LINEAR TECHNOLOGY

Advanced Low Power 5V RS232 Drivers/Receivers with Charge Pump

FEATURES

- Absolutely No Latchup
- CMOS Comparable Low Power — 80mW
- Operates from a **Single 5V Supply**
- **Superior to CMOS**
  - **Easy PC Layout** — Flow Through Architecture
  - Improved Speed — Operates Over 64K Baud
  - Improved Protection — Outputs Can be Forced to ±30V Without Damage
  - Three-State Outputs are High Impedance When Off
  - Only Needs 1μF Capacitors
  - Output Overvoltage Does Not Force Current Back Into Supplies
- 1μA Supply Current in Shutdown
- Available in SO Package

DESCRIPTION

The LT1130 Series are the only RS232 drivers/receivers with charge pump to guarantee absolutely no latchup. These interface optimized devices provide a realistic balance between CMOS levels of power dissipation and real world requirements for ruggedness. The driver outputs are fully protected against overload and can be shorted to ±30V. Unlike CMOS, the advanced architecture of the LT1130 does not load the signal line when "shut down" or when power is off. Both the receiver and RS232 outputs are put into a high impedance state. An advanced output stage allows driving higher capacitive loads at higher speeds with exceptional ruggedness.

For applications requiring only 2 drivers and 2 receivers with charge pump in one package see the LT1180 Series data sheet. All of Linear Technology's RS232 IC's are available in standard surface mount packages.

Basic Operation
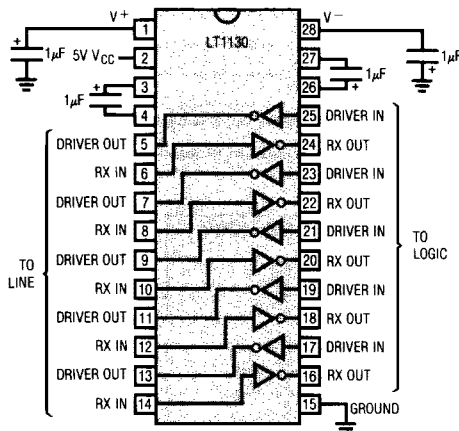
Output Waveform
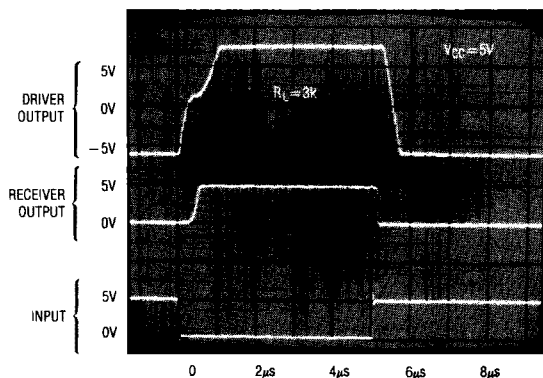
LT1130 5-Driver/5-Receiver RS232 Transceiver
LT1131 5-Driver/4-Receiver RS232 Transceiver w/Shutdown
LT1132 5-Driver/3-Receiver RS232 Transceiver
LT1133 3-Driver/5-Receiver RS232 Transceiver
LT1134 4-Driver/4-Receiver RS232 Transceiver
LT1135 5-Driver/3-Receiver RS232 Transceiver w/o Charge Pump

LT1136 4-Driver/5-Receiver RS232 Transceiver w/Shutdown
LT1137 3-Driver/5-Receiver RS232 Transceiver w/Shutdown
LT1138 5-Driver/3-Receiver RS232 Transceiver w/Shutdown
LT1139 4-Driver/4-Receiver RS232 Transceiver w/Shutdown
LT1140 5-Driver/3-Receiver RS232 Transceiver w/o Charge Pump
LT1141 3-Driver/5-Receiver RS232 Transceiver w/o Charge Pump

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LINEAR TECHNOLOGY

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{CC}) 6V
V+ 13.2V
V− .... −13.2V
Input Voltage
   Driver .... V^- to V^+
   Receiver .... −30V to 30V
   On-Off Pin .... GND to 12V
Output Voltage
   Driver .... V^- + 30V to V^+ − 30V
   Receiver .... − 0.3V to V_{CC} + 0.3V

Short Circuit Duration
   V+ .... 30 Seconds
   V− .... 30 Seconds
   Driver Output .... Indefinite
   Receiver Output .... Indefinite
Operating Temperature Range
   Military (LT113XM/LT114XM) .... −55°C to 125°C
   Industrial (LT113XI/LT114XI) .... − 40°C to 85°C
   Commercial (LT113XC/LT114XC) .... 0°C to 70°C

PRODUCT SELECTION TABLE

Part Number	Power Supply Voltages*	Shutdown	Drivers	Receivers	External Components
LT1130	+5	No	5	5	4 Capacitors
LT1131	+5	Yes	5	4	4 Capacitors
LT1132	+5	No	5	3	4 Capacitors
LT1133	+5	No	3	5	4 Capacitors
LT1134	+5	No	4	4	4 Capacitors
LT1135	+ 5, + 12, − 12	No	5	3	None
LT1136	+5	Yes	4	5	4 Capacitors
LT1137	+5	Yes	3	5	4 Capacitors
LT1138	+5	Yes	5	3	4 Capacitors
LT1139	+ 5, + 12	Yes	4	4	2 Capacitors
LT1140	+ 5, + 12, − 12	Yes	5	3	None
LT1141	+ 5, + 12, − 12	Yes	3	5	None

*The LT1130, LT1131, LT1132, LT1133, LT1134, LT1136, LT1137, and LT1138 can operate with + 5V and + 12V supplies and two external capacitors.

