


FEATURES

- UL Recognized  (LTC1145A, LTC1146A)
File E151738 to UL1577
- **Low Input Current**
LTC1145: 700 μ A
LTC1146: 70 μ A
- Maximum Input Frequency
 LTC1145: 200kHz
 LTC1146: 20kHz
- TTL Level Output
- Noise Filter Prevents Glitches at the Output
- Output Can Be Synchronized to an External Clock

APPLICATIONS

- Low Power Opto-Isolator Replacement
- Isolated Serial Data Interfaces
- Isolated Power MOSFET Drivers

DESCRIPTION

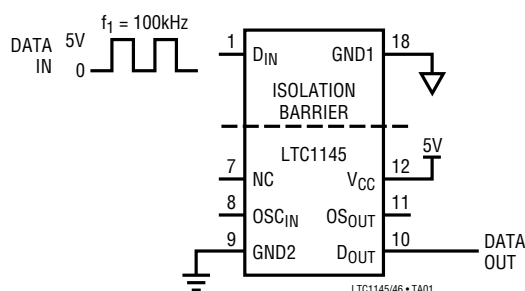
The LTC1145A/LTC1146A provide 2500V_{RMS} (1 minute) or 3000V_{RMS} (1 second) of input to output isolation for TTL digital/CMOS signals. The LTC1145/LTC1146 are intended for less stringent applications and are rated for 500V_{RMS}. Unlike opto-isolators, the input current is a mere 70 μ A for the LTC1146 which can handle frequencies up to 20kHz. The faster LTC1145 will handle frequencies up to 200kHz while only drawing 700 μ A.

The output signal is in phase with the input and swings between GND2 and V_{CC} providing a TTL/CMOS compatible signal without any pull-up resistors. An on-chip noise filter helps prevent glitches and data errors at the output, and a pin is provided for synchronizing the output signal to an external system clock.

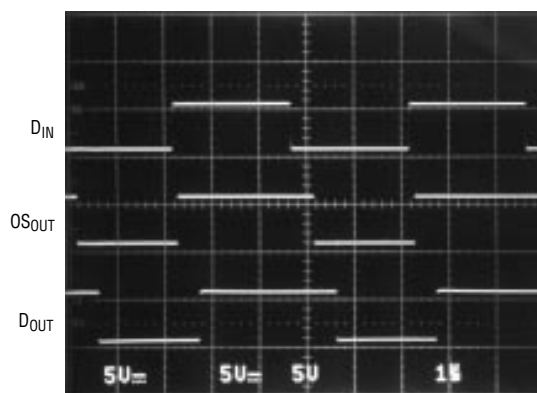
EDN IC Innovation of the Year Winner

TYPICAL APPLICATION

Digital Isolation Interface
Data Rate Up to 200kHz



LTC1145 Typical Waveforms



OSOUT AND DOUT LOADED WITH 15pF SCOPE PROBE

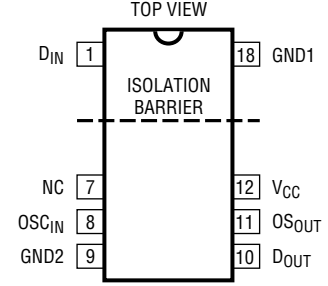
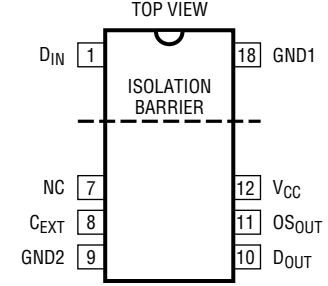
LTC1145/6 • TA02

ABSOLUTE MAXIMUM RATINGS

Supply Voltage 12V
 Input Voltage
 D_{IN} 11V to (GND1 – 0.3V)
 OSC_{IN} ($V_{CC} + 0.3V$) to (GND2 – 0.3V)
 Output Voltage
 OS_{OUT} , D_{OUT} ($V_{CC} + 0.3V$) to (GND2 – 0.3V)

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

PACKAGE/ORDER INFORMATION

|  <p>TOP VIEW</p> <p>ISOLATION BARRIER</p> <p>N PACKAGE 18-LEAD PLASTIC DIP</p> <p>$T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 110^{\circ}C/W$</p> | <p>ORDER PART NUMBER</p> <p>LTC1145CN LTC1145ACN</p> |  <p>TOP VIEW</p> <p>ISOLATION BARRIER</p> <p>N PACKAGE 18-LEAD PLASTIC DIP</p> <p>$T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 110^{\circ}C/W$</p> | <p>ORDER PART NUMBER</p> <p>LTC1146CN LTC1146ACN</p> |
|--|--|---|--|
|--|--|---|--|

Consult factory for Industrial and Military grade parts.

