MIC94066-69

Dual High Side Power Switches

General Description

The MIC94066-69 are dual high-side load switches designed for operation between 1.7V to 5.5V. The devices contain a pair of low on-resistance, 115mΩ(max) P-channel MOSFETs that support over 2A of continuous current. The MIC94067 and MIC94069 feature an active load discharge circuit which insures capacitive loads retain no charge when the main switch is in an OFF state.

An active pull-down on the enable input keeps MIC94066-69 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.

MIC94066-67 feature rapid turn on while MIC94068-69 provide a slew rate controlled Soft-Start turn-on of 800µs (typical) to prevent in-rush current from glitching supply rails.

MIC94066-69's voltage range makes them suitable for 1-cell Lithium ion and 2- to 3-cell NiMH/NiCad/Alkaline powered systems, as well as all 5V applications. Their low operating current of 2µA and low shutdown current of <1µA maximize battery life.

Data sheets and support documentation can be found on Micrel's web site at www.micrel.com.

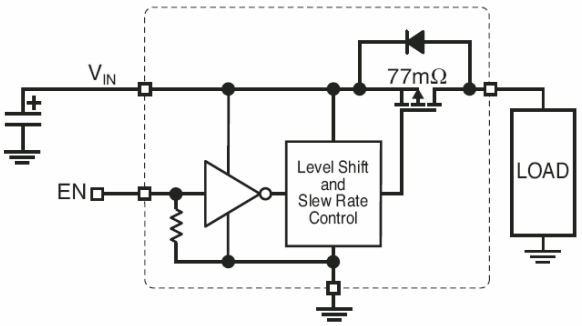
Features

- 1.7V to 5.5V input voltage range
- 2A continuous operating current
- 85mΩ (typ) R_{ON}
- Built-in level shift for control logic; can be operated by 1.5V logic.
- Low 2µA quiescent current
- Soft-Start: MIC94068-69
- Micro-power shutdown <1µA
- Load discharge circuit: MIC94067, MIC94069
- Space saving 2mm x 2mm MLF™

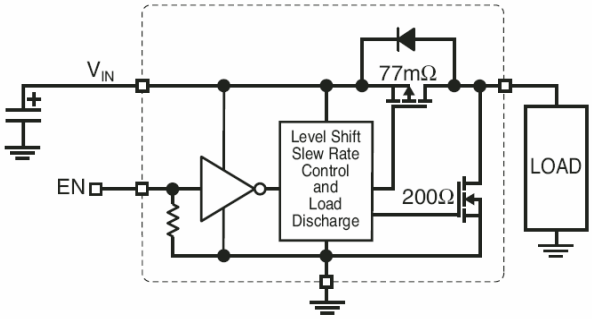
Applications

- Load switch in portable applications:
  - Cellular phones
  - PDAs
  - MP3 players
  - Digital Cameras
  - Portable instrumentation
- Battery switch-over circuits
- Level translators

Typical Application



½ MIC94066, 68
Load Switch Application



½ MIC94067, 69
Load Switch with Capacitive Load Discharge

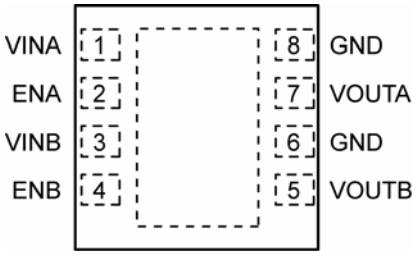
MLF and Micro*Lead* Frame is a registered trademark of Amkor Technologies

Ordering Information

Part Number	Part Marking*	Soft-Start	Load Discharge	Pb-Free Package
MIC94066YML	$\overline{P66}$			2x2 mm MLF™
MIC94067YML	$\overline{P67}$		•	
MIC94068YML	$\overline{P68}$	•		
MIC94069YML	$\overline{P69}$	•	•	

* Note: Over bar symbol may not be to scale

Pin Configuration



Top View
2x2 mm MLF™ (code)

Pin Description

Pin Number	Pin Name	Pin Function
1	$V_{IN}A$	Source of P-channel MOSFET.
2	ENA	Enable (Input): Active-high CMOS compatible control input for switch A. Do not leave floating.
3	$V_{IN}B$	Source of P-channel MOSFET.
4	ENB	Enable (Input): Active-high CMOS compatible control input for switch A. Do not leave floating.
5	$V_{OUT}B$	Drain of P-channel MOSFET.
6	GND	Ground. Both ground pins must be grounded.
7	$V_{OUT}A$	Drain of P-channel MOSFET.
8	GND	Ground. Both ground pins must be grounded.

