19-1402; Rev 0; 11/98

MAXIM

3V to 5.5V, IrDA Infrared Transceiver with Integrated RS-232 Interface

General Description

The MAX3130/MAX3131 combine an IrDA 1.2 compatible infrared transceiver with an RS-232 interface—all in a single 3V-powered hybrid microcircuit. The infrared transceiver supports IrDA data rates of 2.4kbps to 115kbps. The infrared receive channel provides a high-gain/low-noise PIN-diode amplifier with 100µA of ambient photodiode current rejection at a +3V supply. A high-power LED driver capable of sinking 200mA is included in the infrared transmit path. The on-board encoder/decoder (ENDEC) compresses/stretches signals to and from the external UART, allowing IrDA communication even with non-IrDA UARTs.

A 2-driver/2-receiver RS-232 transceiver supports data rates up to 120kbps. A proprietary, high-efficiency, dual charge-pump power supply and a low-dropout transmitter combine to deliver true RS-232 performance from a single +3.0V to +5.5V supply. Selectable shutdown for IR and RS-232 circuitry reduces supply current to 1µA.

The MAX3130 is optimized for applications using a single UART for both infrared and RS-232 communication. The infrared transmitter input and infrared receiver output are multiplexed with one RS-232 transmitter input and one RS-232 receiver output, respectively. The MAX3131's IrDA transceiver and RS-232 transceivers are separate and have their own data inputs and outputs.

Both these devices require a minimum of external components: four small 0.1µF capacitors, a photodiode, an infrared LED, and a current-setting resistor.

Applications

Personal Digital Assistants (PDAs)

Palmtop Computers

Battery-Powered Systems

Hand-Held Equipment

Peripherals

IrDA Applications

Cellular Phones

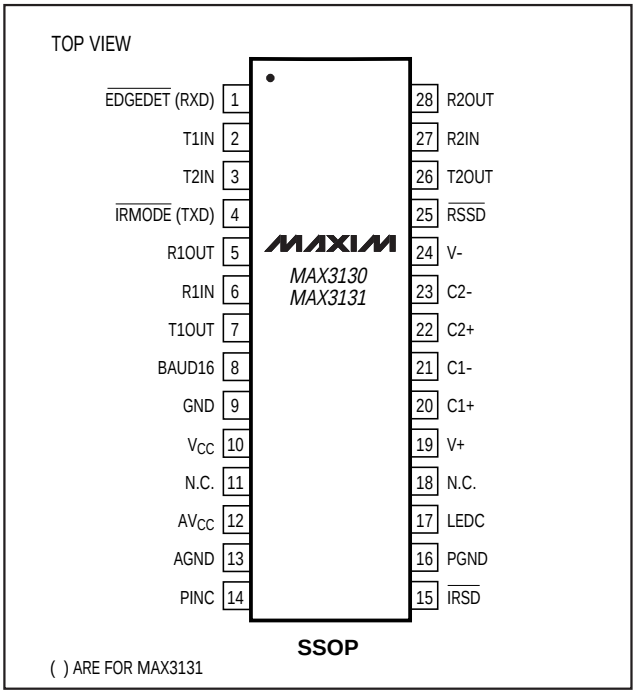
Features

- **Integrated RS-232 and IrDA in Single 28-Pin SSOP Package**
- **370µA Supply Current**
- **IrDA 1.2 Compatible: 2.4kbps to 115kbps Data Rate**
- **On-Board IR Encoder/Decoder Allows Use of Non-IrDA UARTs**
- **+3.0V to +5.5V Single-Supply Operation**
- **Meet EIA/TIA-232 Specifications Down to +3V**
- **200mA, High-Current Infrared LED Drive**
- **1µA Low-Power Shutdown with RS-232 Receivers Active**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX3130CAI	0°C to +70°C	28 SSOP
MAX3130EAI	-40°C to +85°C	28 SSOP
MAX3131CAI	0°C to +70°C	28 SSOP
MAX3131EAI	-40°C to +85°C	28 SSOP

Pin Configuration



For free samples & the latest literature: http://www.maxim-ic.com, or phone 1-800-998-8800. For small orders, phone 1-800-835-8769.

