

## FEATURES

- Operates from a Single 3.3V Supply
- Low Supply Current:  $I_{CC} = 200\mu\text{A}$
- ESD Protection Over  $\pm 10\text{kV}$
- Available in 16-Pin SOIC Narrow Package
- Uses Small Capacitors:  $0.1\mu\text{F}$
- Operates to 120kbaud
- Output Overvoltage Does Not Force Current Back into Supplies
- EIA/TIA562 I/O Lines Can Be Forced to  $\pm 25\text{V}$  Without Damage
- Pin Compatible with LT1181A


## APPLICATIONS

- Notebook Computers
- Palmtop Computers

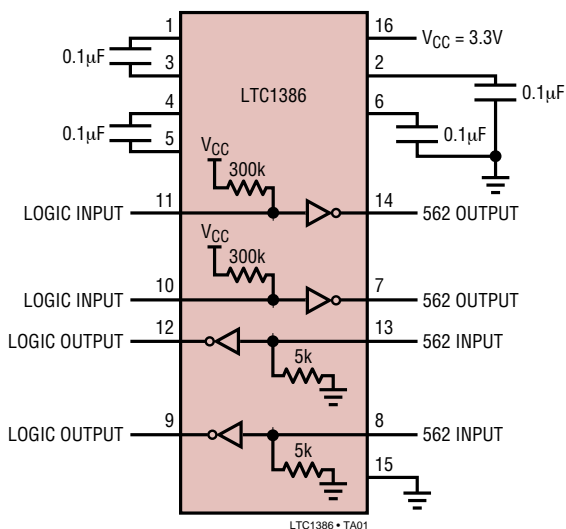
## DESCRIPTION

The LTC<sup>®</sup>1386 is an ultra-low power 2-driver/2-receiver EIA/TIA562 transceiver that operates from a single 3.3V supply. The charge pump requires only four space-saving  $0.1\mu\text{F}$  capacitors. The supply current ( $I_{CC}$ ) of the transceiver is only  $200\mu\text{A}$  with driver outputs unloaded.

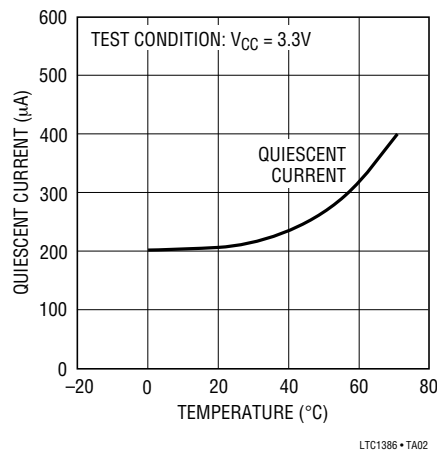
The LTC1386 is fully compliant with all data rate and overvoltage EIA/TIA562 specifications. The transceiver can operate up to 120kbaud with a  $1000\text{pF}$ ,  $3\text{k}\Omega$  load. Both driver outputs and receiver inputs can be forced to  $\pm 25\text{V}$  without damage and can survive multiple  $\pm 10\text{kV}$  ESD strikes.