Absolute Maximum Ratings[1]

Input Voltage (V_{IN}) ..... +6V
Enable Voltage (V_{EN}) ..... +6V
Continuous Drain Current (I_D) [3]
T_A = 25°C ..... ±2A
T_A = 85°C ..... ±1.4A
Pulsed Drain Current (I_{DP}) [4] ..... ±6A
Continuous Diode Current (I_S) [4] ..... –50mA
Storage Temperature (T_s) ..... –55°C to +150°C
EDS Rating – HBM [6] 4KV

Operating Ratings[2]

Input Voltage (V_{IN}) ..... +1.7 to +5.5V
Junction Temperature (T_A) ..... –40°C to +125°C
Package Thermal Resistance
2x2 MLF (Θ_{JA}) ..... 90°C/W
2x2 MLF (Θ_{JC}) [3] ..... 45°C/W

Electrical Characteristics

V_{IN} = 5V; T_A = 25°C, bold values indicate –40°C≤ T_A ≤ +85°C, unless noted.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{EN_TH}	Enable Threshold Voltage	V_{IN} = 1.8V to 4.5V, I_D = –250µA	0.5		1.2	V
		V_{IN} = 1.7V to 4.5V, I_D = –250µA	0.4		1.2	V
I_{EN}	Enable Input Current	V_{IN} = V_{EN} = 5.5V		2	4	µA
I_{VIN}	OFF State Leakage Current	V_{IN} = +5.5V, V_{EN} = 0V			1	µA
$R_{DS(ON)}$	P-Channel Drain to Source On Resistance	V_{IN} = +4.5V, ID = –100mA, V_{EN} = 1.5V		85	115	mΩ
		V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V		100	140	mΩ
		V_{IN} = +2.5V, ID = –100mA, V_{EN} = 1.5V		145	200	mΩ
		V_{IN} = +1.8V, ID = –100mA, V_{EN} = 1.5V		155	215	mΩ
		V_{IN} = +1.7V, ID = –100mA, V_{EN} = 1.5V		165	225	mΩ
$R_{SHUTDOWN}$	Turn-off Impedance	V_{IN} = +3.6V, I_{TEST} = 1mA, V_{EN} = 0V MIC94067, 69		200	300	Ω

Dynamic

Symbol	Parameter	Condition	Min	Typ	Max	Units
t_{ON_DLY}	Turn-On Delay Time	V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94066, 67		0.85	1.5	µs
		V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94068, 69		700	1200	µs
t_{ON_RISE}	Turn-On Rise Time	V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94066, 67	0.5	1	5	µs
		V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94068, 69	500	800	1500	µs
t_{OFF_DLY}	Turn-Off Delay Time	V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94066, 67		115	200	ns
		V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94068, 69		100	200	ns

Dynamic (cont.)

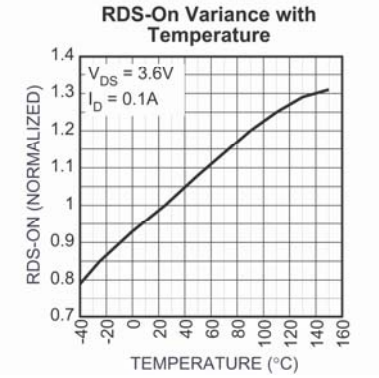
t_{OFF_FALL}	Turn-Off Fall Time	V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94066, 67		60	100	ns
		V_{IN} = +3.6V, ID = –100mA, V_{EN} = 1.5V MIC94068, 69		60	100	ns