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3V to 5.5V, IrDA Infrared Transceiver with Integrated RS-232 Interface

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +6V
AV_{CC} to AGND .....-0.3V to +6V
V_{CC} to AV_{CC} .....±0.3V
AGND, PGND to GND .....±0.1V
V+ to GND .....-0.3V to +7V
V- to GND .....+0.3V to -7V
V+ to V- .....+13V
Inputs (referenced to GND)
T1IN, T2IN, TXD, $\overline{RSSD}$, $\overline{IRMODE}$, BAUD16, $\overline{IRSD}$ .....-0.3V to +6V
R1IN, R2IN .....±25V
Outputs (referenced to GND)
T1OUT, T2OUT .....±13.2V
R1OUT, R2OUT, $\overline{EDGEDET}$, RXD .....-0.3V to (V_{CC} + 0.3V)
LEDC .....-0.3V to +6V
Output Short-Circuit Duration (to V_{CC} or GND)
T1OUT, T2OUT .....Continuous
Output Currents
LEDC Continuous 200mA
LEDC 20% Duty Cycle t_{ON} < 90µs 500mA
Input Current
PINC 10mA
Continuous Power Dissipation (T_A = +70°C)
SSOP (derate 9.52mW/°C above +70°C) 762mW
Operating Temperature Ranges
MAX3130/MAX3131CAI .....0°C to +70°C
MAX3130/MAX3131EAI .....-40°C to +85°C
Storage Temperature Range .....-65°C to +160°C
Lead Temperature (soldering, 10sec) .....+300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = AV_{CC} = 3.0V to 5.5V, GND = AGND = PGND, C1–C4 = 0.1µF (Note 1), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = AV_{CC} = 3.3V.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS					
Power-Supply Current	V_{CC} = 3.3V or 5V, T_A = +25°C (Note 2)		0.25	1.0	mA
Analog Power-Supply Current	T_A = +25°C (Note 2)		120	200	µA
Shutdown Supply Current	$\overline{RSSD}$ = low or $\overline{IRMODE}$ = low, T_A = +25°C (Note 2)		1.0	10	µA
Shutdown Analog Supply Current	$\overline{IRSD}$ = low, T_A = +25°C (Note 2)		0.01	1.0	µA
LOGIC INPUTS (T1IN, T2IN, TXD, $\overline{IRMODE}$, BAUD16, $\overline{IRSD}$, $\overline{RSSD}$)					
Input Logic Threshold Low				0.8	V
Input Logic Threshold High	V_{CC} = AV_{CC} = 3.3V	2.0			V
	V_{CC} = AV_{CC} = 5V	2.4			
Input Leakage Current	V_{IN} = 0 to V_{CC}		±0.01	±1.0	µA
LOGIC OUTPUTS (R1OUT, R2OUT, RXD, $\overline{EDGEDET}$)					
Output Voltage Low	I_{SINK} = 1.6mA		0.1	0.4	V
Output Voltage High	I_{SOURCE} = 1.0mA	V_{CC} - 0.6	V_{CC} - 0.05		V
IR RECEIVER					
Data Rate	(Note 3)	2.4		115.2	kbps
Equivalent Input Noise Current			10		nA_{RMS}
Input Current Sensitivity	(Note 3)	0.0002		6	mA
Ambient Photodiode Current Rejection	AV_{CC} = 3.3V		100		µA
	AV_{CC} = 5V		375		

