

# DALLAS

SEMICONDUCTOR

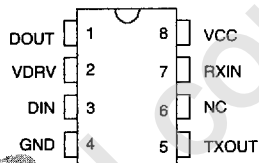
## DS1275

### Line-Powered RS-232 Transceiver Chip

#### FEATURES

- Low-power serial transmitter/receiver for battery-backed systems
- Transmitter steals power from receive signal line to save power
- Ultra-low static current, even when connected to RS-232-C port
- Variable transmitter level from +5 to +12 volts
- Compatible with RS-232-C signals
- Available in 8-pin, 150-mil wide SOIC package (DS1275S)
- Low-power CMOS

#### PIN ASSIGNMENT



DS1275 8-Pin DIP (300 Mil.)  
See Mech. Drawings  
Section

#### PIN DESCRIPTION

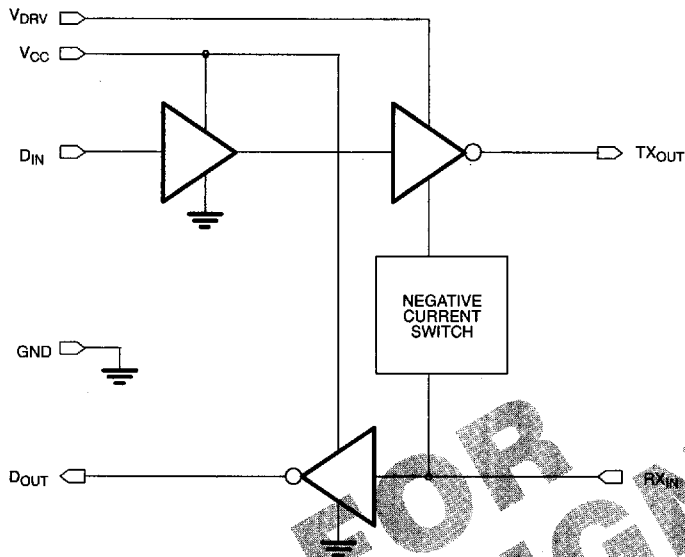
DOUT	- Digital data out
VDRV	- Transmit driver +V
DIN	- Digital data in
GND	- System ground (0V)
TXOUT	- Transmit RS-232 out
NC	- No connection
RXIN	- Receive RS-232 in
VCC	- System logic supply (+5V)

#### DESCRIPTION

The DS1275 Line-Powered RS-232 Transceiver Chip is a CMOS device that provides a low-cost, very low-power interface to RS-232 serial ports. The receiver input translates RS-232 signal levels to common CMOS/TTL levels. The transmitter employs a unique circuit which steals current from the receive RS-232 signal when that signal is in a negative state (marking). Since most serial communication ports remain in a negative state statical-

ly, using the receive signal for negative power greatly reduces the DS1275's static power consumption. This feature is especially important for battery-powered systems such as laptop computers, remote sensors, and portable medical instruments. During an actual communication session, the DS1275's transmitter will use system power (5-12 volts) for positive transitions while still employing the receive signal for negative transitions.

DS1275 BLOCK DIAGRAM Figure 1



## OPERATION

Designed for the unique requirements of battery-backed systems, the DS1275 provides a low-power half-duplex interface to an RS-232 serial port. Typically, a designer must use an RS-232 device which uses system power during both negative and positive transitions of the transmit signal to the RS-232 port. If the connector to the RS-232 port is left connected for an appreciable time after the communication session has ended, power will statically flow into that port, draining the battery capacity. The DS1275 eliminates this static current drain by stealing current from the receive line ( $RX_{IN}$ ) of the RS-232 port when that line is at a negative level (marking). Since most asynchronous communication over an RS-232 connection typically remains in a marking state when data is not being sent, the DS1275 will not consume system power in this condition. System power would only be used when positive-going transitions are needed on the transmit RS-232 output ( $TX_{OUT}$ ) when data is sent. However, since synchronous communication sessions typically exhibit a very low duty-cycle, overall system power consumption remains low.

