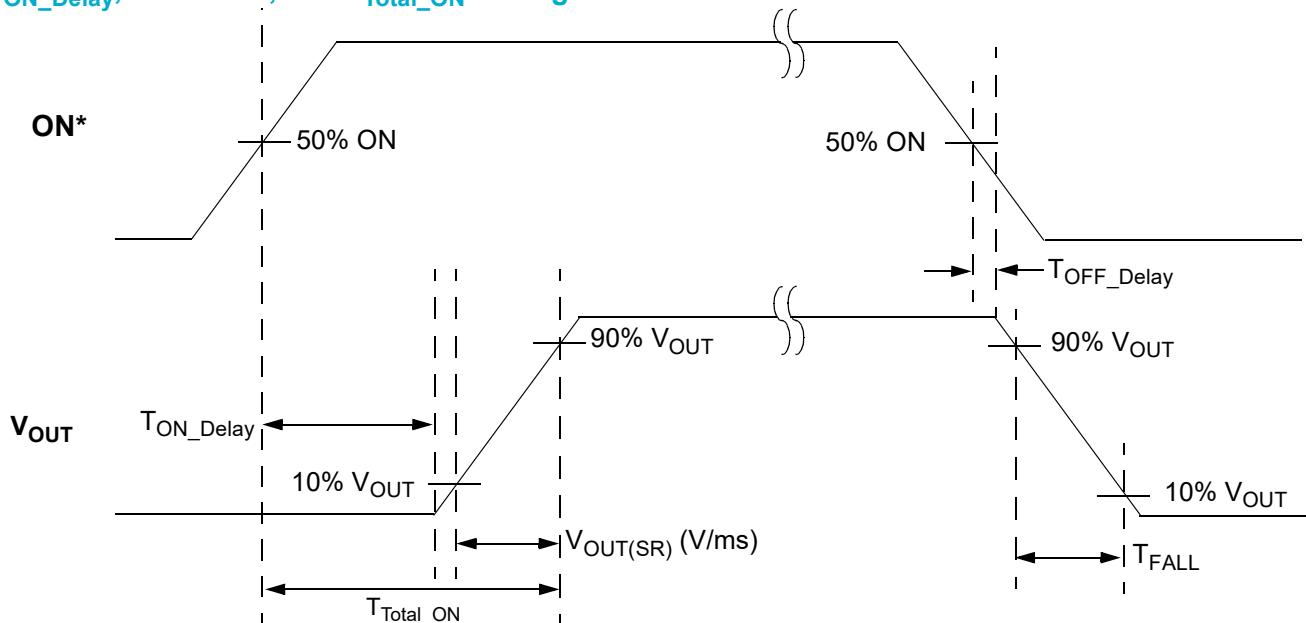
### Electrical Characteristics (continued)

T<sub>A</sub> = -40 °C to 125 °C(unless otherwise stated). Typical values are at T<sub>A</sub> = 25 °C

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
T <sub>ON_Delay</sub>	ON Delay Time	50% ON to V <sub>OUT</sub> Ramp Start, V <sub>DD</sub> = V <sub>IN</sub> = 5 V; R <sub>LOAD</sub> = 20 Ω; C <sub>LOAD</sub> = 10 μF	--	300	500	μs
V <sub>OUT(SR)</sub>	V <sub>OUT</sub> Slew Rate	10% V <sub>OUT</sub> to 90% V <sub>OUT</sub> ↑; V <sub>DD</sub> = V <sub>IN</sub> = 5 V; R <sub>LOAD</sub> = 20 Ω; C <sub>LOAD</sub> = 10 μF	2	2.85	3.8	V/ms
T <sub>Total_ON</sub>	Total Turn ON Time	50% ON to 90% V <sub>OUT</sub> ↑; V <sub>DD</sub> = V <sub>IN</sub> = 5 V; R <sub>LOAD</sub> = 20 Ω; C <sub>LOAD</sub> = 10 μF	1.2	1.8	2.4	ms
T <sub>OFF_Delay</sub>	OFF Delay Time	50% ON to V <sub>OUT</sub> Fall Start; V <sub>DD</sub> = V <sub>IN</sub> = 5 V; R <sub>LOAD</sub> = 20 Ω; no C <sub>LOAD</sub>	--	6.5	9	μs
C <sub>LOAD</sub>	Output Load Capacitance	C <sub>LOAD</sub> connected from V <sub>OUT</sub> to GND	1	10	100	μF
I <sub>LIMIT</sub>	Active Current Limit, I <sub>ACL</sub>	V <sub>OUT</sub> > 0.25 V; R <sub>SET</sub> = 40 kΩ <sup>1</sup>	1.5	2	2.5	A
	Short-circuit Current Limit, I <sub>SCL</sub>	V <sub>OUT</sub> < 0.25 V	--	0.5	--	A
T <sub>FAULT<sub>LOW</sub></sub>	FAULT Assertion Time	Abnormal Step Load Current event to FAULT <sub>↓</sub>	5	8	12	ms
T <sub>FAULT<sub>HIGH</sub></sub>	FAULT De-assertion Time	Delay to FAULT <sub>↑</sub> after fault condition is removed <sup>1</sup>	5	8	12	ms
FAULT <sub>VOL</sub>	FAULT Output Low Voltage	I <sub>FAULT</sub> = 1 mA	--	0.2	--	V
ON_V <sub>IH</sub>	High Input Voltage on ON pin		0.85	--	V <sub>DD</sub>	V
ON_V <sub>IL</sub>	Low Input Voltage on ON pin		-0.3	0	0.3	V
R <sub>DISCHRG</sub>	Output Discharge Resistance	V <sub>DD</sub> = V <sub>IN</sub> = 5 V	--	210	250	Ω
THERM <sub>ON</sub>	Thermal shutoff turn-on temperature	V <sub>DD</sub> = V <sub>IN</sub> = 5 V	--	150	--	°C
THERM <sub>OFF</sub>	Thermal shutoff turn-off temperature	V <sub>DD</sub> = V <sub>IN</sub> = 5 V	--	130	--	°C
Notes:						
1. See Application Diagram on Page 15.						

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

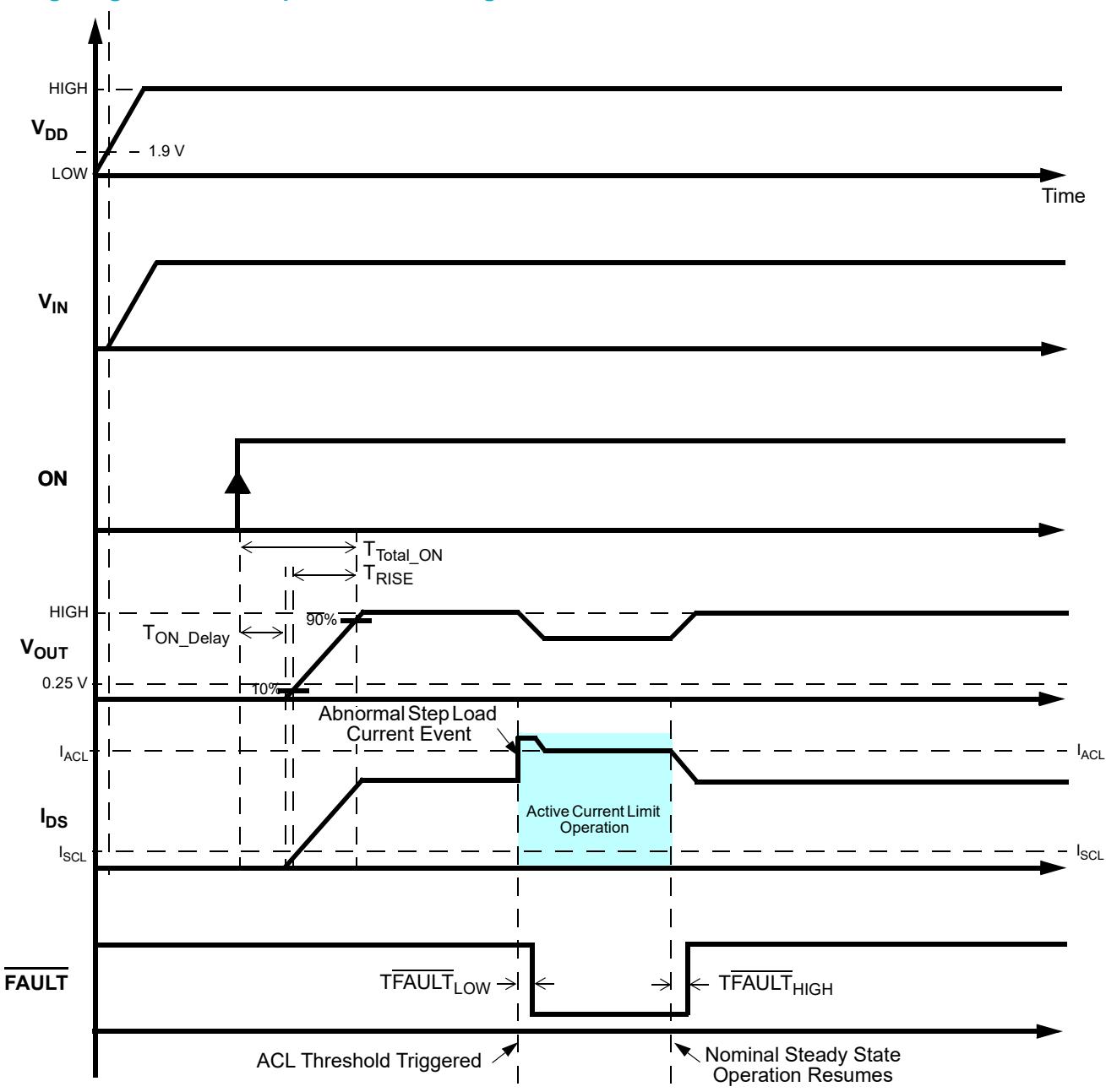
### T<sub>ON</sub>\_Delay, Slew Rate, and T<sub>Total</sub>\_ON Timing Details



\* Rise and Fall times of the ON signal are 100 ns

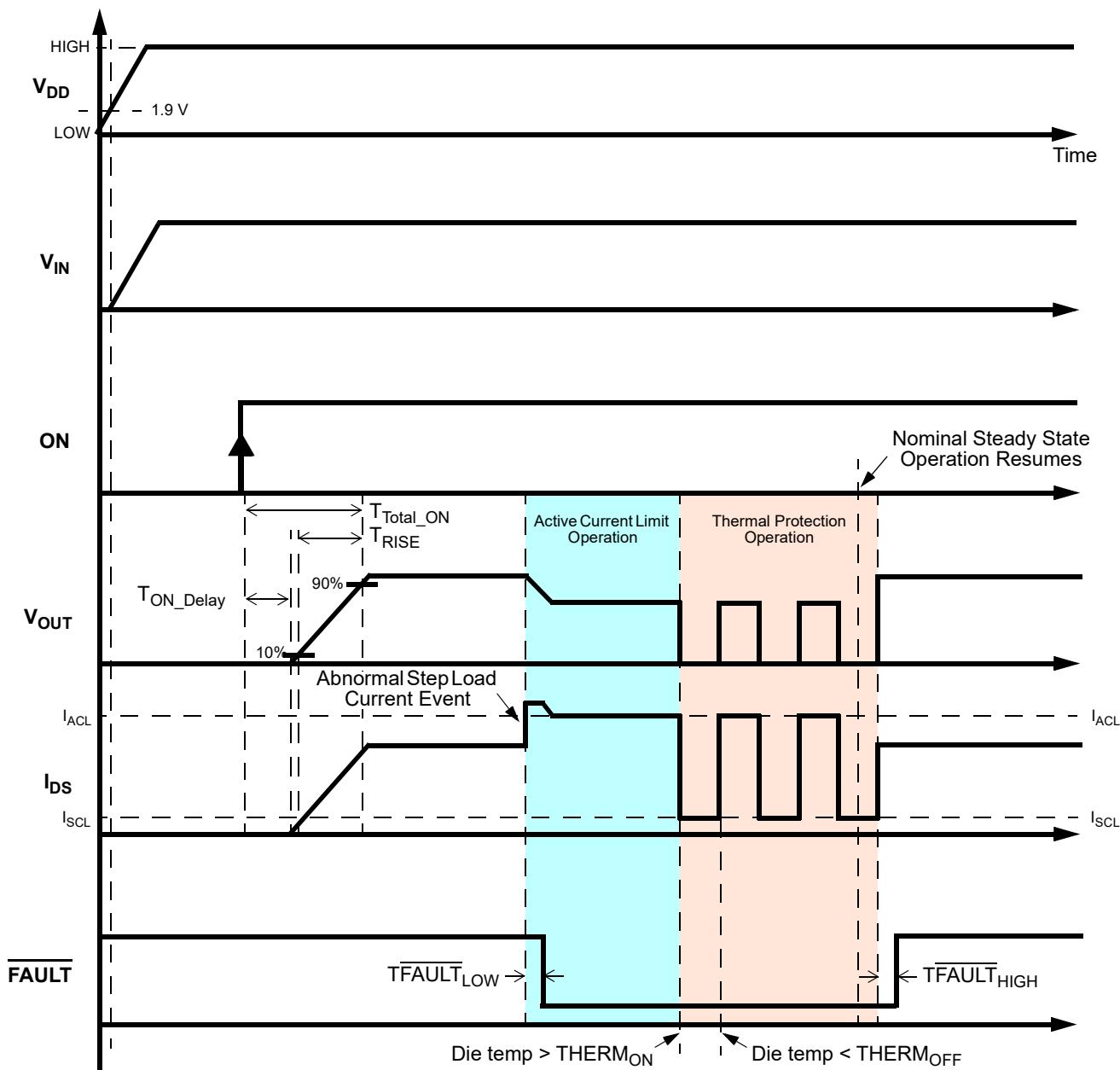
A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### Timing Diagram - Basic Operation including Active Current Limit Protection



