# 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.

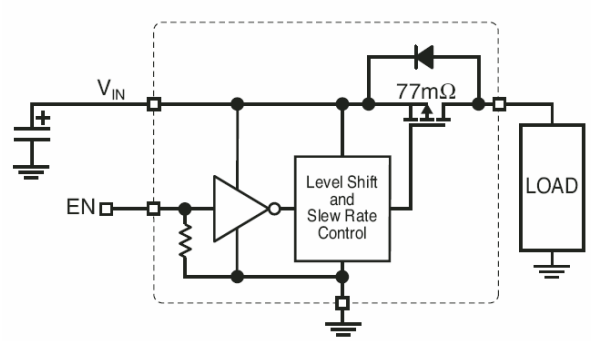
## Features

- 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™

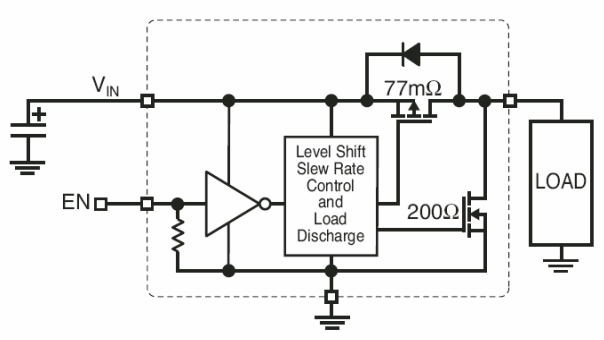
## Applications

- 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**



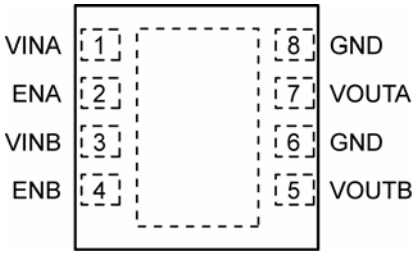

**½ MIC94067, 69**
**Load Switch with Capacitive Load Discharge**

## Ordering Information

| Part Number | Part Marking* | Soft-Start | Load Discharge | Pb-Free Package |
|---|---|---|---|---|
| MIC94066YML | P66 | | | 2x2 mm MLF™ |
| MIC94067YML | P67 | | • | |
| MIC94068YML | P68 | • | | |
| MIC94069YML | 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 ($\Theta_{JA}$) ..... 90°C/W
2x2 MLF ($\Theta_{JC}$) [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.)

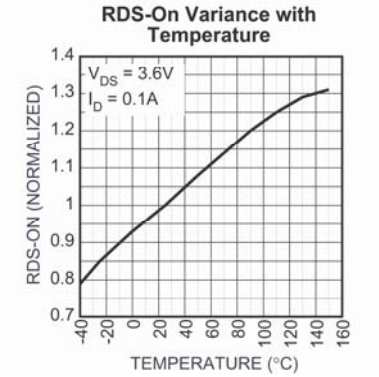
| | | | | | | |
|---|---|---|---|---|---|---|
| $t_{OFF\_FALL}$ | Turn-Off Fall Time | $V_{IN}$ = +3.6V, ID = –100mA, $V_{EN}$ = 1.5V MIC94066, 67 | | 60 | 100 | ns |
| | | $V_{IN}$ = +3.6V, ID = –100mA, $V_{EN}$ = 1.5V MIC94068, 69 | | 60 | 100 | ns |

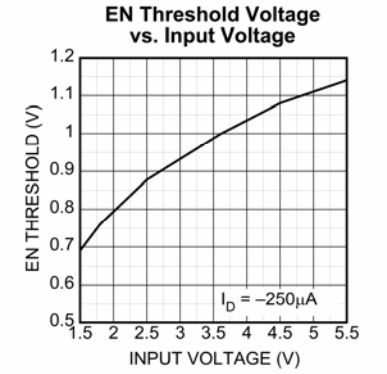
Notes:

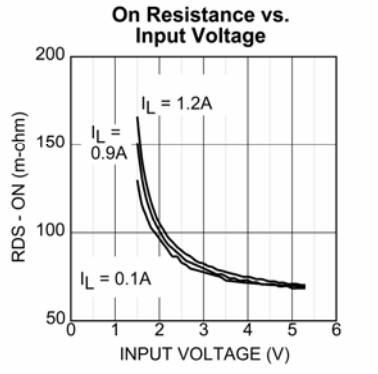
1. Exceeding the absolute maximum rating may damage the device.
2. The device is not guaranteed to function outside its operating rating.
3. With backside thermal contact to PCB.
4. Pulse width <300µs with < 2% duty cycle.
5. Continuous body diode current conduction (reverse conduction, i.e. $V_{OUT}$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

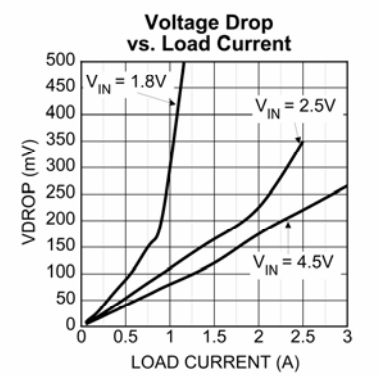
## Typical Characteristics

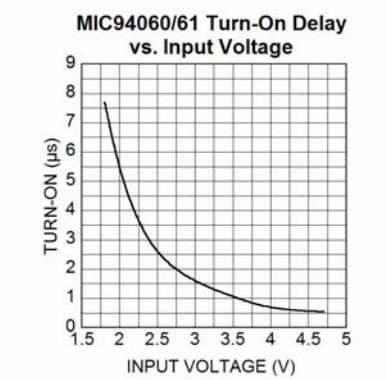
$R_L$ = 100mA, $C_L$ = 0µF for the following plots

