



LTC1177-5/LTC1177-12

Isolated MOSFET Drivers

FEATURES

- **UL Recognized**  File E151738 to UL1577
- **No Secondary Power Supply**
- **Drives Any Logic Level FET**
- Low Input Current: 1mA Typ (LTC1177-5), 2.5mA Typ (LTC1177-12)
- Turns On in 1ms Typ and Turns Off in 1ms Typ
- 2500V_{RMS} of Isolation Voltage
- Isolates Input from High Voltage Transients at Load
- Clean, Bounce-Free Switching
- Current Limit
- Small Outline Package

APPLICATIONS

- Solid State Relay
- Isolated Solenoid Driver
- Isolated Motor Driver
- Isolated Lamp Driver

DESCRIPTION

The LTC[®]1177-5/LTC1177-12 are isolated high side MOSFET drivers. When used with an external N-channel MOSFET, the LTC1177-5/LTC1177-12 form an isolated solid state switch for reliable bounce-free switching operation. The output does not require an auxiliary power supply to maintain an on-state condition.

Two lead frame capacitors are used to transfer energy from the input to drive the gate of the MOSFET and provide the necessary isolation. Unlike optoisolated FET drivers, the input current for the LTC1177-5 is only 1mA and 2.5mA for LTC1177-12. It also does not have the aging problems endemic to optocouplers.

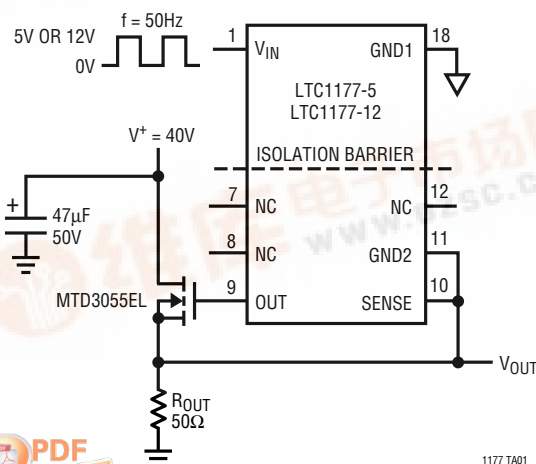
Both devices provide 2500V_{RMS} (1 minute) or 3000V_{RMS} (1 second) of output-to-input isolation.

The LTC1177-5/LTC1177-12 are available in the 18-pin PDIP or 28-pin SW package.

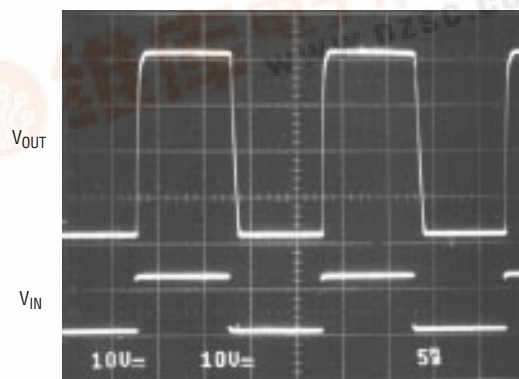
 LTC and LT are registered trademarks of Linear Technology Corporation.

TYPICAL APPLICATION

Isolated High Side Switch



Input vs Output



1177 TA02

LTC1177-5/LTC1177-12

ABSOLUTE MAXIMUM RATINGS

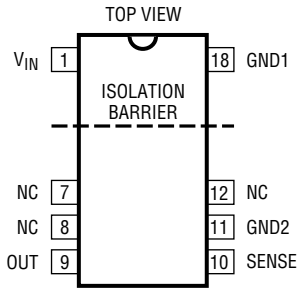
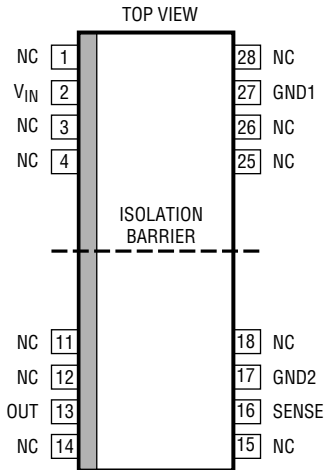
Input Voltages