PACKAGE/ORDER INFORMATION

10-56

PACKAGE/ORDER INFORMATION

5-DRIVER/3-RECEIVER	ORDER PART NUMBER	3-DRIVER/5-RECEIVER	ORDER PART NUMBER
TOP VIEW

LT1132

V+ 1 — 24 V−
5V V_CC 2 — 23 C2−
C1+ 3 — 22 C2+
C1− 4 — 21 DRIVER IN
DRIVER OUT 5 — 20 DRIVER IN
DRIVER OUT 6 — 19 RX OUT
RX IN 7 — 18 DRIVER IN
DRIVER OUT 8 — 17 DRIVER IN
DRIVER OUT 9 — 16 RX OUT
RX IN 10 — 15 DRIVER IN
DRIVER OUT 11 — 14 RX OUT
RX IN 12 — 13 GROUND

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SOL
(.300" WIDE) | LT1132MJ
LT1132CJ
LT1132CN
LT1132IJ
LT1132IN
LT1132CS | TOP VIEW

LT1133

V+ 1 — 24 V−
5V V_CC 2 — 23 C2−
C1+ 3 — 22 C2+
C1− 4 — 21 DRIVER IN
DRIVER OUT 5 — 20 RX OUT
RX IN 6 — 19 DRIVER IN
DRIVER OUT 7 — 18 RX OUT
RX IN 8 — 17 RX OUT
RX IN 10 — 16 RX OUT
DRIVER OUT 11 — 15 DRIVER IN
RX IN 12 — 14 RX OUT
— 13 GROUND

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SOL
(.300" WIDE) | LT1133MJ
LT1133CJ
LT1133CN
LT1133IJ
LT1133IN
LT1133CS |
| **4-DRIVER/4-RECEIVER**

TOP VIEW

LT1134

V+ 1 — 24 V−
5V V_CC 2 — 23 C2−
C1+ 3 — 22 C2+
C1− 4 — 21 DRIVER IN
DRIVER OUT 5 — 20 RX OUT
RX IN 6 — 19 DRIVER IN
DRIVER OUT 7 — 18 RX OUT
RX IN 8 — 17 DRIVER IN
DRIVER OUT 9 — 16 RX OUT
RX IN 10 — 15 DRIVER IN
DRIVER OUT 11 — 14 RX OUT
RX IN 12 — 13 GROUND

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SCL
(.300" WIDE) | LT1134MJ
LT1134CJ
LT1134CN
LT1134IJ
LT1134IN
LT1134CS | **5-DRIVER/3-RECEIVER WITHOUT CHARGE PUMP**

TOP VIEW

LT1135

12V V+ 1 — 20 −12V V−
5V V_CC 2 — 19 DRIVER IN
DRIVER OUT 3 — 18 DRIVER IN
DRIVER OUT 4 — 17 RX OUT
RX IN 5 — 16 DRIVER IN
DRIVER OUT 6 — 15 DRIVER IN
DRIVER OUT 7 — 14 RX OUT
RX IN 8 — 13 DRIVER IN
DRIVER OUT 9 — 12 RX OUT
RX IN 10 — 11 GROUND

J PACKAGE
20-LEAD CERAMIC DIP
(.300" WIDE)
N PACKAGE
20-LEAD PLASTIC DIP
(.300" WIDE)
S PACKAGE
20-LEAD PLASTIC SOL
(.300" WIDE) | LT1135MJ
LT1135CJ
LT1135CN
LT1135IJ
LT1135IN
LT1135CS |
| **4-DRIVER/5-RECEIVER WITH SHUTDOWN**

TOP VIEW

LT1136

V+ 1 — 28 V−
5V V_CC 2 — 27 C2−
C1+ 3 — 26 C2+
C1− 4 — 25 DRIVER IN
DRIVER OUT 5 — 24 RX OUT
RX IN 6 — 23 DRIVER IN
DRIVER OUT 7 — 22 RX OUT
RX IN 8 — 21 DRIVER IN
DRIVER OUT 9 — 20 RX OUT
RX IN 10 — 19 DRIVER IN
DRIVER OUT 11 — 18 RX OUT
RX IN 12 — 17 RX OUT
RX IN 13 — 16 GROUND
ON/OFF 14 — 15

J PACKAGE
28-LEAD CERAMIC DIP
(.600" WIDE)
N PACKAGE
28-LEAD PLASTIC DIP
(.600" WIDE)
S PACKAGE
28-LEAD PLASTIC SOL
(.600" WIDE) | LT1136MJ
LT1136CJ
LT1136CN
LT1136IJ
LT1136IN
LT1136CS | **3-DRIVER/5-RECEIVER WITH SHUTDOWN**