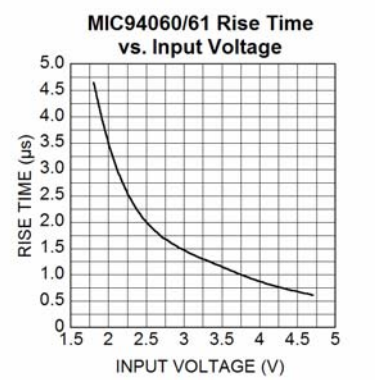


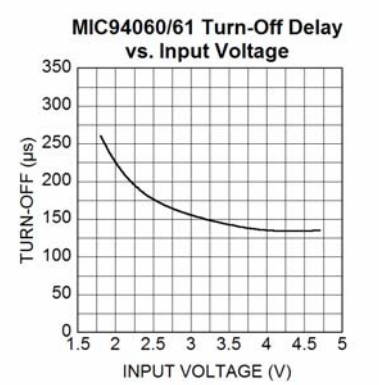



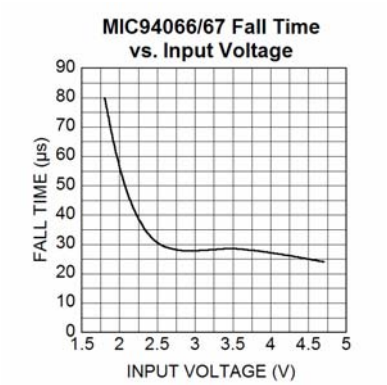



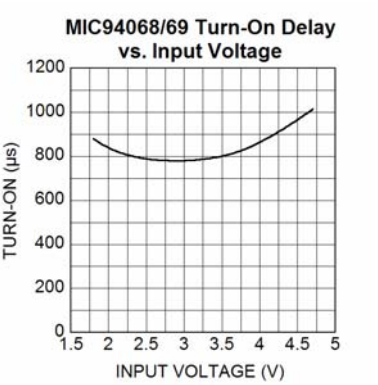



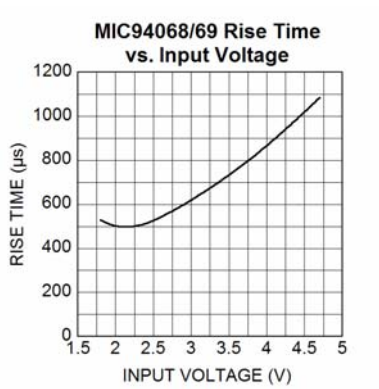



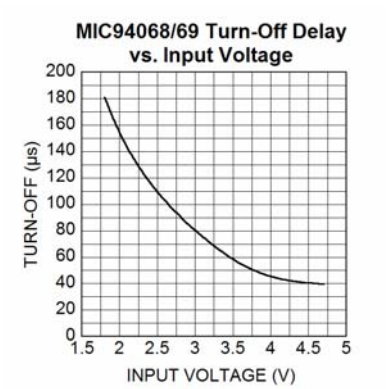