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

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------|---------------------------------------|---|------------------|--------------------------|------------------------------|---------------------------|
| LTC1145 | | | | | | |
| V_{OL} | Output Low Voltage | OS_{OUT} , D_{OUT} at 4mA | ● | | 0.4 | V |
| V_{OH} | Output High Voltage | OS_{OUT} , D_{OUT} at 4mA | ● | 3.5 | | V |
| V_{IL} | External Frequency Input Low Voltage | OSC_{IN} | ● | | 0.8 | V |
| V_{IH} | External Frequency Input High Voltage | OSC_{IN} | ● | 2.4 | | V |
| I_{IN} | Input Current | OSC_{IN} at 5V D_{IN} at 3V D_{IN} at 5V D_{IN} at 10V | ● ● ● ● | 0.45 0.70 1.85 | 10.0 0.65 1.30 3.20 | μA mA mA mA |
| I_{CC} | Supply Current | $OSC_{IN} = 0V$ | ● | 2 | 3.5 | mA |
| t_{PLH1} | D_{IN} to OS_{OUT} , Low to High | $C_L = 15pF$ | ● | 0.2 | 0.7 | μs |
| t_{PHL1} | D_{IN} to OS_{OUT} , High to Low | $C_L = 15pF$ | ● | 0.4 | 1.1 | μs |
| t_{PLH2} | D_{IN} to D_{OUT} , Low to High | $C_L = 15pF$ | ● | 0.7 | 1.5 | μs |
| t_{PHL2} | D_{IN} to D_{OUT} , High to Low | $C_L = 15pF$ | ● | 1.1 | 2 | μs |
| SR | Input Signal Slew Rate | D_{IN} | | 1 | | V/ μs |
| CMSR | Common-Mode Slew Rate (Note 1) | $D_{IN} = GND1$ Connected to V_{CM} | | | 1000 | V/ μs |
| V_{INH} | Input High Voltage | D_{IN} | ● | 3 | | V |
| V_{INL} | Input Low Voltage | D_{IN} | ● | | 0.8 | V |
| V_{ISO} | Isolation Voltage, LTC1145A | 1 Minute (Note 2) 1 Second | | 2500 3000 | | V_{RMS} V_{RMS} |

ELECTRICAL CHARACTERISTICS

$V_{CC} = 5V$, $T_A = 25^\circ C$ unless otherwise noted.

| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP | MAX | UNITS |
|----------------|--------------------------------------|---------------------------------------|-----|------|------|------------|
| LTC1146 | | | | | | |
| V_{OL} | Output Low Voltage | OS_{OUT} , D_{OUT} at 4mA | ● | | 0.4 | V |
| V_{OH} | Output High Voltage | OS_{OUT} , D_{OUT} at 4mA | ● | 3.5 | | V |
| V_{IL} | Input Low Voltage | D_{IN} | ● | | 0.8 | V |
| V_{IH} | Input High Voltage | D_{IN} | ● | 3 | | V |
| I_{IN} | Input Current | D_{IN} at 3V | ● | 40 | 80 | μA |
| | | D_{IN} at 5V | ● | 70 | 120 | μA |
| | | D_{IN} at 10V | ● | 225 | 350 | μA |
| I_{CC} | Supply Current | $V_{CC} = 5V$ | ● | 1.8 | 3 | mA |
| t_{PLH1} | D_{IN} to OS_{OUT} , Low to High | $C_L = 15pF$ | ● | 0.5 | 1.5 | μs |
| t_{PHL1} | D_{IN} to OS_{OUT} , High to Low | $C_L = 15pF$ | ● | 6 | 11 | μs |
| t_{PLH2} | D_{IN} to D_{OUT} , Low to High | $C_L = 15pF$, $C_{EXT} = 50pF$ | ● | 5 | 10 | μs |
| t_{PHL2} | D_{IN} to D_{OUT} , High to Low | $C_L = 15pF$, $C_{EXT} = 50pF$ | ● | 10 | 18 | μs |
| SR | Input Signal Slew Rate | D_{IN} | | 1 | | V/ μs |
| CMSR | Common-Mode Slew Rate (Note 1) | $D_{IN} = GND1$ Connected to V_{CM} | | | 1000 | V/ μs |
| V_{ISO} | Isolation Voltage, LTC1146A | 1 Minute (Note 2) | | 2500 | | V_{RMS} |
| | | 1 Second | | 3000 | | V_{RMS} |

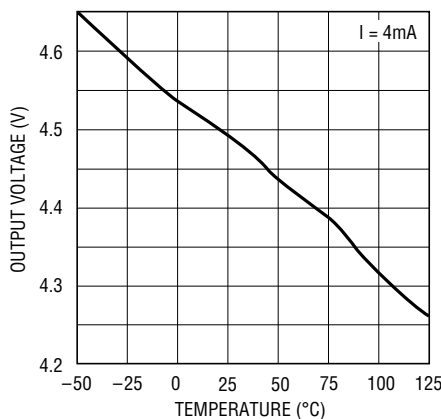
The ● denotes specifications which apply over the operating temperature range.