V_{IN} (LTC1177-5)	6V to (GND1 – 0.3V)
V_{IN} (LTC1177-12)	13.2V to (GND1 – 0.3V)
Sense (LTC1177-5)	6V to (GND2 – 0.3V)
Sense (LTC1177-12)	12V to (GND2 – 0.3V)
Output Voltages	12V to (GND2 – 0.3V)

Operating Temperature Range

Commercial	0°C to 70°C
Industrial	–40°C to 85°C
Storage Temperature Range	–65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

PACKAGE/ORDER INFORMATION

 N PACKAGE 18-LEAD PDIP ISOLATION BARRIER $T_{JMAX} = 125^{\circ}\text{C}$, $\theta_{JA} = 110^{\circ}\text{C/W}$	ORDER PART NUMBER	 SW PACKAGE 28-LEAD PLASTIC SO WIDE ISOLATION BARRIER $T_{JMAX} = 125^{\circ}\text{C}$, $\theta_{JA} = 125^{\circ}\text{C/W}$	ORDER PART NUMBER
	LTC1177CN-5 LTC1177CN-12 LTC1177IN-5 LTC1177IN-12		LTC1177CSW-5 LTC1177CSW-12 LTC1177ISW-5 LTC1177ISW-12

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS $V_{IN} = 5\text{V}$, $T_A = 25^{\circ}\text{C}$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LTC1177-5			UNITS
				MIN	TYP	MAX	
V _{OUT}	Output Voltage (Refer to GND2)	C _{OUT} = 1000pF, No Load (N Pkg)	●	6.5	7.5	10	V
		C _{OUT} = 1000pF, No Load, V _{IN} = 4.75V (N Pkg)	●	5.5	6.5	10	V
		C _{OUT} = 1000pF, No Load (SW Pkg)	●	7.0	8.0	10	V
		C _{OUT} = 1000pF, No Load, V _{IN} = 4.75V (SW Pkg)	●	6.0	7.0	10	V
I _{IN}	Input Current	C _{IN} = 1000pF	●		1.0	1.5	mA
I _{LIM}	Current Limit	R _{SENSE} = 1Ω (LTC1177C-5)	●	400	620	800	mA
		R _{SENSE} = 1Ω (LTC1177I-5)	●	350	620	900	mA
t _{ON}	Turn-On Time	C _{OUT} = 1000pF, No Load (LTC1177C-5)	●		1.0	4.0	ms
		C _{OUT} = 1000pF, No Load (LTC1177I-5)	●		1.0	4.5	ms
t _{OFF}	Turn-Off Time	C _{OUT} = 1000pF, No Load	●		1.0	1.8	ms
V _{ISO}	Isolation Voltage	1 Minute (Note 1) 1 Second		2500 3000			V _{RMS} V _{RMS}
t _{CM}	Common Mode Slew Rate	V _{OUT} < 1.5, C _{OUT} = 1000pF				1000	V/μs

ELECTRICAL CHARACTERISTICS

$V_{IN} = 12V$, $T_A = 25^\circ C$ unless otherwise noted.