A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

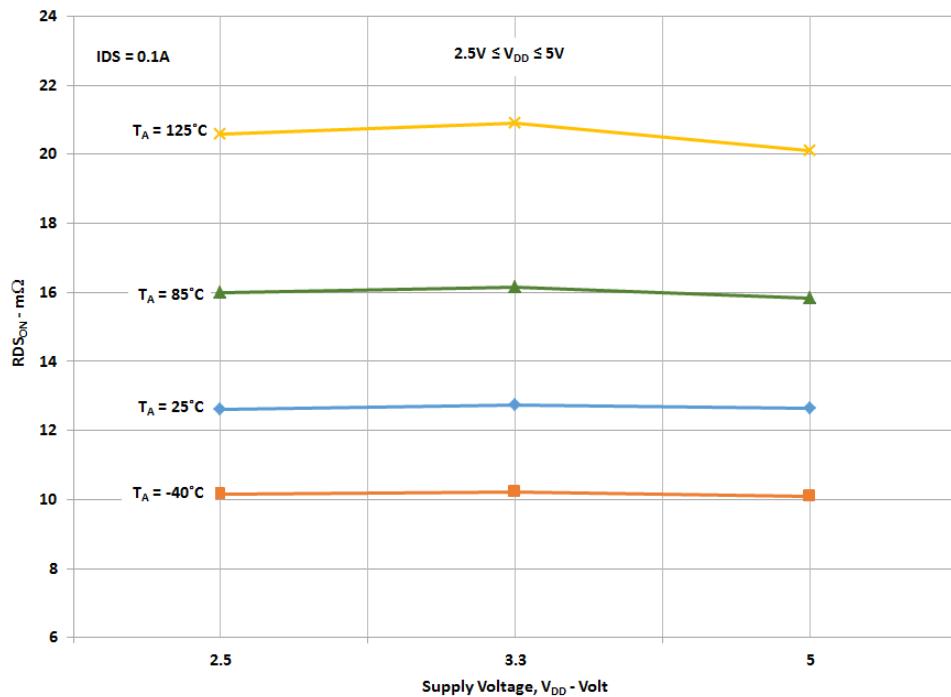
### Timing Diagram - Active Current Limit & Thermal Protection Operation



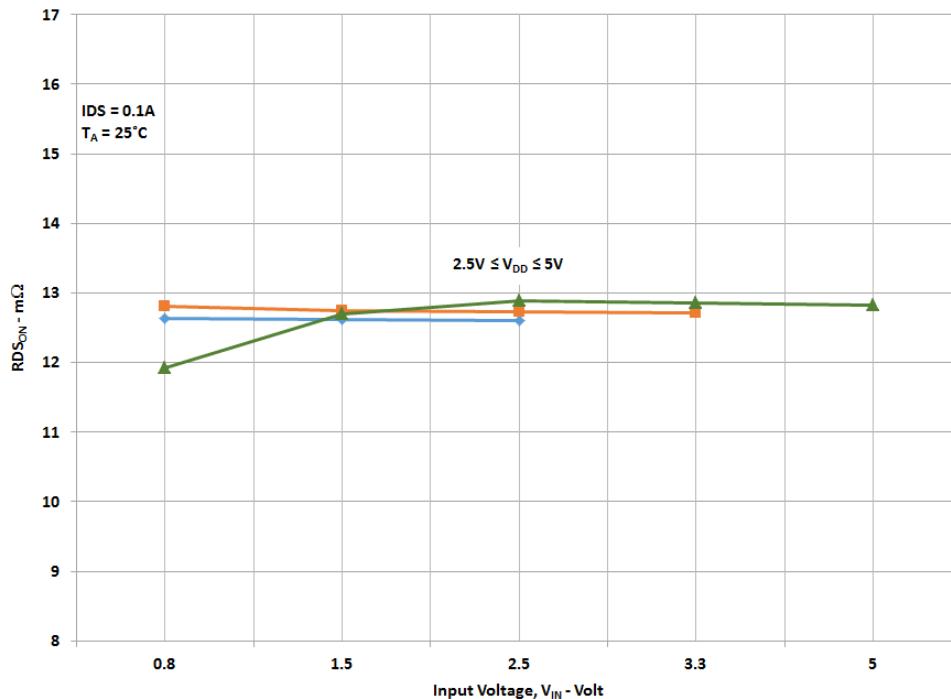
A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

## Typical Performance Characteristics

### RDS<sub>ON</sub> vs. Temperature and V<sub>DD</sub>

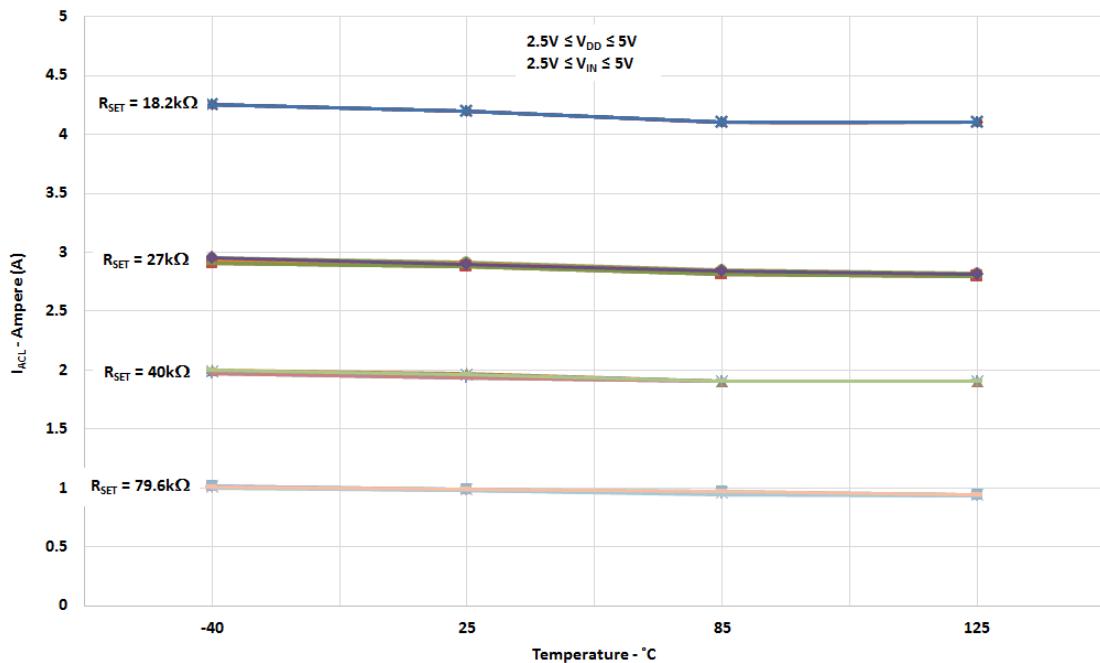


### RDS<sub>ON</sub> vs. V<sub>IN</sub> and V<sub>DD</sub>

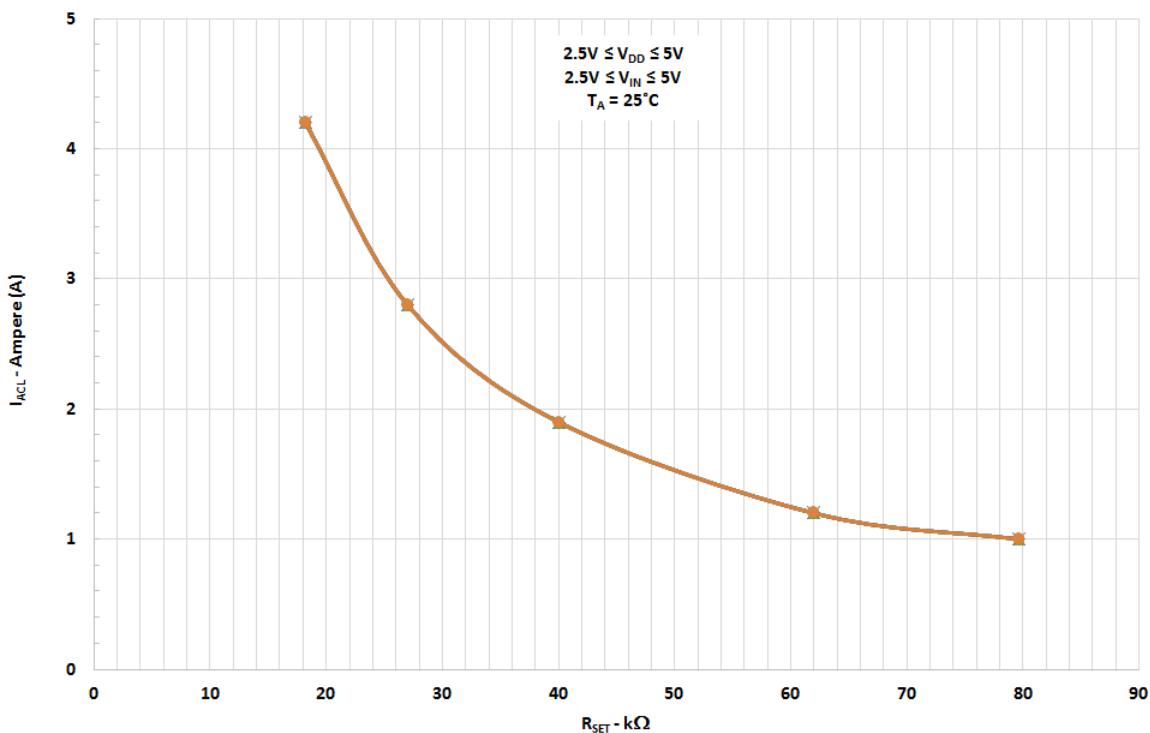


A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### I<sub>ACL</sub> vs. Temperature, R<sub>SET</sub>, V<sub>DD</sub>, and V<sub>IN</sub>