Note 1: Pins 1 and 18 are connected together. Pins 7 through 12 are connected together.

Note 2: Value derived from 1 second test.

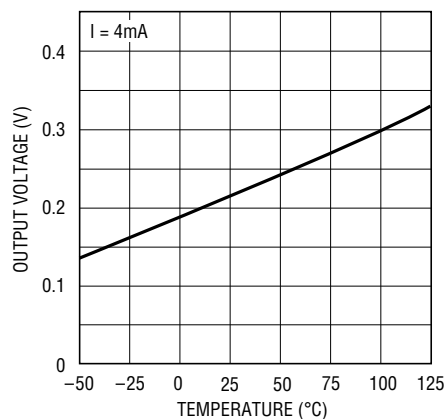
TYPICAL PERFORMANCE CHARACTERISTICS

Output High Voltage (D_{OUT} and OS_{OUT}) vs Temperature



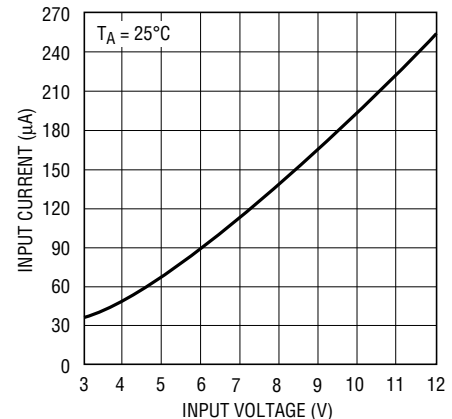
LTC1145/6 • TPC01

Output Low Voltage (D_{OUT} and OS_{OUT}) vs Temperature



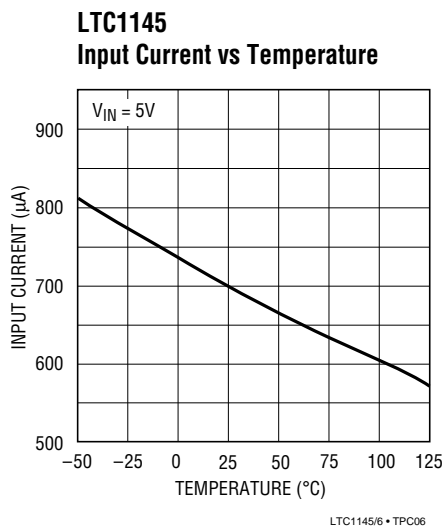
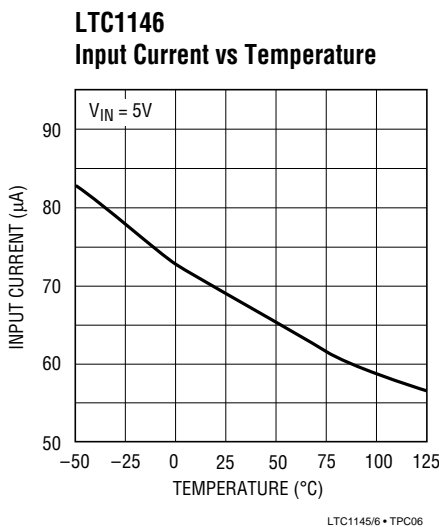
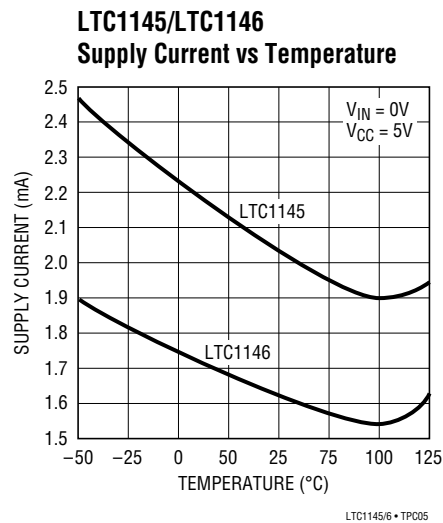
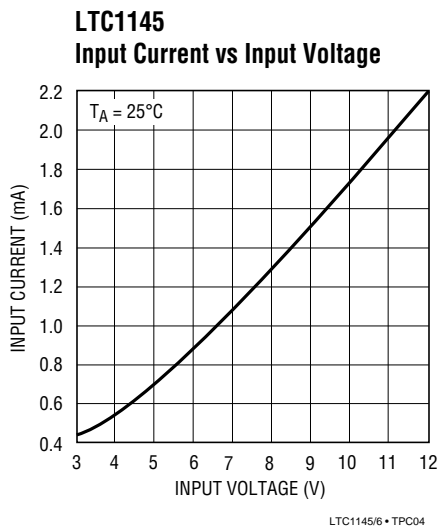
LTC1145/6 • TPC01

LTC1146
Input Current vs Input Voltage



LTC1145/6 • TPC03

TYPICAL PERFORMANCE CHARACTERISTICS



PIN FUNCTIONS

Pin 1 (D_{IN}): Data Input

Pin 7 (NC): Not Connected

Pin 8 (LTC1145 OSC_{IN}): External Frequency Input. The signal on this pin overrides the internal oscillator frequency.