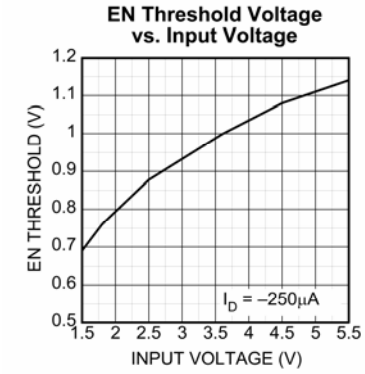
Notes:

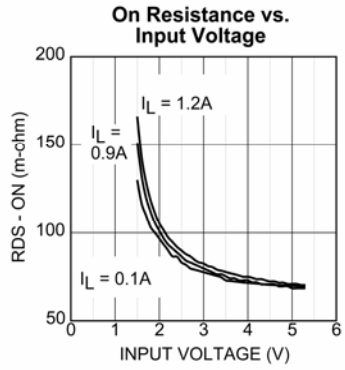
1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. With backside thermal contact to PCB.
4. Pulse width <300µs with < 2% duty cycle.
5. Continuous body diode current conduction (reverse conduction, i.e. V_{OUT} to V_{IN}) is not recommended.
6. Devices are ESD sensitive. Handling precautions recommended. HBM (Human body model), 1.5k in series with 100pF.

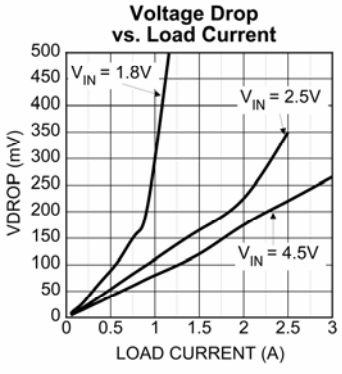
Typical Characteristics

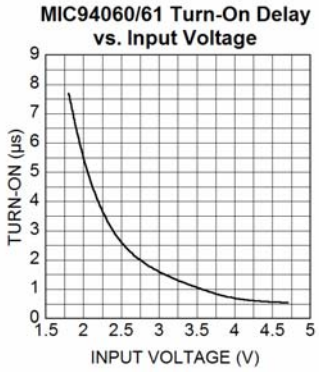
R_L = 100mA, C_L = 0µF for the following plots