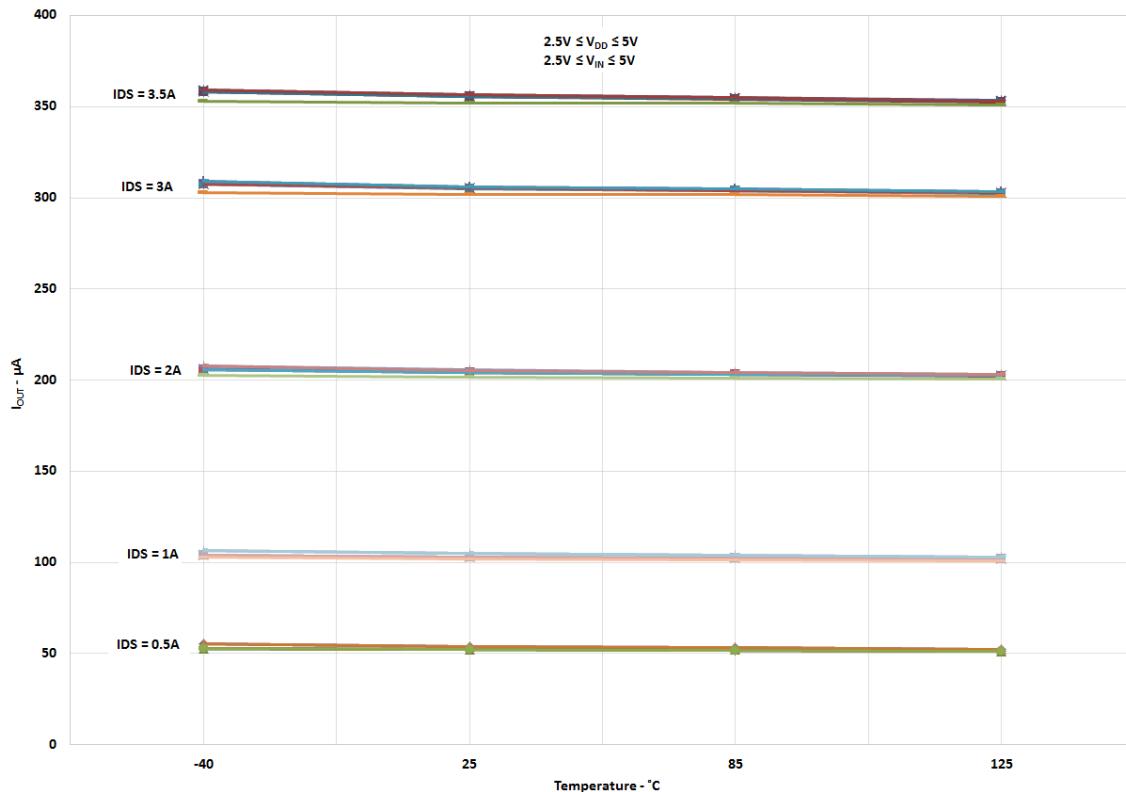


### I<sub>ACL</sub> vs. R<sub>SET</sub>, V<sub>DD</sub>, and V<sub>IN</sub>

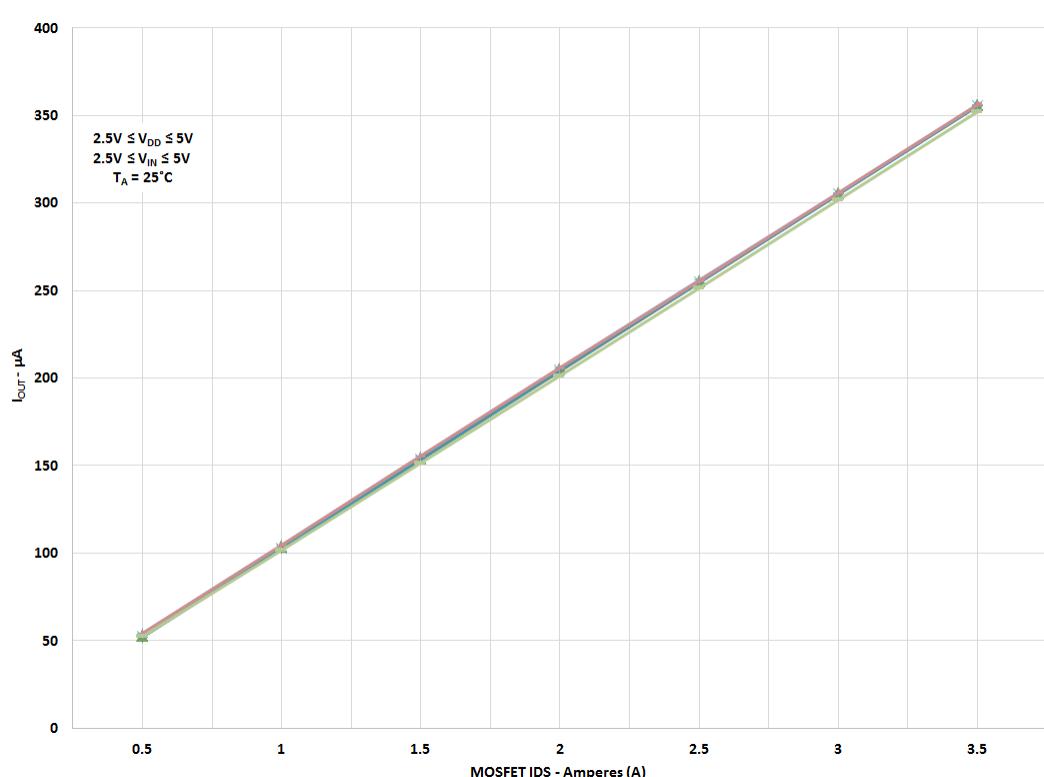


A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### I<sub>OUT</sub> vs. Temperature and MOSFET IDS

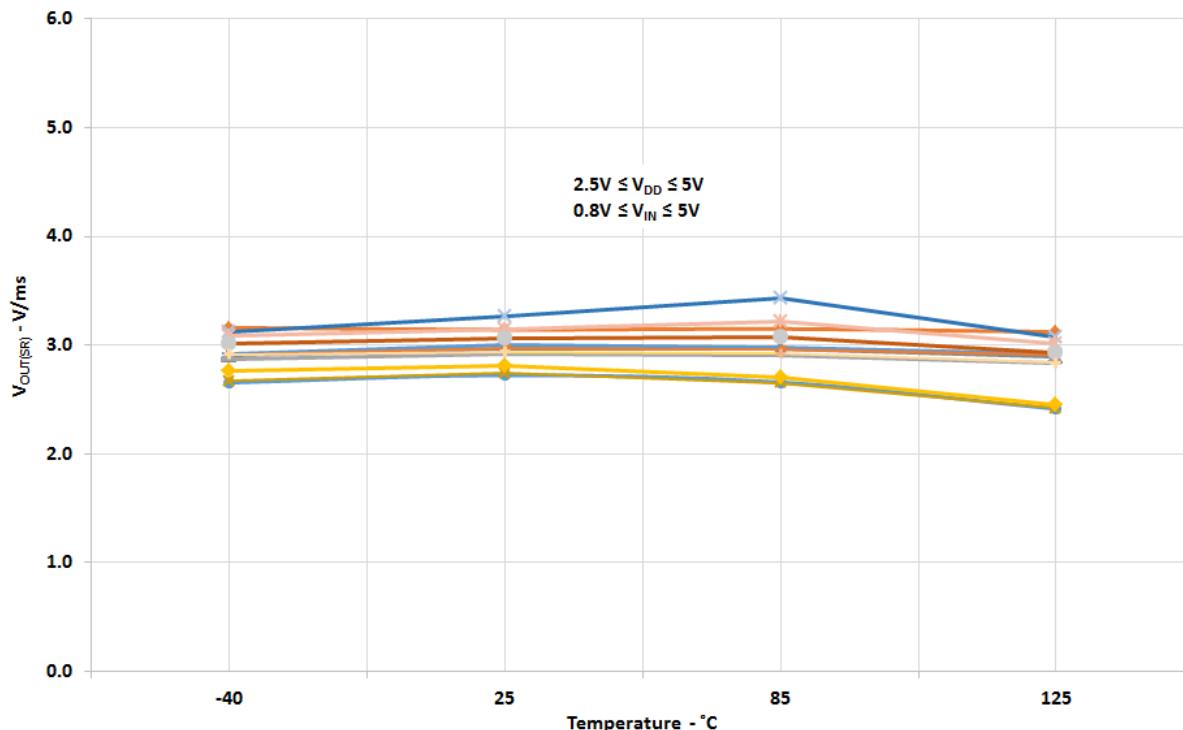
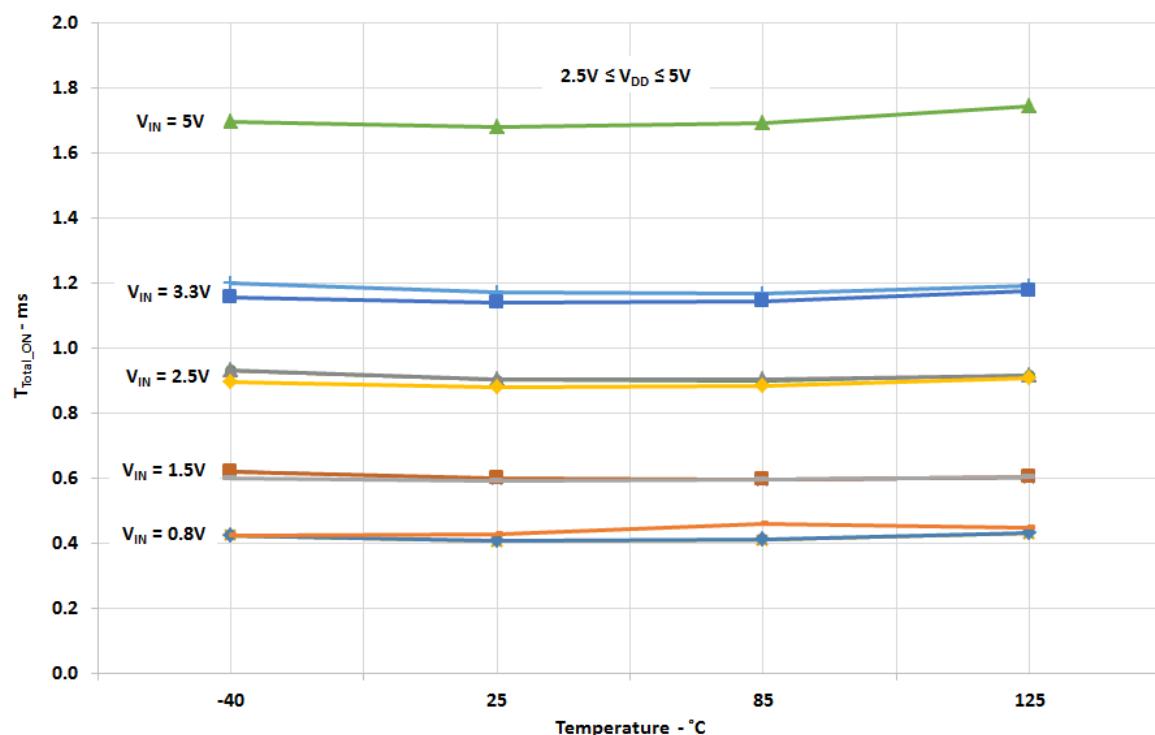


### I<sub>OUT</sub> vs. MOSFET IDS and Temperature



## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

V<sub>OUT</sub> Slew Rate vs. Temperature, V<sub>DD</sub>, and V<sub>IN</sub>T<sub>Total\_ON</sub> vs. Temperature, V<sub>DD</sub>, and V<sub>IN</sub>

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### Typical Turn-on Waveforms

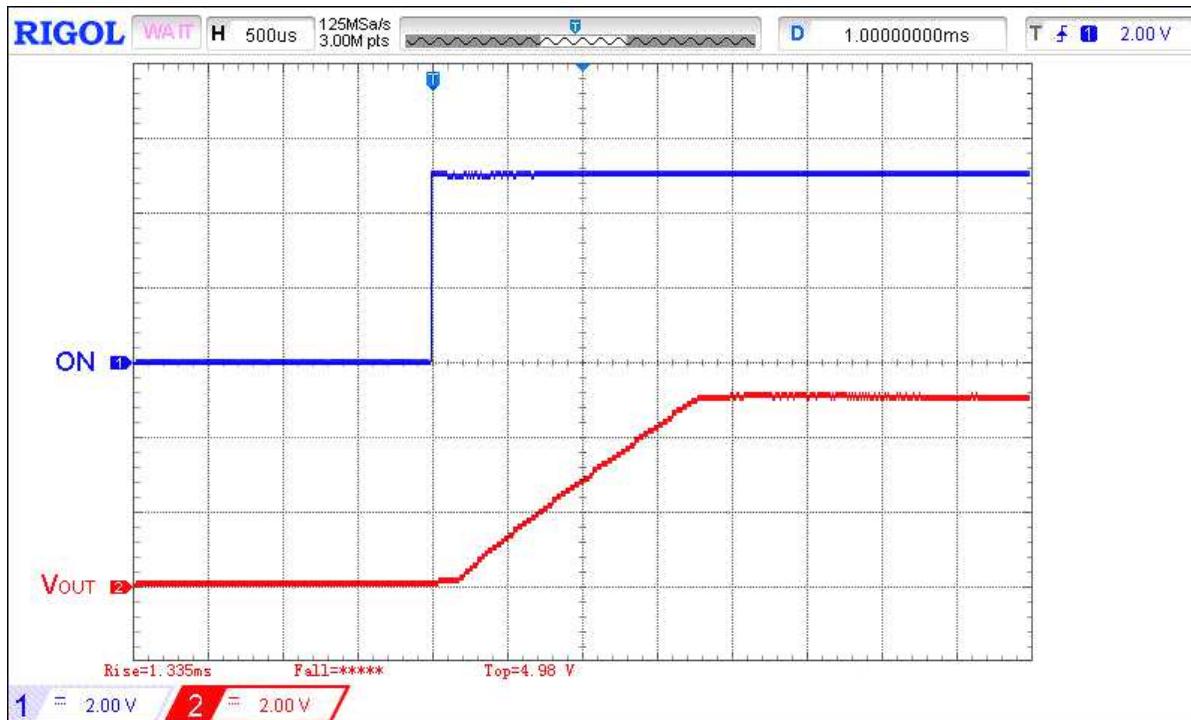


Figure 1. Typical Turn ON operation waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $R_{LOAD} = 20$   $\Omega$