TOP VIEW

LT1137

V+ 1 — 28 V−
5V V_CC 2 — 27 C2−
C1+ 3 — 26 C2+
C1− 4 — 25 DRIVER IN
DRIVER OUT 5 — 24 RX OUT
RX IN 6 — 23 DRIVER IN
DRIVER OUT 7 — 22 RX OUT
RX IN 8 — 21 RX OUT
RX IN 9 — 20 RX OUT
RX IN 10 — 19 DRIVER IN
DRIVER OUT 11 — 18 RX OUT
RX IN 12 — 17 GROUND
ON/OFF 13 — 16
— 14 — 15

J PACKAGE
28-LEAD CERAMIC DIP
(.600" WIDE)
N PACKAGE
28-LEAD PLASTIC DIP
(.600" WIDE)
S PACKAGE
28-LEAD PLASTIC SOL
(.600" WIDE) | LT1137MJ
LT1137CJ
LT1137CN
LT1137IJ
LT1137IN
LT1137CS |

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PACKAGE/ORDER INFORMATION

5-DRIVER/3-RECEIVER WITH SHUTDOWN	ORDER PART NUMBER	4-DRIVER/4-RECEIVER WITH SHUTDOWN WITH +12V AND +5V SUPPLIES	ORDER PART NUMBER

TOP VIEW — LT1138

V+ 1	28 V−
5V Vcc 2	27 C2−
C1+ 3	26 C2+
C1− 4	25 DRIVER IN
DRIVER OUT 5	24 DRIVER IN
DRIVER OUT 6	23 RX OUT
RX IN 7	22 RX OUT
DRIVER OUT 8	21 RX OUT
RX IN 9	20 DRIVER IN
DRIVER OUT 10	19 RX OUT
RX IN 11	18 DRIVER IN
DRIVER OUT 12	17 GROUND
ON/OFF 13	16
14	15

J PACKAGE
28-LEAD CERAMIC DIP
(.600" WIDE)
S PACKAGE
28-LEAD PLASTIC SOL
(.600" WIDE)
N PACKAGE
28-LEAD PLASTIC DIP
(.600" WIDE)

LT1138MJ
LT1138CJ
LT1138CN
LT1138IJ
LT1138IN
LT1138CS

TOP VIEW — LT1139

1	24 V−
5V Vcc 2	23 C−
12V INPUT 3	22 C+
DRIVER OUT 4	21 DRIVER IN
RX IN 5	20 RX OUT
DRIVER OUT 6	19 DRIVER IN
RX IN 7	18 RX OUT
DRIVER OUT 8	17 DRIVER IN
RX IN 9	16 RX OUT
DRIVER OUT 10	15 DRIVER IN
RX IN 11	14 RX OUT
ON/OFF 12	13 GROUND

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SOL
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)

LT1139MJ
LT1139CJ
LT1139CN
LT1139IJ
LT1139IN
LT1139CS

5-DRIVER/3-RECEIVER WITHOUT CHARGE PUMP		3-DRIVER/5-RECEIVER WITHOUT CHARGE PUMP	

TOP VIEW — LT1140

12V V+ 1	24 −12V V−
5V Vcc 2	23
3	22 DRIVER IN
DRIVER OUT 4	21 DRIVER IN
DRIVER OUT 5	20 RX OUT
RX IN 6	19 DRIVER IN
DRIVER OUT 7	18 DRIVER IN
DRIVER OUT 8	17 RX OUT
RX IN 9	16 DRIVER IN
DRIVER OUT 10	15 RX OUT
RX IN 11	14 GROUND
ON/OFF 12	13

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SOL
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)

LT1140MJ
LT1140CJ
LT1140CN
LT1140IJ
LT1140IN
LT1140CS

TOP VIEW — LT1141

12V V+ 1	24 −12V V−
5V Vcc 2	23
3	22 RX OUT
RX IN 4	21 DRIVER IN
DRIVER OUT 5	20 RX OUT
RX IN 6	19 DRIVER IN
DRIVER OUT 7	18 RX OUT
RX IN 8	17 DRIVER IN
DRIVER OUT 9	16 RX OUT
RX IN 10	15 RX OUT
RX IN 11	14 GROUND
ON/OFF 12	13

J PACKAGE
24-LEAD CERAMIC DIP
(.300" WIDE)
S PACKAGE
24-LEAD PLASTIC SOL
(.300" WIDE)
N PACKAGE
24-LEAD PLASTIC DIP
(.300" WIDE)

LT1141MJ
LT1141CJ
LT1141CN
LT1141IJ
LT1141IN
LT1141CS

For 2-Driver/2-Receiver devices, see LT1080/81 and LT1180/81 data sheet.