Pin 8 (LTC1146 C_{EXT}): External Capacitor. Connecting a capacitor at this pin allows the internal oscillator frequency to be slowed down.

Pin 9 (GND2): The Ground Connection of the Receiver Die.

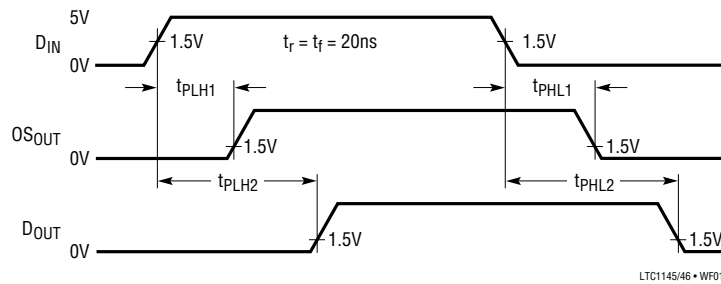
Pin 10 (D_{OUT}): Data Output. The output signal has gone through the internal filter. The output level is TTL compatible.

Pin 11 (OS_{OUT}): One-Shot Output. The output signal that does not go through the internal filter. The output level is TTL compatible.

Pin 12 (V_{CC}): Positive Supply of the Receiver Die, $4.5V < V_{CC} < 5.5V$.

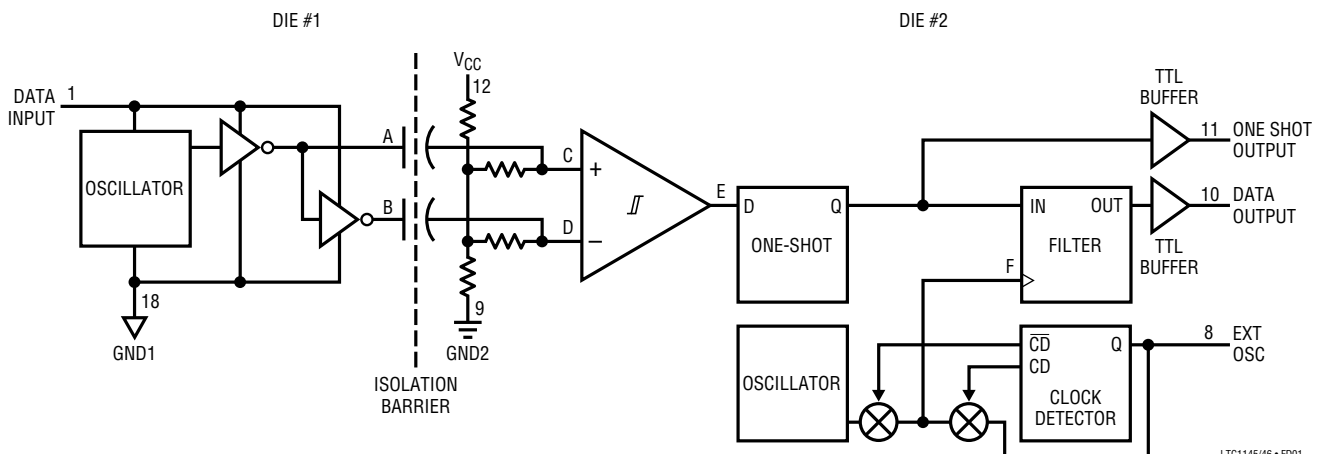
Pin 18 (GND1): The Ground Connection of the Driver Die.