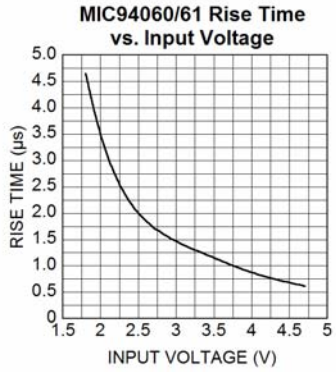


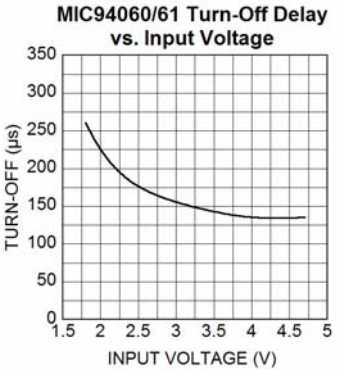


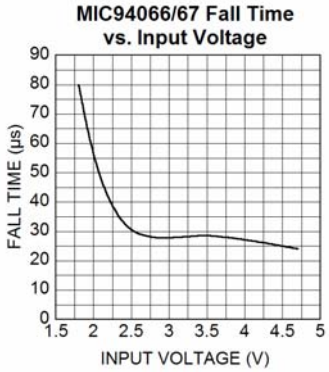


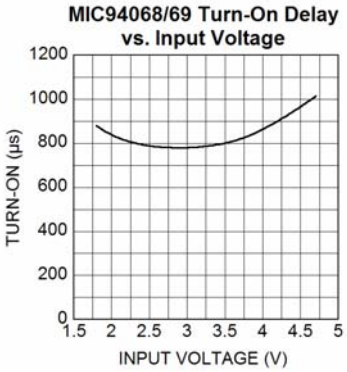


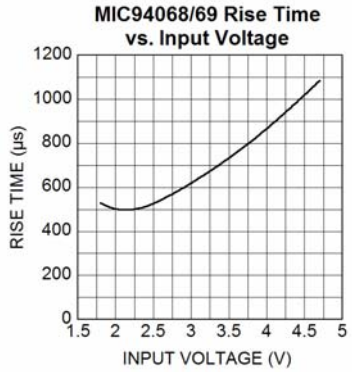


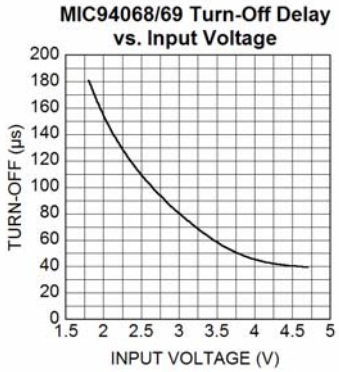


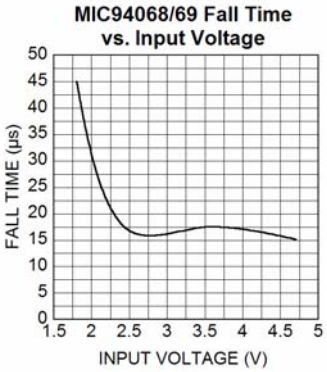






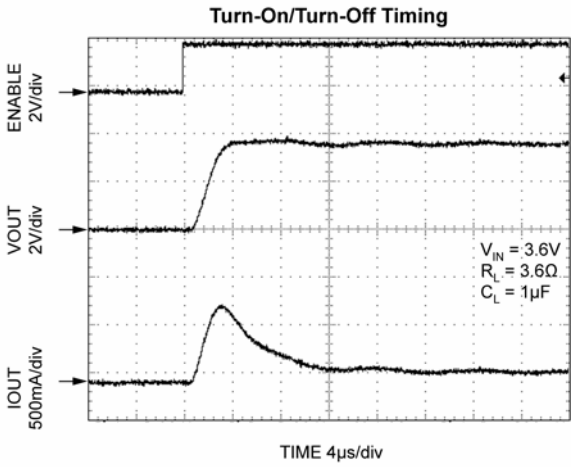


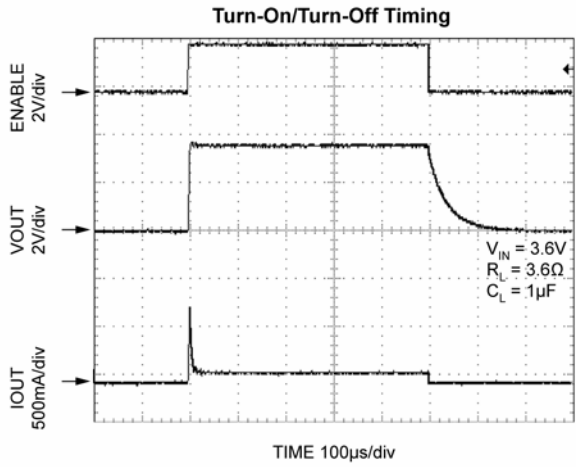


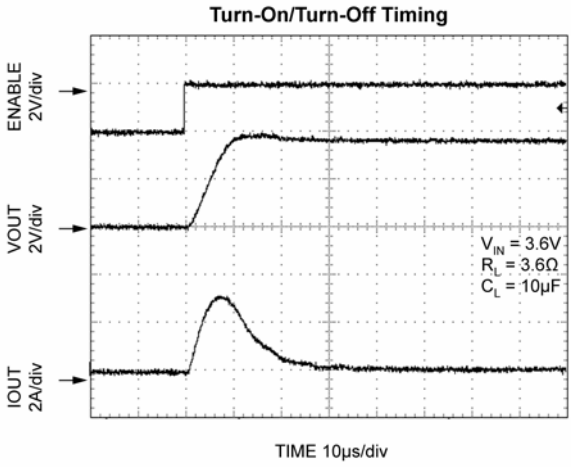


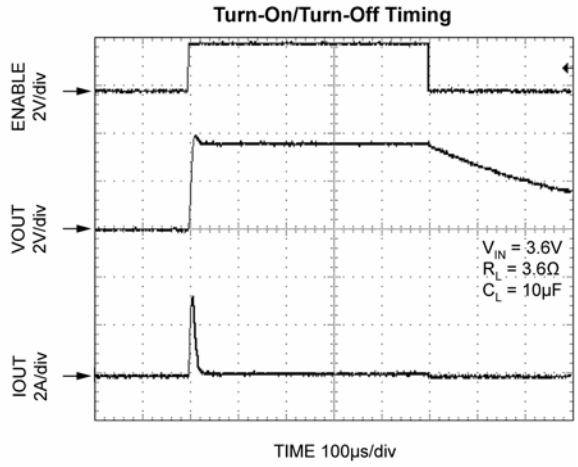
Functional Characteristics

MIC94066

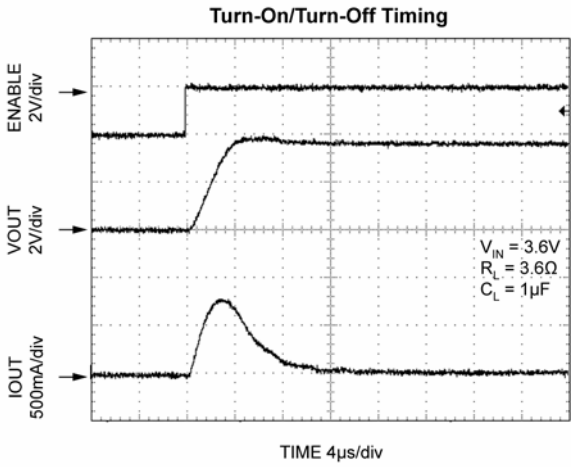


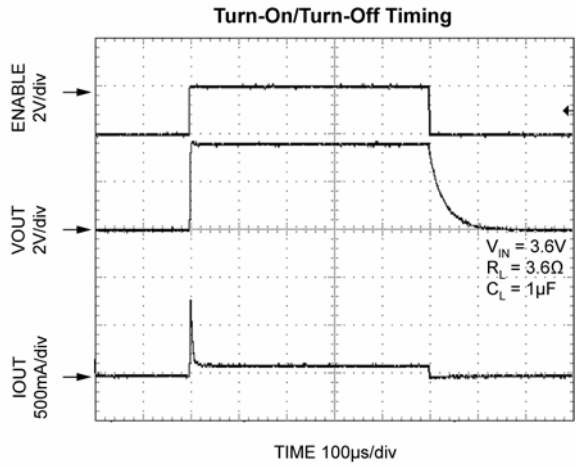


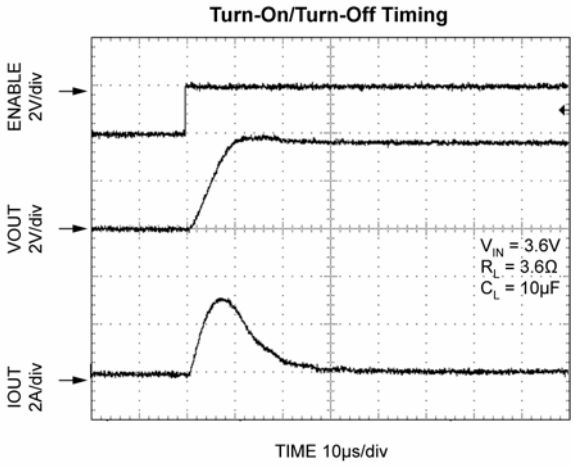




MIC94067


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 500mA/div