ELECTRICAL CHARACTERISTICS (Note 1)

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Any Driver							
Output Voltage Swing	Load = 3k to GND	Positive	●	5.0	7.3		V
		Negative	●	−5.0	−6.5		V
Logic Input Voltage	Input Low Level (V$_{OUT}$ = High)		●		1.4	0.8	V
Level	Input High Level (V$_{OUT}$ = Low)		●	2.0	1.4		V
Logic Input Current	0.8V ≤ V$_{IN}$ ≤ 2.0V		●		5	20	μA
Output Short Circuit Current	V$_{OUT}$ = 0V				12		mA
Output Leakage Current	SHUTDOWN (Note 2), V$_{OUT}$ = ± 30V (Note 3)		●		10	100	μA
Slew Rate	R$_L$ = 3kΩ, C$_L$ = 51pF			4	15	30	V/μs

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ELECTRICAL CHARACTERISTICS (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Any Receiver						
Input Voltage Thresholds	Input Low Threshold, (V_{OUT} = High)		0.8	1.3		V
	Input High Threshold, (V_{OUT} = Low)			1.7	2.4	V
Hysteresis		●	0.1	0.4	1.0	V
Input Resistance			3	5	7	kΩ
Output Voltage	Output Low, I_{OUT} = – 1.6mA	●		0.2	0.4	V
	Output High, I_{OUT} = 160μA (V_{CC} = 5V)	●	3.5	4.8		V
Output Short Circuit Current	Sinking Current, V_{OUT} = V_{CC}		– 10	– 20		mA
	Sourcing Current, V_{OUT} = 0V		0.4	1		mA
Output Leakage Current	SHUTDOWN (Note 2), 0V ≤ V_{OUT} ≤ V_{CC}	●		1	10	μA
Power Supply Generator						
V⁺ Output				8		V
V⁻ Output				– 7.5		V
Supply Current				17	27	mA
Supply Leakage Current	SHUTDOWN, – 55°C ≤ T_A ≤ 125°C	●		1	100	μA
	SHUTDOWN, 0°C ≤ T_A ≤ 70°C	●		1	10	μA
Supply Rise Time	SHUTDOWN To Turn On			2		ms
On/Off Pin Current	SHUTDOWN, 0V ≤ $V_{ON/\overline{OFF}}$ ≤ 5V	●	– 15		80	μA

The ● denotes the specifications which apply over the full operating temperature range. (0°C ≤ T_A ≤ 70°C for commercial grade, – 40°C ≤ T_A ≤ 85°C for industrial grade, and – 55°C ≤ T_A ≤ 125°C for military grade).

Note 1: Testing done at V_{CC} = 5V and $V_{ON/\overline{OFF}}$ = 3V

Note 2: $V_{ON/\overline{OFF}}$ ≤ 0.1V

Note 3: For LT1139, 40, and 41 with 12V supplies, V_{OUT} leakage is 200μA and V_{OUT} is forced to ± 25V.

PIN FUNCTIONS

V_{CC}: Input supply pin. Supply current drops to zero in the SHUTDOWN mode.

GND: Ground pin.

On/$\overline{Off}$: Controls the operation mode of the device and is TTL/CMOS compatible. A logic low puts the device in the SHUTDOWN mode which reduces input supply current to zero and places both driver and receiver outputs in a high impedance state. A logic high fully enables the device.

V +: Positive supply (RS232 drivers). V + ≈ 2V_{CC} – 1.5V. Requires an external capacitor (≥ 1μF) for charge storage. Capacitor may be tied to ground or + 5V input supply. V + voltage is short circuit proof for 30 seconds. With multiple transceivers, the V + and V – pins may be paralleled into common capacitors.

V –: Negative supply (RS232 drivers). V – ≈ – (2V_{CC} – 2.5V). Requires an external capacitor (≥ 1μF) for charge storage.

Loading does reduce V – voltage. V – is short circuit proof for 30 seconds. With multiple transceivers, the V + and V – pins may be paralleled into common capacitors.

DRIVER IN: RS232 driver input pins. Inputs are TTL/CMOS compatible. Inputs should not be allowed to float. Tie unused inputs to V_{CC}.

DRIVER OUT: Driver outputs with RS232 voltage levels. Outputs are in a high impedance state when in the SHUTDOWN mode or when power is off (V_{CC} = 0V) to allow data line sharing. Outputs are fully short circuit protected from V – + 30V to V + – 30V with power on, off, or in the SHUTDOWN mode. Typical output breakdowns are greater than ± 45V and higher applied voltages will not damage the device if moderately current limited. Although the outputs are protected, short circuits on one output can load the power supply generators disrupting the signal level from other outputs.

LT1130 Series

RX IN: Receiver inputs. Accepts RS232 voltage levels (±30V) and has 0.4V of hysteresis to provide noise immunity. Input impedance is nominally 5kΩ.

RX OUT: Receiver outputs with TTL/CMOS voltage levels. Outputs are in a high impedance state when in the SHUTDOWN mode to allow data line sharing. Outputs are fully short circuit protected to ground or V_{CC} with power on, off, or in the SHUTDOWN mode.
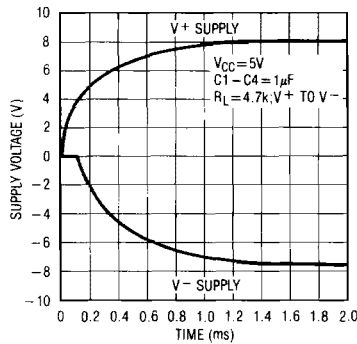
C1 +; C1 −; C2 +; C2 −: Requires an external capacitor (≥ 1μF) from C1 + to C1 − and another from C2 + to C2 −. In applications where larger positive voltages are available, such as + 12V, C1 can be eliminated and the positive voltage connected directly to the C1 + terminal.