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## TYPICAL APPLICATION



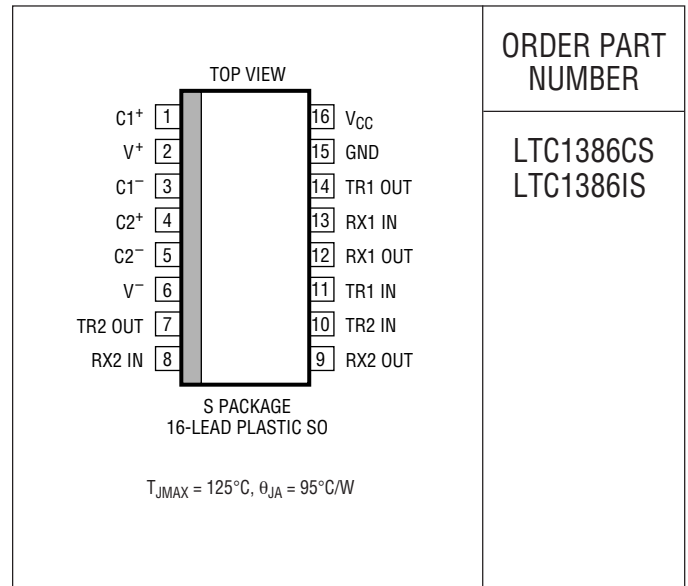
Quiescent Supply Current vs Temperature



## ABSOLUTE MAXIMUM RATINGS

|                                      |                          |
|--------------------------------------|--------------------------|
| Supply Voltage ( $V_{CC}$ )          | 5V                       |
| Input Voltage                        |                          |
| Driver                               | -0.3V to $V_{CC} + 0.3V$ |
| Receiver                             | -25V to 25V              |
| Digital Input                        | -0.3V to $V_{CC} + 0.3V$ |
| Output Voltage                       |                          |
| Driver                               | -25V to 25V              |
| Receiver                             | -0.3V to $V_{CC} + 0.3V$ |
| Short-Circuit Duration               |                          |
| $V^+$                                | 30 sec                   |
| $V^-$                                | 30 sec                   |
| Driver Output                        | Indefinite               |
| Receiver Output                      | Indefinite               |
| Operating Temperature Range          |                          |
| LTC1386C                             | 0°C to 70°C              |
| LTC1386I                             | -40°C to 85°C            |
| Storage Temperature Range            | -65°C to 150°C           |
| Lead Temperature (Soldering, 10 sec) | 300°C                    |

## PACKAGE/ORDER INFORMATION



ORDER PART NUMBER

LTC1386CS  
LTC1386IS

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## DC ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range.  $V_{CC} = 3.3V$ ,  $C1 = C2 = C3 = C4 = 0.1\mu F$ , unless otherwise noted.

| PARAMETER                     | CONDITIONS  | MIN    | TYP         | MAX          | UNITS                   |
|-------------------------------|---|--------|-------------|--------------|-------------------------|
| <b>Any Driver</b>             |   |        |             |              |                         |
| Output Voltage Swing          | 3k to GND<br>Positive<br>Negative   | ●<br>● | 3.7<br>-3.7 | 4.5<br>-4.5  | V<br>V                  |
| Logic Input Voltage Level     | Input Low Level ( $V_{OUT} = \text{High}$ )<br>Input High Level ( $V_{OUT} = \text{Low}$ )                  | ●<br>● | 2.0         | 1.4<br>1.4   | 0.8<br>V<br>V           |
| Logic Input Current           | $V_{IN} = V_{CC}$<br>$V_{IN} = 0V$  | ●<br>● |             | -20          | 5<br>$\mu A$<br>$\mu A$ |
| Output Short-Circuit Current  | $V_{OUT} = 0V$  |        | ±9          | ±10          | mA                      |
| <b>Any Receiver</b>           |   |        |             |              |                         |
| Input Voltage Thresholds      | Input Low Threshold<br>Input High Threshold   | ●<br>● | 0.8         | 1.3<br>1.7   | 2.4<br>V<br>V           |
| Hysteresis                    |   | ●      | 0.1         | 0.4          | 1<br>V                  |
| Input Resistance              | $-10V \leq V_{IN} \leq 10V$   |        | 3           | 5            | 7<br>kΩ                 |
| Output Voltage                | Output Low, $I_{OUT} = -1.6mA$ ( $V_{CC} = 3.3V$ )<br>Output High, $I_{OUT} = 160\mu A$ ( $V_{CC} = 3.3V$ ) | ●<br>● |             | 0.2<br>3.0   | 0.4<br>V<br>V           |
| Output Short-Circuit Current  | Sinking Current, $V_{OUT} = V_{CC}$<br>Sourcing Current, $V_{OUT} = GND$                                    |        | -5          | -20          | 7<br>mA<br>mA           |
| <b>Power Supply Generator</b> |   |        |             |              |                         |
| $V^+$ Output Voltage          | $I_{OUT} = 0mA$<br>$I_{OUT} = 5mA$  |        |             | 5.7<br>5.5   | V<br>V                  |
| $V^-$ Output Voltage          | $I_{OUT} = 0mA$<br>$I_{OUT} = -5mA$   |        |             | -5.3<br>-5.0 | V<br>V                  |
| <b>Power Supply</b>           |   |        |             |              |                         |
| $V_{CC}$ Supply Current       | No Load (Note 2), 0°C to 70°C<br>No Load (Note 2), -40°C to 85°C  | ●<br>● |             | 0.2<br>0.35  | 0.5<br>1.0<br>mA<br>mA  |

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**AC CHARACTERISTICS** The ● denotes specifications which apply over the full operating temperature range.  
 $V_{CC} = 3.3V$ ,  $C_1 = C_2 = C_3 = C_4 = 0.1\mu F$ , unless otherwise noted.