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 1µF
TIME 4µs/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 500mA/div
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 1µF
TIME 100µs/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 2A/div
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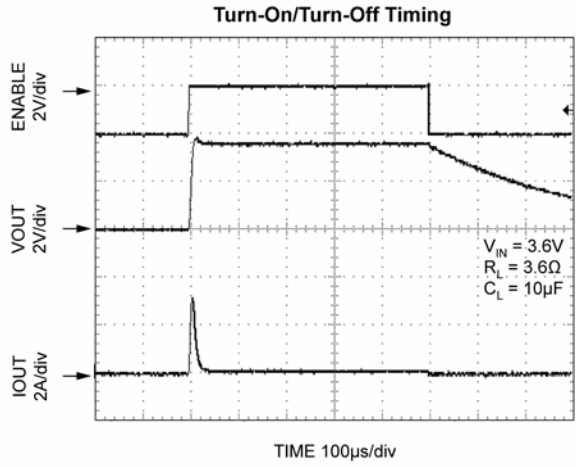
R_L = 3.6Ω
C_L = 10µF
TIME 10µs/div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ENABLE 2V/div
VOUT 2V/div
IOUT 2A/div
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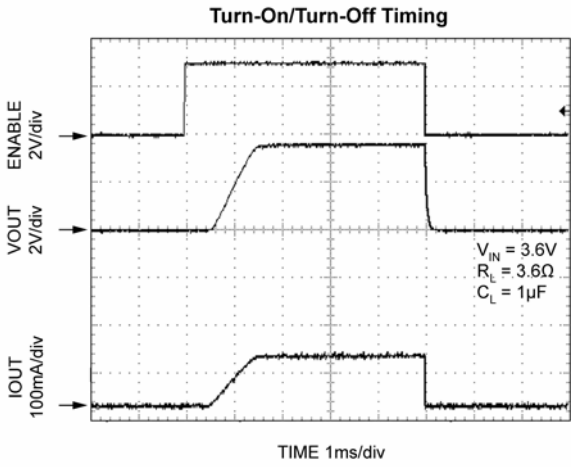
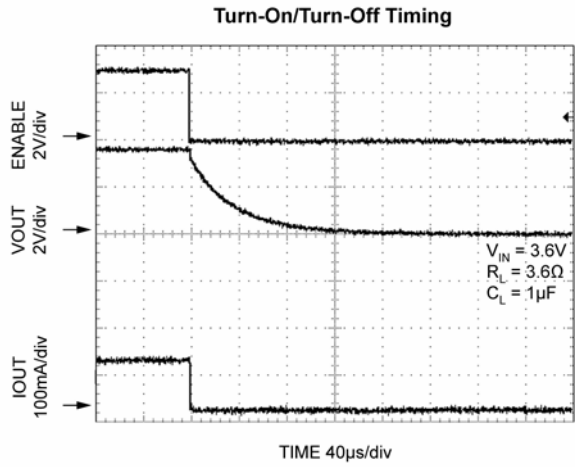
R_L = 3.6Ω
C_L = 10µF
TIME 100µs/div