TYPICAL PERFORMANCE CHARACTERISTICS

Driver Output Voltage
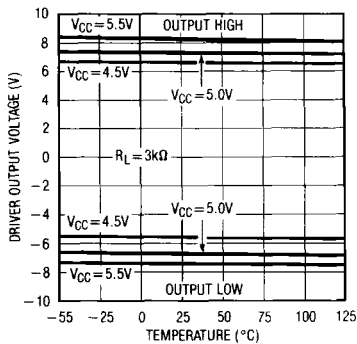
Supply Generation from V_{CC} or Shutdown

Receiver Input Thresholds
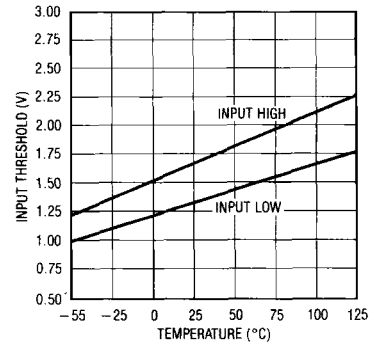
Receiver Output Short Circuit Current
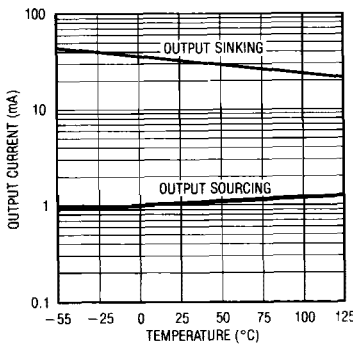
On-$\overline{Off}$ Pin Current vs Voltage

On-$\overline{Off}$ Pin Thresholds

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TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current in Shutdown

Driver Output Leakage in Shutdown
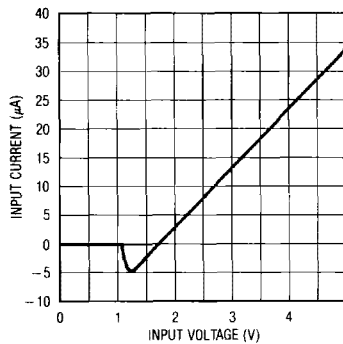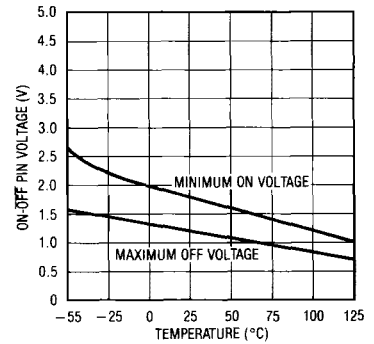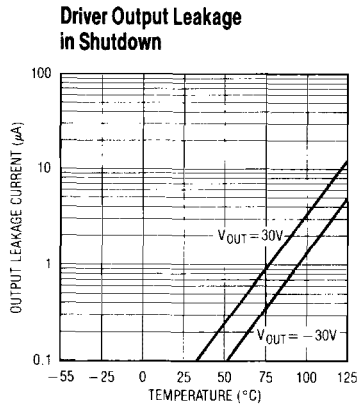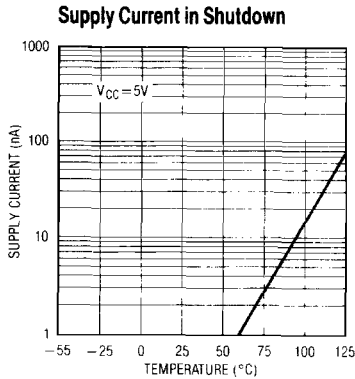
Output Waveforms
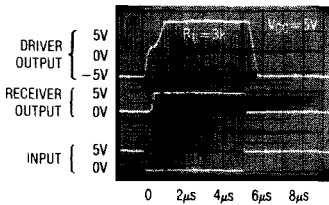
Shutdown to Driver Output
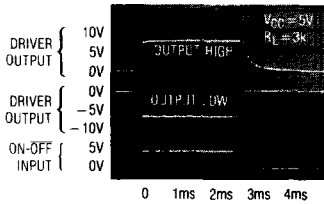
Shutdown to Receiver Output
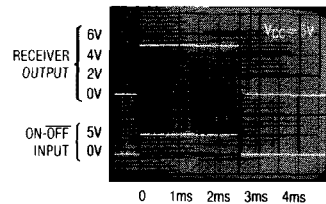
APPLICATION HINTS

The driver output stage of the LT1130 offers significantly improved protection over older bipolar and CMOS designs. In addition to current limiting, the driver output can be externally forced to ±30V with no damage or excessive current flow, and will not disrupt the supplies. Some drivers have diodes connected between the outputs and the supplies, so externally applied voltages can cause excessive supply voltage to develop.

