LTC1156



Quad High Side Micropower MOSFET Driver with Internal Charge Pump

DESCRIPTION

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The LTC1156 guad High side gate driver allows using low cost N-channel FETs for high side switching applications. An internal charge pump boosts the gate drive voltage above the positive rail, fully enhancing an N-channel MOS switch with no external components. Micropower operation, with $16\mu A$ standby current and $95\mu A$ operating current, allows use in virtually all systems with maximum efficiency.

Included on chip is independent over-current sensing to provide automatic shutdown in case of short circuits. A time delay can be added to the current sense to prevent false triggering on high in-rush current loads.

The LTC1156 operates off of a 4.5V to 18V supply and is well suited for battery-powered applications, particularly where micropower "sleep" operation is required.

The LTC1156 is available in both 16-pin DIP and 16-pin SOL packages.

FEATURES

- No External Charge Pump Components
- Fully Enhances N-Channel Power MOSFETs
- 16 Microamps Standby Current
- 95 Microamps ON Current
- Wide Power Supply Range 4.5V to 18V
- Controlled Switching ON and OFF Times
- **Replaces P-Channel High Side Switches**
- Compatible with Standard Logic Families
- Available in 16-pin SOL Package

APPLICATIONS

- Laptop Computer Power Switching
- SCSI Termination Power Switching
- Cellular Telephone Power Management
- P-Channel Switch Replacement
- Battery Charging and Management
- Low Frequency H-Bridge Driver
- Stepper Motor and DC Motor Control

TYPICAL APPLICATION



Laptop Computer Power Management

ALL COMPONENTS SHOWN ARE SURFACE MOUNT. MINIMUM PARTS COUNT SHOWN. CURRENT LIMITS CAN BE SET SEPARATELY AND TAILORED TO INDIVIDUAL LOAD CHARACTERISTICS

IMS026 INTERNATIONAL MANUFACTURING SERVICES. INC. (401) 683-9700

Standby Supply Current



ABSOLUTE MAXIMUM RATINGS

Supply Voltage	22V
Input Voltage	$(V_{S} + 0.3V)$ to $(GND - 0.3V)$
Gate Voltage	$(V_{S} + 24V)$ to $(GND - 0.3V)$
Current (Any Pin)	50mA

Operating Temperature Range	
LTC1156C	0°C to 70°C
Storage Temperature Range	65°C to 150°C
Lead Temperature (Soldering, 10 sec.)300°C

PACKAGE/ORDER INFORMATION



Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS $V_s = 4.5V$ to 18V, $T_A = 25^{\circ}C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		MIN	ТҮР	MAX	UNITS
V _S	Supply Voltage	(Note 1)	•	4.5		18	V
Ι _Q	Quiescent Current OFF	V _S = 5V, V _{IN} = 0V (Note 2)			16	40	μA
IQ	Quiescent Current ON	$V_{S} = 5V, V_{IN} = 5V$ (Note 3)			95	125	μA
Ι _Q	Quiescent Current ON	V _S = 12V, V _{IN} = 5V (Note 3)			180	400	μA
V _{INH}	Input High Voltage		•	2.0			V
V _{INL}	Input Low Voltage		•			0.8	V
l _{IN}	Input Current	$0V < V_{IN} < V_S$	•			±1.0	μA
C _{IN}	Input Capacitance				5		pF
V _{SEN}	Drain Sense Threshold Voltage		•	80 75	100 100	120 125	mV mV
I _{SEN}	Drain Sense Input Current	$0V < V_{SEN} < V_{S}$	•			±0.1	μA
V _{GATE} – V _S	Gate Voltage Above Supply	$V_{S} = 5V$ $V_{S} = 6V$ $V_{S} = 12V$	• • •	6.0 7.5 15	7.0 8.3 18	9.0 15.0 25	V V V
t _{ON}	Turn-ON Time	$\label{eq:states} \begin{array}{l} V_S = 5V, \ C_{GATE} = 1000 pF\\ Time \ for \ V_{GATE} > V_S + 2V\\ Time \ for \ V_{GATE} > V_S + 5V\\ \hline V_S = 12V, \ C_{GATE} = 1000 pF\\ Time \ for \ V_{GATE} > V_S + 5V\\ Time \ for \ V_{GATE} > V_S + 5V\\ \hline \end{array}$		50 200 50 120	250 1100 180 450	750 2000 500 1200	μs μs μs μs



ELECTRICAL CHARACTERISTICS $V_s = 4.5V$ to 18V, $T_A = 25^{\circ}C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	ТҮР	MAX	UNITS
t _{OFF}	Turn-OFF Time	$V_{S} = 5V, C_{GATE} = 1000pF$	10	36	60	
		$V_{\rm S} = 12V, C_{\rm GATE} = 1000 \rm pF$	10	50	00	μ5
		Time for V _{GATE} < 1V	10	26	60	μs
t _{SC} Short Circuit Turn-OFF Time	$V_S = 5V, C_{GATE} = 1000pF$					
	Time for V _{GATE} < 1V	5	16	30	μs	
	V _S = 12V, C _{GATE} = 1000pF					
	Time for V _{GATE} < 1V	5	16	30	μs	

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denotes specifications which apply over the full operating temperature range.