MIC94068


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 100mA/div
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 1µF
TIME 1ms/div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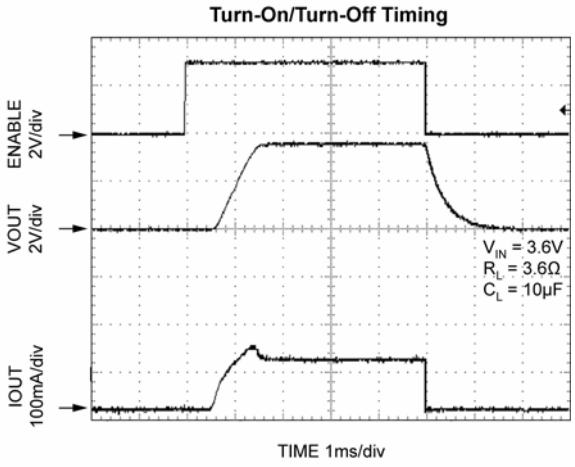
Turn-On/Turn-Off Timing
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VOUT 2V/div
IOUT 100mA/div
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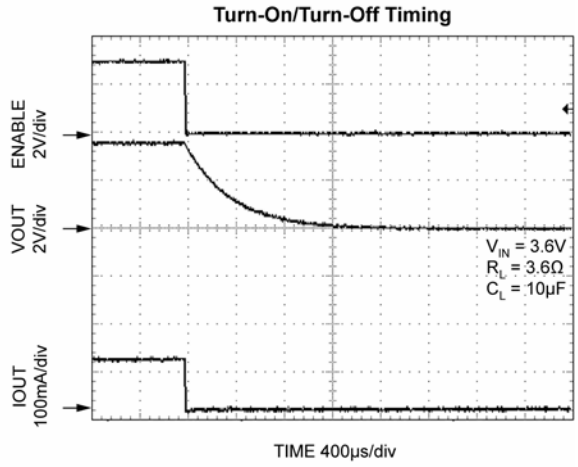
R_L = 3.6Ω
C_L = 10µF
TIME 1ms/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
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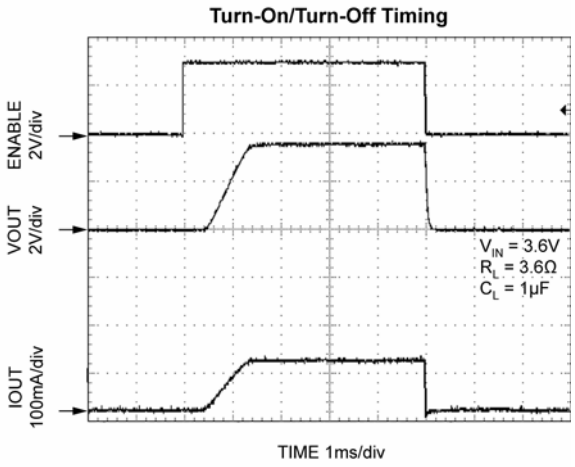
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 10µF
TIME 400µs/div

