The Infinite Bandwidth Company™

MIC94060/94061

100mΩSC-70-6 Smart Load Switch

Final

General Description

The MIC94060 and MIC94061 are smart high-side load switches housed in the SC-70-6 package. The devices contain a low on-resistance, 100mΩ(max) p-channel MOSFET that is driven by built-in level-shift and slew-rate control circuitry. The low on-resistance of the devices allows for them to support over 2A of continuous current. The MIC94061 features an active pull-down circuit that discharges capacitive loads through a 200Ω switch when the IC is set to the OFF state.

Pull down circuitry keeps the MIC94060/1 in a default OFF state until the EN pin is pulled to a high level. The built-in level shift circuitry allows for a logic signal that may be different from the supply voltage to switch the high-side P-channel MOSFET on or off. The 1µs turn-on slew rate control prevents in-rush current from causing glitches on the supply rail.

Battery life is saved in portable applications with the IC's low quiescent current of 2µA and low shutdown current of <1µA. Their 1.8V to 5.5V operating voltage range makes the MIC94060/1 suitable for 1-cell Li Ion, 2- to 3-cell NiMH / NiCad / Alkaline, as well as other sub-5V input applications.

Integrating the level-shift and slew-rate control circuitry saves valuable board space and reduces component placement cost compared to discrete solutions.

The MIC94060/1 are housed in the *Teeny*™ SC-70-6 package and have a junction temperature range of –40°C to +150°C.

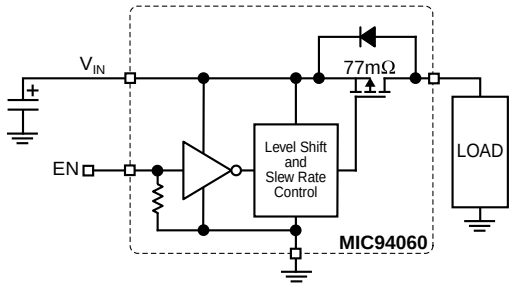
Features

- 1.8V to 5.5V input voltage range
- Built-in level shift circuitry:
  - Can be driven by 1.5V logic
- Low on-resistance p-channel MOSFET:
  - 77mΩ at V_{GS} = 4.5V (typ)
  - 2A continuous current
- Built-in slew-rate control:
  - Controlled 1µs turn-on rise-time
  - Fast 60ns turn-off fall time
- Low 2µA quiescent current
- <1µA micropower shutdown
- Built-in fast-off load discharge circuit (MIC94061)
- *Teeny*™ SC-70-6 package
- –40°C to +150°C junction temperature range

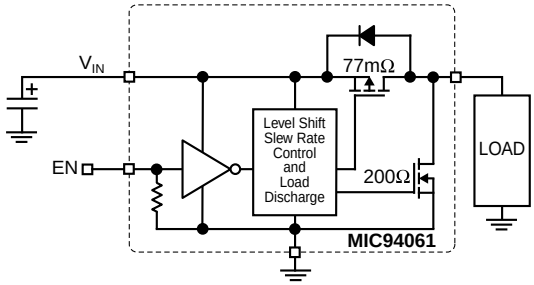
Applications

- Load switch in portable applications:
  - Cellular phones
  - PDAs
  - MP3 players
  - Digital cameras
  - Notebook PCs
  - Barcode scanners
- Battery switch over circuits
- Level translators

Typical Application



Load Switch Application

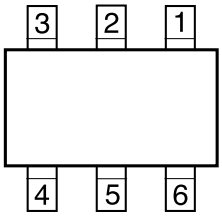


Load Switch Application with Capacitive Load Discharge

Ordering Information

Part Number	Load Discharge Circuitry	Marking	Junction Temp. Range	Package
MIC94060BC6	NO	P54	–40°C to +150°C	SC-70-6
MIC94061BC6	YES	P55	–40°C to +150°C	SC-70-6

Pin Configuration



MIC94060/1
SC-70-6 (C6)

Pin Description

Pin Number	Pin Name	Pin Function
1	VOUT	Drain of P-channel MOSFET. No bypass capacitor required.
2, 5	GND	Ground connections.
3	EN	Enable input.
4	VIN	Source of P-channel MOSFET. No bypass capacitor required.
6	NC	No connect