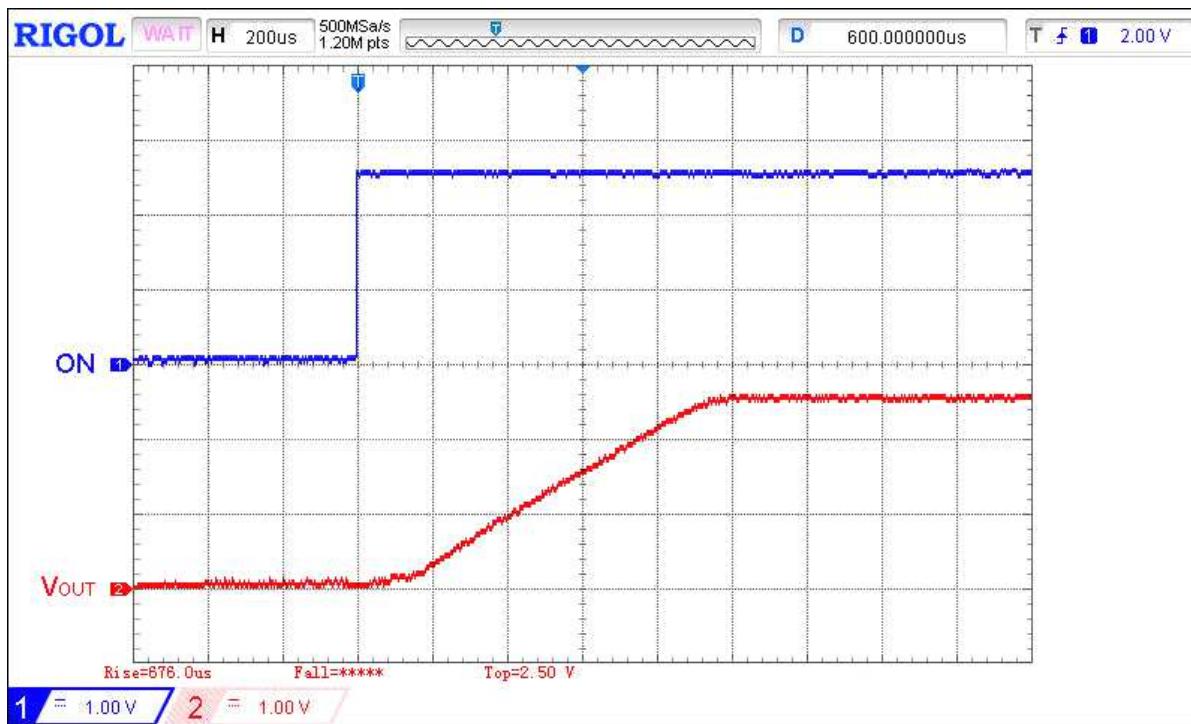


Figure 2. Typical Turn ON operation waveform for  $V_{DD} = V_{IN} = 2.5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $R_{LOAD} = 20$   $\Omega$

## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

## Typical Turn-off Waveforms

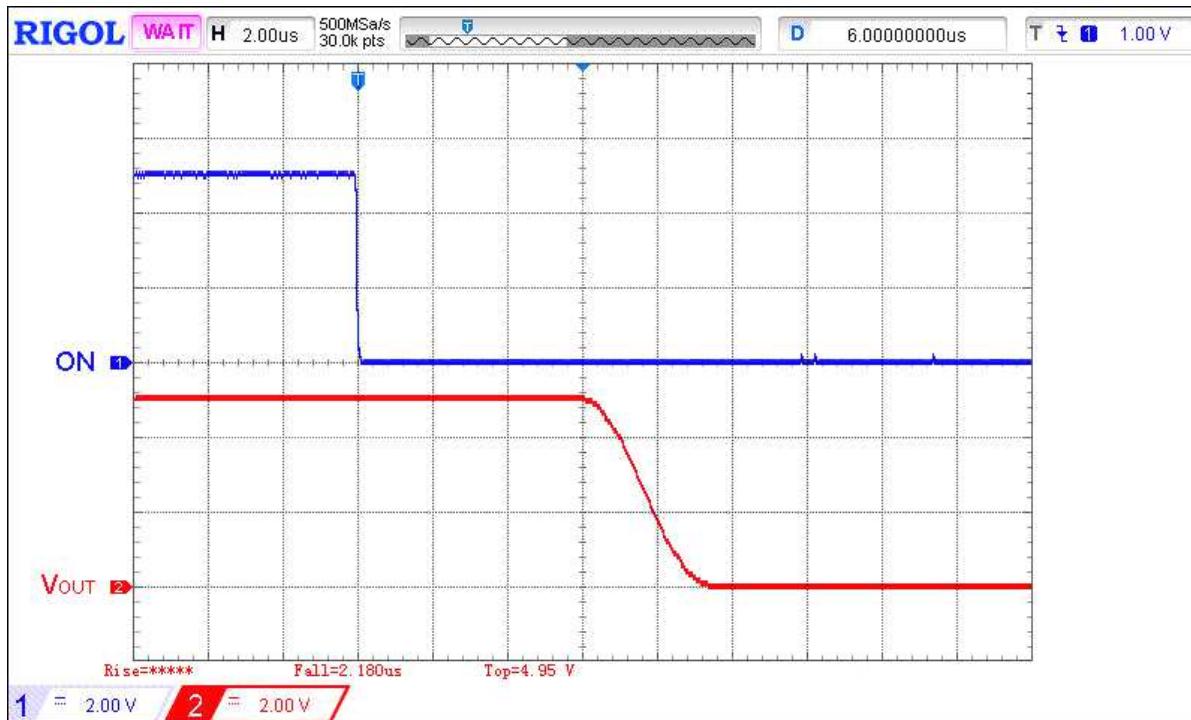


Figure 3. Typical Turn OFF operation waveform for  $V_{DD} = V_{IN} = 5$  V, no  $C_{LOAD}$ ,  $R_{LOAD} = 20$  Ω

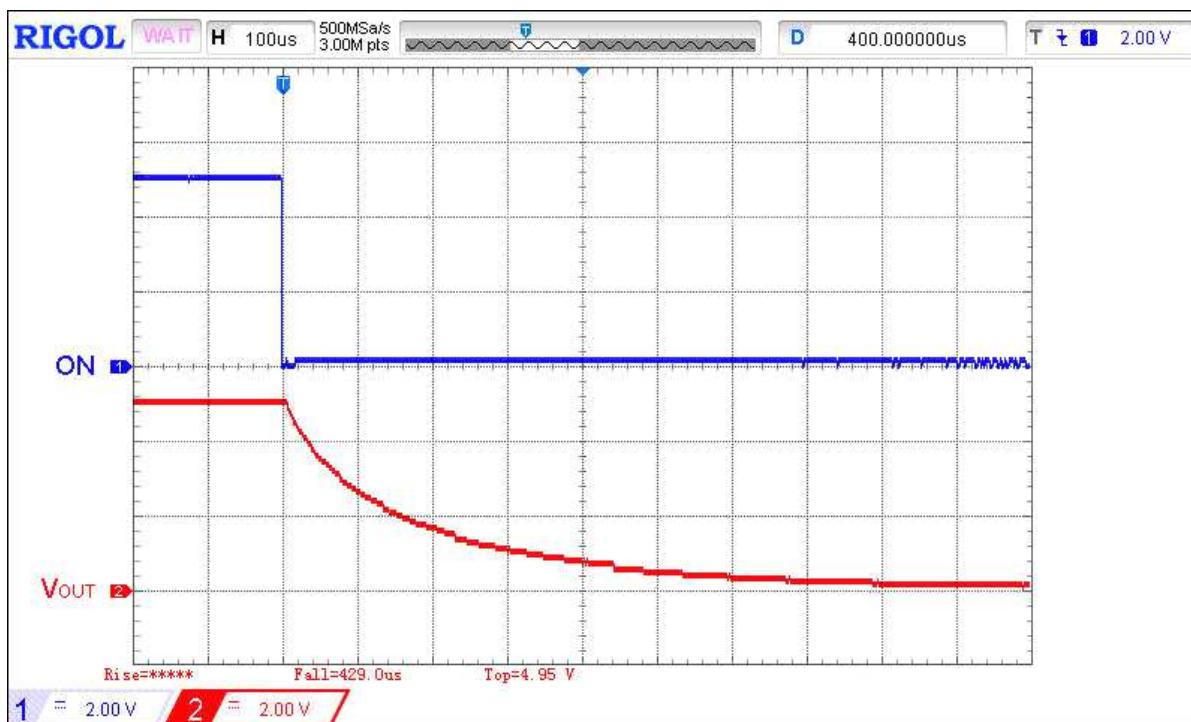


Figure 4. Typical Turn OFF operation waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$  μF,  $R_{LOAD} = 20$  Ω

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

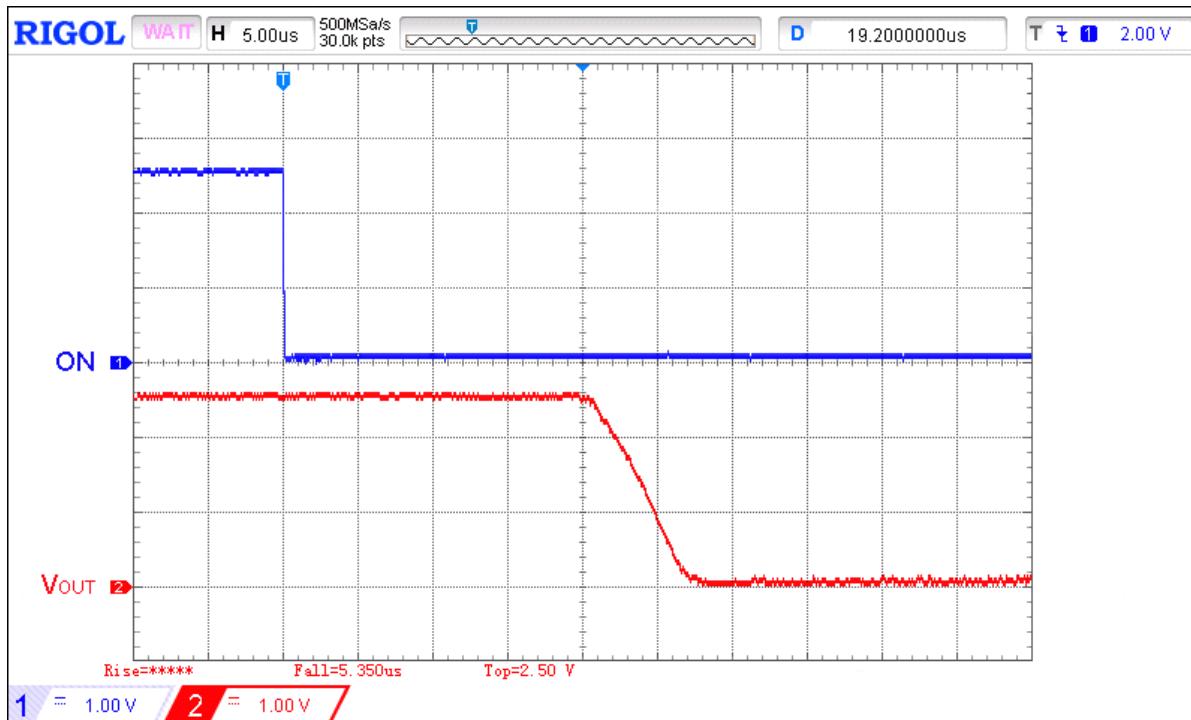


Figure 5. Typical Turn OFF operation waveform for  $V_{DD} = V_{IN} = 2.5$  V, no  $C_{LOAD}$ ,  $R_{LOAD} = 20$  Ω