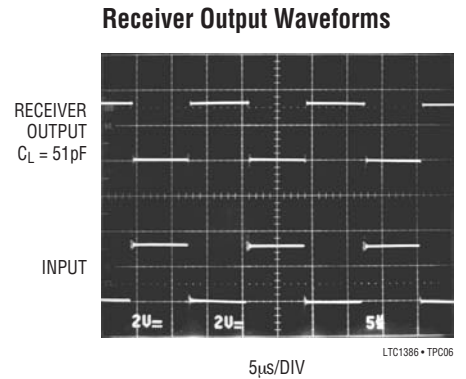
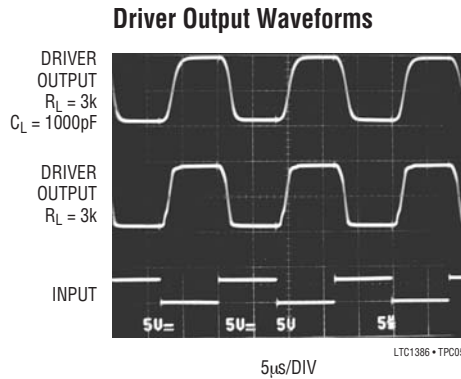
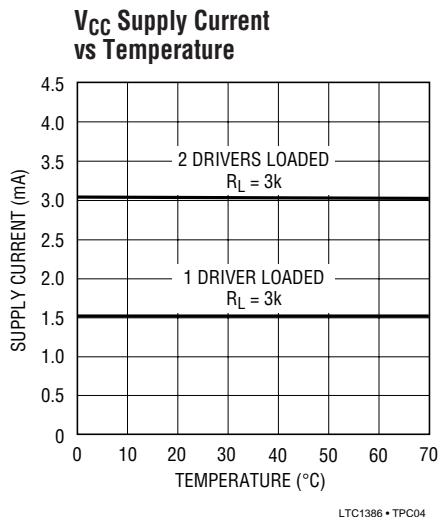
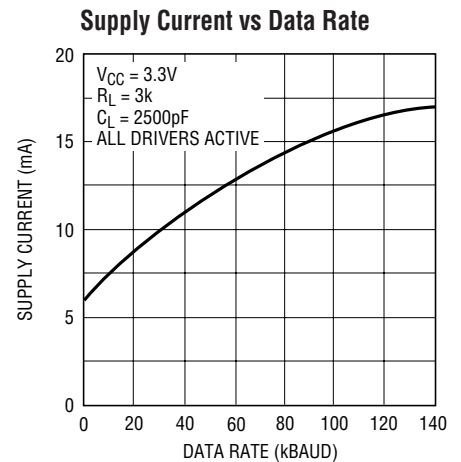
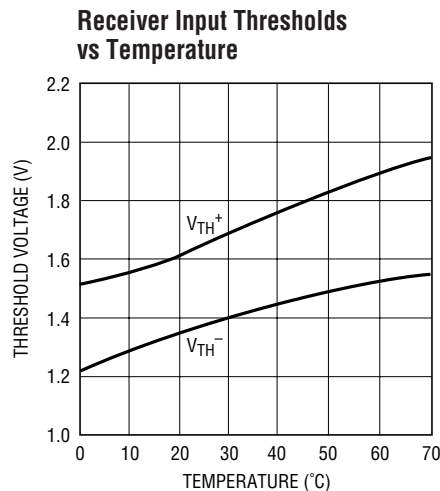
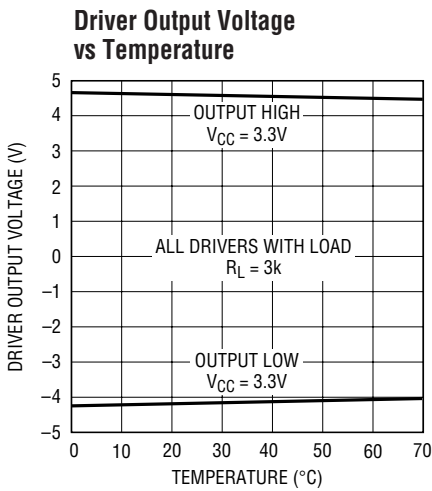
| PARAMETER   | CONDITIONS                  | MIN | TYP | MAX | UNITS     |
|---|-----------------------------|-----|-----|-----|-----------|
| Slew Rate   | $R_L = 3k$ , $C_L = 51pF$   |     | 8   | 30  | $V/\mu S$ |
|   | $R_L = 3k$ , $C_L = 1000pF$ | 3   | 5   |     | $V/\mu S$ |
| Driver Propagation Delay<br>(TTL to EIA/TIA562)   | $t_{HLD}$ (Figure 1)        | ●   | 2   | 3.5 | $\mu S$   |
|   | $t_{LHD}$ (Figure 1)        | ●   | 2   | 3.5 | $\mu S$   |
| Receiver Propagation Delay<br>(EIA/TIA562 to TTL) | $t_{HLR}$ (Figure 2)        | ●   | 0.3 | 0.8 | $\mu S$   |
|   | $t_{LHR}$ (Figure 2)        | ●   | 0.3 | 0.8 | $\mu S$   |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

