

## General Description

The MIC2507 is a quad integrated high-side power switch that consists of four protected N-channel MOSFET output pass transistors each with a dedicated TTL compatible input and charge pump. The MIC2507 can be used instead of separate high-side drivers and MOSFETs in many low-voltage applications.

The MIC2507 switches 2.7V to 7.5V and can deliver at least 1A continuous current from any individual output. A slow turn-on feature prevents high inrush current when switching capacitive loads. The internal control circuitry is powered from switch #1's supply input. The MIC2507 allows any output to be pulled higher than its input voltage while in the off state.

A multipurpose open-drain fault flag output indicates overcurrent limiting, open-load detection, and thermal shutdown.

Overcurrent limiting is internally fixed and requires no external components.

Open-load detection is active only when the switch is off. Open-load detection requires one high-value resistor from the load to the supply.

Thermal shutdown turns off the output if the die temperature exceeds approximately 135°C. The switch automatically restarts when the temperature falls 10°C.

The MIC2507 is available in SOIC packages with a temperature range of -40°C to +85°C.

## Features

- 2.7V to 7.5V supply
- Current limit
- Open-load detection
- Thermal shutdown
- Open-drain fault flag
- <math>1\mu\text{A}</math> off-state current
- Slow turn-on and fast turnoff  
1ms typical rise time (load dependent)
- Low MOSFET on-resistance  
120m $\Omega$  typical at 5V  
130m $\Omega$  typical at 3.3V

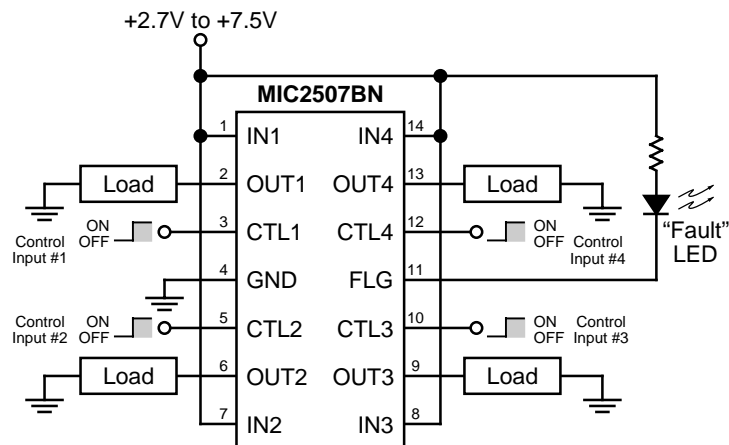
## Applications

- Battery Management
- Power Management

## Ordering Information

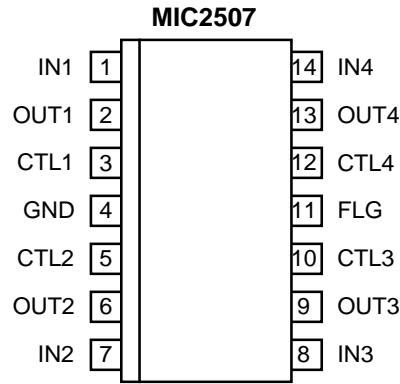
Part Number	Temperature Range	Package
MIC2507BM	-40°C to +85°C	14-lead SOIC

## Typical Application



Distributed-Load Power Switch

## Pin Configuration



**14-Pin SOIC (M)**

## Pin Description

Pin Number	Pin Name	Pin Function
1	IN1	Supply #1 Input: Output MOSFET drain. Also is the supply input for the common oscillator, thermal shutdown, and flag circuitry. Must be powered to use switch #2, #3, or #4. Connect to supply for switch #1.
2	OUT1	Switch #1 Output: Output MOSFET source. Typically connect to switched side of load. Output can be pulled above input voltage in off mode.
3	CTL1	Control #1 (Input): Noninverting TTL compatible control input.
4	GND	Ground: Power return.
5	CTL2	Control #2 (Input): Same function as CTL1.
6	OUT2	Supply #2 Output: Output MOSFET source.
7	IN2	Switch #2 Input: Output MOSFET drain. Also is supply voltage for respective channel control input and charge pump.
8	IN3	Switch #3 Input: Same function as IN2.
9	OUT3	Supply #3 Output: Output MOSFET source.
10	CTL3	Control #3 (Input): Same function as CTL1.
11	FLAG	Fault Flag (Output): Active-low, open-drain output. If all CTLs are low, indicates open load. If any CTL is high, indicates current limit or thermal shutdown.
12	CTL4	Control #4 (Input): Same function as CTL1.
13	OUT4	Supply #4 Input: Output MOSFET source.
14	IN4	Switch #4 Output: Same function as IN2.