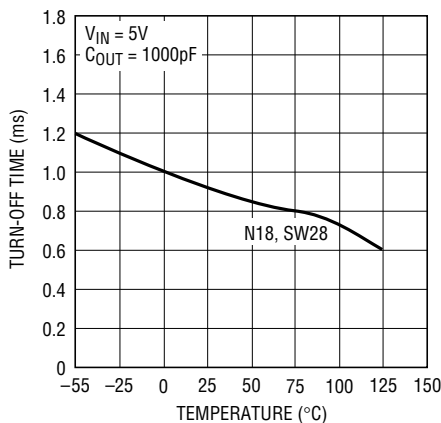
SYMBOL	PARAMETER	CONDITIONS		LTC1177-12			UNITS
				MIN	TYP	MAX	
V_{OUT}	Output Voltage (Refer to GND2)	$C_{OUT} = 1000pF$, No Load (LTC1177C-12, N Pkg)	●	4.65	5.2	8	V
		$C_{OUT} = 1000pF$, No Load (LTC1177C-12, SW Pkg)	●	5.00	5.7	8	V
		$C_{OUT} = 1000pF$, $V_{IN} = 11.4V$ (LTC1177C-12, N Pkg)	●	4.40	4.9	7	V
		$C_{OUT} = 1000pF$, $V_{IN} = 11.4V$ (LTC1177C-12, SW Pkg)	●	4.60	5.3	7	V
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, N Pkg)	●	4.50	5.2	8	V
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, SW Pkg)	●	4.75	5.7	8	V
		$C_{OUT} = 1000pF$, $V_{IN} = 11.4V$ (LTC1177I-12, SW Pkg)	●	4.50	5.3	7	V
I_{IN}	Input Current	$C_{IN} = 1000pF$ (LTC1177C-12)	●		2.5	3.0	mA
		$C_{IN} = 1000pF$ (LTC1177I-12)	●		2.5	3.4	mA
I_{LIM}	Current Limit	$R_{SENSE} = 1\Omega$ (LTC1177C-12)	●	400	620	800	mA
		$R_{SENSE} = 1\Omega$ (LTC1177I-12)	●	350	620	900	mA
t_{ON}	Turn-On Time	$C_{OUT} = 1000pF$, No Load (LTC1177C-12)	●		1.0	2.5	ms
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, N Pkg)			1.0		ms
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, SW Pkg)	●		1.0	2.5	ms
t_{OFF}	Turn-Off Time	$C_{OUT} = 1000pF$, No Load (LTC1177C-12)	●		1.0	1.2	ms
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, N Pkg)			1.0		ms
		$C_{OUT} = 1000pF$, No Load (LTC1177I-12, SW Pkg)	●		1.0	1.5	ms
V_{ISO}	Isolation Voltage	1 Minute (Note 1)		2500			V_{RMS}
		1 Second		3000			V_{RMS}
TCM	Common Mode Slew Rate	$V_{OUT} < 1.5V$, $C_{OUT} = 1000pF$				1000	$V/\mu s$

The ● denotes specifications which apply over the full operating temperature range.

Note 1: Value derived from 1 second test.