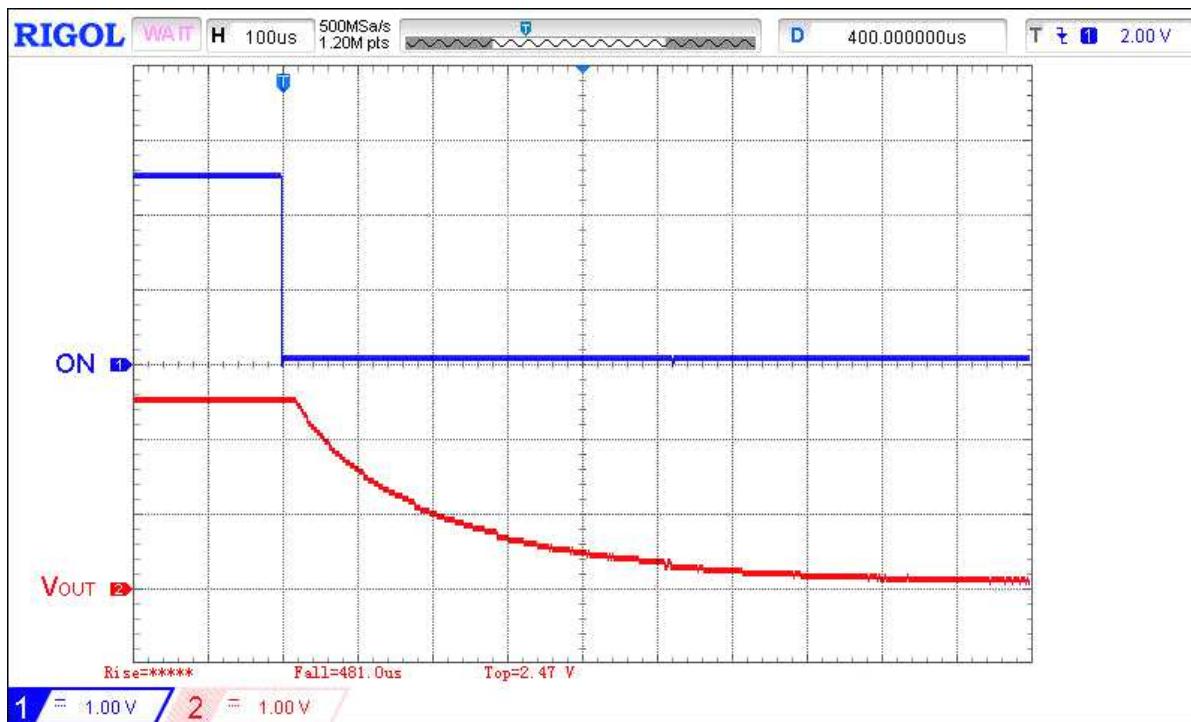


Figure 6. Typical Turn OFF operation waveform for  $V_{DD} = V_{IN} = 2.5$  V,  $C_{LOAD} = 10$  μF,  $R_{LOAD} = 20$  Ω

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### SLG59M1707V Application Diagram

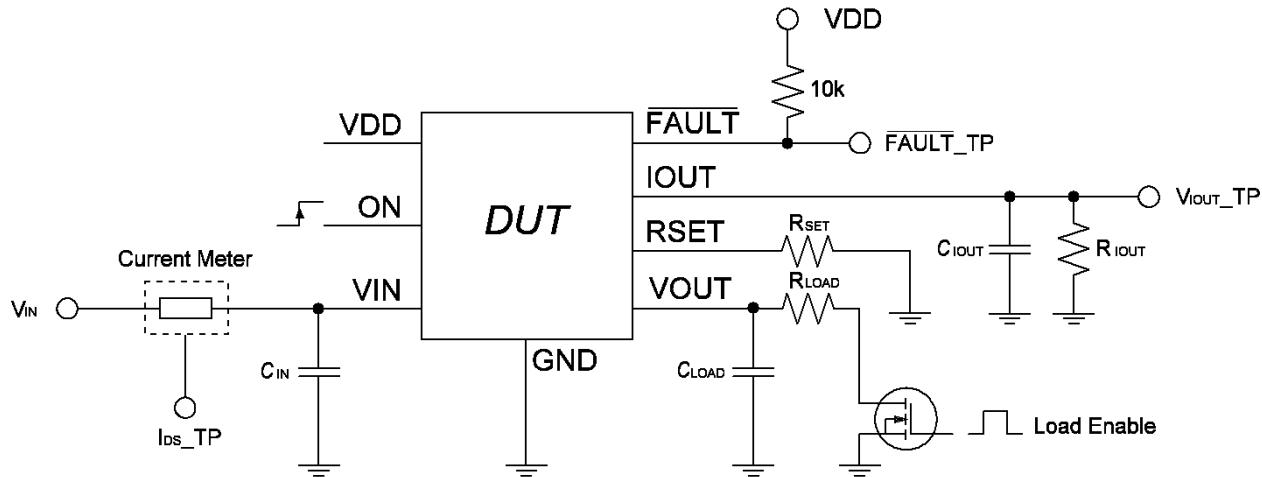


Figure 7. Test setup Application Diagram

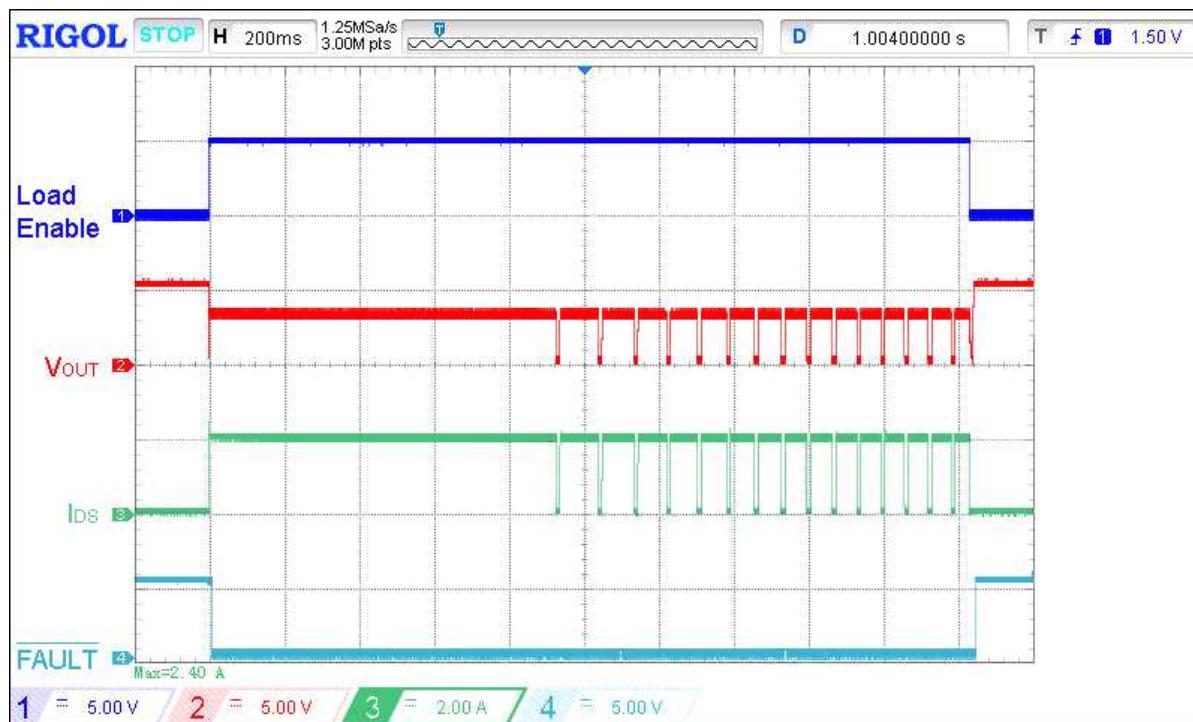


Figure 8. Typical ACL operation waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10 \mu\text{F}$ ,  $I_{DS} = 2$  A,  $R_{SET} = 40$  kΩ

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

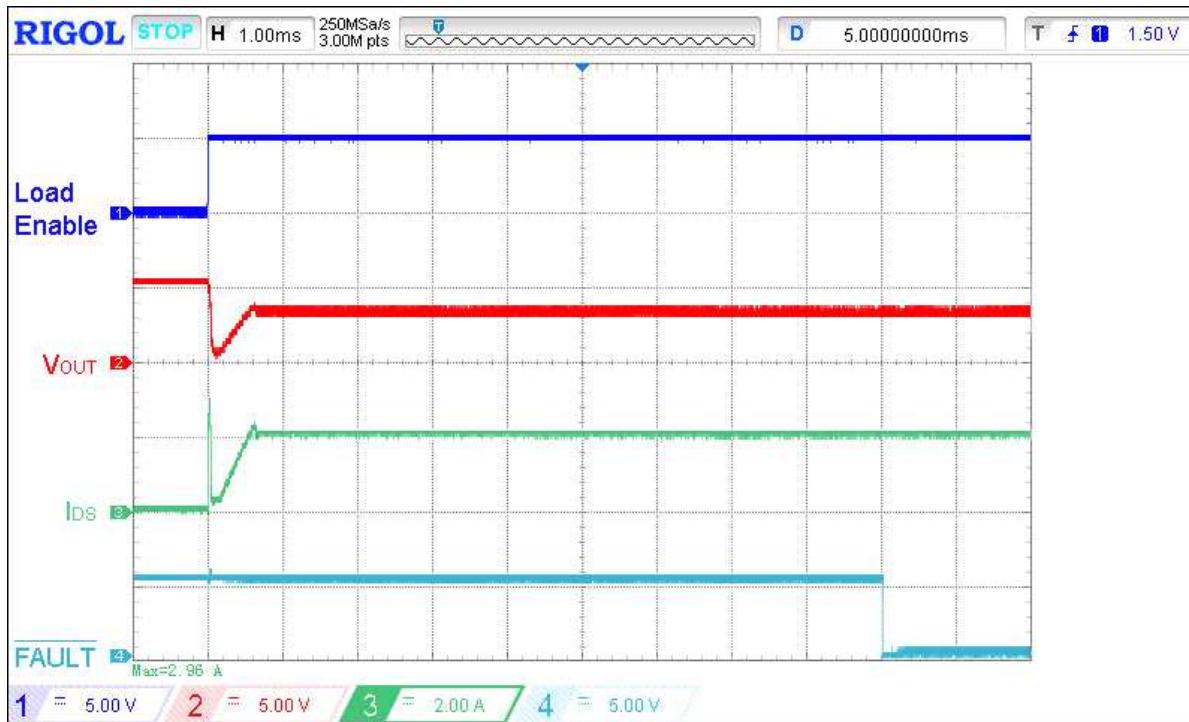


Figure 9. Typical FAULT assertion waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $I_{ACL} = 2$  A,  $R_{SET} = 40$  k $\Omega$ , switch in 2  $\Omega$  load