## RECEIVER SECTION

The  $RX_{IN}$  pin is the receive input for an RS-232 signal whose levels can range from  $\pm 3$  to  $\pm 15$  volts. A negative data signal is called a mark while a positive data signal is

called a space. These signals are inverted and then level-shifted to normal +5 volt CMOS/TTL logic levels. The logic output associated with  $RX_{IN}$  is  $D_{OUT}$  which swings from  $+V_{CC}$  to ground. Therefore, a mark on  $RX_{IN}$  produces a logic 1 at  $D_{OUT}$ ; a space produces a logic 0.

The input threshold of  $RX_{IN}$  is typically around 1.8 volts with 500 millivolts of hysteresis to improve noise rejection. Therefore, an input positive-going signal must exceed 1.8 volts to cause  $D_{OUT}$  to switch states. A negative-going signal must now be lower than 1.3 volts (typically) to cause  $D_{OUT}$  to switch again. An open on  $RX_{IN}$  is interpreted as a mark, producing a logic 1 at  $D_{OUT}$ .

## TRANSMITTER SECTION

$D_{IN}$  is the CMOS/TTL-compatible input for digital data from the user system. A logic 1 at  $D_{IN}$  produces a mark (negative data signal) at  $TX_{OUT}$  while a logic 0 produces a space (positive data signal). As mentioned earlier, the transmitter section employs a unique driver design that uses the  $RX_{IN}$  line for swinging to negative levels. The  $RX_{IN}$  line must be in a marking or idle state to take advantage of this design; if  $RX_{IN}$  is in a spacing state,  $TX_{OUT}$  will only swing to ground. When  $TX_{OUT}$  needs to transition to a positive level, it uses the  $V_{DRV}$  power pin for this level.  $V_{DRV}$  can be a voltage supply between 5 to

12 volts, and in many situations it can be tied directly to the +5 volt  $V_{CC}$  supply. *It is important to note that  $V_{DRV}$  must be greater than or equal to  $V_{CC}$  at all times.*

The voltage range on  $V_{DRV}$  permits the use of a 9-volt battery in order to provide a higher voltage level when  $TX_{OUT}$  is in a space state. When  $V_{CC}$  is shut off to the DS1275 and  $V_{DRV}$  is still powered (as might happen in a battery-backed condition), only a small leakage current (about 50-100 nA) will be drawn. If  $TX_{OUT}$  is loaded during such a condition,  $V_{DRV}$  will draw current only if  $RX_{IN}$  is not in a negative state. During normal operation ( $V_{CC}=5$  volts),  $V_{DRV}$  will draw less than 2  $\mu$ A when  $TX_{OUT}$  is marking. Of course, when  $TX_{OUT}$  is spacing,  $V_{DRV}$  will draw substantially more current – about 3 mA depending upon its voltage and the impedance that  $TX_{OUT}$  sees.

The  $TX_{OUT}$  output is slew-rate limited to less than 30 volts/ $\mu$ s in accordance with RS-232 specifications. In the event  $TX_{OUT}$  should be inadvertently shorted to ground, internal current-limiting circuitry prevents damage, even if continuously shorted.

### RS-232 COMPATIBILITY

The intent of the DS1275 is not so much to meet all the requirements of the RS-232 specification as to offer a low-power solution that will work with most RS-232 ports with a connector length of less than 10 feet. As a prime example, the DS1275 will not meet the RS-232 requirement that the signal levels be at least  $\pm 5$  volts minimum when terminated by a 3K ohm load and  $V_{DRV}=+5$  volts. Typically a voltage of 4 volts will be present at  $TX_{OUT}$  when spacing. However, since most RS-232 receivers will correctly interpret any voltage over 2 volts as a space, there will be no problem transmitting data.