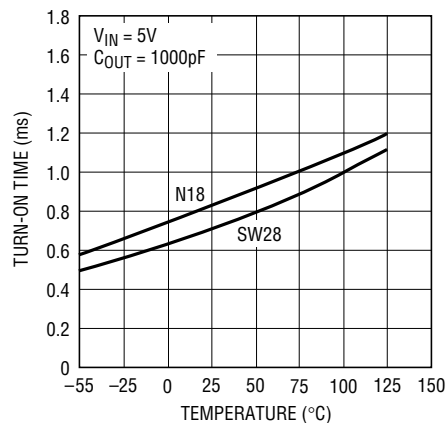
TYPICAL PERFORMANCE CHARACTERISTICS

LTC1177-5
Turn-Off Time to $V_{OUT} = 1V$
vs Temperature



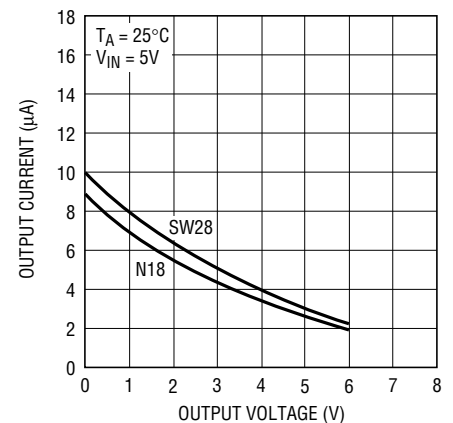
1177-5 G01

LTC1177-5
Turn-On Time to $V_{OUT} = 4.5V$
vs Temperature



1177-5 G02

LTC1177-5
Output Current vs Output Voltage

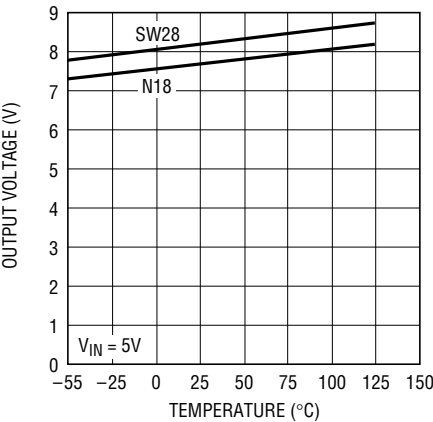


1177-5 G03

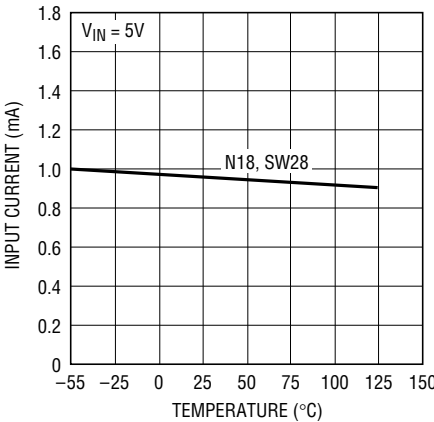
LTC1177-5/LTC1177-12

TYPICAL PERFORMANCE CHARACTERISTICS

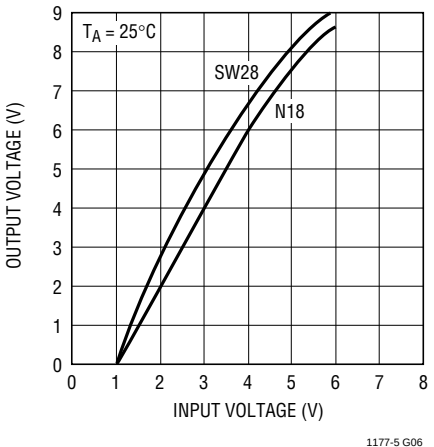
LTC1177-5
Output Voltage vs Temperature



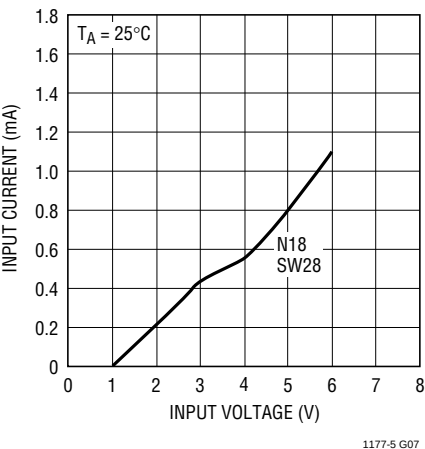
LTC1177-5
Input Current vs Temperature



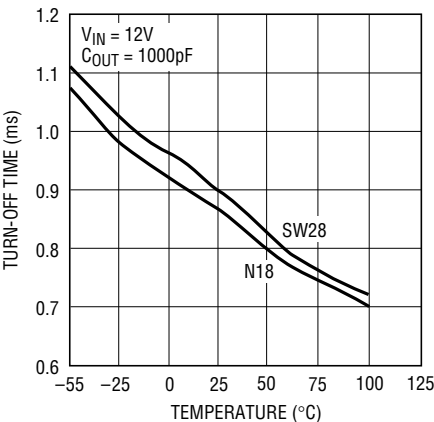
LTC1177-5
Output Voltage vs Input Voltage



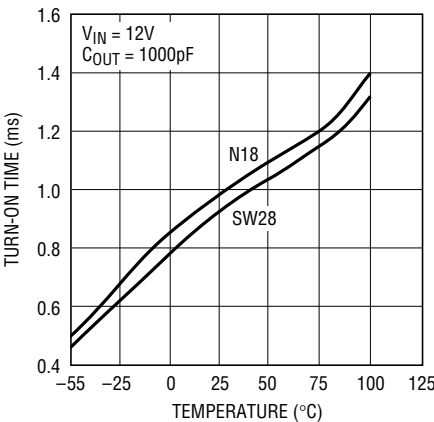
LTC1177-5
Input Current vs Input Voltage