Absolute Maximum Ratings (Note 1)

Input Voltage (V_{IN}) ..... +6V
Enable Voltage (V_{EN}) ..... +6V
Continuous Drain Current (I_D) **Note 3**
T_A = 25°C ..... ±2A
T_A = 85°C ..... ±1.4A
Pulsed Drain Current (I_{DP}) **Note 5** ..... ±6A
Continuous Diode Current (I_S) **Note 7** ..... –50mA
Power Dissipation **Note 3**
SC-70-6 lead (T_A = 85°C) ..... 270 mW
Ambient Storage Temperature (T_S) ..... –55°C to +150°C
ESD Rating **Note 4**

Operating Ratings (Note 2)

Input Voltage Range (V_{IN}) ..... 1.8V to 5.5V
Junction Temperature Range (T_J) ..... –40°C to +150°C
Package Thermal Impedance **Note 3**
θ_{JA} SC-70-6 lead ..... 240°C/W

Electrical Characteristics

T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Condition	Min	Typ	Max	Units
Static						
$V_{EN(th)}$	EN Threshold Voltage	V_{IN} = 1.8V to 4.5V, I_D = –250µA	0.5		1.2	V
I_{EN}	EN Input Current (Quiescent Current)	V_{IN} = V_{EN} = 5.5V		2	4	µA
I_{VIN}	OFF State Leakage Current	V_{EN} = OPEN or 0V, V_{IN} = +5.5V			1	µA
$R_{DS(ON)}$	P-Channel Drain-Source On-Resistance	V_{IN} = 4.5V, I_D = –100 mA; V_{EN} = 1.5V V_{IN} = 3.6V, I_D = –100 mA; V_{EN} = 1.5V V_{IN} = 2.5V, I_D = –100 mA; V_{EN} = 1.5V V_{IN} = 1.8V, I_D = –100 mA; V_{EN} = 1.5V		77 85 100 145	100 115 140 200	mΩ mΩ mΩ mΩ
$R_{SHUTDOWN}$	Turn-off Impedance (94061)	V_{IN} = 3.6V, V_{EN} = 0V or OPEN		200	300	Ω
Dynamic (Note 6)						
$t_{d(on)}$	Turn-On Delay Time	V_{IN} = 3.6V, I_D = –100mA, V_{EN} = 1.5V		850	1500	ns
t_r	Turn-On Rise Time	V_{IN} = 3.6V, I_D = –100mA, V_{EN} = 1.5V	0.5	1	5	µs
$t_{d(off)}$	Turn-Off Delay Time	V_{IN} = 3.6V, I_D = –100mA, V_{EN} = 1.5V		100	150	ns
t_f	Turn-Off Fall Time	V_{IN} = 3.6V, I_D = –100mA, V_{EN} = 1.5V		60	100	ns

Note 1. T_A = 25°C unless otherwise noted. Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. 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.

Note 2. This device is not guaranteed to operate beyond its specified operating rating.

Note 3. Mounted on 1 square-inch pad of 2 oz. copper.

Note 4. IC devices are inherently ESD sensitive. Handling precautions required.

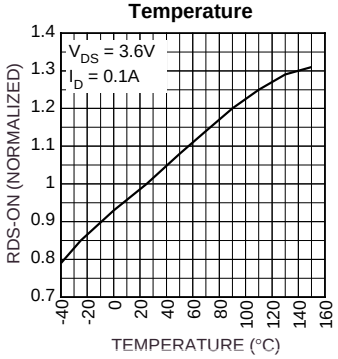
Note 5. Pulse width < 300µs with <2% duty cycle.

Note 6. Dynamic specifications are guaranteed by design.

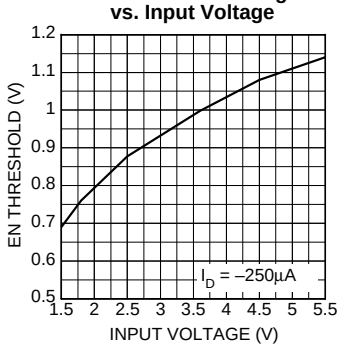
Note 7. Body diode current conduction is not recommended.