SWITCHING TIME WAVEFORMS



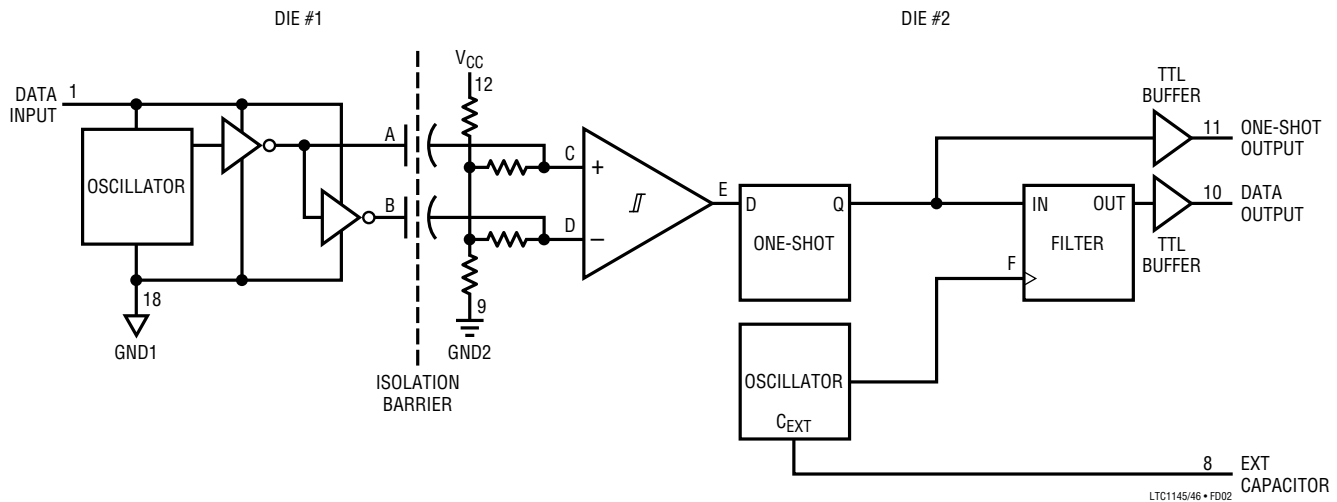
FUNCTIONAL DIAGRAMS

LTC1145



FUNCTIONAL DIAGRAMS

LTC1146



OPERATION

Basic Functionality

The LTC1145/LTC1146 consist of two separate die (see Functional Diagram) and two internal 1pF capacitors which provide isolation. Die #1 contains a low power oscillator and two low power drivers. The supply current for the oscillator and drivers comes from the digital input.

When the digital input exceeds 3V, the oscillator turns on and provides a 4MHz square wave to the drivers (400kHz for the LTC1146). The drivers pass the signal through the isolation capacitors and form a differential signal at the input to the comparator (points C and D) on die #2. As soon as the comparator output changes state in either direction, the one-shot output (OS) goes high. The time constant of the one-shot is set to 2 times the oscillation period, so the one-shot output will stay high as long as the oscillation continues. When the digital input goes low, the

oscillator on die #1 turns off and the one-shot output resets low.

To increase the noise immunity of the system, a filter is added to die #2. The filter is basically a binary counter clocked by either an internal free running oscillator or external oscillator. A clock detector circuit disconnects the internal oscillator from the filter and connects the external oscillator after detecting three pulses on the OSC_{IN} pin. The frequency of the internal free running oscillator on die #2 is designed to match the frequency of the gated oscillator on die #1, but the two oscillators are not synchronized. For the digital output (D_{OUT}) to go high, the filter must count four consecutive clock cycles with the one-shot output remaining high. For the digital output to go low, the filter must count four consecutive clock cycles with the one-shot output remaining low.