MIC94069


Turn-On/Turn-Off Timing
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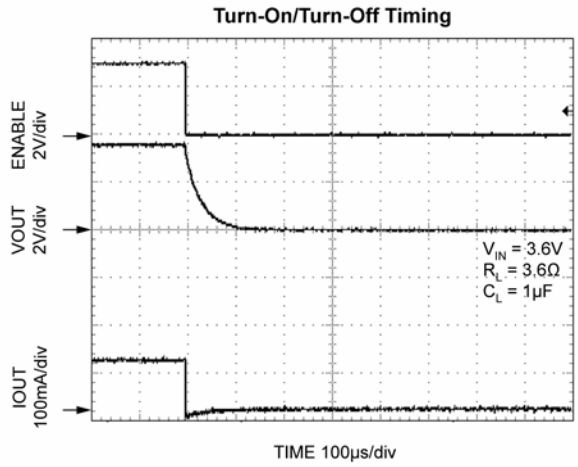
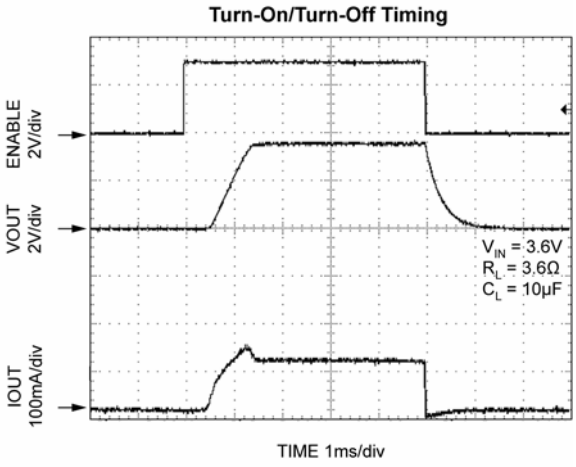
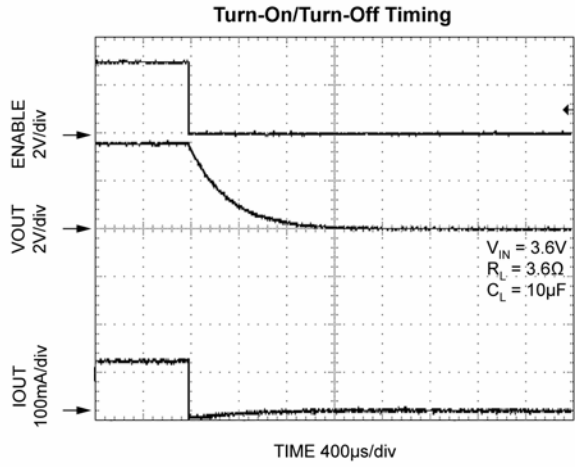
R_L = 3.6Ω
C_L = 1µF
TIME 1ms/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 100mA/div
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 1µF
TIME 100µs/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 100mA/div
V_{IN} = 3.6V
R_L = 3.6Ω
C_L = 10µF
TIME 1ms/div