**Note 2:** Supply current is measured with driver and receiver outputs unloaded.

**Note 3:** Measurements made in the shutdown mode are performed with  $V_{ON/OFF} = 0V$ .

**TYPICAL PERFORMANCE CHARACTERISTICS**



## PIN FUNCTIONS

**V<sub>CC</sub>**: 3.3V Input Supply Pin. This pin should be decoupled with a 0.1 $\mu$ F ceramic capacitor.

**GND**: Ground Pin.

**V<sup>+</sup>**: Positive Supply Output (EIA/TIA562 Drivers).  $V^+ \cong 2V_{CC} - 1V$ . This pin requires an external capacitor  $C = 0.1\mu F$  for charge storage. The capacitor may be tied to ground or  $V_{CC}$ . With multiple devices, the  $V^+$  and  $V^-$  pins may share a common capacitor. For large numbers of devices, increasing the size of the shared common storage capacitors is recommended to reduce ripple.

**V<sup>-</sup>**: Negative Supply Output (RS232 Drivers).  $V^- \cong -(2V_{CC} - 1.3V)$ . This pin requires an external capacitor  $C = 0.1\mu F$  for charge storage.

**C1<sup>+</sup>, C1<sup>-</sup>, C2<sup>+</sup>, C2<sup>-</sup>**: Commutating Capacitor Inputs. These pins require two external capacitors  $C = 0.1\mu F$ : one from  $C1^+$  to  $C1^-$  and another from  $C2^+$  to  $C2^-$ . To maintain

charge pump efficiency, the capacitor's effective series resistance should be less than  $2\Omega$ .

**TR IN**: EIA/TIA562 Driver Input Pins. Inputs are TTL/CMOS compatible. The inputs of unused drivers can be left unconnected since 300k input pull-up resistors to  $V_{CC}$  are included on chip.

**TR OUT**: Driver Outputs at EIA/TIA562 Voltage Levels. The driver outputs are protected against ESD to  $\pm 10kV$  for human body model discharges.

**RX IN**: Receiver Inputs. These pins can be forced to  $\pm 25V$  without damage. The receiver inputs are protected against ESD to  $\pm 10kV$  for human body model discharges. Each receiver provides 0.4V of hysteresis for noise immunity.