OPERATION

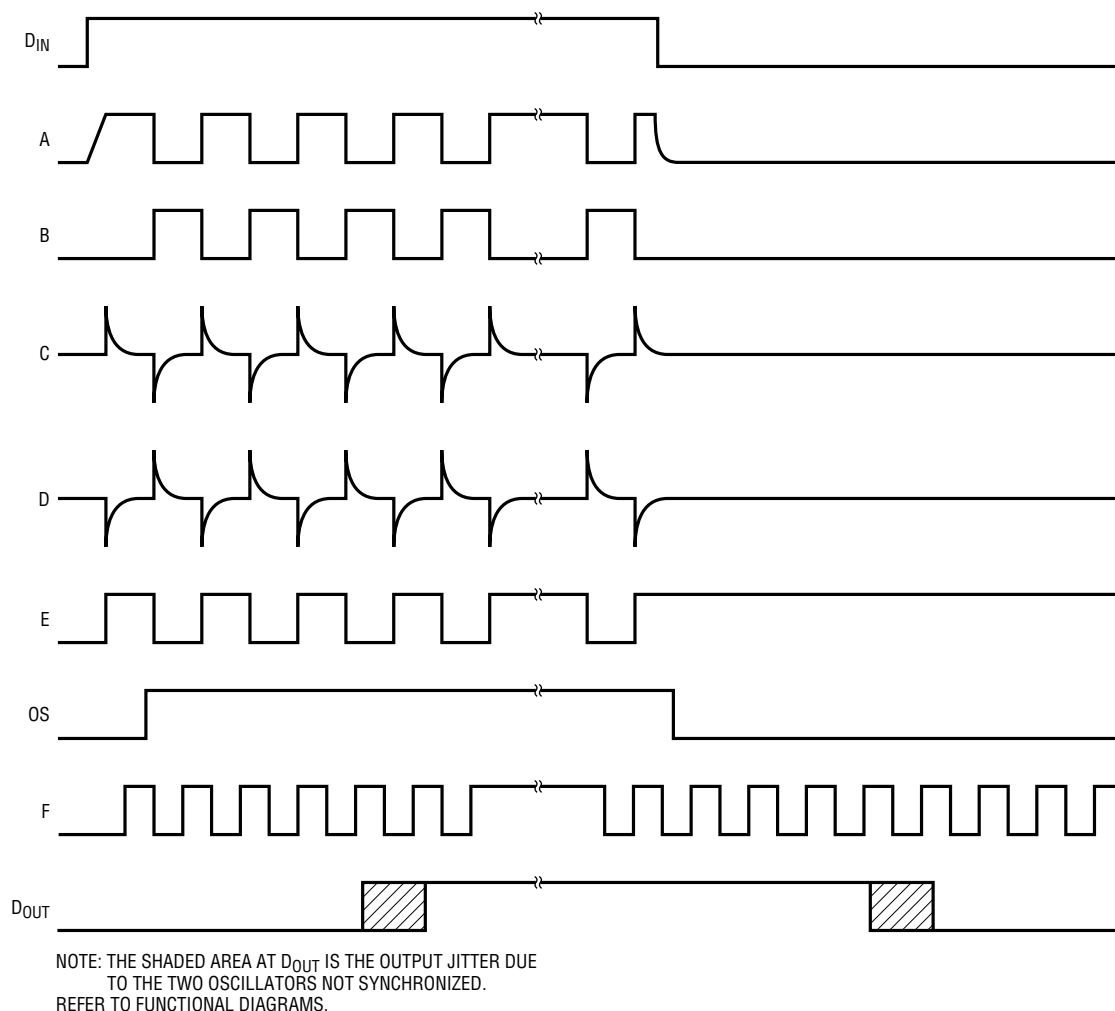


Figure 1. Block Diagram Waveforms

Noise and Glitch Immunity

As an example, assume that the digital input is low and the oscillator on die #1 is off. There is a very large fast rising common-mode signal at the ground and input pins to die #1 with respect to the ground of die #2.

Any mismatch in the internal capacitors will convert the common-mode signal into a differential glitch at the inputs to the comparator. The output of the comparator will toggle and the output of the one-shot will go high. However, the filter will only count one clock cycle before the output of the one-shot resets, so the digital output will remain low. The filter works as long as the period of the common-mode signal is greater than the one-shot period.