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ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = AV_{CC} = 3.0V to 5.5V, GND = AGND = PGND, C1–C4 = 0.1µF (Note 1), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = AV_{CC} = 3.3V.)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
IR Receiver Disable Time	Delay until I_{AVCC} < 1µA			10		µs
IR Receiver Enable Time	Delay until maximum IR receive data rate is valid			300		µs
IR Receiver Output Pulse Width	BAUD16 = static (Note 3)	Data rate = 2.4kbps	1		90	µs
		Data rate = 115kbps	1	1.6	8	
IR TRANSMITTER						
Transmitter Rise Time	10% to 90% of 200mA drive current			20	600	ns
Transmitter Fall Time	90% to 10% of 200mA drive current			20	600	ns
Transmitter Output Resistance	I_{OUT} = 200mA	AV_{CC} = 3.3V		1.15	2	Ω
		AV_{CC} = 5V		0.9	1.6	
Off-Leakage Current	V_{LEDC} = 5.5V			0.01	10.0	µA
IrDA ENCODER/DECODER (ENDEC)						
Maximum Operating Frequency	Maximum frequency at BAUD16				2	MHz
IR Output Pulse Width	f_{BAUD16} = 1.8432MHz, measured at V_{LEDC}		1.43		2.23	µs
BAUD16 Operating Frequency Range	f_{BAUD16} required to enable ENDEC		34.6		2000	kHz
RS-232 RECEIVER						
Input Voltage Range			-25		25	V
Input Threshold Low	V_{CC} = 3.3V		0.6	1.2		V
	V_{CC} = 5V		0.8	1.5		
Input Threshold High	V_{CC} = 3.3V			1.5	2.4	V
	V_{CC} = 5V			1.8	2.4	
Input Hysteresis				0.3		V
Input Resistance	T_A = +25°C		3	5	7	kΩ
Receiver Propagation Delay	R_IN to R_OUT, C_L = 150pF	t_{PHL}		300		ns
		t_{PLH}		300		
Receiver Skew	$\lvert t_{PHL} - t_{PLH} \rvert$, C_L = 150pF			300		ns
RS-232 TRANSMITTER OUTPUTS						
Output Voltage Swing	T1OUT, T2OUT, loaded with 3kΩ to GND		±5	±5.4		V
Output Resistance	V_{CC} = V+ = V- = 0, T_OUT = ±2V		300	10M		Ω
Output Short-Circuit Current	V_{T_OUT} = 0			±35	±60	mA
Output Leakage Current	V_{T_OUT} = ±12V, V_{CC} = 0 to 5.5V, RS-232 transceiver shutdown				±25	µA
Maximum Data Rate	R_L = 3kΩ, C_L = 1000pF, one transmitter switching		120	235		kbps
Transmitter Skew	$\lvert t_{PHL} - t_{PLH} \rvert$			300		ns

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3V to 5.5V, IrDA Infrared Transceiver with Integrated RS-232 Interface

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = AV_{CC} = 3.0V to 5.5V, GND = AGND = PGND, C1–C4 = 0.1µF (Note 1), T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = AV_{CC} = 3.3V.)

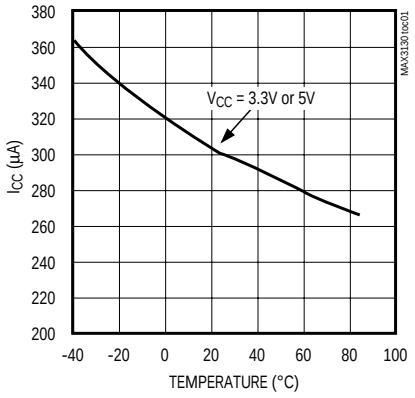
PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Transition-Region Slew Rate	V_{CC} = 3.3V, R_L = 3kΩ to 7kΩ, measured from +3V to -3V or -3V to +3V, T_A = +25°C	C_L = 150pF to 1000pF	6		30	V/µs
		C_L = 150pF to 2500pF	4		30	
Transmitter Enable Time	Delay until transmitter outputs are valid			100		µs

Note 1: C1–C4 = 0.1µF, tested at +3.3V ±10%. C1 = 0.047µF, C2–C4 = 0.33µF, tested at +5.0V ±10%.
Note 2: All supply current measurements are made under no-load condition on all outputs, and all input voltages are at V_{CC} or GND.
Note 3: For a compliant IrDA input signal where the data rate is within the supported data rate for the IR receive mode: rise/fall times are less than 600ns and pulse widths are between 1.41µs and 3/16 of the baud rate.