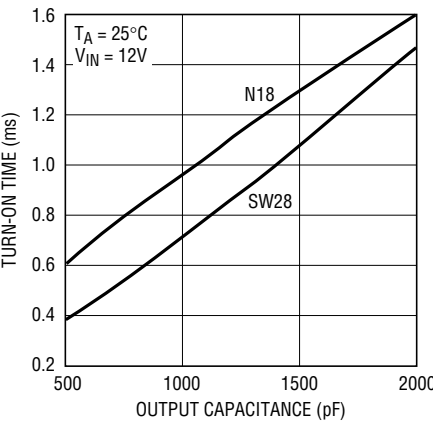
LTC1177-12 Turn-Off Time to $V_{OUT} = 1V$ vs Temperature



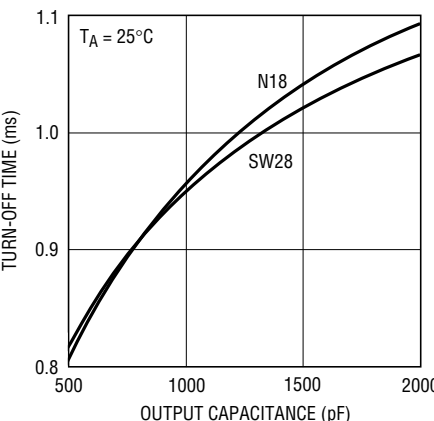
LTC1177-12 Turn-On Time to $V_{OUT} = 4.5V$ vs Temperature



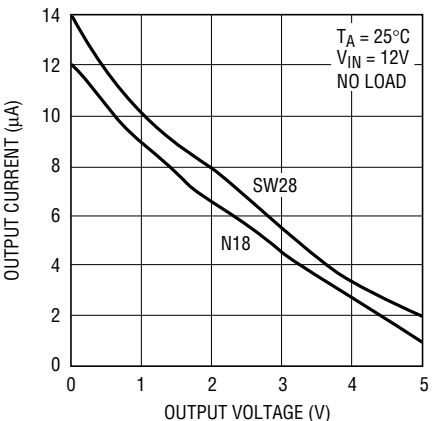
LTC1177-12
Turn-On Time to $V_{OUT} = 4.5V$ vs Output Capacitance



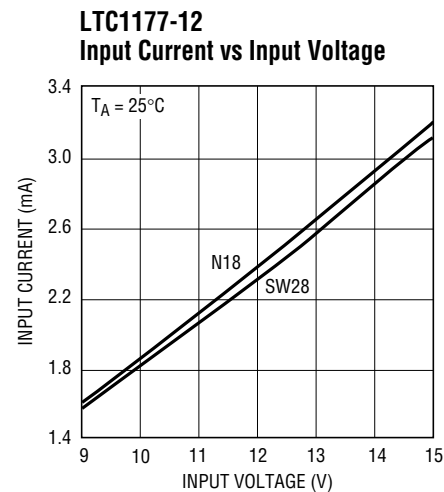
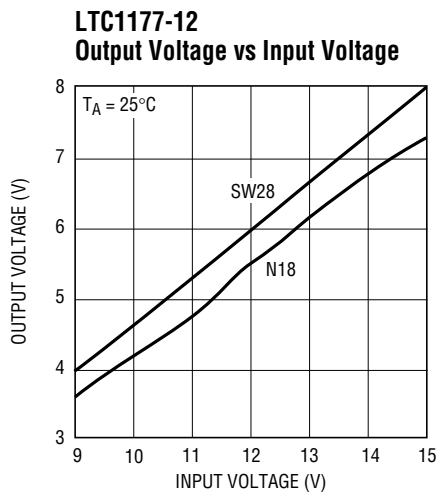
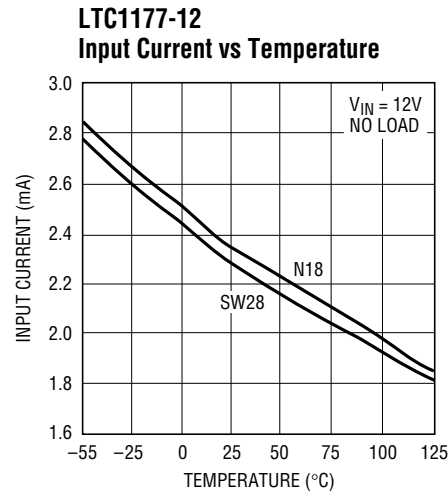
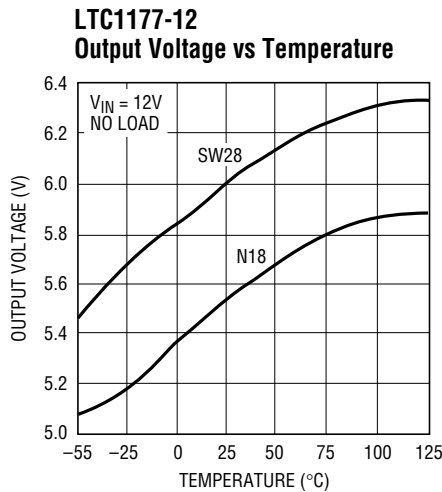
LTC1177-12
Turn-Off Time to $V_{OUT} = 1V$ vs Output Capacitance