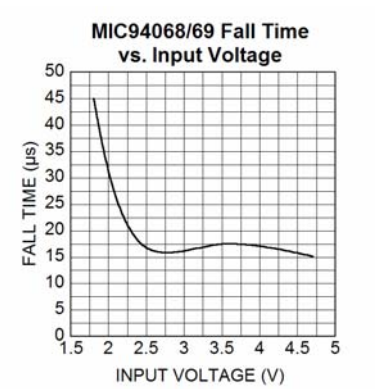



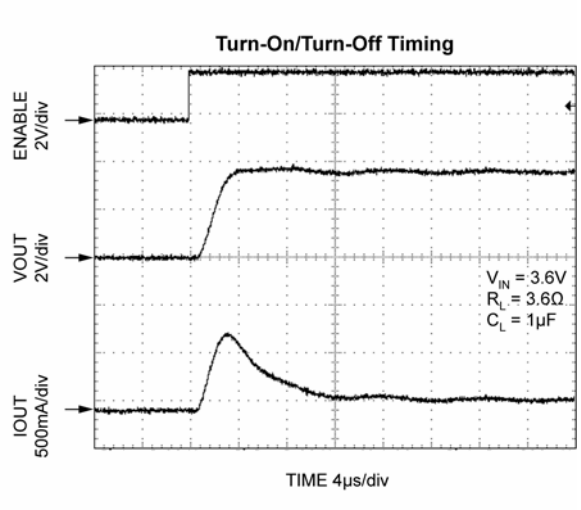



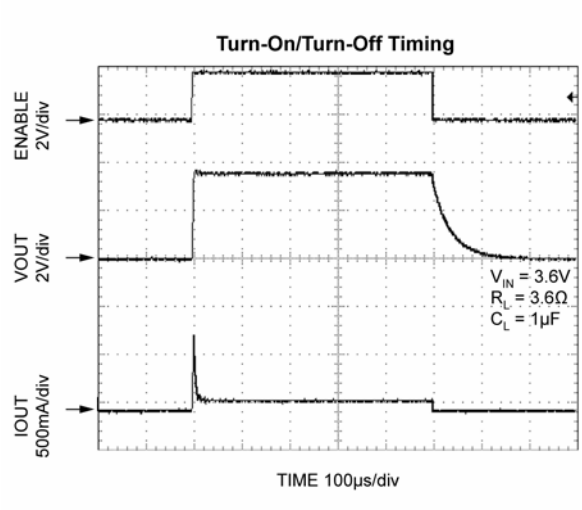



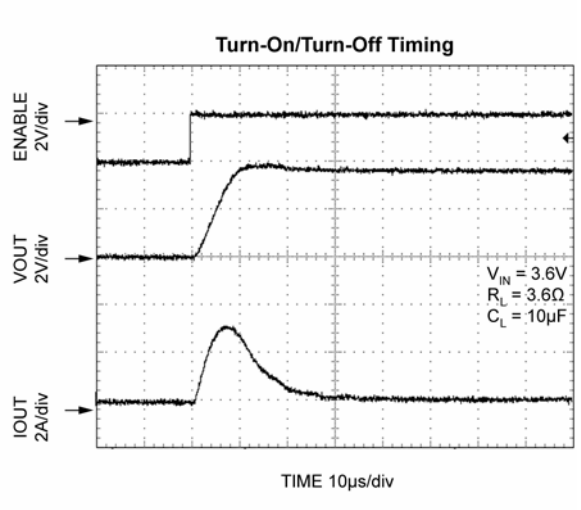



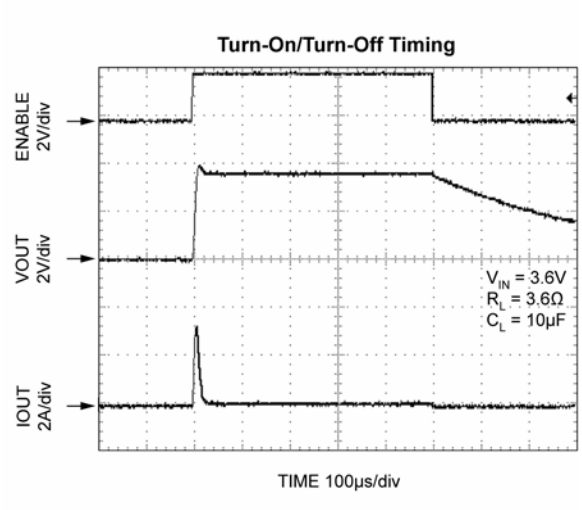