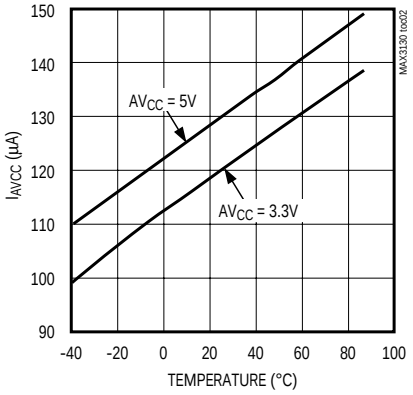
Typical Operating Characteristics

(V_{CC} = AV_{CC} = 3.3V, GND = AGND = PGND, C1–C4 = 0.1µF, R_L = 3kΩ, T_A = +25°C, unless otherwise noted.)

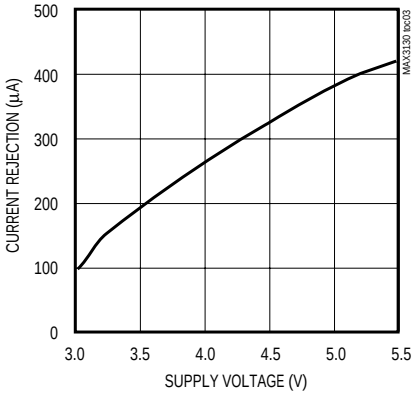
SUPPLY CURRENT vs. TEMPERATURE



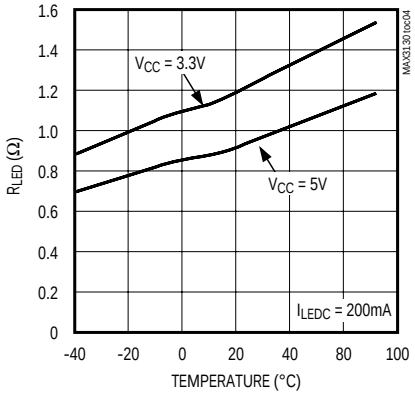
ANALOG SUPPLY CURRENT vs. TEMPERATURE



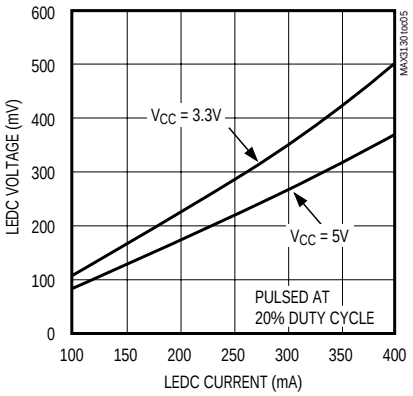
AMBIENT PHOTODIODE CURRENT REJECTION vs. SUPPLY VOLTAGE



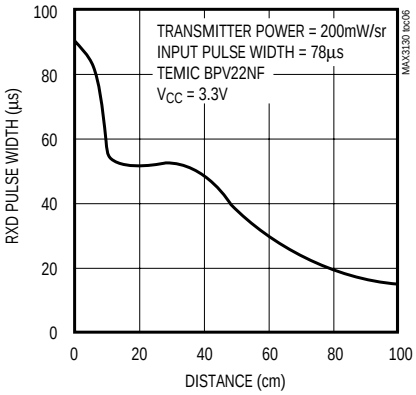
LED DRIVER ON-RESISTANCE vs. TEMPERATURE