LTC1177-12
Output Current vs Output Voltage



TYPICAL PERFORMANCE CHARACTERISTICS



PIN FUNCTIONS

V_{IN}: Voltage Input, $5.25V \geq V_{IN} \geq 4.75V$ (LTC1177-5) and $12.6V \geq V_{IN} \geq 11.4V$ (LTC1177-12). Connect a $0.01\mu F$ capacitor between V_{IN} and GND1 when the source impedance is high or the V_{IN} connection is long.

OUT: Output Voltage. The output voltage level is 8V (typ) for SW package and 7.5V (typ) for N package (LTC1177-5) with 5V at V_{IN} pin; 5.7V (typ) for SW package and 5.2V (typ) for N package (LTC1177-12) with 12V at V_{IN} pin. This pin is to drive the gate of the external N-channel MOSFET.

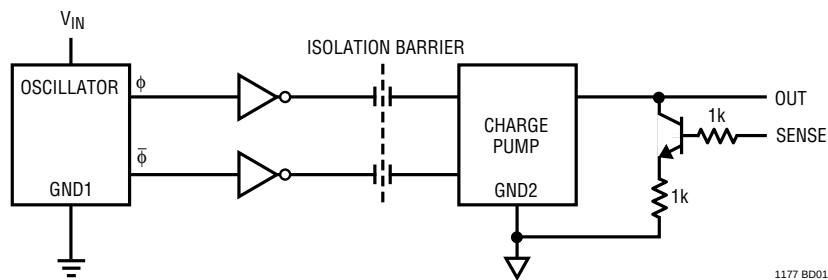
SENSE: Current Limit Sense Input. Connecting a 1Ω resistor from the Sense pin to GND2 limits the current through the power MOSFET to 620mA (typ). $I_{LIM} = 620mV/R_{SENSE}$.

GND2: Floating Ground Connects to the source of the external N-channel MOSFET.

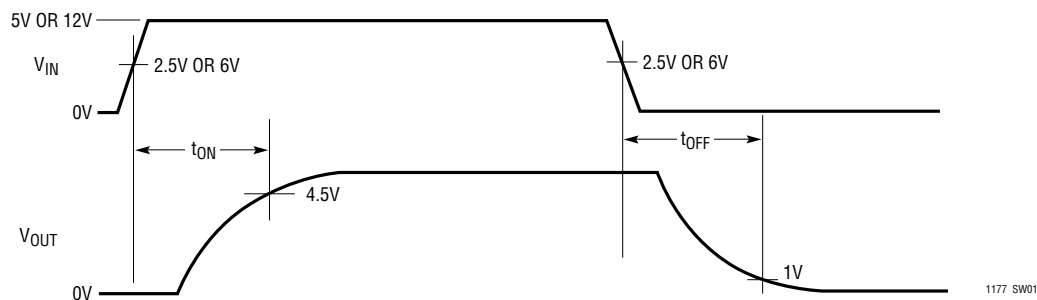
GND1: Input Ground. The ground connection of the input control signal.