## Absolute Maximum Ratings

Supply Voltage ( $V_{IN\ max}$ )	8V
Output Current ( $I_{OUT\ max}$ )	Internally Limited
Control Input ( $V_{CTLn\ min/max}$ )	-0.3V to 15V
Fault Flag Voltage ( $V_{FLG\ max}$ )	40V
Fault Flag Current ( $I_{FLG\ max}$ )	25mA
Storage Temperature	-65°C to +150°C
Lead Temperature	260°C
Junction Temperature ( $T_J$ )	Internally Limited

## Operating Ratings

Supply Voltage ( $V_{IN}$ )	+2.7V to +7.5V
Ambient Operating Temperature ( $T_A$ )	-40°C to +85°C
Thermal Resistance ( $\theta_{JA}$ )	120°C/W

## Electrical Characteristics

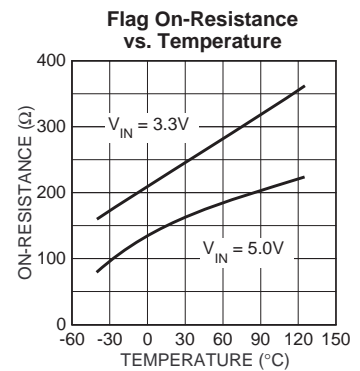
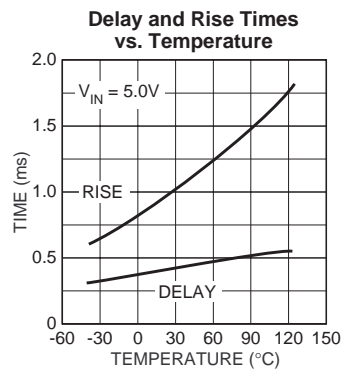
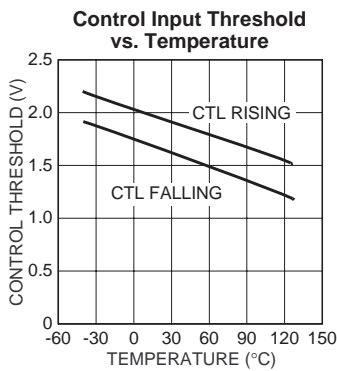
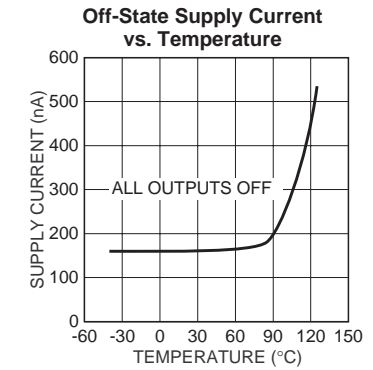
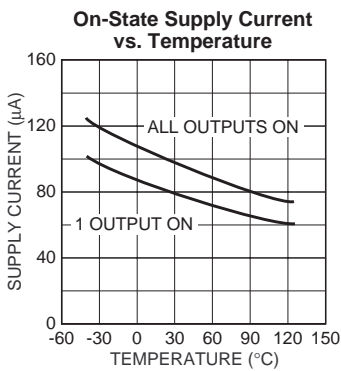
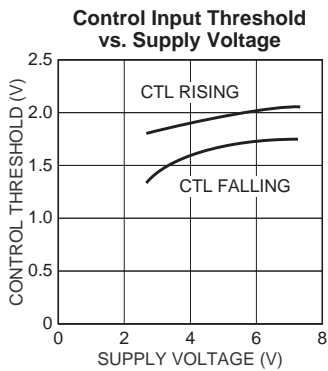
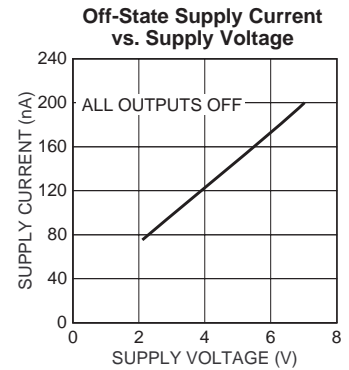
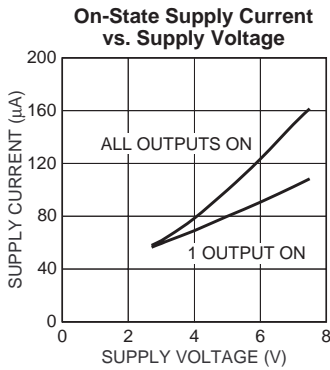
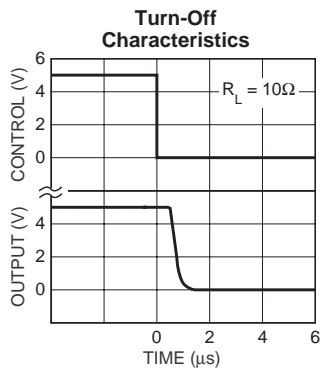
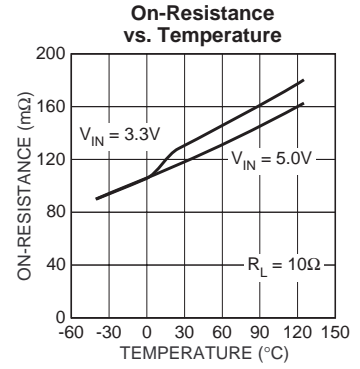
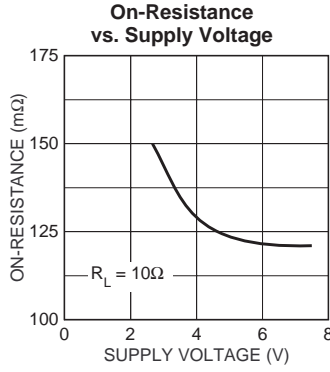
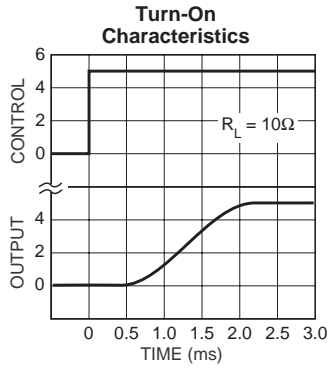
$V_{IN} = +5V$ ;  $T_A = 25^\circ C$ , **bold** values indicated  $-40^\circ C \leq T_A \leq +85^\circ C$ ; unless noted.