### APPLICATIONS INFORMATION

The DS1275 is designed as a low-cost, RS-232-C interface expressly tailored for the unique requirements of battery-operated handheld products. As shown in the electrical specifications, the DS1275 draws exceptionally low operating and static current. During normal operation when data from the handheld system is sent from the  $TX_{OUT}$  output, the DS1275 only draws significant  $V_{DRV}$  current when  $TX_{OUT}$  transitions positively (spacing). This current flows primarily into the RS-232 receiver's 3-7K ohm load at the other end of the attach-

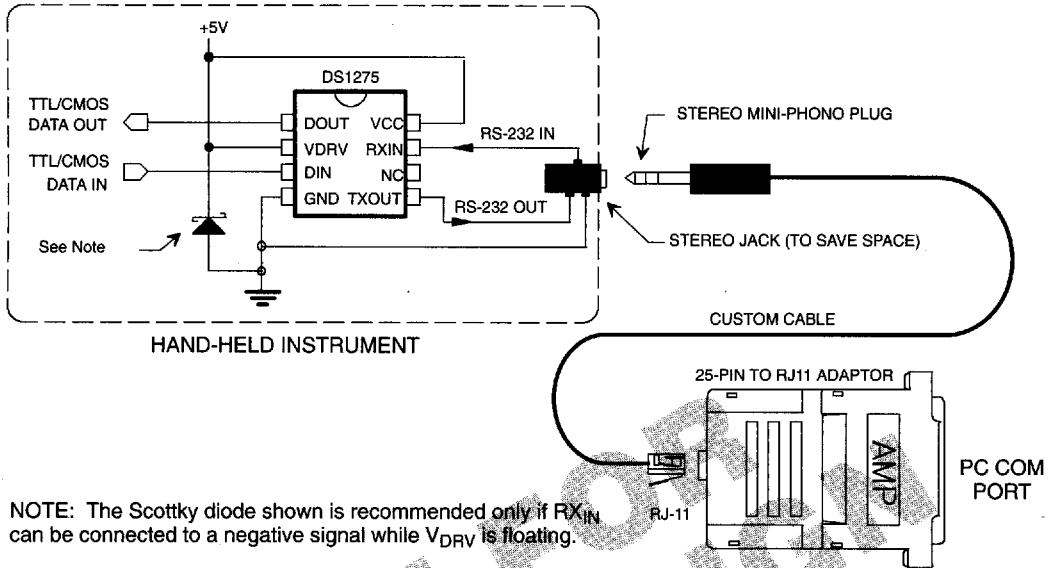
ing cable. When  $TX_{OUT}$  is marking (a negative data signal), the  $V_{DRV}$  current falls dramatically since the negative voltage is provided by the transmit signal from the other end of the cable. This represents a large reduction in overall operating current, since typical RS-232 interface chips use charge-pump circuits to establish both positive and negative levels at the transmit driver output.

To obtain the lowest power consumption from the DS1275, observe the following guidelines. First, to minimize  $V_{DRV}$  current when connected to an RS-232 port, always maintain  $D_{IN}$  at a logic 1 when data is not being transmitted (idle state). This will force  $TX_{OUT}$  into the marking state, minimizing  $V_{DRV}$  current. Second,  $V_{DRV}$  current will drop to less than 100 nA when  $V_{CC}$  is grounded. Therefore, if  $V_{DRV}$  is tied directly to the system battery, the logic +5 volts can be turned off to achieve the lowest possible power state.