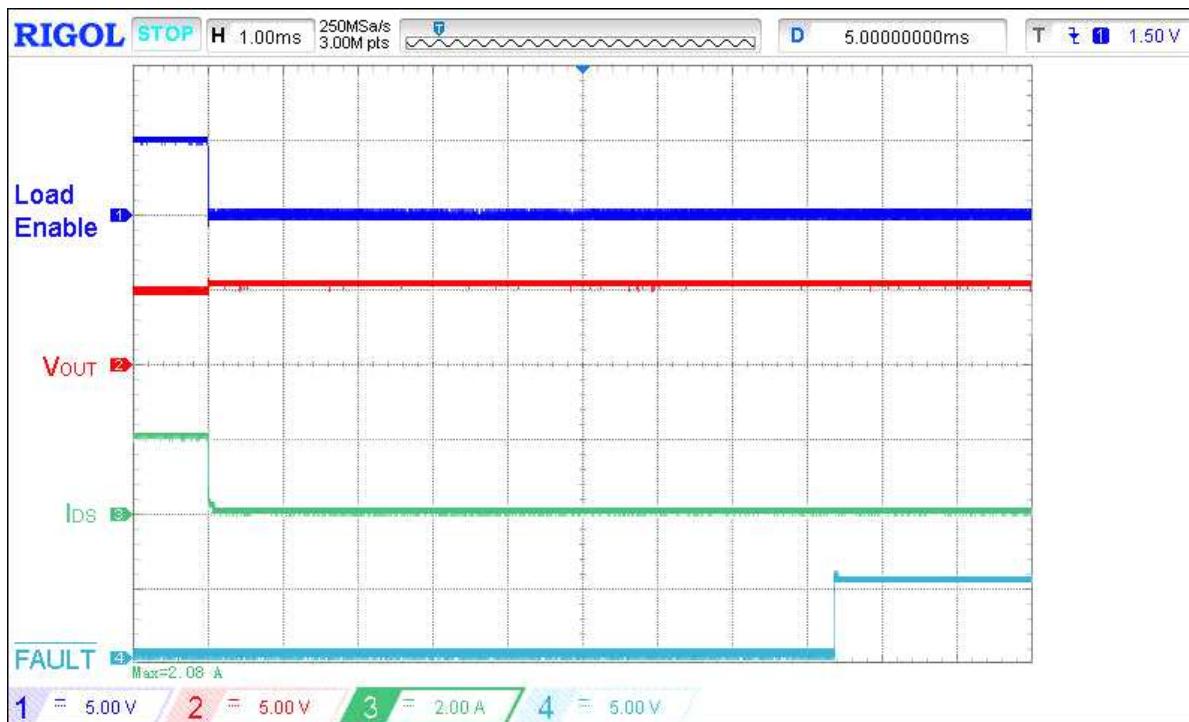


Figure 10. Typical FAULT de-assertion waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $I_{ACL} = 2$  A,  $R_{SET} = 40$  k $\Omega$ , switch out 2  $\Omega$  load

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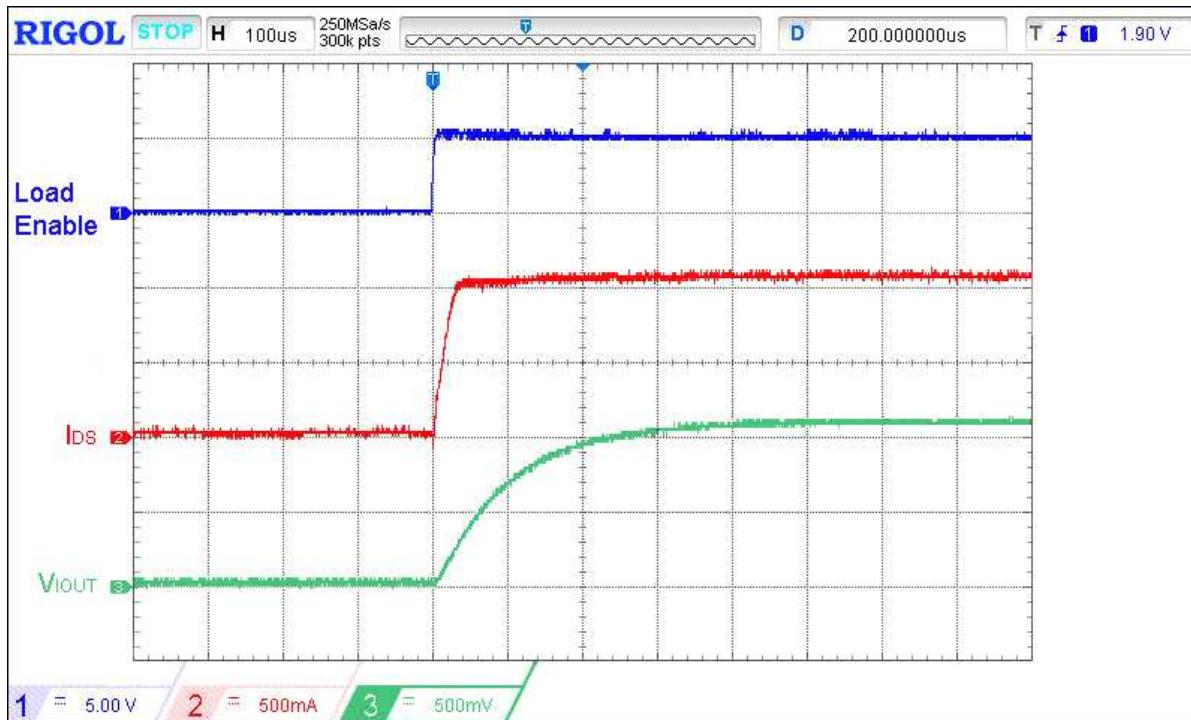


Figure 11. Typical  $I_{OUT}$  response time waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $R_{LOAD} = 5$   $\Omega$ ,  $C_{IOUT} = 0.01$   $\mu$ F,  $R_{IOUT} = 10$  k $\Omega$ , Load Step 0 A to 1 A

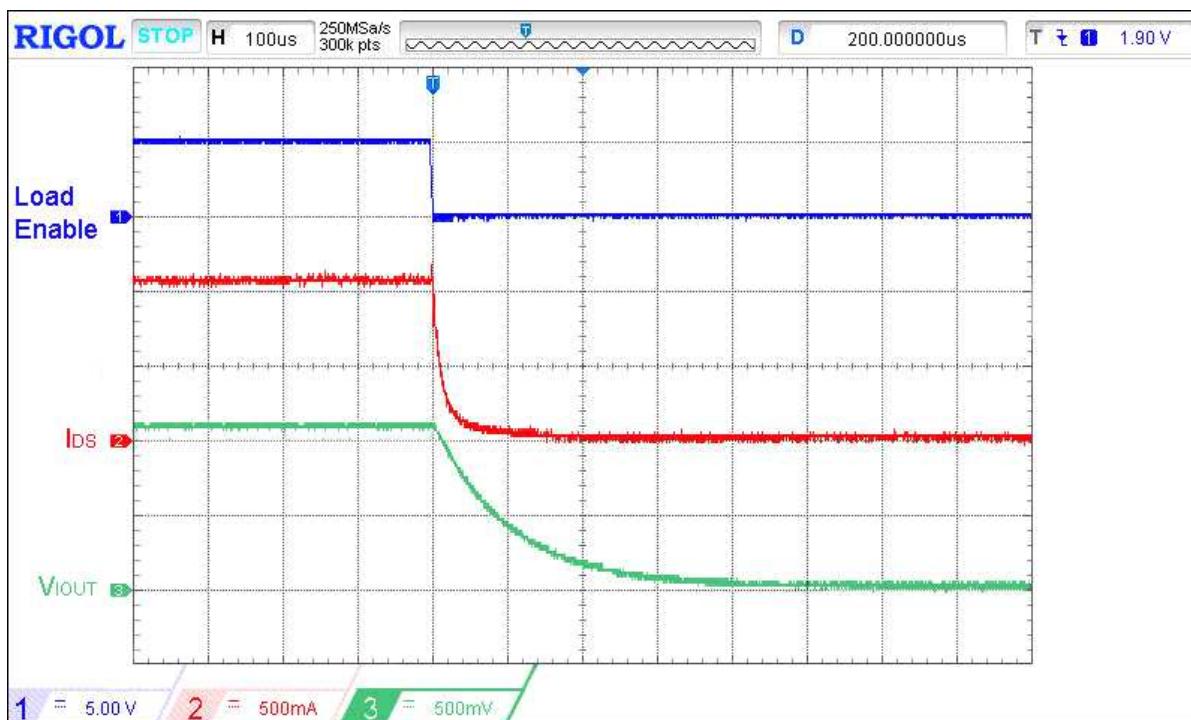


Figure 12. Typical  $I_{OUT}$  response time waveform for  $V_{DD} = V_{IN} = 5$  V,  $C_{LOAD} = 10$   $\mu$ F,  $R_{LOAD} = 5$   $\Omega$ ,  $C_{IOUT} = 0.01$   $\mu$ F,  $R_{IOUT} = 10$  k $\Omega$ , Load Step 1 A to 0 A

# SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

## SLG59M1707V Power-Up/Power-Down Sequence Considerations

To ensure glitch-free power-up and proper operation under all conditions, apply  $V_{DD}$  first, followed by  $V_{IN}$  after  $V_{DD}$  exceeds 1.9 V. Then allow  $V_{IN}$  to reach 90% of its max value before toggling the ON pin from Low-to-High. Likewise, power-down in reverse order.

If  $V_{DD}$  and  $V_{IN}$  need to be powered up simultaneously, glitching can be minimized by having a suitable load capacitor. A 10 µF  $C_{LOAD}$  will prevent glitches for rise times of  $V_{DD}$  and  $V_{IN}$  higher than 2 ms.

If the ON pin is powered up together with  $V_{DD}$  or toggled HIGH before  $V_{DD}$  and  $V_{IN}$  have reached their steady-state values, the load switch functions and timing parameters may differ from datasheet specifications.

## SLG59M1707V Current Limiting Operation

The SLG59M1707V has two types of current limiting triggered by the output  $V_{OUT}$  voltage.

### 1. Standard Current Limiting Mode (with Thermal Shutdown Protection)

When the  $V_{OUT}$  voltage > 250 mV, the output current is initially limited to the Active Current Limit ( $I_{ACL}$ ) specification listed in the Electrical Characteristics table. The ACL monitor's response time is very fast and is triggered within a few microseconds to sudden (transient) changes in load current. When a load current overload is detected, the ACL monitor increases the FET resistance to keep the current from exceeding the load switch's  $I_{ACL}$  threshold. During active current-limit operation,  $V_{OUT}$  is also reduced by  $I_{ACL} \times R_{DS(ON)(ACL)}$ . This observed behavior is illustrated in the timing diagrams on Pages 6 and 7.

When a current-limit event is detected, the  $\overline{FAULT}$  signal becomes asserted in approximately  $T_{FAULT\_LOW}$  and the SLG59M1707V operates in constant current mode with the output current set by  $R_{SET}$  (see  $R_{SET}$ -Current Limit Table). The SLG59M1707V continues to operate in constant current mode indefinitely until a) the current-limit event has elapsed or b) the SLG59M1707V's internal thermal shutdown threshold is reached. When a current-limit event has elapsed or been removed, its  $\overline{FAULT}$  signal will be deasserted after approximately  $T_{FAULT\_HIGH}$ .

Once thermal shutdown has been triggered, the IC's  $\overline{FAULT}$  signal will remain asserted. As the die cools, the MOSFET will be turned back on when the die temperature falls to ~130°C; in this case, the  $\overline{FAULT}$  signal will be deasserted in approximately  $T_{FAULT\_HIGH}$ . If the current-limiting condition has not elapsed or been removed, die temperature will increase and the SLG59M1707V's thermal shutdown operation will repeat indefinitely.

### 2. Short Circuit Current Limiting Mode (with Thermal Shutdown Protection)

The SLG59M1707V's short-circuit current-limit monitor includes two operating modes depending upon the state of the IC's ON pin:

#### a) Before ON low-to-high transition

When the  $V_{OUT}$  voltage < 0.25 V (which is the case with a hard short, such as a solder bridge on the power rail), the load switch's internal Short-circuit Current Limit (SCL) monitor limits the FET current to approximately 500 mA (the  $I_{SCL}$  threshold). The SLG59M1707V's short-circuit current limit (SCL) protection scheme is disabled automatically once  $V_{OUT}$  rises above 0.25 V. While the internal Thermal Shutdown Protection circuit remains enabled and since the  $I_{SCL}$  threshold is much lower than the  $I_{ACL}$  threshold, thermal shutdown protection may become activated only at higher ambient temperatures.

#### b) After ON low-to-high transition

If a short-circuit or a very large load current transient occurs after an ON low-to-high transition, the SLG59M1707V's internal SCL circuit will be triggered if  $V_{OUT}$  falls by 0.4 V. The response time of this fast turn-off detection is ~1 µs.

## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### SLG59M1707V FAULT Operation

As previously stated in the Pin Description section, the open-drain  $\overline{\text{FAULT}}$  output is asserted when an active-current limit (ACL) or thermal shutdown fault condition is detected. This output becomes asserted in  $\overline{\text{TFAULT}}_{\text{LOW}}$  upon the detection of a fault condition and becomes deasserted  $\overline{\text{TFAULT}}_{\text{HIGH}}$  once the fault condition is removed. If the ON pin is toggled HIGH-to-LOW while the FAULT output is low, the FAULT output is deasserted without delay.