Parameter	Condition	Min	Typ	Max	Units
Supply Current	CTL1-4 = logic 0; OUT = open		0.1	10	$\mu A$
	CTL1 = logic 1; CTL2-4 = logic 0; OUT = open		80	160	$\mu A$
	CTL1-4 = logic 1; OUT = open		100	180	$\mu A$
Control Input Threshold Voltages	$V_{CTLn}$ rising		1.9	2.4	V
	$V_{CTLn}$ falling	0.8	1.6		V
Control Input Current	CTLn = logic 0		0.010	1	$\mu A$
	CTLn = logic 1		0.010	1	$\mu A$
Control Input Capacitance			1		pF
Output MOSFET Resistance	$V_{IN} = 5V$		120	180 <b>240</b>	m $\Omega$ m $\Omega$
	$V_{IN} = 3.3V$		130	200 <b>260</b>	m $\Omega$ m $\Omega$
Output Leakage			0.05	10	$\mu A$
Output Turn-On Delay Time	$R_L = 10\Omega$ each output		0.5	1.5	ms
Output Turn-On Rise Time	$R_L = 10\Omega$ each output		1.6	5.0	ms
Output Turn-off Delay + Fall Time	$R_L = 10\Omega$ each output		1.0	10	$\mu s$
Current Limit Threshold		1	2		A
Open Load Threshold	CTLn = logic low, <b>Note 1</b>		1.1	1.6	V
Overtemperature Threshold	$T_J$ increasing		135		$^\circ C$
	$T_J$ decreasing		125		$^\circ C$
Error Flag Output Resistance	$V_{IN} = 5V$		160	300	$\Omega$
	$V_{IN} = 3.3V$		240	500	$\Omega$
Error Flag Saturation Voltage	$I_L = 1mA$		160	300	mV