LTC1177-5/LTC1177-12

BLOCK DIAGRAM

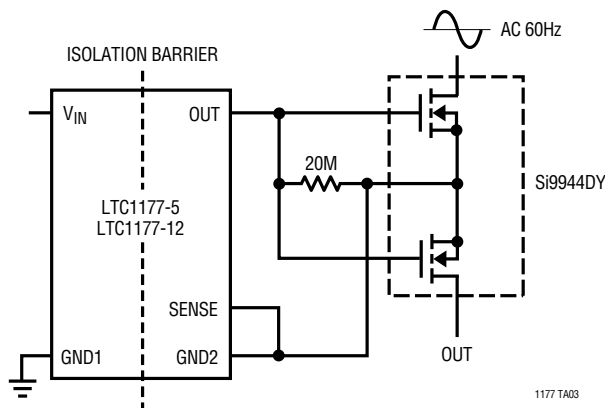


SWITCHING WAVEFORMS

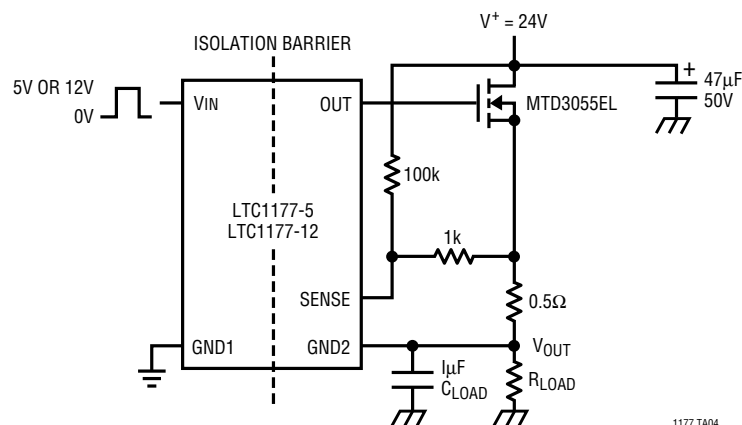


TYPICAL APPLICATIONS

Solid State Relay



Isolated High Side Switch with Fold-Back Current Limit



The schematic shows two LTC1177-5 LTC1177-12 comparators connected in a differential configuration. A dashed vertical line labeled "ISOLATION BARRIER" separates the two comparators. The top comparator has its V_{IN} input connected to a common-mode input signal and its $GND1$ pin connected to ground. Its OUT pin is connected to the gate of the top MOSFET of an IRFR224 pair. The bottom comparator has its V_{IN} input connected to a common-mode input signal and its $GND1$ pin connected to ground. Its OUT pin is connected to the gate of the bottom MOSFET of the IRFR224 pair. The $SENSE$ pins of both comparators are connected to a common sense line, which is then connected to the source of the MOSFET pair. The $GND2$ pins of both comparators are connected to a common ground. The MOSFET pair is configured as a source follower, with its sources connected to a common source resistor (20M) and its gates connected to the outputs of the comparators. The drain of the MOSFET pair is connected to a common drain supply (AC 60Hz). The output of the MOSFET pair is labeled OUT .