Note 1: Both V_S pins (3 and 8) must be connected together, and both ground pins (1 and 6) must be connected together.

Note 2: Quiescent current OFF is for all channels in OFF condition.

Note 3: Quiescent current ON is per driver and is measured independently.

TYPICAL PERFORMANCE CHARACTERISTICS



V_S = 18V

 $V_{\rm S} = 5V$

25 50

TEMPERATURE (°C)

0

75 100 125

1156 G04

Supply Current per Channel ON



Supply Current per Channel ON



High Side Gate Voltage



Low Side Gate Voltage





40

30

20

10

0

-50 25

TYPICAL PERFORMANCE CHARACTERISTICS



BLOCK DIAGRAM



OPERATION

The LTC1156 contains four independent power MOSFET gate drivers and protection circuits (refer to the Block Diagram for detail). Each section of LTC1156 consists of the following functional blocks:

TTL and CMOS Compatible Inputs

Each driver input has been designed to accommodate a wide range of logic families. The input threshold is set at 1.3V with approximately 100mV of hysteresis.



OPERATION

A voltage regulator with low standby current provides continuous bias for the TTL to CMOS converters. The TTL to CMOS converter output enables the rest of the circuitry. In this way the power consumption is kept to a minimum in the standby mode.

Internal Voltage Regulation

The output of the TTL to CMOS converter drives two regulated supplies which power the low voltage CMOS logic and analog blocks. The regulator outputs are isolated from each other so that the noise generated by the charge pump logic is not coupled into the 100mV reference or the analog comparator.

Gate Charge Pump

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Gate drive for the power MOSFET is produced by an adaptive charge pump circuit which generates a gate voltage substantially higher than the power supply voltage. The charge pump capacitors are included on chip and therefore no external components are required to generate the gate drive.

Drain Current Sense

The LTC1156 is configured to sense the drain current of the power MOSFET in high side applications. An internal 100mV reference is compared to the drop across a sense resistor (typically 0.002Ω to 0.1Ω) in series with the drain lead. If the drop across this resistor exceeds the internal 100mV threshold, the input latch is reset and the gate is quickly discharged by a large N-channel transistor. A simple RC network can be added to delay the over-current protection so that large in-rush current loads such as lamps or capacitors can be started.

Supply and Ground Pins

The two supply pins (3 and 8) of the LTC1156 must be connected together at all times and the two ground pins (1 and 6) must be connected together at all times. The two supply pins should be connected to the "top" of the drain current sense resistor/s to ensure accurate sensing.

For further applications information, see the LTC1155 Dual High Side Micropower MOSFET Driver data sheet.

TYPICAL APPLICATIONS



⁴⁻Cell Extremely Low Voltage Drop Regulator and Three Load Switches with Short-Circuit Protection and 20 μA Standby Current

TYPICAL APPLICATIONS



24V to 30V Quad Industrial Switch with Thermal Shutdown

Automotive Triple High Side Switch with Reverse Battery Interrupt, Short-Circuit and High-Voltage Transient Protection ($20\mu A$ Standby Current)





TYPICAL APPLICATIONS



4-Phase Stepper Motor Driver with Short-Circuit Protection

Full H-Bridge Driver with Short-Circuit Protection and 16 μA Standby Current Low Frequency Operation (<100Hz)



For more Typical Applications, see LTC1155 data sheet.



Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of circuits as described herein will not infringe on existing patent rights.

PACKAGE DESCRIPTION Dimesions in inches (millimeters) unless otherwise noted.

0.770 (19.558) 0.300 - 0.325 0.130 ± 0.005 0.045 - 0.065 . (7.620 - 8.255) (3.302 ± 0.127) $(\overline{1.143} - 1.651)$ 16 15 14 13 12 11 10 9 0.015 • (0.381) MIN 0.260 ± 0.010 0.065 $(\overline{6.604 \pm 0.254})$ 0.009 - 0.015 (1.651) Ā (0.229 - 0.381)TYP 0.325 +0.025 -0.015 1 2 3 4 5 6 7 8 0.125 0.045 ± 0.015 0.018 ± 0.003 (8.255+0.635) (3.175) MIN $(\overline{1.143 \pm 0.381})$ (0.457 ± 0.076) $\underline{0.100\pm0.010}$ N16 1291 (2.540 ± 0.254)

N Package 16-Lead Plastic DIP

S Package 16-Lead Plastic SOL



SOL16 12/91

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