LEDC VOLTAGE vs. LEDC CURRENT



RXD OUTPUT PULSE WIDTH vs. DISTANCE (2400bps)



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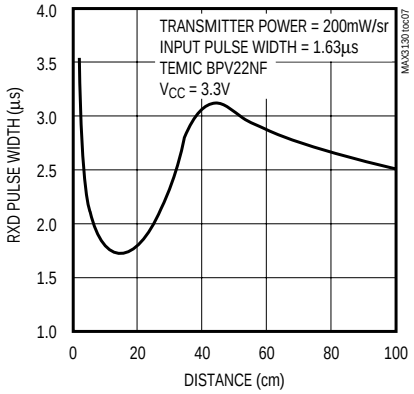
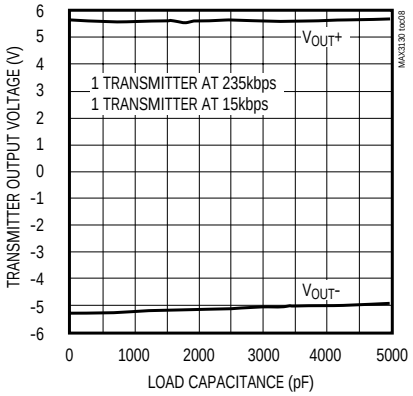
Typical Operating Characteristics (continued)

(V_{CC} = AV_{CC} = 3.3V, GND = AGND = PGND, C1–C4 = 0.1µF, R_L = 3kΩ, T_A = +25°C, unless otherwise noted.)

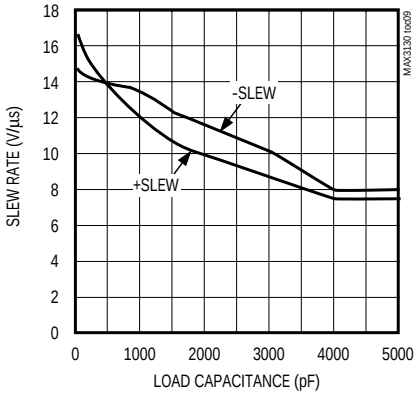
RXD OUTPUT PULSE WIDTH vs. DISTANCE (115.2 kbps)



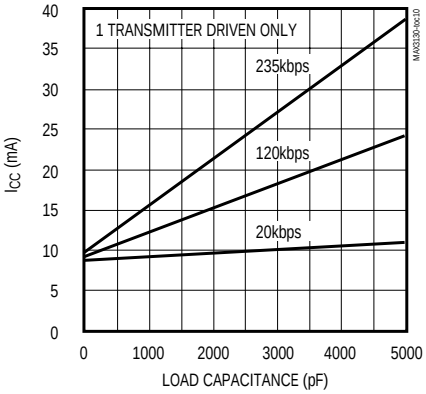
TRANSMITTER OUTPUT VOLTAGE vs. LOAD CAPACITANCE



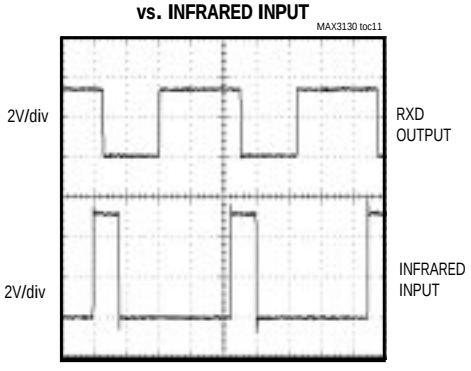
RS-232 TRANSMITTER SLEW RATE vs. LOAD CAPACITANCE



SUPPLY CURRENT vs. LOAD CAPACITANCE (RS-232 TRANSMITTING)