### FULL-DUPLEX OPERATION

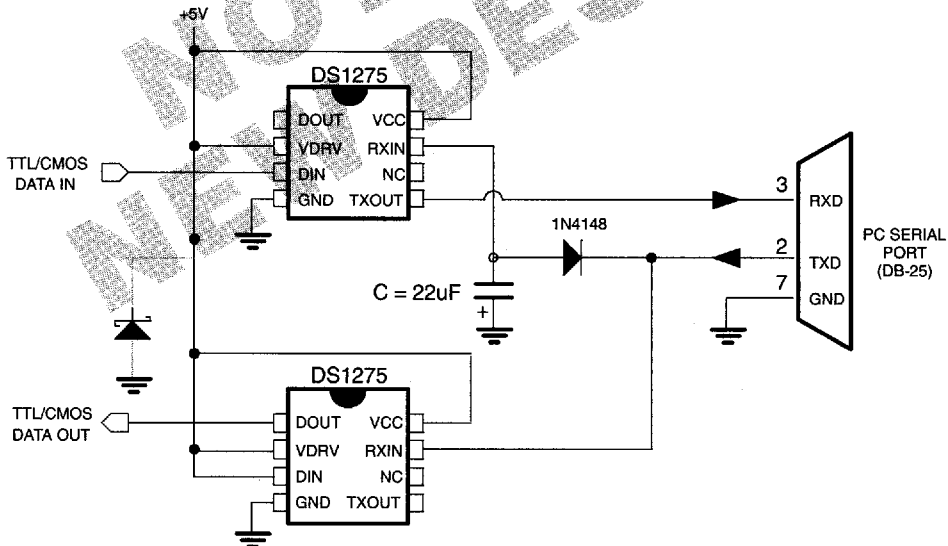
The DS1275 is intended primarily for half-duplex operation; that is,  $RX_{IN}$  should remain idle in the marking state when transmitting data out  $TX_{OUT}$  and visa versa. However, the part can be operated full-duplex with most RS-232-C serial ports since signals swinging between 0 and +5V will usually be correctly interpreted by an RS-232-C receiver device. The 5-volt swing occurs when  $TX_{OUT}$  attempts to swing negative while  $RX_{IN}$  is at a positive voltage, which turns on an internal weak pull-down to ground for the  $TX_{OUT}$  driver's negative reference. So, transmit mark signals at  $TX_{OUT}$  may have voltage jumps from some negative value (corresponding to  $RX_{IN}$  marking) to approximately ground. One possible problem that may occur in this case is if the receiver at the other end requires a negative voltage for recognizing a mark. In this situation, the full-duplex circuit shown in Figure 3 can be used as an alternative. The 22  $\mu$ F capacitor forms a negative-charge reservoir; consequently, when the TXD line is spacing (positive),  $TX_{OUT}$  still has a negative source available for a time period determined by the capacitor and the load resistance at the other end (3-7K ohms). This circuit was tested from 150-19,200 bps with error-free operation using a SN75154 Quad Line Receiver as the receiver for the  $TX_{OUT}$  signal. Note that the SN75154 can have a marking input threshold below ground; hence there is the need for  $TX_{OUT}$  to swing both positive and negative in full-duplex operation with this device.

**HANDHELD RS-232-C APPLICATION USING A STEREO MINI-JACK** Figure 2



NOTE: The Scottky diode shown is recommended only if RX<sub>IN</sub> can be connected to a negative signal while V<sub>DRV</sub> is floating.

**FULL-DUPLEX CIRCUIT USING NEGATIVE-CHARGE STORAGE** Figure 3



**NOTE:**

The capacitor stores negative charge whenever the TXD signal from the PC serial port is in a marking data state (a negative voltage that is typically -10 volts). The top DS1275's TX<sub>OUT</sub> uses this negative charge reservoir when it is in a marking state. The capacitor will discharge to 0 volts when the TXD line is spacing (and TX<sub>OUT</sub> is still marking) at a time constant determined by its value and the value of the load resistance reflected back to TX<sub>OUT</sub>. However, when TXD is marking, the capacitor will quickly charge back to -10 volts. Note that TXD remains in a marking state when idle, which improves the performance of this circuit.

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**LATCHUP PROTECTION**

In most cases the DS1275 offers a high level of ESD and latchup protection. However, latchup can occur if  $V_{DRV}$  is left floating (high impedance) while a negative signal is attached to  $RX_{IN}$ . One possible scenario for this is as follows: if the handheld device is powered off with a FET switch, floating  $V_{DRV}$ , and at the same time the user still

has the the RS-232-C port connected. In order to eliminate this latchup potential, a Schottky diode from  $V_{DRV}$  to ground is recommended as shown in Figure 2. The lower clamp voltage of the Schottky (300 mV) is required to prevent an internal silicon diode on the DS1275 from turning on, which precipitates the latchup condition.