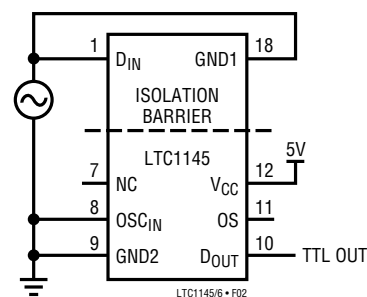


Figure 2. Common-Mode Rejection Test Circuit

OPERATION

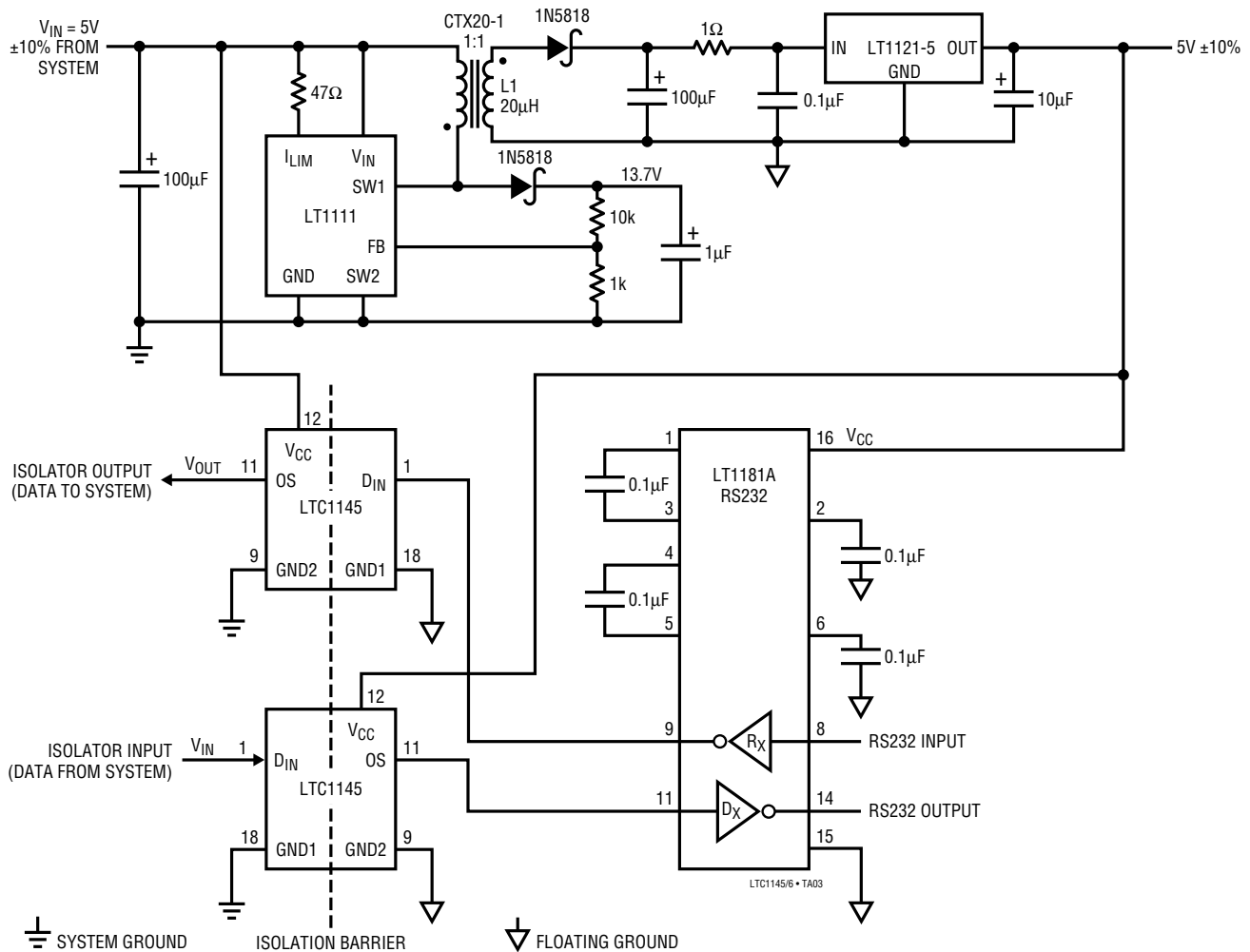
Internal Capacitors

A special lead frame has been designed for the LTC1145/LTC1146 which includes two die paddles and the isolation capacitors. Each capacitor is formed by three parallel metal fingers spaced about 20 mils apart. The capacitors' metal fingers and bonding posts replace the 5 center pins on each side of the 18-pin package. The dielectric for the

capacitors is the plastic package moulding compound. The material has a high dielectric constant and a high breakdown voltage. Typically the capacitance between the input and output is in the order of 1pF. This provides sufficient isolation in even the most critical of applications and is suitable for handling high voltage with high $\Delta V/\Delta t$.