LT1130 Driver

OUTPUT CAN BE FORCED EXTERNALLY

±30V OVERVOLTAGE
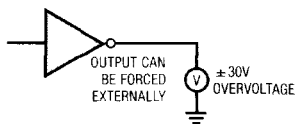
Older RS232 Drivers and CMOS Drivers

V +

WITH SOME DRIVERS, EXTERNALLY APPLIED VOLTAGE CAN FORCE THE SUPPLIES

V −
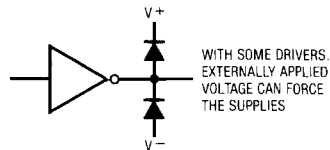
APPLICATION HINTS

Placing the LT1130 type device in the SHUTDOWN mode puts both the driver and receiver outputs in a high impedance state. This allows data line sharing and transceiver applications.

The SHUTDOWN mode also drops input supply current to zero for power-conscious systems.

Transceiver

Sharing a Receiver Line
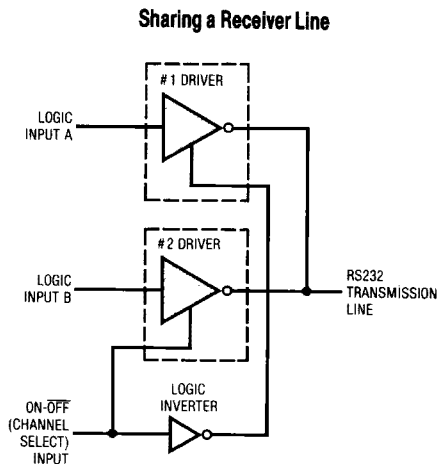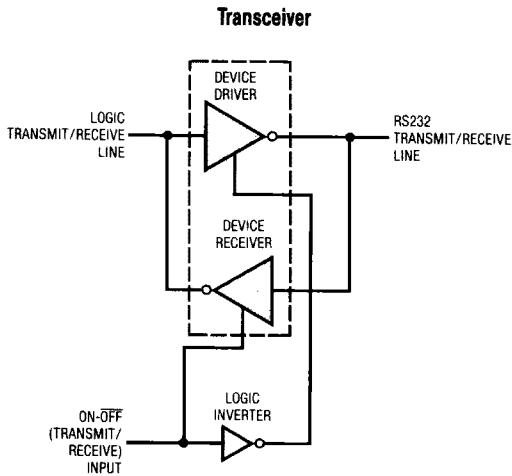
Sharing a Transmitter Line
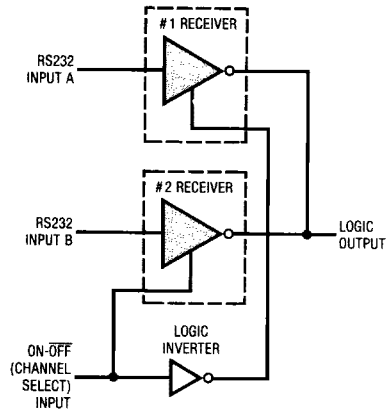
When driving CMOS logic from a receiver that will be used in the SHUTDOWN mode and there is no other active receiver on the line, a 51k resistor can be placed from the logic input to V_{CC} to force a definite logic level when the receiver output is in a high impedance state.
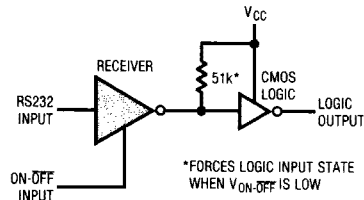
To protect against receiver input overloads in excess of ±30V, a voltage clamp can be placed on the data line and still maintain RS232 compatibility.
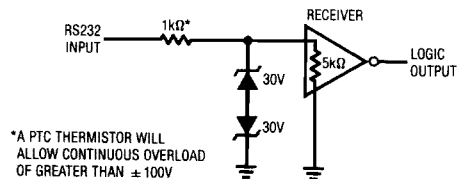
TYPICAL APPLICATIONS