**RX OUT**: Receiver Outputs with TTL/CMOS Voltage Levels.

## SWITCHING TIME WAVEFORMS

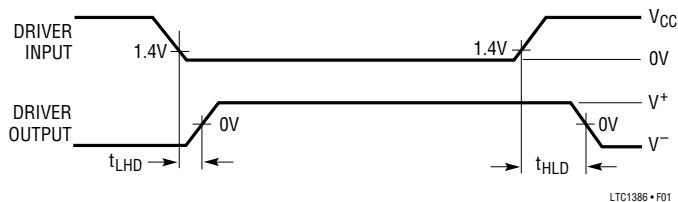


Figure 1. Driver Propagation Delay Timing

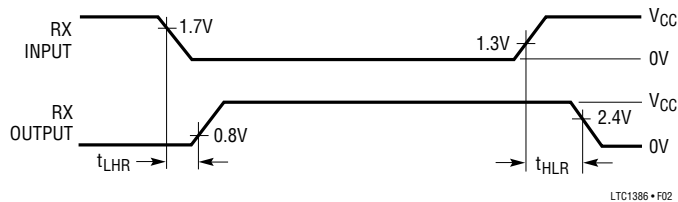
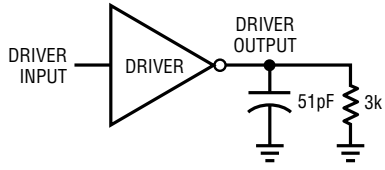