## Functional Characteristics

### MIC94066

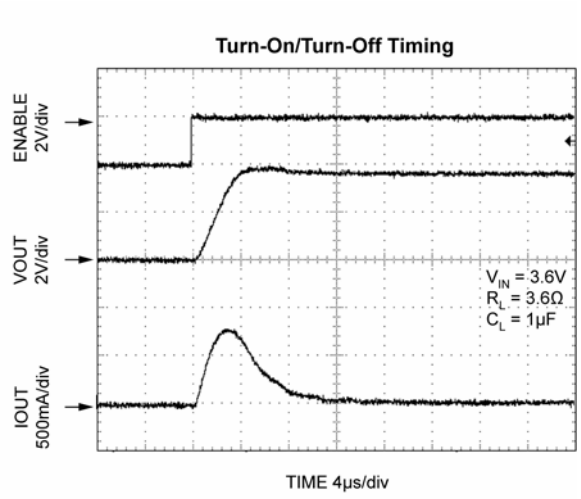


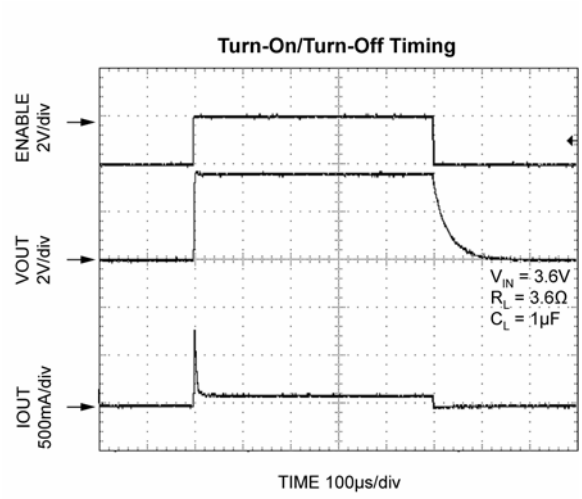



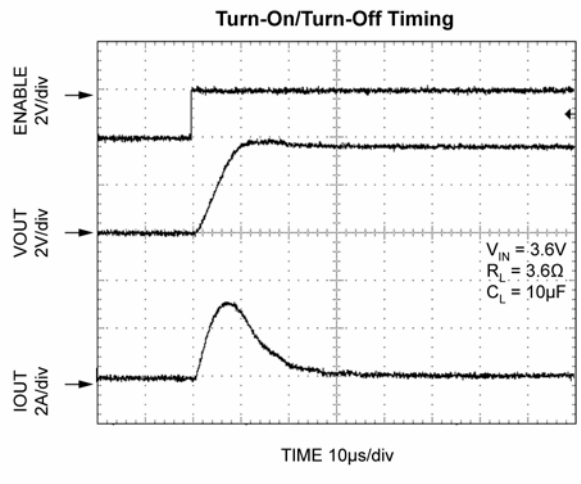



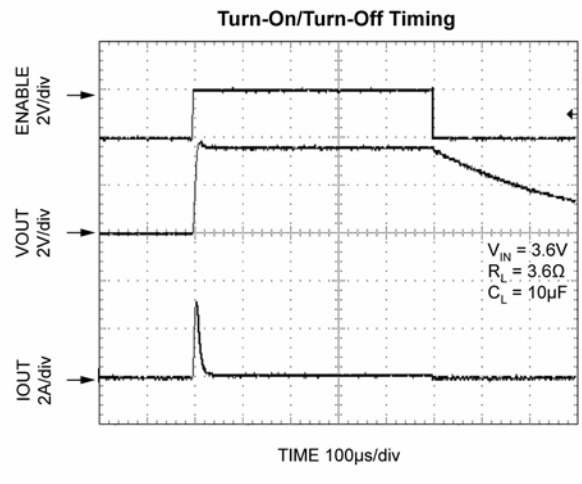



## MIC94067

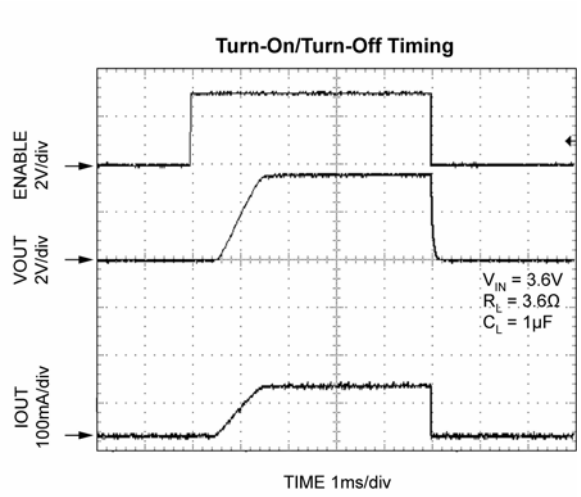


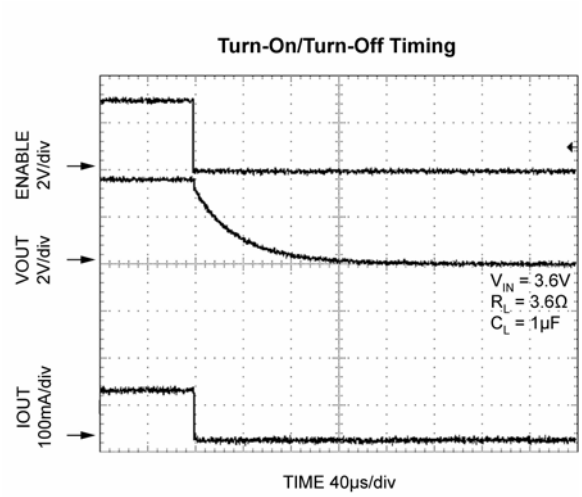