Basic Operation
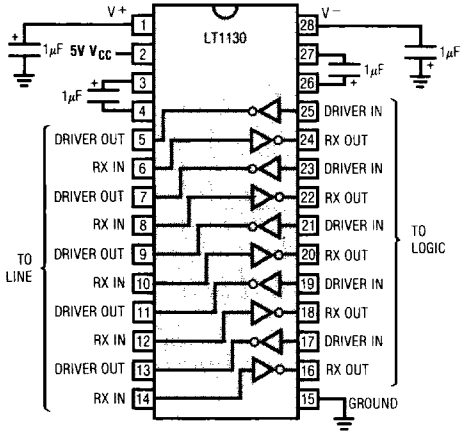
Operating with +5V and +12V Supplies
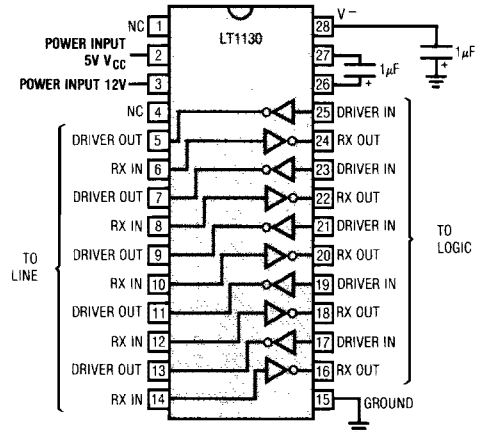
Paralleling Power Supply Generator
with Common Storage Capacitors
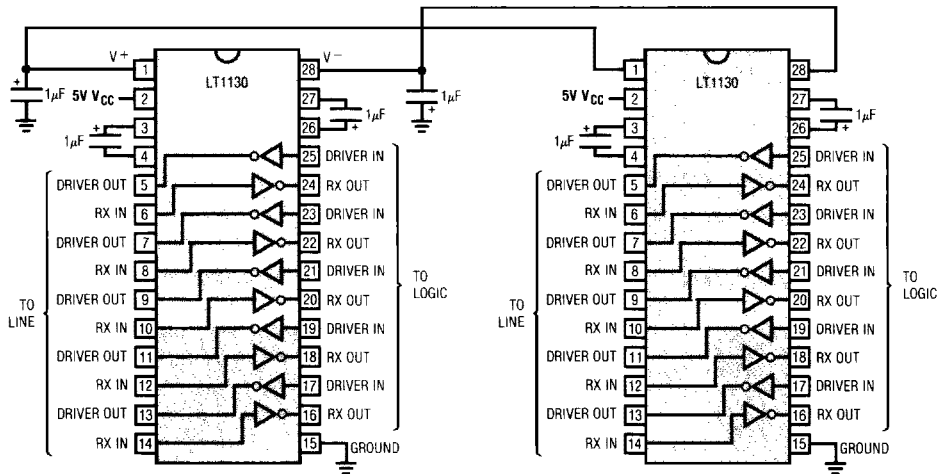
2500V Isolated 5-Driver/5-Receiver RS232 Transceiver
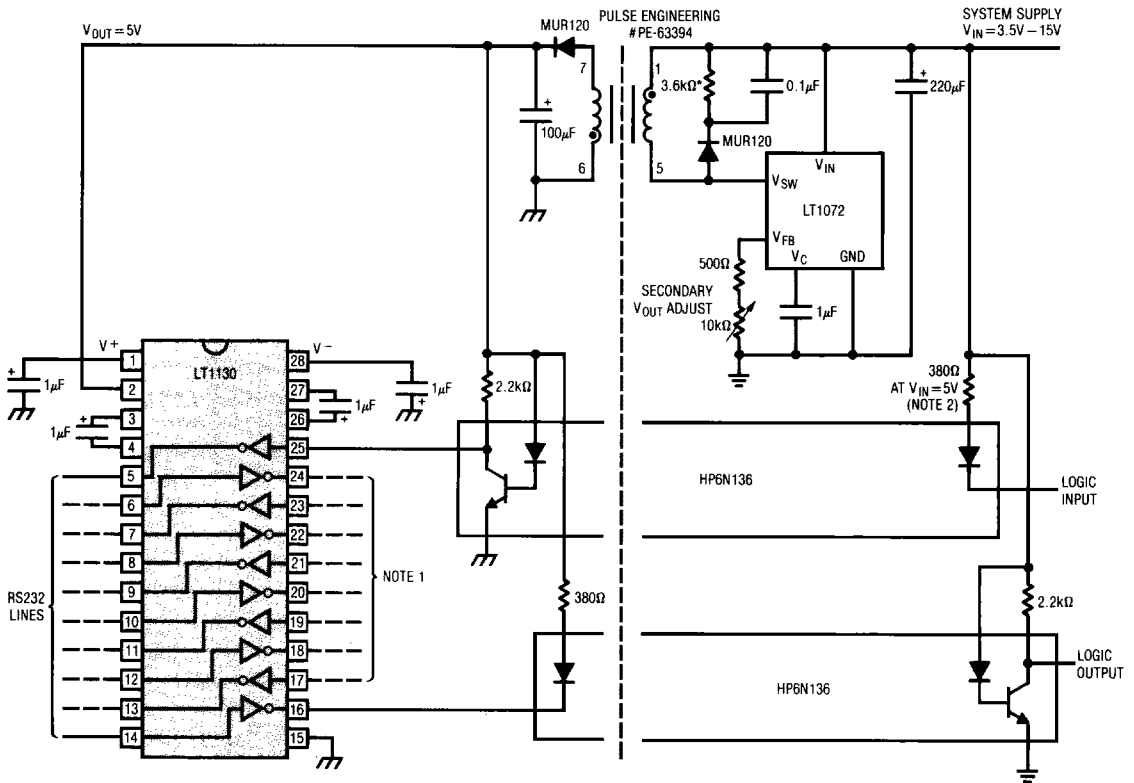
= SYSTEM GROUND