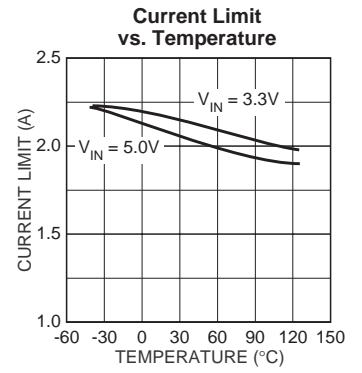
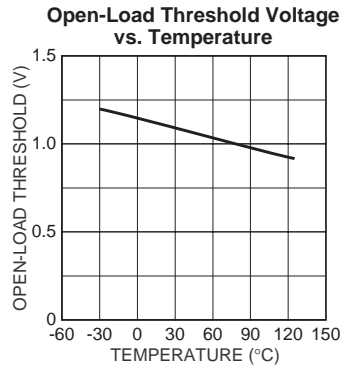
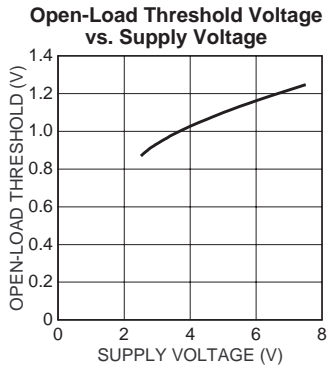
**General Note:** Devices are ESD protected; however, handling precautions are recommended.