### Setting the SLG59M1707V Output Current Limit with $R_{\text{SET}}$

The current-limit operation of the SLG59M1707V begins by choosing the appropriate ±1%-tolerance  $R_{\text{SET}}$  value for the application. The recommended range for  $R_{\text{SET}}$  is:

$$20 \text{ k}\Omega \leq R_{\text{SET}} \leq 80 \text{ k}\Omega$$

which corresponds to an output constant current limit in the following range:

$$1 \text{ A} \leq I_{\text{ACL}} \leq 4 \text{ A}$$

**Table 1: Setting Current Limit Threshold vs.  $R_{\text{SET}}$**

Constant Current Limit (A)	$R_{\text{SET}}$ (kΩ)
1	80
2	40
4	20

### Power Dissipation

The junction temperature of the SLG59M1707V depends on different factors such as board layout, ambient temperature, and other environmental factors. The primary contributor to the increase in the junction temperature of the SLG59M1707V is the power dissipation of its power MOSFET. Its power dissipation and the junction temperature in nominal operating mode can be calculated using the following equations:

$$PD = R_{\text{DS,ON}} \times I_{\text{DS}}^2$$

where:

PD = Power dissipation, in Watts (W)

$R_{\text{DS,ON}}$  = Power MOSFET ON resistance, in Ohms (Ω)

$I_{\text{DS}}$  = Output current, in Amps (A)

and

$$T_J = PD \times \theta_{JA} + T_A$$

where:

$T_J$  = Junction temperature, in Celsius degrees (°C)

$\theta_{JA}$  = Package thermal resistance, in Celsius degrees per Watt (°C/W)

$T_A$  = Ambient temperature, in Celsius degrees (°C)

## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### Power Dissipation (continued)

During active current-limit operation, the SLG59M1707V's power dissipation can be calculated by taking into account the voltage drop across the load switch ( $V_{IN} - V_{OUT}$ ) and the magnitude of the output current in active current-limit operation ( $I_{ACL}$ ):

$$PD = (V_{IN} - V_{OUT}) \times I_{ACL} \text{ or}$$

$$PD = (V_{IN} - (R_{LOAD} \times I_{ACL})) \times I_{ACL}$$

where:

PD = Power dissipation, in Watts (W)

$V_{IN}$  = Input Voltage, in Volts (V)

$R_{LOAD}$  = Load Resistance, in Ohms (Ω)

$I_{ACL}$  = Output limited current, in Amps (A)

$V_{OUT} = R_{LOAD} \times I_{ACL}$

For more information on GreenFET load switch features, please visit our website and see App Note "AN-1068 GreenFET and High Voltage GreenFET Load Switch Basics".

**SLG59M1707V**

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

**Layout Guidelines:**

1. The VDD pin needs a 0.1µF (or larger) external capacitor to smooth pulses from the power supply. Locate this capacitor as close as possible to the SLG59M1707V's pin 1.
2. Since the VIN and VOUT pins dissipate most of the heat generated during high-load current operation, it is highly recommended to make power traces as short, direct, and wide as possible. A good practice is to make power traces with absolute minimum widths of 15 mils (0.381 mm) per Ampere. A representative layout, shown in [Figure 13](#), illustrates proper techniques for heat to transfer as efficiently as possible out of the device;
3. To minimize the effects of parasitic trace inductance on normal operation, it is recommended to connect input C<sub>IN</sub> and output C<sub>LOAD</sub> low-ESR capacitors as close as possible to the SLG59M1707V's VIN and VOUT pins;
4. The GND pin should be connected to system analog or power ground plane.
5. 2 oz. copper is recommended for high current operation.

**SLG59M1707V Evaluation Board:**

A GreenFET Evaluation Board for SLG59M1707V is designed according to the statements above and is illustrated on [Figure 13](#). Please note that evaluation board has D\_Sense and S\_Sense pads. They cannot carry high currents and dedicated only for RDS<sub>ON</sub> evaluation.

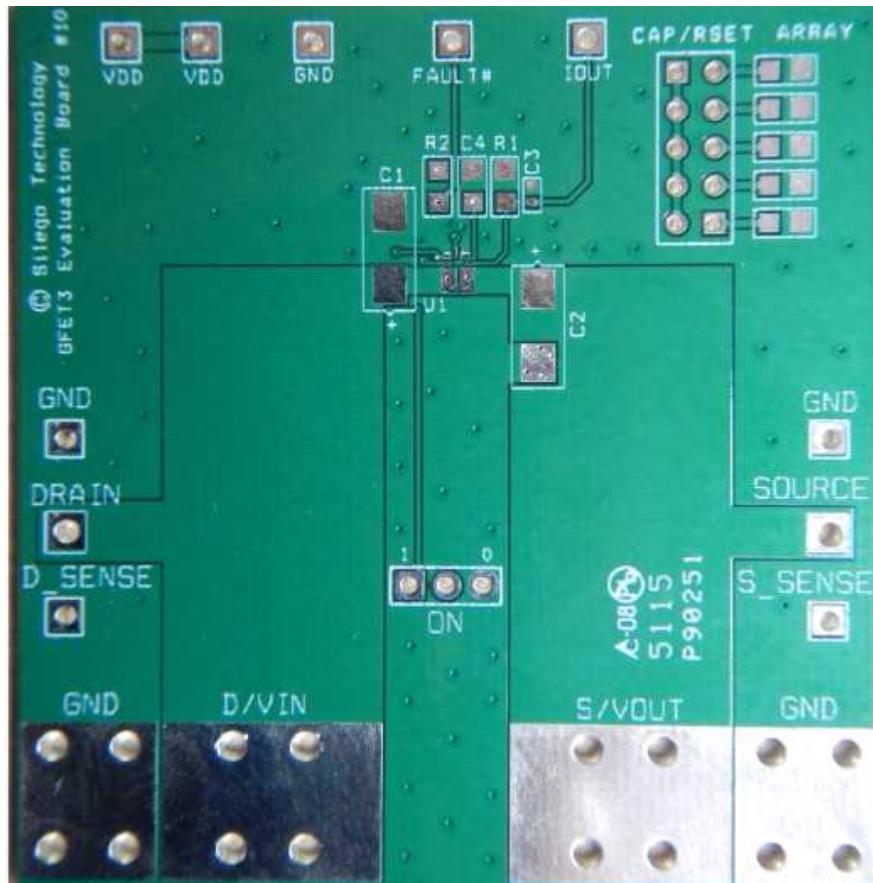


Figure 13. SLG59M1707V Evaluation Board

## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

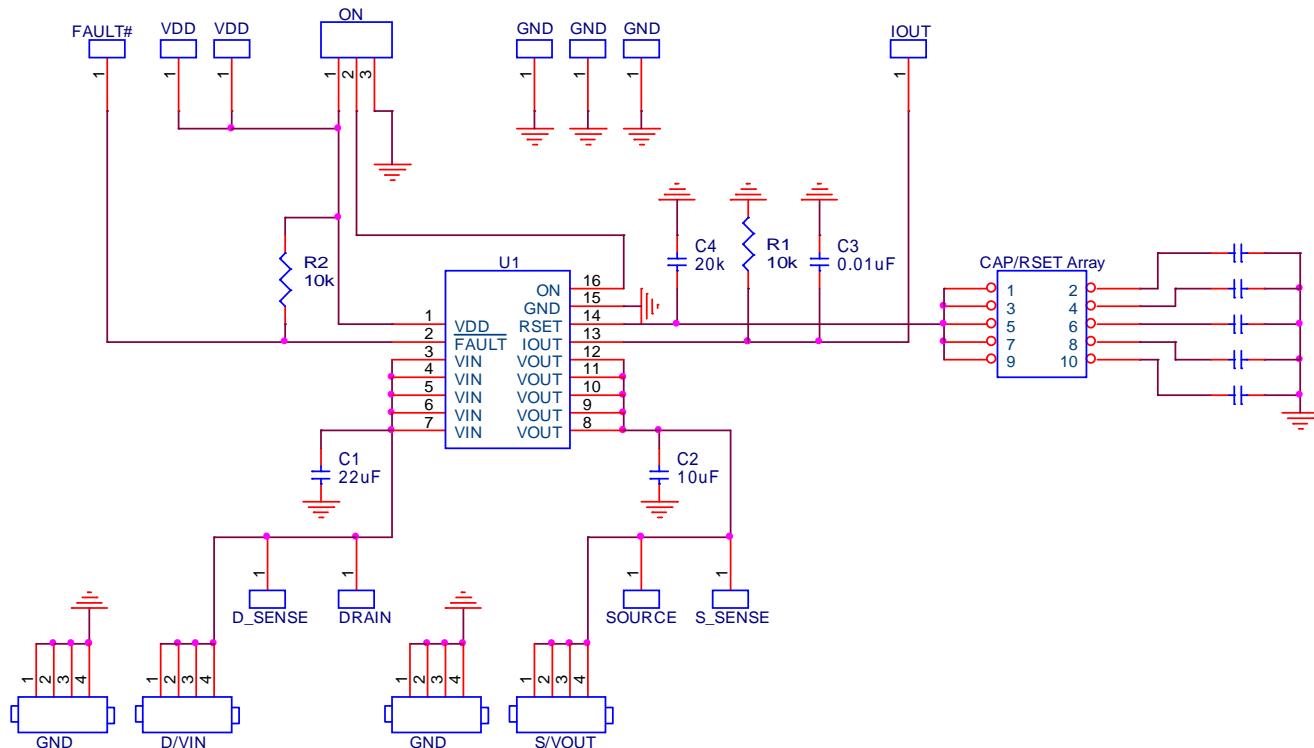


Figure 14. SLG59M1707V Evaluation Board Connection Circuit

### Basic Test Setup and Connections

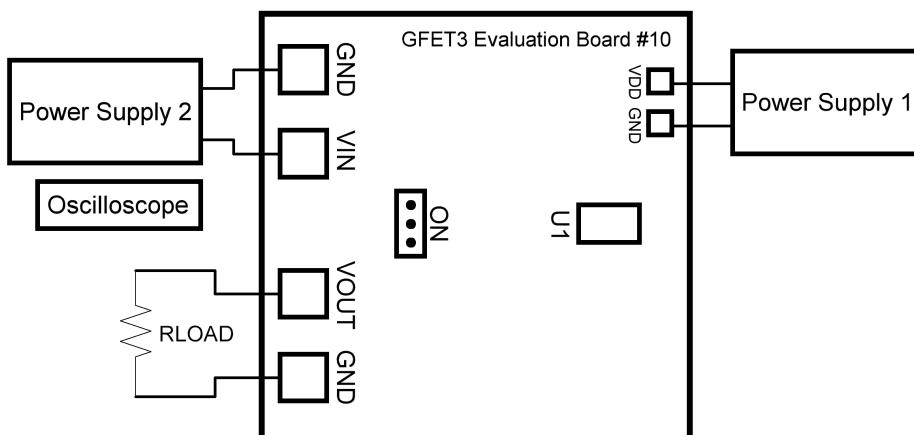


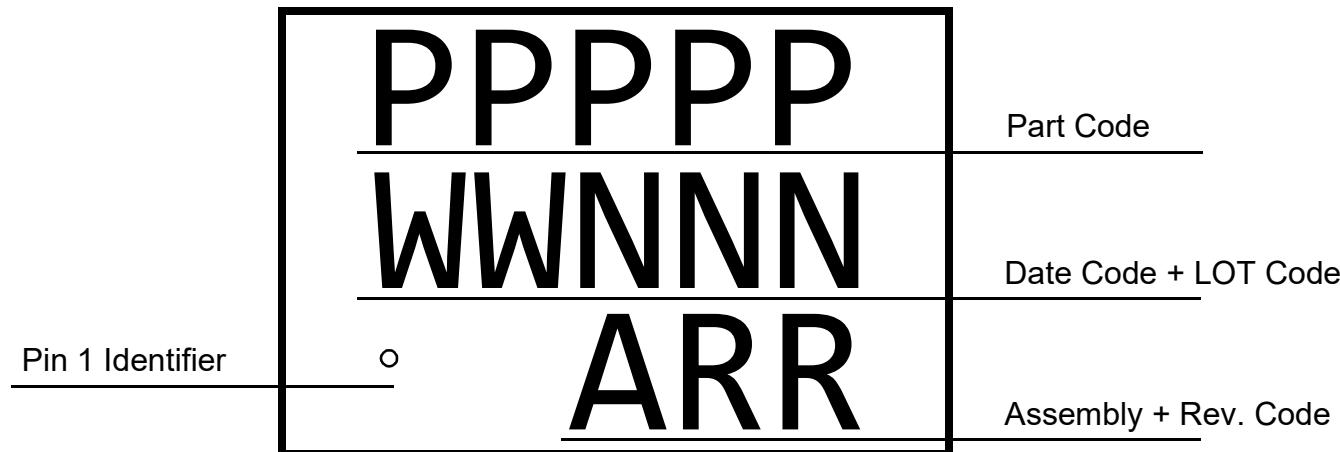
Figure 15. SLG59M1707V Evaluation Board Connection Circuit

### EVB Configuration

1. Connect oscilloscope probes to D/VIN, S/VOUT, ON, etc.;
2. Turn on Power Supply 1 and set desired  $V_{DD}$  from 2.5 V...5.5 V range;
3. Turn on Power Supply 2 and set desired  $V_{IN}$  from 0.8 V... $V_{DD}$  range;
3. Toggle the ON signal High or Low to observe SLG59M1707V operation.