**NOT FOR  
NEW DESIGN**

**ABSOLUTE MAXIMUM RATINGS\***

V <sub>CC</sub>	-0.3 to +7 volts
V <sub>DRV</sub>	-0.3 to +13 volts
RX <sub>IN</sub>	±15 volts
D <sub>IN</sub>	-0.3 to V <sub>CC</sub> + 0.3 volts
TX <sub>OUT</sub>	±15 volts
D <sub>OUT</sub>	-0.3 to V <sub>CC</sub> + 0.3 volts
Storage Temperature	-55°C to +125°C
Operating Temperature	0°C to 70°C

\* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

**RECOMMENDED DC OPERATING CONDITIONS**

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
Logic Supply	V <sub>CC</sub>	4.5	5.0	5.5	V	1
Transmit Driver Supply	V <sub>DRV</sub>	4.5	5-12	13.0	V	1
Logic 1 Input	V <sub>IH</sub>	2.0		V <sub>CC</sub> +0.3	V	2
Logic 0 Input	V <sub>IL</sub>	-0.3		+0.8	V	
RS-232 Input Range (RX <sub>IN</sub> )	V <sub>RS</sub>	-15		+15	V	
Dynamic Supply Current D <sub>IN</sub> = V <sub>CC</sub>	I <sub>DRV1</sub> I <sub>CC1</sub>		0.1 0.5	5.0 5.0	mA mA	3
D <sub>IN</sub> = GND	I <sub>DRV1</sub> I <sub>CC1</sub>		3.8 0.5	5.0 5.0	mA mA	
Static Supply Current D <sub>IN</sub> = V <sub>CC</sub>	I <sub>DRV2</sub> I <sub>CC2</sub>		1.5 10.0	15.0 15.0	μA μA	4
D <sub>IN</sub> = GND	I <sub>DRV2</sub> I <sub>CC2</sub>		3.8 10.0	5.0 30.0	mA μA	
Driver Leakage Current (V <sub>CC</sub> = 0V)	I <sub>DRV3</sub>		0.05	1.0	μA	5

**DC ELECTRICAL CHARACTERISTICS**(0°C to 70°C; V<sub>CC</sub> = V<sub>DRV</sub> = 5V ± 10%)

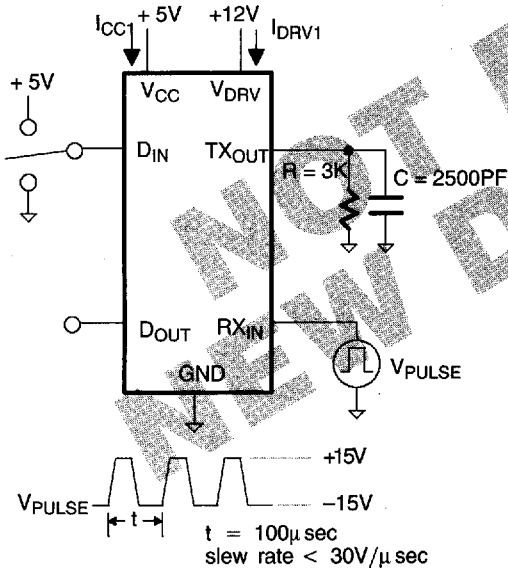
PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	NOTES
TX <sub>OUT</sub> Level High	V <sub>OTXH</sub>	3.5	4.0	4.5	V	6
TX <sub>OUT</sub> Level Low	V <sub>OTXL</sub>	-8.5	-9.0		V	7
TX <sub>OUT</sub> Short Circuit Current	I <sub>SC</sub>		+60	+85	mA	
TX <sub>OUT</sub> Output Slew Rate	t <sub>SR</sub>			30	V/μs	
Propagation Delay	t <sub>PD</sub>		5		μs	8
RX <sub>IN</sub> Input Threshold Low	V <sub>TL</sub>	0.8	1.2	1.6	V	
RX <sub>IN</sub> Input Threshold High	V <sub>TH</sub>	1.6	2.0	2.4	V	
RX <sub>IN</sub> Threshold Hysteresis	V <sub>HYS</sub>	0.5	0.8		V	9
D <sub>OUT</sub> Output Current @ 2.4 V	I <sub>OH</sub>	-1.0			mA	
D <sub>OUT</sub> Output Current @ 0.4 V	I <sub>OL</sub>			3.2	mA	