Typical Characteristics

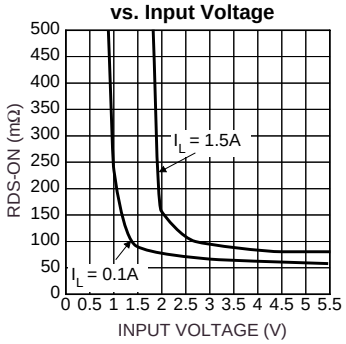
RDS-On Variance with Temperature



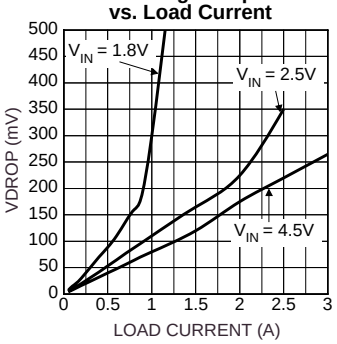
EN Threshold Voltage vs. Input Voltage



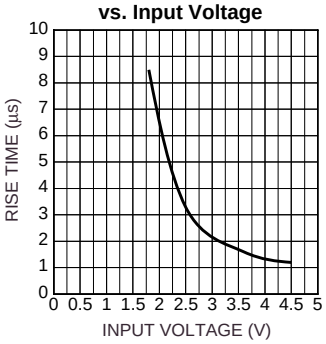
On Resistance vs. Input Voltage



Voltage Drop vs. Load Current

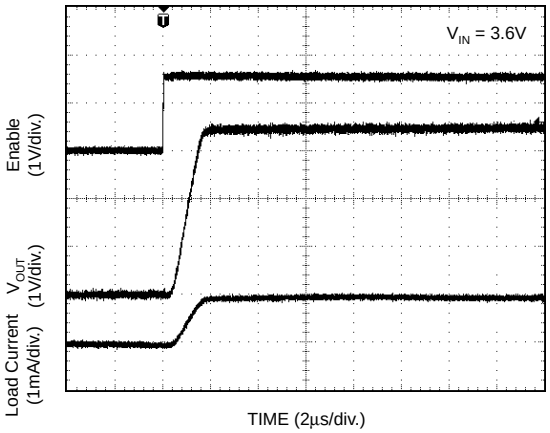


Turn On Time vs. Input Voltage

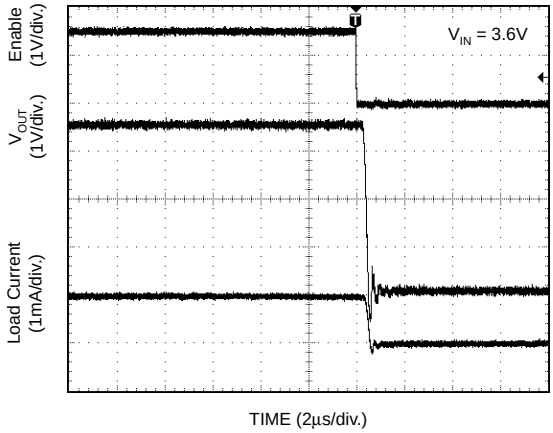


Timing Waveforms

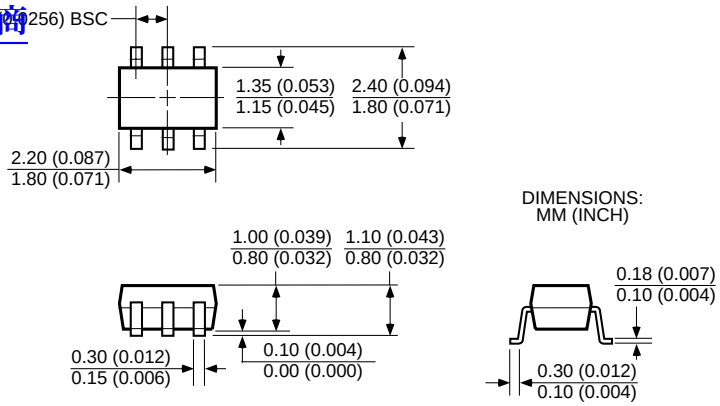
Turn-On Response



Turn-Off Response



Package Information



SC-70-6 Pin (C6)

MICREL, INC. 1849 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL + 1 (408) 944-0800 FAX + 1 (408) 944-0970 WEB http://www.micrel.com