Turn-On/Turn-Off Timing
ENABLE 2V/div
VOUT 2V/div
IOUT 100mA/div
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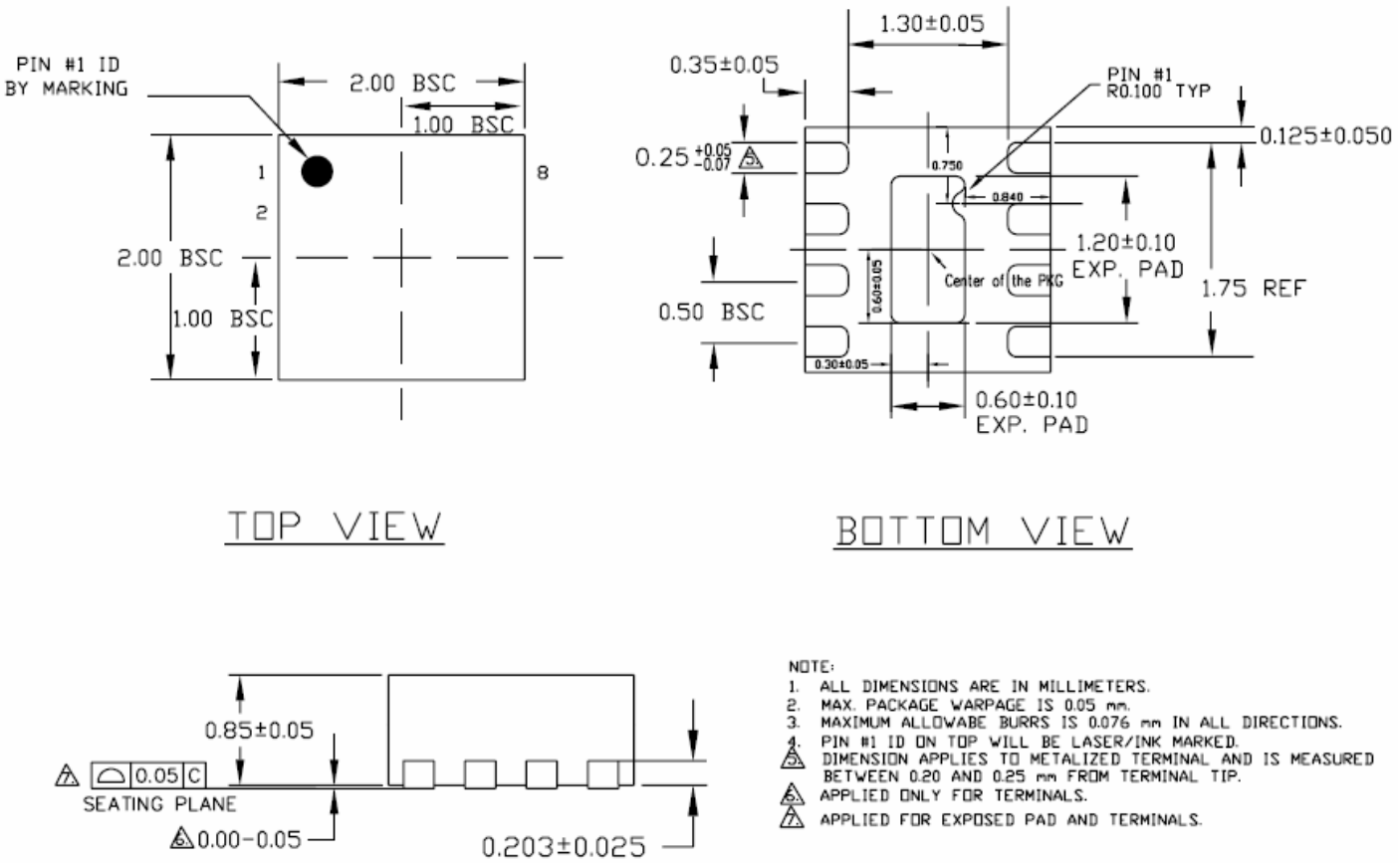
R_L = 3.6Ω
C_L = 10µF
TIME 400µs/div

Package Information



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