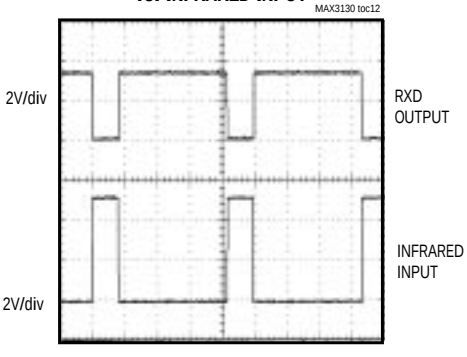


RXD OUTPUT vs. INFRARED INPUT



V_{CC} = 3.3V, 115.2kbps AT 1cm DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

RXD OUTPUT vs. INFRARED INPUT



V_{CC} = 3.3V, 2400bps AT 1cm DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

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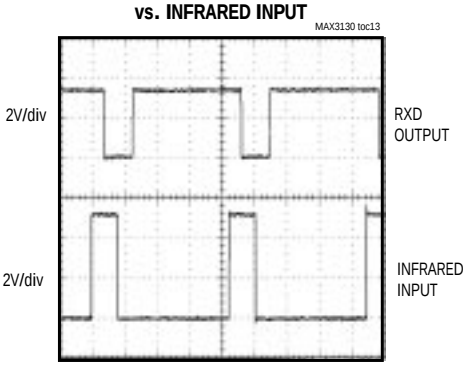
3V to 5.5V, IrDA Infrared Transceiver with Integrated RS-232 Interface

Typical Operating Characteristics (continued)

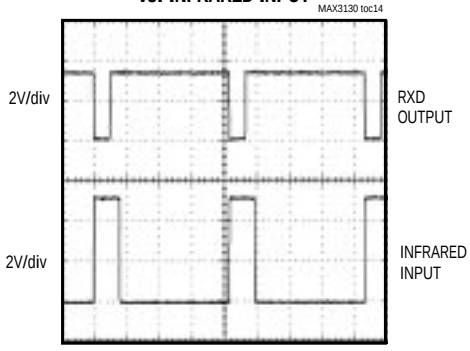
(V_{CC} = AV_{CC} = 3.3V, GND = AGND = PGND, C1–C4 = 0.1µF, R_L = 3kΩ, T_A = +25°C, unless otherwise noted.)

RXD OUTPUT vs. INFRARED INPUT



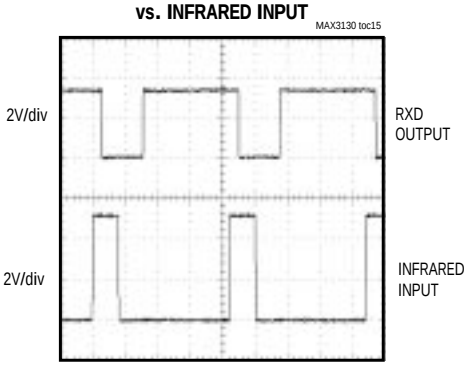
V_{CC} = 3.3V, 115.2kbps AT 10cm DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

RXD OUTPUT vs. INFRARED INPUT



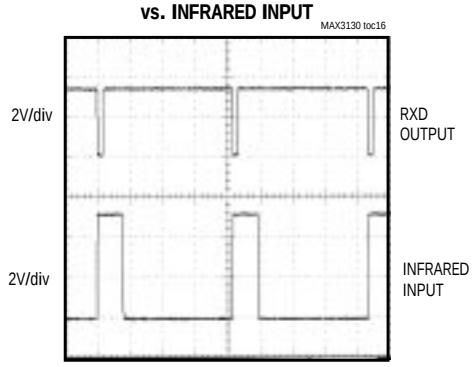
V_{CC} = 3.3V, 2400bps AT 10cm DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

RXD OUTPUT vs. INFRARED INPUT



V_{CC} = 3.3V, 115.2kbps AT 1m DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