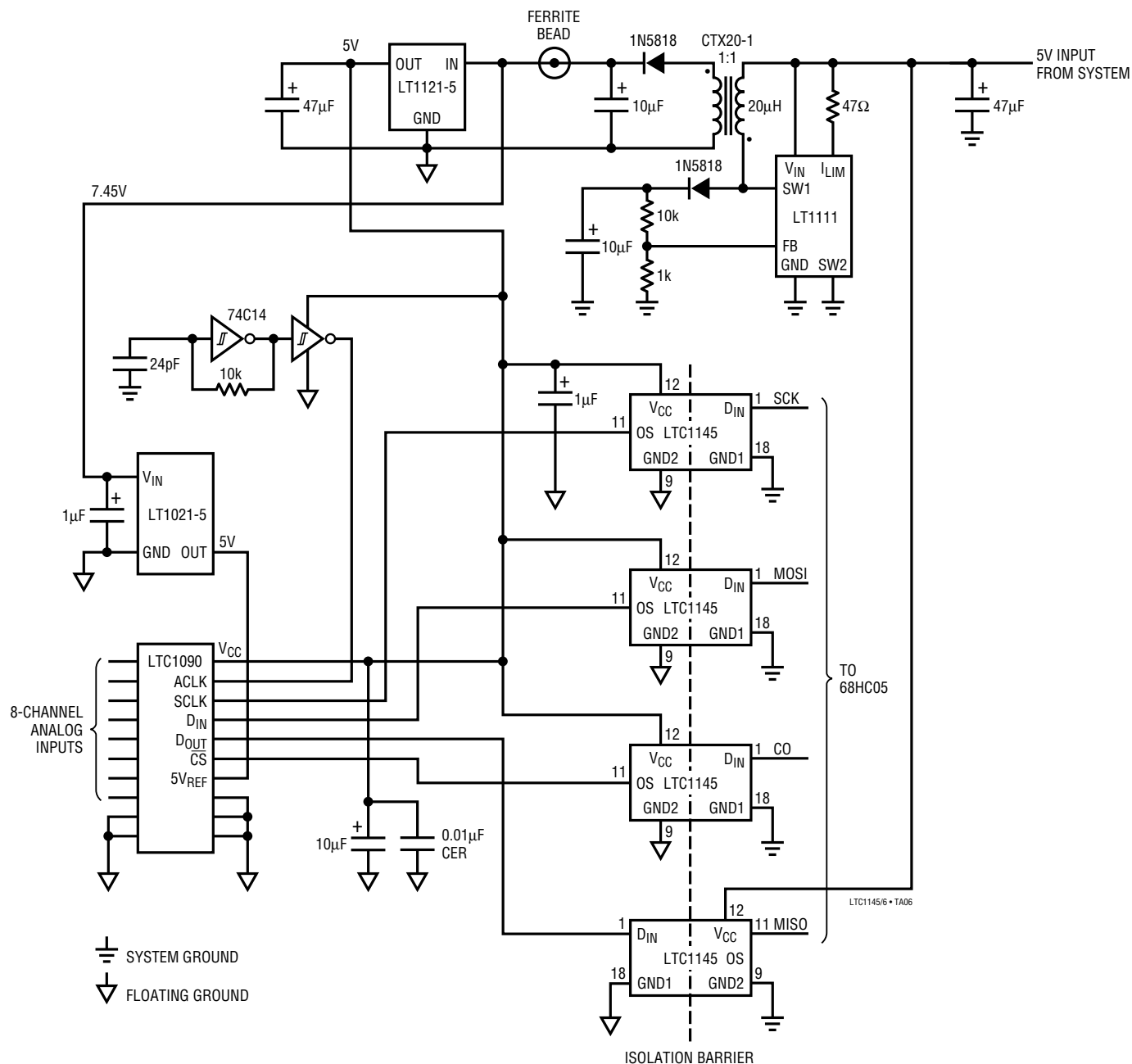
TYPICAL APPLICATIONS

Isolated RS232 Driver/Receiver



TYPICAL APPLICATIONS

Isolated 10-Bit Data Acquisition Systems



The schematic diagram illustrates the load current measurement circuit, divided into three main sections: Power Supply, Signal Conditioning, and Load Connection.

Power Supply Section: The circuit is powered by a 110 VAC source through a fuse. The AC is rectified by a V150LA20 (GE) Transient Absorber. The resulting DC is filtered by a 1.35 μF 400V capacitor. The circuit includes two 1N5819 diodes for protection. The load current is measured by a shunt resistor R_{SHUNT} in series with the load. The maximum load current is defined as $I_{\text{LOAD(MAX)}} = 0.1\text{V}/R_{\text{SHUNT}}$. The shunt voltage is divided by a 161k resistor and a 10k resistor to provide a signal to the comparators.

Signal Conditioning Section: The signal is processed by an LTC1145 (Line Voltage Frequency Out, FS = 100kHz) and an AD537 (Load Current Frequency Out, FS = 100kHz). The LTC1145 output is connected to the AD537 input. The AD537 output is connected to the input of the first LT1013 comparator. The first comparator's output is connected to the input of the second LT1013 comparator. The second comparator's output is connected to the output of the circuit.

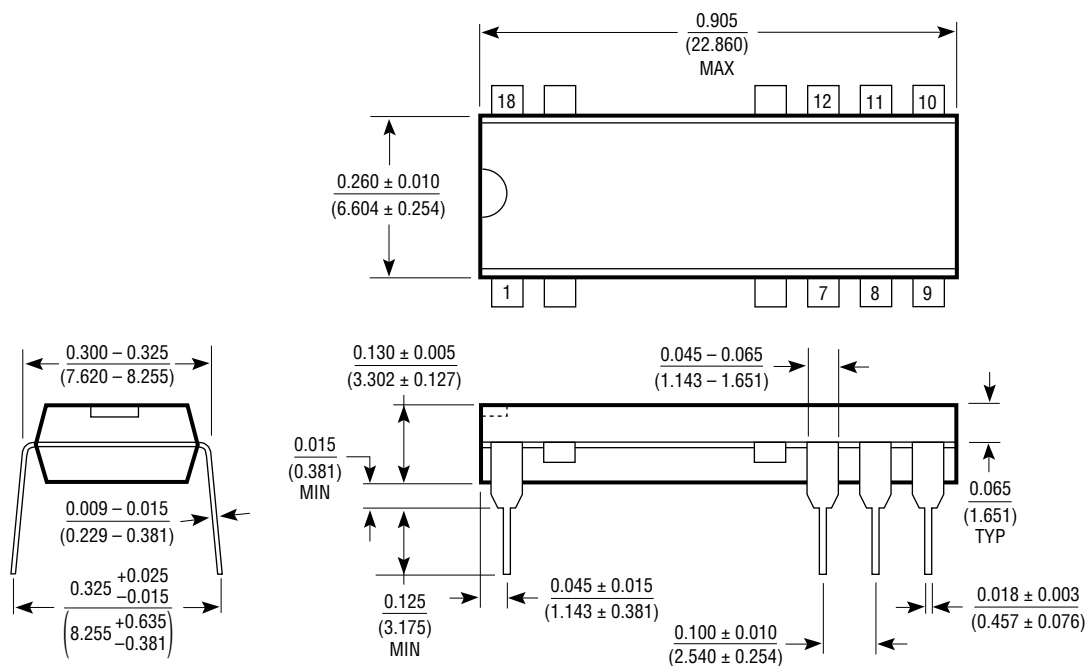
Load Connection Section: The load is connected to the power supply through the shunt resistor R_{SHUNT} . The load current is measured by the shunt resistor.

Legend: The diagram includes a legend for ground symbols: a solid ground symbol represents SYSTEM GROUND, and a floating ground symbol represents FLOATING GROUND.

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

N Package 18-Lead Plastic DIP



N18 0893