5V OR 12V

1 9

LTC1177-5
LTC1177-12

GND 18 10 11

49.9k
4.32k
5k
6.81k
49.9k

1 2 3 4 5 6 7 8

ON/OFF V⁺
LTC1041 V_{P-P}
V_{IN} V_{P-P}
SET POINT OSC
GND DELTA

DELTA = 0.5°F

10M 10µF 1µF

2 4 7, 8 1, 3 5, 6

Si9955DY

56Ω 100nF

26VAC
2-WIRE
THERMOSTAT

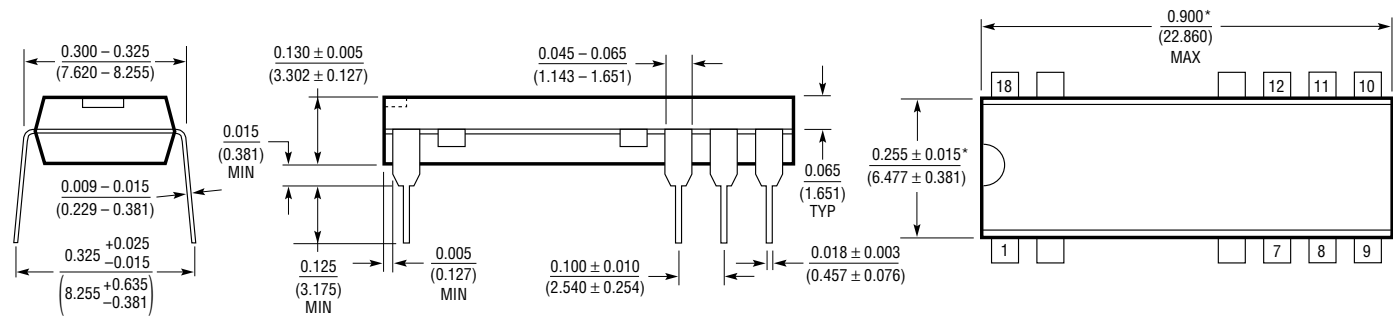
ALL RESISTORS 1%
* YELLOW SPRINGS INSTRUMENT CO. INC. P/N 44007
DRIVING THERMISTOR WITH V_{P-P} ELIMINATES 3.8°F
SELF-HEATING ERROR

1177 TA06

LTC1177-5/LTC1177-12

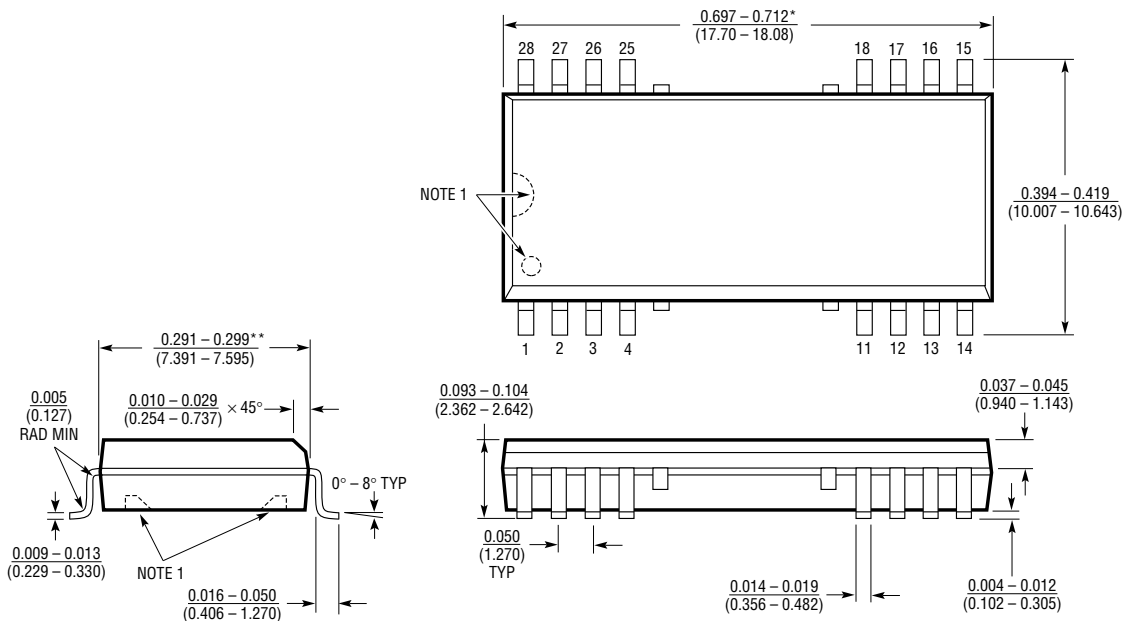
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

N Package
18-Lead PDIP Isolation Barrier (Narrow 0.300)
(LTC DWG # 05-08-1590)



*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

SW Package
28-Lead Plastic Small Outline Isolation Barrier (Wide 0.300)
(LTC DWG # 05-08-1690)



NOTE:
1. PIN 1 IDENT. NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS
THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS.
*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE
**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1145/LTC1146	Low Power Digital Isolator	Passes Digital Information Across Isolation Barrier
LT®1158	Half-Bridge N-Channel Power MOSFET Driver	Useful for Motor Speed Control, Synchronous Switching Regulator
LTC1255	Dual 24V High Side MOSFET Driver	User Set Current Limiting