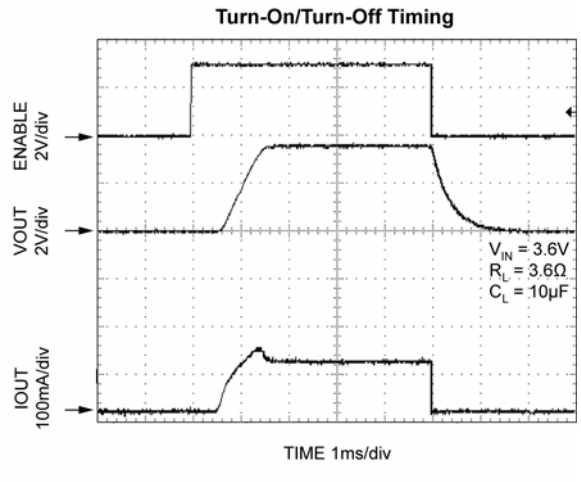



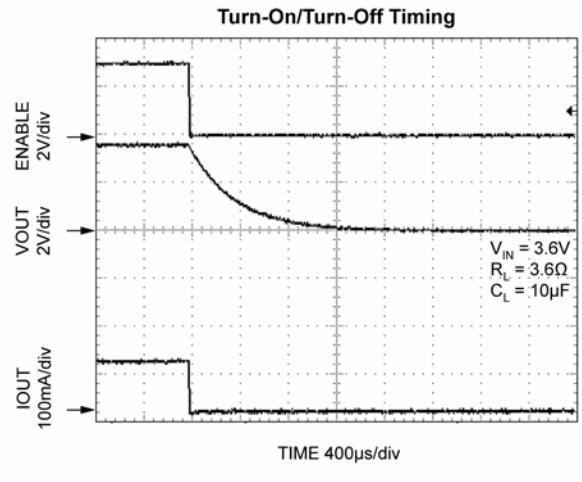



## MIC94068

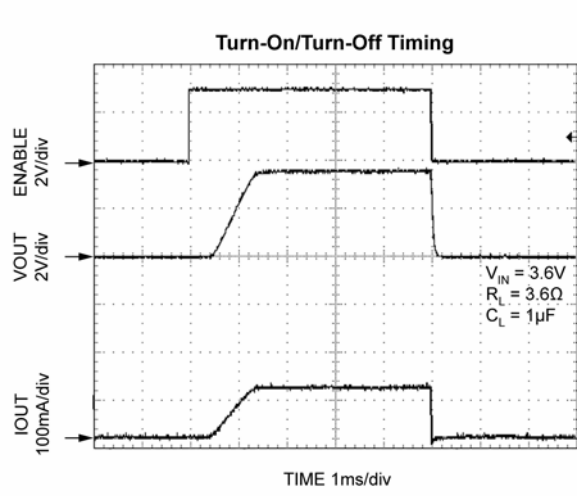


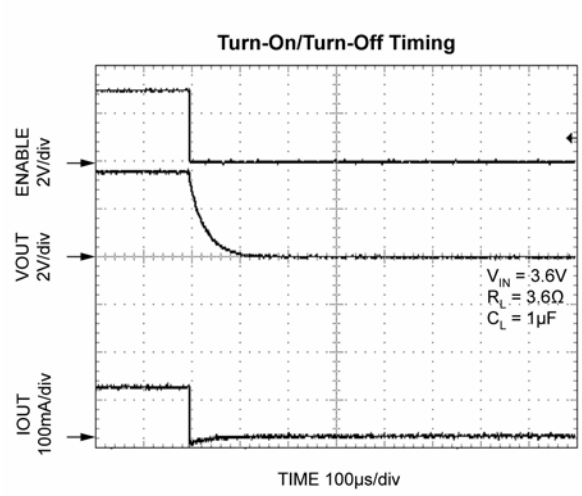



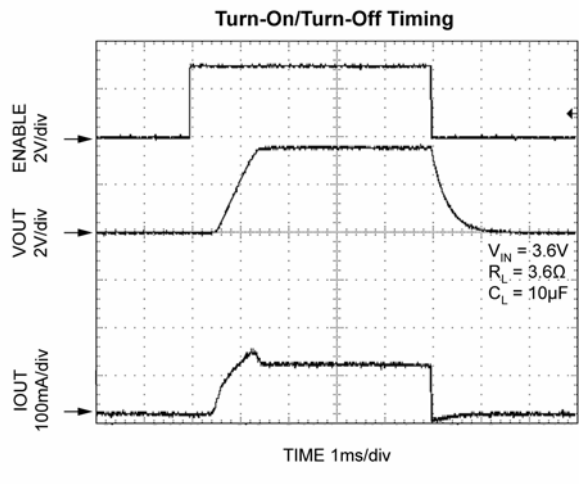