**Note 1:** Open load threshold is the OUT voltage where FLG becomes active (low). OUT driven externally.

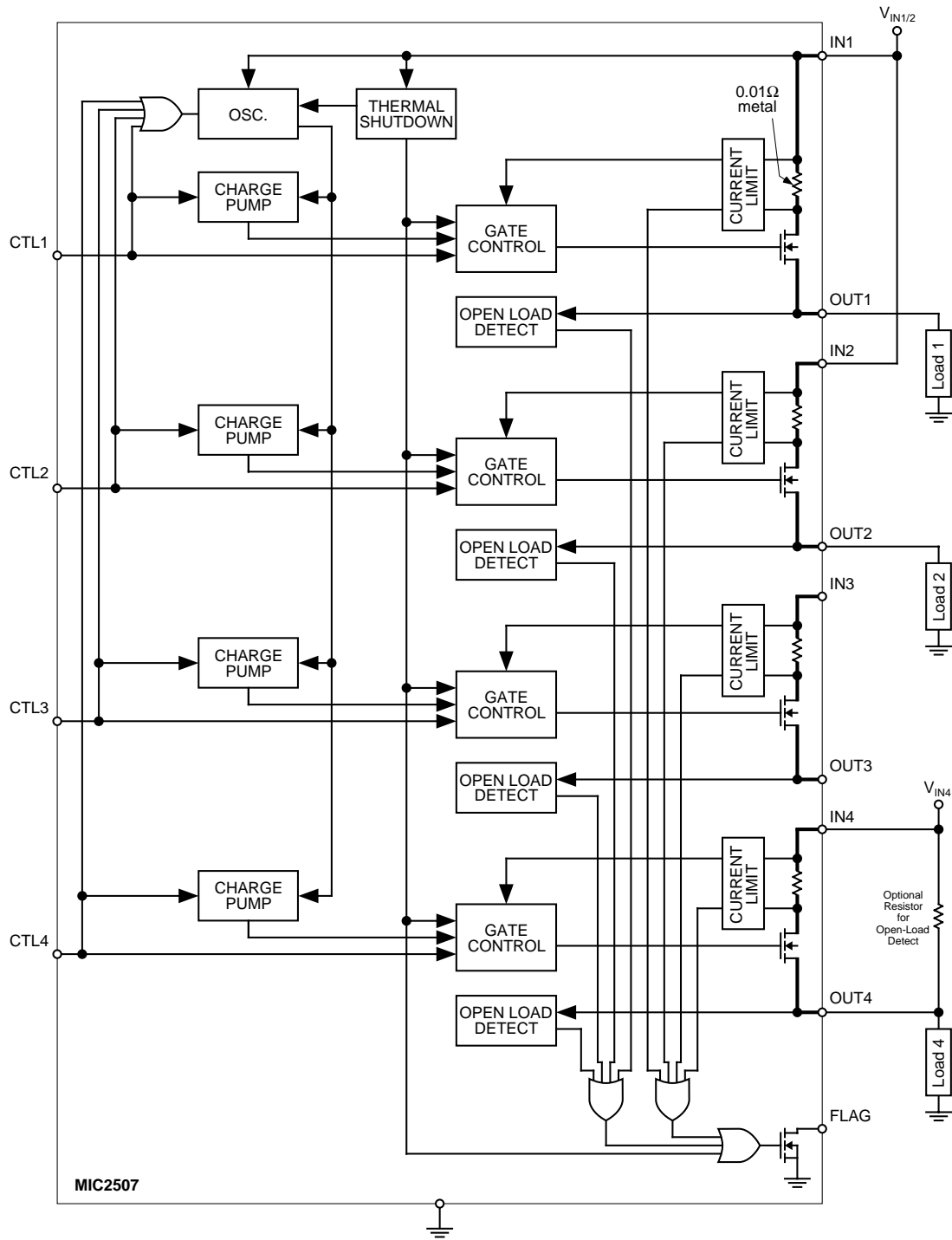
# Typical Characteristics



# Typical Characteristics



# Block Diagram



## Functional Description

The MIC2507 is a noninverting device. A TTL high applied to a CTL (control) input turns on the respective output transistor. A TTL low turns off the output transistor. Overcurrent and overtemperature fault conditions inhibit MOSFET turn on.

### Supply Inputs

IN1 (supply input #1) is the supply side of switch #1 but also powers the common oscillator, thermal shutdown, and flag. Power **must** be applied to IN1 to use switch #2, #3, or #4. IN1 powers the charge pump for switch #1.

IN2, IN3, and IN4 are the supplies for switches #2, #3, and #4, respectively. Each supply input powers its respective charge pump and control input circuitry.

### Control Input

Applying a TTL high signal to any CTL input activates the oscillator and the CTL input's respective charge pump and gate control circuit. If there are no fault conditions, the output MOSFET turns ON.

### Oscillator/Charge Pump

The oscillator produces a 100kHz square wave output which drives each charge pump. The oscillator is disabled when all CTL inputs are low or die temperature is greater than 135°C.

Each charge pump is a voltage quintupler (5×). Its output voltage is clamped to prevent the output switch gate oxide damage. The charge pump capacitors are self contained.

### Gate Control

Each gate control circuit charges the output MOSFET's gate from its charge pump or discharges the MOSFET gate to ground as determined by the control input and thermal shutdown.

## Thermal Shutdown

Thermal shutdown shuts off all output MOSFETs and signals the fault flag if the die temperature exceeds approximately 135°C. 10°C of hysteresis prevents the switch from turning on until the die temperature drops to approximately 125°C.

Thermal shutdown is indicated by the fault flag only when CTL is high (MOSFET on).

### Overcurrent Limit

The overcurrent limit level is preset internally. The preset level prevents damage to the output MOSFET but allows a minimum current of 1A through the output MOSFET. Output current is monitored across an internal shunt resistor.

Overcurrent detection functions only when CTL is logic high (output is on).

### Open-Load Detection

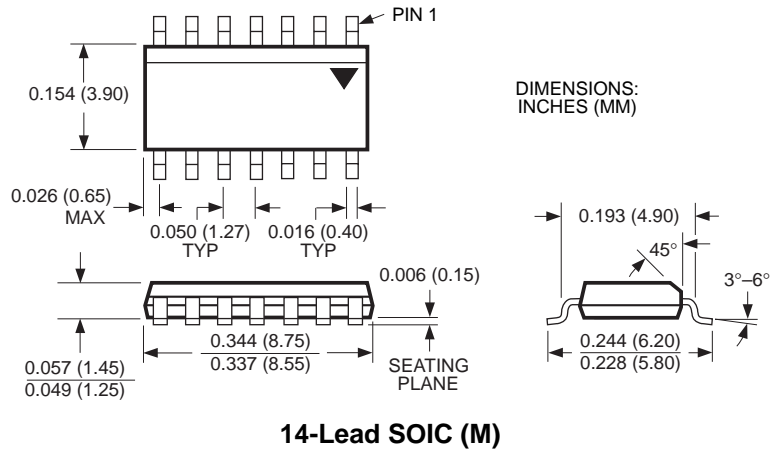
Open-load detection indicates the absence of an output load by signaling the fault flag. Open-load detection is optional and is enabled by connecting a high-value pull-up resistor between IN and OUT. If there is no load, the circuit detects a high OUT voltage and signals the fault flag. Under normal conditions, the low resistance of a typical load pulls OUT low.

Open-load detection functions only when CTL is low (output is off).

### Fault Flag

FLG (fault flag) is an N-channel open-drain MOSFET output. The fault-flag MOSFET is active (low) for one or more of the following conditions on any one or more outputs: open load, current limit, or thermal shutdown.

# Package Information





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