RXD OUTPUT vs. INFRARED INPUT



V_{CC} = 3.3V, 2400bps AT 1m DISTANCE
TEMIC BPV22NF
TRANSMIT POWER 200mW/sr

Pin Description

PIN		NAME	FUNCTION
MAX3130	MAX3131		
1	—	$\overline{\text{EDGEDET}}$	Edge Detector Output. $\overline{\text{EDGEDET}}$ goes low if activity is sensed on either the RS-232 receiver or the IrDA receiver, depending on the state of $\overline{\text{IRMODE}}$. See *$\overline{\text{EDGEDET}}$: Edge-Detection Circuitry* section.
—	1	RXD	IR Receiver TTL/CMOS Data Output
2	2	T1IN	TTL/CMOS RS-232 Transmitter Input

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Pin Description (continued)

PIN		NAME	FUNCTION
MAX3130	MAX3131		
3	3	T2IN	TTL/CMOS RS-232 Transmitter Input. For the MAX3130, drive $\overline{IRMODE}$ low to connect T2IN to the IR transmitter input, and drive $\overline{IRMODE}$ high to connect T2IN to the RS-232 transmitter input. For the MAX3131, T2IN is always connected to the RS-232 transmitter input.
4	—	$\overline{IRMODE}$	IR Mode Control. Drive $\overline{IRMODE}$ low to connect R2OUT to the IR receiver output and T2IN to the IR transmitter input. Driving $\overline{IRMODE}$ low also shuts down the RS-232 charge pump and puts the RS-232 transmitter outputs in a high-impedance state. Drive $\overline{IRMODE}$ high to connect R2OUT to the RS-232 receiver output and connect T2IN to the RS-232 transmitter input.
—	4	TXD	IR Transmitter TTL/CMOS Data Input
5	5	R1OUT	TTL/CMOS RS-232 Receiver Output
6	6	R1IN	RS-232 Receiver Input
7	7	T1OUT	RS-232 Transmitter Output
8	8	BAUD16	16-Times Baud-Rate Input. To use the ENDEC, apply a signal that is 16 times the baud rate into BAUD16. Connect BAUD16 to GND or V_{CC} to disable the ENDEC.
9	9	GND	Ground
10	10	V_{CC}	3.0V to 5.5V Supply Voltage
11, 18	11, 18	N.C.	No Connection. **Do not make connections to these pins.**
12	12	AV_{CC}	Analog Supply Voltage V_{CC} for IR Signal Processing. AV_{CC} range is 3.0V to 5.5V.
13	13	AGND	Analog Ground for IR Signal Processing. Connect to GND.
14	14	PINC	Silicon PIN Photodiode Input. Connect PINC to the cathode of the PIN photodiode. Connect the anode of the PIN photodiode to GND.
15	15	$\overline{IRSD}$	Shutdown Input for the IrDA Transceiver Circuitry
16	16	PGND	Power Ground for IR LED Driver. Connect to GND.
17	17	LEDC	Open-Drain Output for Driving the IR LED. Connect LEDC to the cathode of the IR LED.
19	19	V+	+5.5V Generated by the Internal Charge Pump
20	20	C1+	Positive Terminal of the Voltage-Doubling Charge-Pump Capacitor
21	21	C1-	Negative Terminal of the Voltage-Doubling Charge-Pump Capacitor
22	22	C2+	Positive Terminal of the Inverting Charge-Pump Capacitor
23	23	C2-	Negative Terminal of the Inverting Charge-Pump Capacitor
24	24	V-	-5.5V Generated by the Internal Charge Pump
25	25	$\overline{RSSD}$	Shutdown Input for the RS-232 Transmitters and Charge Pump
26	26	T2OUT	RS-232 Transmitter Output
27	27	R2IN	RS-232 Receiver Input
28	28	R2OUT	TTL/CMOS RS-232 Receiver Output. For the MAX3130, drive $\overline{IRMODE}$ low to connect R2OUT to the IR receiver output, and drive $\overline{IRMODE}$ high to connect R2OUT to the RS-232 receiver output. For the MAX3131, R2OUT is always internally connected to the RS-232 receiver output.