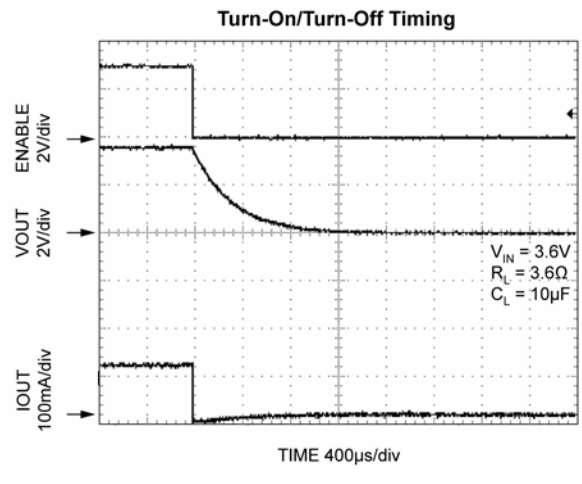



## MIC94069

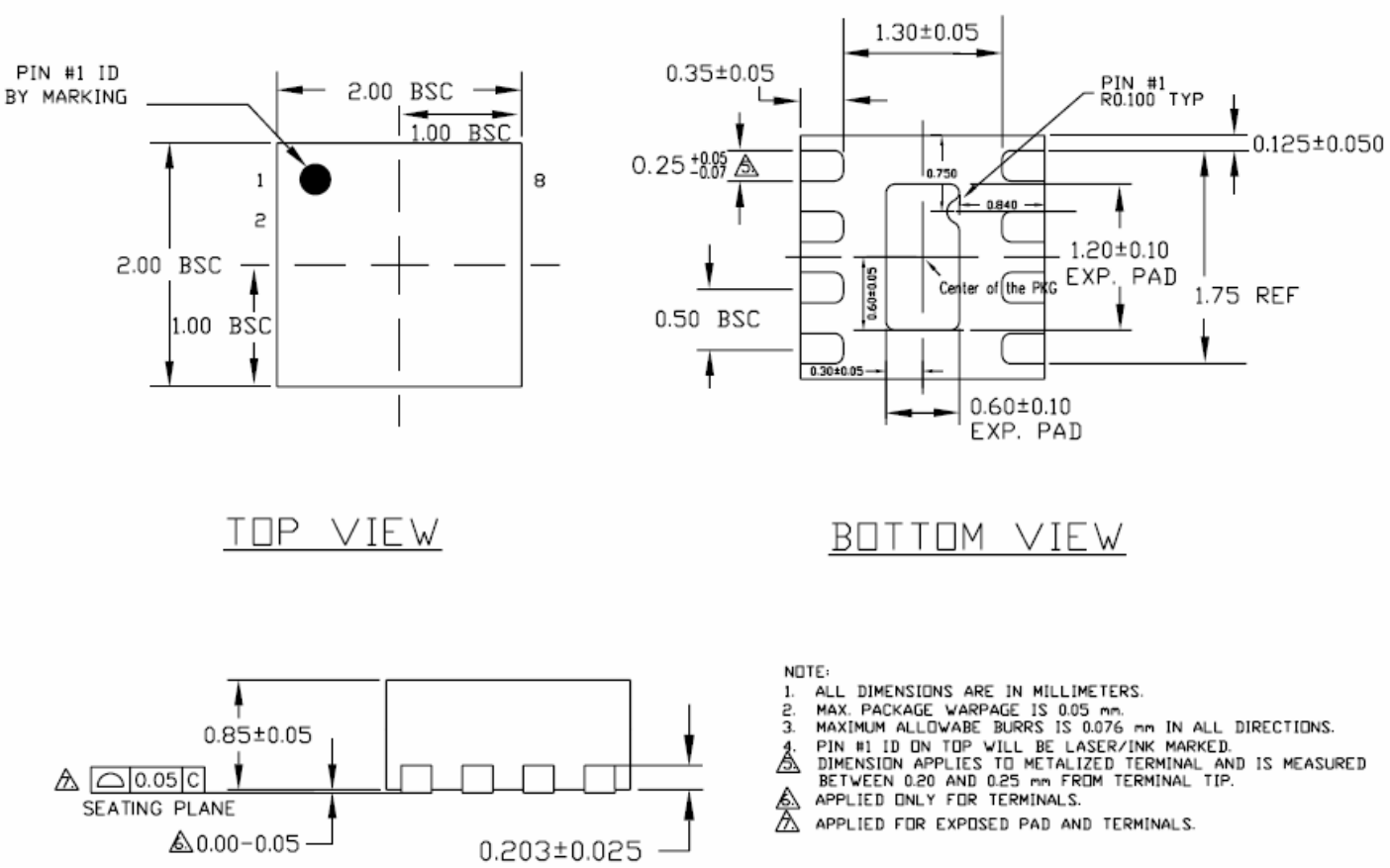


## Package Information




***MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA***
TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB http:/www.micrel.com