Figure 2. Receiver Propagation Delay Timing

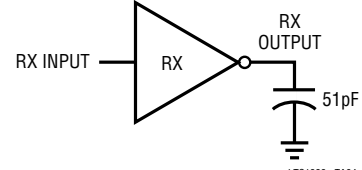
# TEST CIRCUITS

Driver Timing Test Load



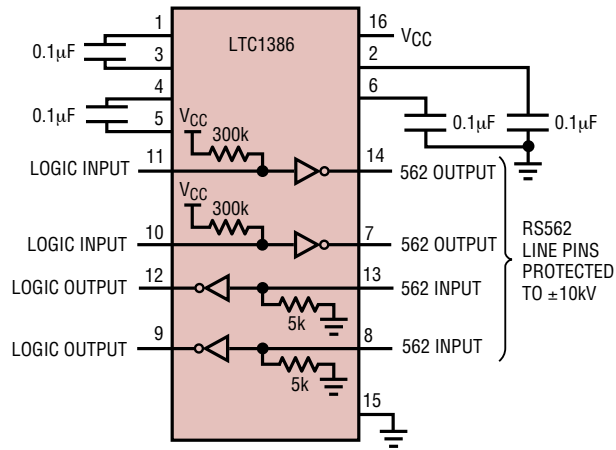
LTC1386 • TA03

Receiver Timing Test Load



LTC1386 • TA04

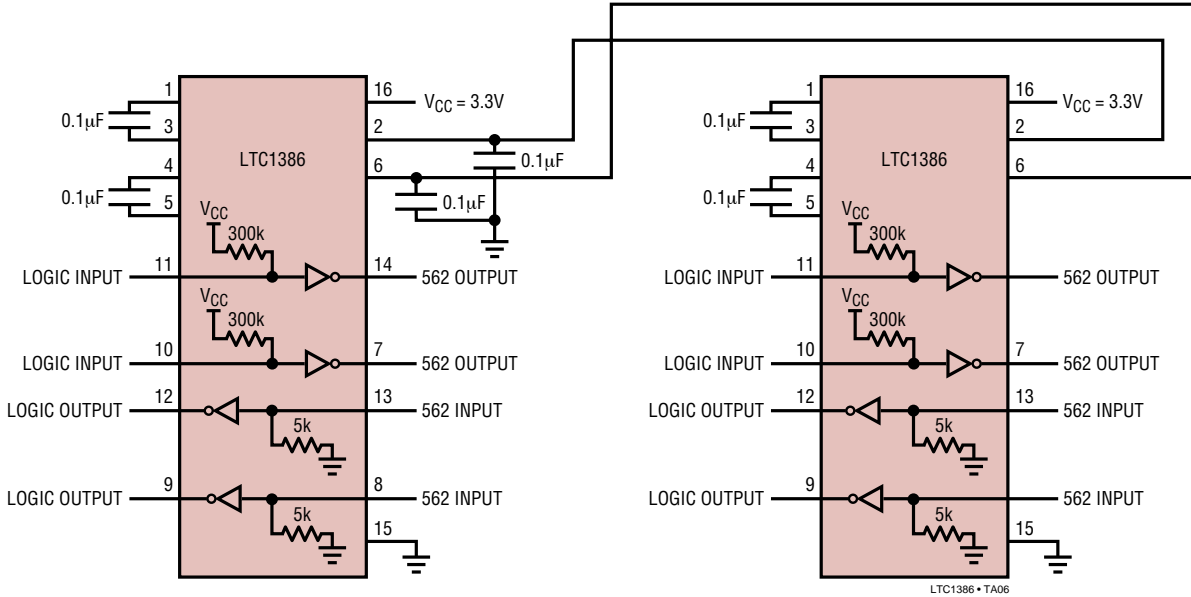
ESD Test Circuit



1386 TA05

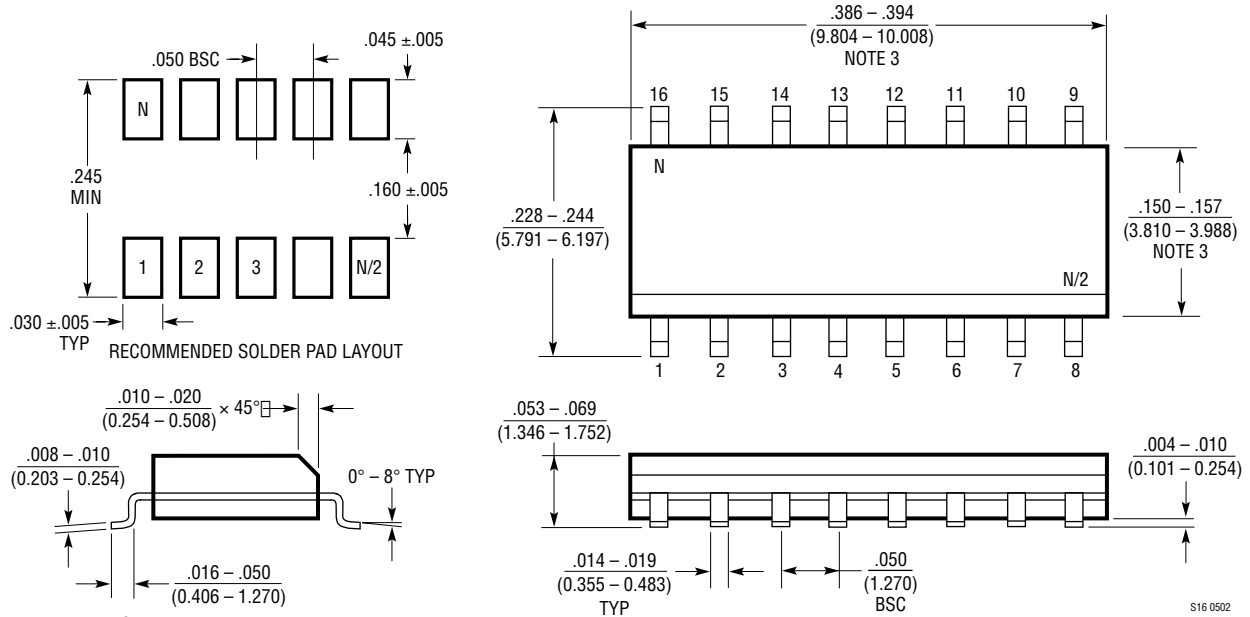
## TYPICAL APPLICATIONS

Paralleling Power Supply Generator  
with Common Storage Capacitors



# PACKAGE DESCRIPTION

## S Package 16-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)



- NOTE:
1. DIMENSIONS IN  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
  2. DRAWING NOT TO SCALE
  3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED  $.006''$  (0.15mm)

S16 0502

**RELATED PARTS**

| PART NUMBER   | DESCRIPTION  | COMMENTS   |
|---------------|--|--|
| LT1780/LT1781 | 5V, 2 Driver, 2 Receiver RS232 Transceivers        | ±15kV ESD per IEC 1000-4                             |
| LTC1327       | 3.3V, 3 Driver, 5 Receiver RS562 Transceiver       | 300µA Supply Current, 0.2µA in Shutdown              |
| LTC1348       | 3.3V to 5V, 3 Driver, 5 Receiver RS232 Transceiver | True RS232 on 3.3V, 5 Receivers Active in Shutdown   |
| LTC1382       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 220µA Supply Current, 0.2µA in Shutdown              |
| LTC1383       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 220µA Supply Current, Narrow 16-pin SO               |
| LTC1384       | 5V, 2 Driver, 2 Receiver RS232 Transceiver         | 220µA Supply Current, 2 Receivers Active in Shutdown |
| LTC1385       | 3.3V, 2 Driver, 2 Receiver RS562 Transceiver       | 220µA Supply Current, 2 Receivers Active in Shutdown |