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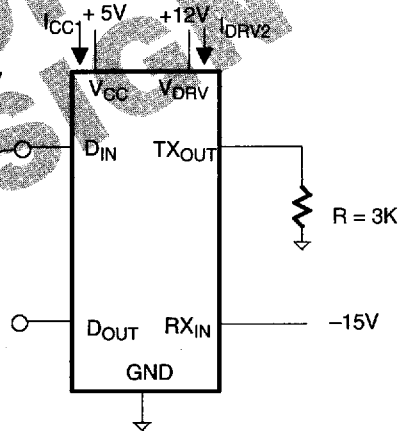
**NOTES:**

1.  $V_{DRV}$  must be greater than or equal to  $V_{CC}$ .
2.  $V_{CC} = V_{DRV} = 5V \pm 10\%$ .
3. See test circuit in Figure 4.
4. See test circuit in Figure 5.
5. See test circuit in Figure 6.
6.  $D_{IN} = V_{IL}$  and  $TX_{OUT}$  loaded by 3K ohms to ground.
7.  $D_{IN} = V_{IH}$ ,  $RX_{IN} = -10$  volts and  $TX_{OUT}$  loaded by 3K ohms to ground.
8.  $D_{IN}$  to  $TX_{OUT}$  - see Figure 7.
9.  $V_{HYS} = V_{TH} - V_{TL}$ .

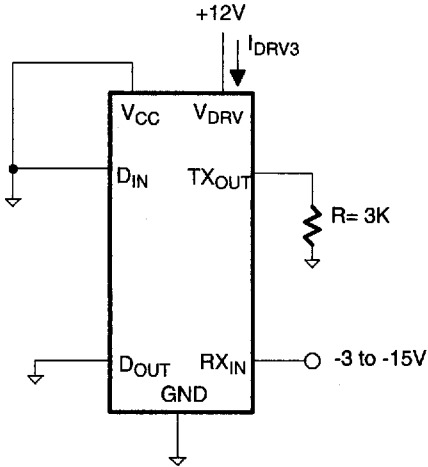
**DYNAMIC OPERATING CURRENT TEST CIRCUIT Figure 4**



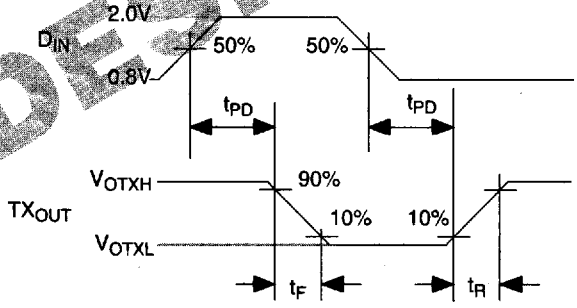
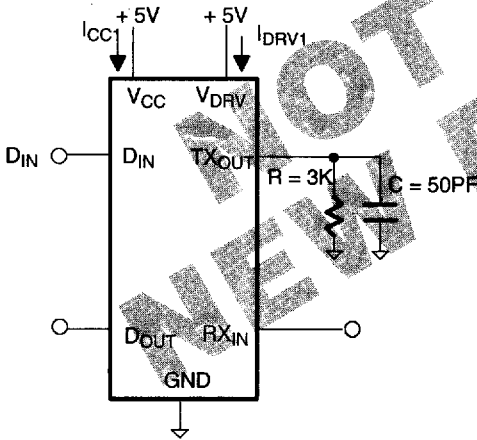
**STATIC OPERATING CURRENT TEST CIRCUIT Figure 5**



**DRIVER LEAKAGE TEST CIRCUIT** Figure 6



**PROPAGATION DELAY TEST CIRCUIT** Figure 7



$$t_{SR} = \frac{0.8(V_{OTXH} - V_{OTXL})}{t_F \text{ or } t_R}$$

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