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

#### Package Top Marking System Definition



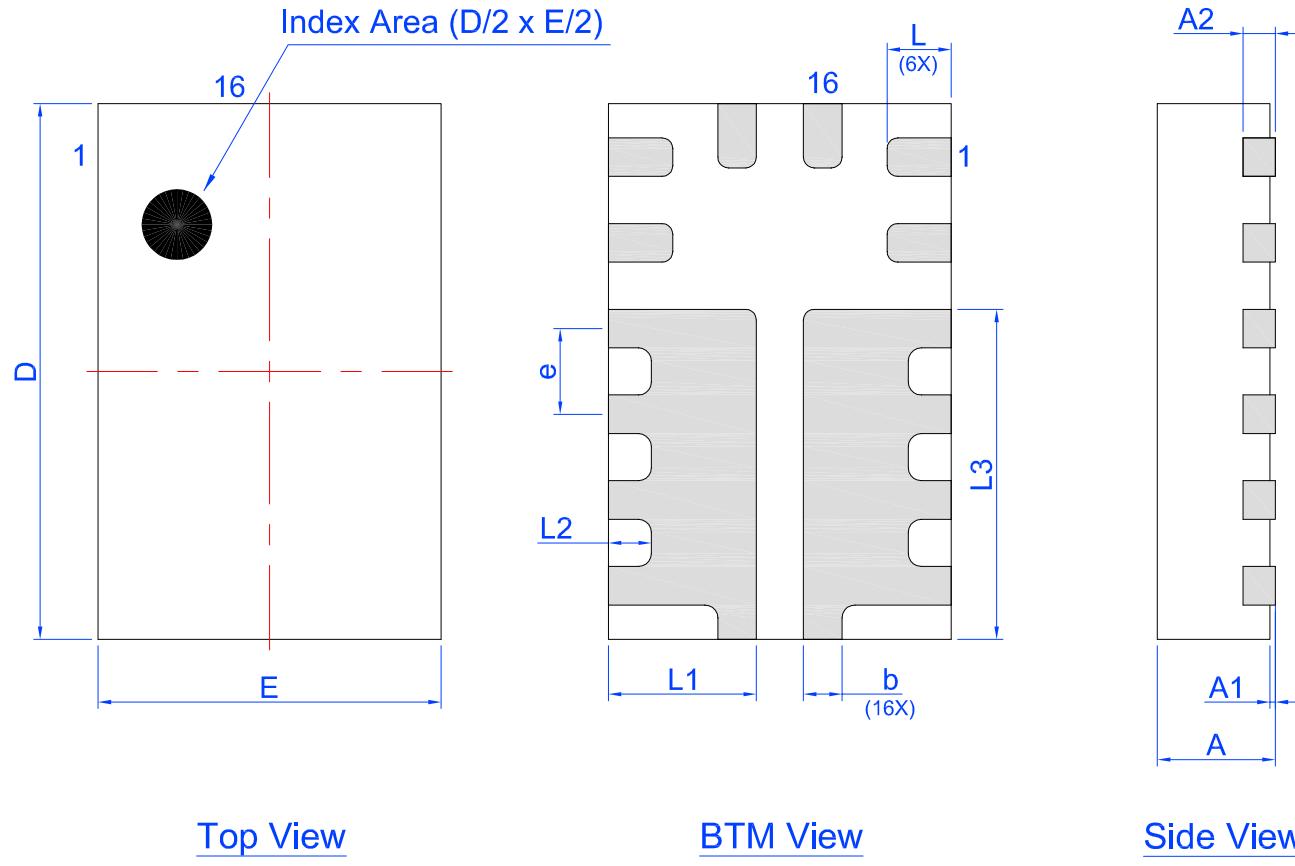
Note 1: Each character in code field can be alphanumeric A-Z and 0-9

Note 2: Character in code field can be alphabetic A-Z

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### Package Drawing and Dimensions

16 Lead STQFN Package 1.6 mm x 2.5 mm (Fused Lead)



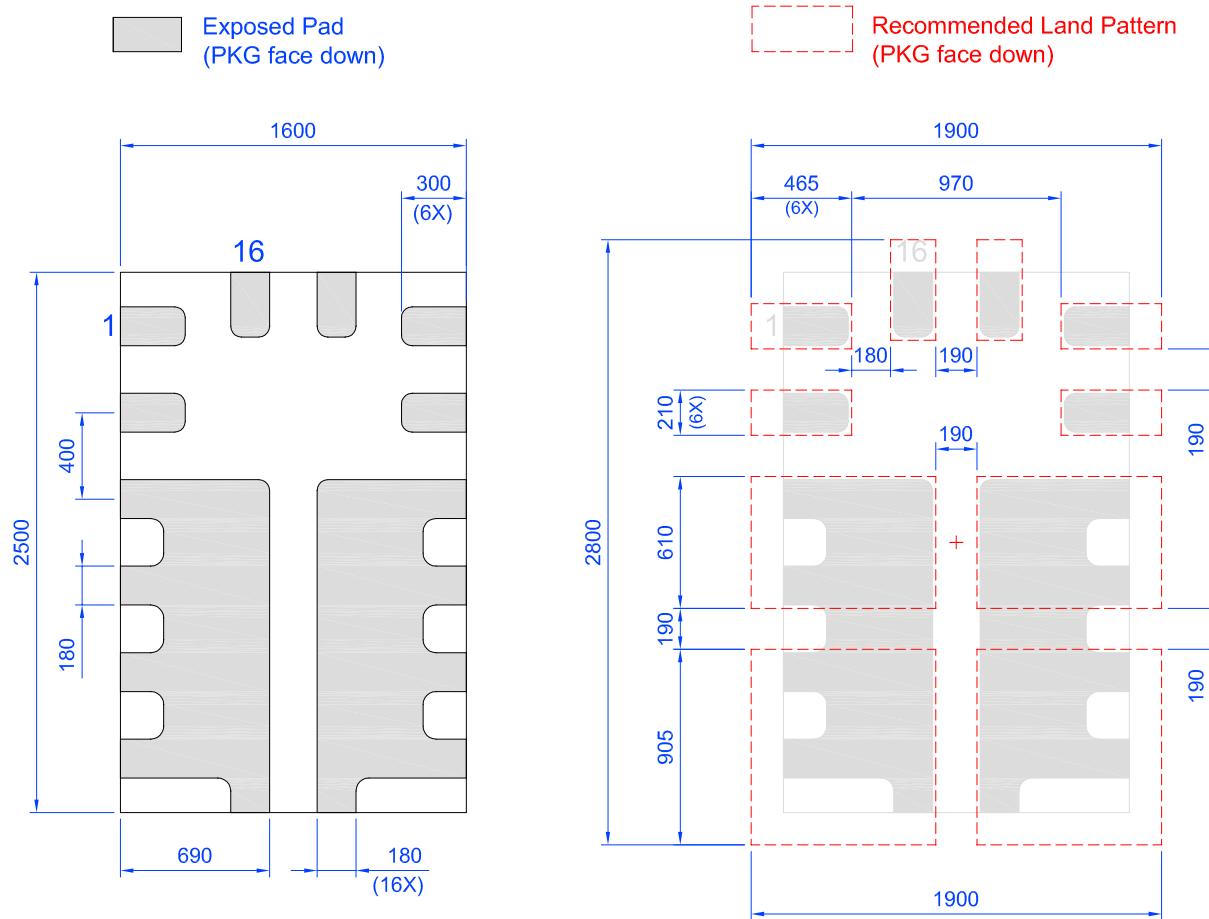
Unit: mm

Symbol	Min	Nom.	Max	Symbol	Min	Nom.	Max
A	0.50	0.55	0.60	D	2.45	2.50	2.55
A1	0.005	-	0.05	E	1.55	1.60	1.65
A2	0.10	0.15	0.20	L	0.25	0.30	0.35
b	0.13	0.18	0.23	L1	0.64	0.69	0.74
e	0.40 BSC			L2	0.15	0.20	0.25
				L3	1.49	1.54	1.59

## SLG59M1707V

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

## SLG59M1707V 16-pin STQFN PCB Landing Pattern



## SLG59M1707V

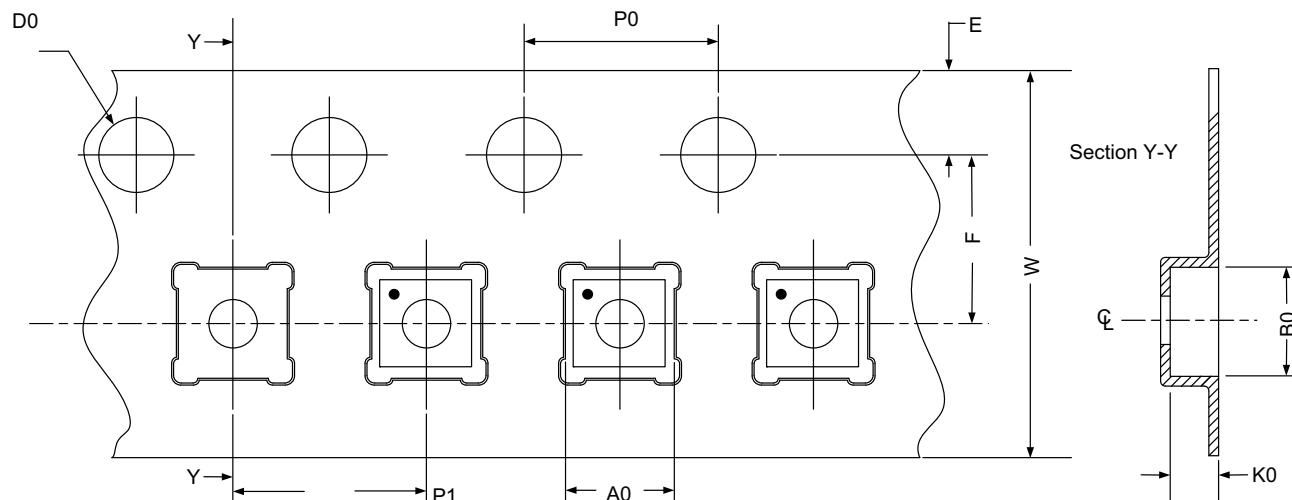
A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

## Tape and Reel Specifications

Package Type	# of Pins	Nominal Package Size [mm]	Max Units		Reel & Hub Size [mm]	Leader (min)		Trailer (min)		Tape Width [mm]	Part Pitch [mm]
			per Reel	per Box		Pockets	Length [mm]	Pockets	Length [mm]		
STQFN 16L 1.6x2.5mm 0.4P FCA Green	16	1.6x2.5x 0.55mm	3000	3000	178/60	100	400	100	400	8	4

## Carrier Tape Drawing and Dimensions

Package Type	Pocket	BTM Length	Pocket	BTM Width	Pocket Depth	Index Hole Pitch	Pocket Pitch	Index Hole Diameter	Index Hole to Tape Edge	Index Hole to Pocket Center	Tape Width
	A0	B0	K0	P0	P1	D0	E	F	W		
STQFN 16L 1.6x2.5mm 0.4P FCA Green		1.8		2.8	0.7	4	4	1.55	1.75	3.5	8



## Recommended Reflow Soldering Profile

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 2.2 mm<sup>3</sup> (nominal). More information can be found at [www.jedec.org](http://www.jedec.org).

A 125 °C Rated, 4 mm<sup>2</sup>, 13 mΩ, 3.5 A Load Switch with Protection Features and an Analog Current Monitor Output

### Revision History

Date	Version	Change
2/3/2022	1.02	Updated Company name and logo Fixed typos
1/21/2021	1.04	Updated EC Table
1/6/2020	1.03	Updated style and formatting Added Layout Guidelines Fixed typos
12/20/2019	1.02	Clarified Power ON sequence descriptions Fixed typos
3/9/2017	1.01	Fixed Figure 9
2/23/2017	1.00	Production Release

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