= FLOATING COMMON

NOTE 1: REPEAT THE OPTOCOUPLER CONNECTIONS FOR EACH LINE.
NOTE 2: SELECT FOR 10mA THROUGH LED.
*FOR IMPROVED EFFICIENCY, REPLACE THE 3.6kΩ RESISTOR WITH A 30V ZENER DIODE.
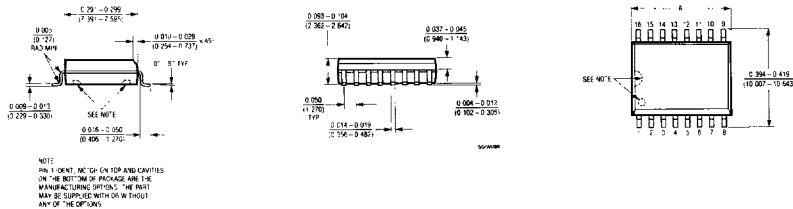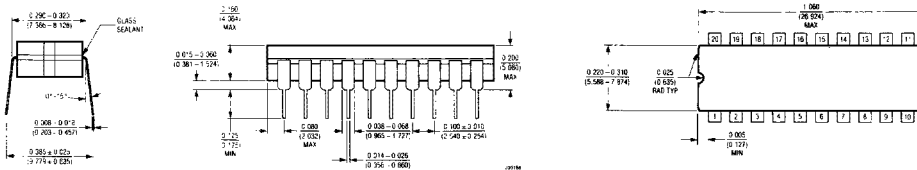
RS232 Driver Signals
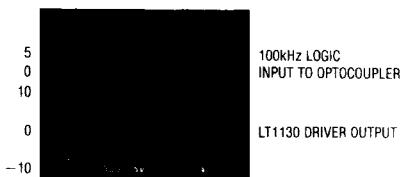
5
0   100kHz LOGIC
10   INPUT TO OPTOCOUPLER

0   LT1130 DRIVER OUTPUT

−10

RS232 Receiver Signals
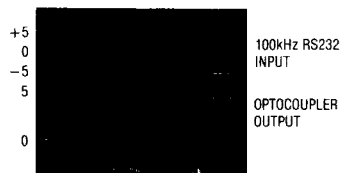
+5
0   100kHz RS232
−5   INPUT

5
           OPTOCOUPLER
           OUTPUT
0

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

S Package
20-, 24- and 28-Lead Plastic SOL
(.300"/.300"/.600" Wide)

NO. OF LEADS	"A" DIM
16	0.385 – 0.415 (10.033 – 10.541)
18	0.450 – 0.470 (11.430 – 11.938)
20	0.495 – 0.515 (12.573 – 13.081)
24	0.600 – 0.615 (15.240 – 15.621)
28	0.700 – 0.715 (17.780 – 18.161)

NOTE
PIN 1 IDENT, NOTCH ON TOP AND CAVITIES
ON THE BOTTOM OF PACKAGE ARE THE
MANUFACTURING OPTIONS. THE PART
MAY BE SUPPLIED WITH OR WITHOUT
ANY OF THE OPTIONS

J Package
20-Lead Ceramic DIP
(.300" Wide)

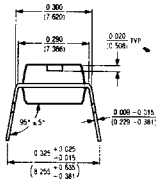## N Package
20-Lead Plastic DIP
(.300" Wide)
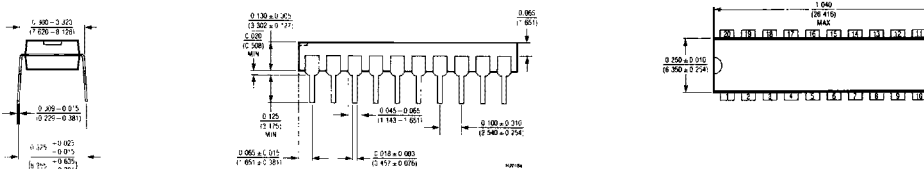
J Package
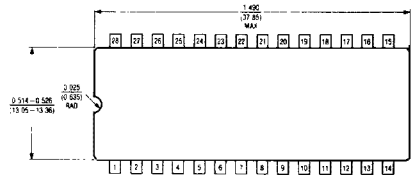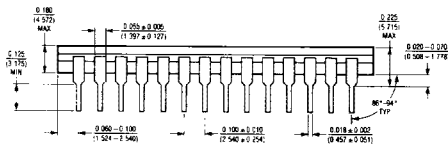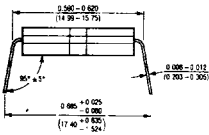## 24-Lead Ceramic DIP
(.300" Wide)
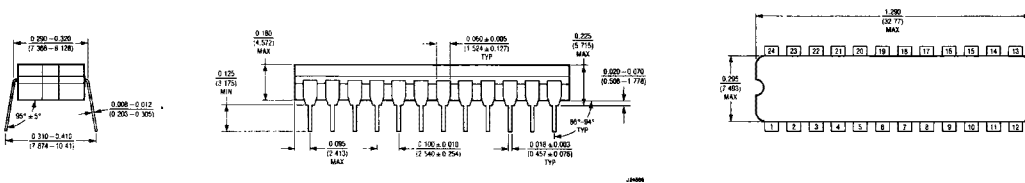
PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

**N Package
24-Lead Plastic DIP
(.300″ Wide)**

**J Package
28-Lead Ceramic DIP
(.600″ Wide)**

**N Package
28-Lead Plastic DIP
(.600″ Wide)**

LINEAR
TECHNOLOGY