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MAX3130 Function Table

MAX3130 CONTROL INPUTS			LOGIC INPUTS		RS-232 I/O				LOGIC OUTPUTS		IrDA OUTPUT	IrDA INPUT
$\overline{RSSD}$	$\overline{IRMODE}$	$\overline{IRSD}$	T1IN	T2IN	T1OUT	T2OUT	R1IN	R2IN	R1OUT	R2OUT	LEDC	PINC
X	0	0	RS-232 Input	IrDA Input	High-Z	High-Z	RS-232 Input	RS-232 Input	RS-232 Output	IrDA Output	Enabled	Disabled
X	0	1	RS-232 Input	IrDA Input	High-Z	High-Z	RS-232 Input	RS-232 Input	RS-232 Output	IrDA Output	Enabled	Enabled
0	1	0	RS-232 Input	RS-232 Input	High-Z	High-Z	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	Disabled	Disabled
0	1	1	RS-232 Input	RS-232 Input	High-Z	High-Z	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	Disabled	Enabled
1	1	0	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	Disabled	Disabled
1	1	1	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	RS-232 Input	RS-232 Input	RS-232 Output	RS-232 Output	Disabled	Enabled

X = Don't care

MAX3131 Operational Modes Table

$\overline{RSSD}$	$\overline{IRSD}$	T_OUT	R_IN	LEDC	RXD
0	0	High-Z	Enabled	Enabled	Logic High
0	1	High-Z	Enabled	Enabled	IrDA Output
1	0	Enabled	Enabled	Enabled	Logic High
1	1	Enabled	Enabled	Enabled	IrDA Output

Detailed Description

The MAX3130/MAX3131 are IrDA 1.2 compatible, infrared transceivers with an integrated RS-232 interface. By selecting appropriate external optical components, these devices support IrDA 1.2 data rates from 2.4kbps to 115kbps at distances from 1cm to 1m. A low-noise design allows them to achieve a bit-error rate below 10^{-8} at maximum data rates. On-chip filtering rejects out-of-band ambient light signals that interfere with infrared communication. Both devices include a high-power LED driver capable of sinking 200mA.

The MAX3130 and MAX3131 contain two RS-232 drivers and two RS-232 receivers that support data rates up to 120kbps. The RS-232 transceiver is powered by a high-efficiency, dual charge-pump power supply that operates with input supply voltages from +3.0V to +5.5V.

The MAX3130 is optimized for applications using a single UART for both infrared and RS-232 communication. The infrared transmitter input and infrared receiver output are multiplexed with one RS-232 transmitter input and one RS-232 receiver output, respectively. The MAX3131 IrDA and RS-232 transceivers are independent of each other for use in simultaneous multiprotocol transceiver applications.

IR Receivers

The receiver amplifier reverse biases the PIN diode with approximately 1.2V, and the PIN diode converts pulses of IR light into pulses of current. The input transimpedance (current-to-voltage) amplifier converts and amplifies these current pulses into voltage pulses. The MAX3130/MAX3131 incorporate filters that remove low-frequency ambient light interference and high-frequency circuit noise from these voltage pulses. A high-speed comparator then translates these voltage pulses into CMOS output levels. Figures 1 and 2 show system functional diagrams.

The RXD pin is the output of the infrared receiver for the MAX3131. The R2OUT pin is the output of the infrared receiver for the MAX3130 ($\overline{IRMODE}$ = low). With the ENDEC disabled, the infrared receiver output pulses low upon each incoming infrared pulse. The pulse width of the receiver output depends on many factors, including transmitter distance and power, PIN photodiode efficiency and area, and incoming data rate. Under all circumstances the output pulse is less than one baud period. To communicate with UARTs that are not IrDA compatible, enable the ENDEC (see the *IrDA Encoder/Decoder (ENDEC)* section).

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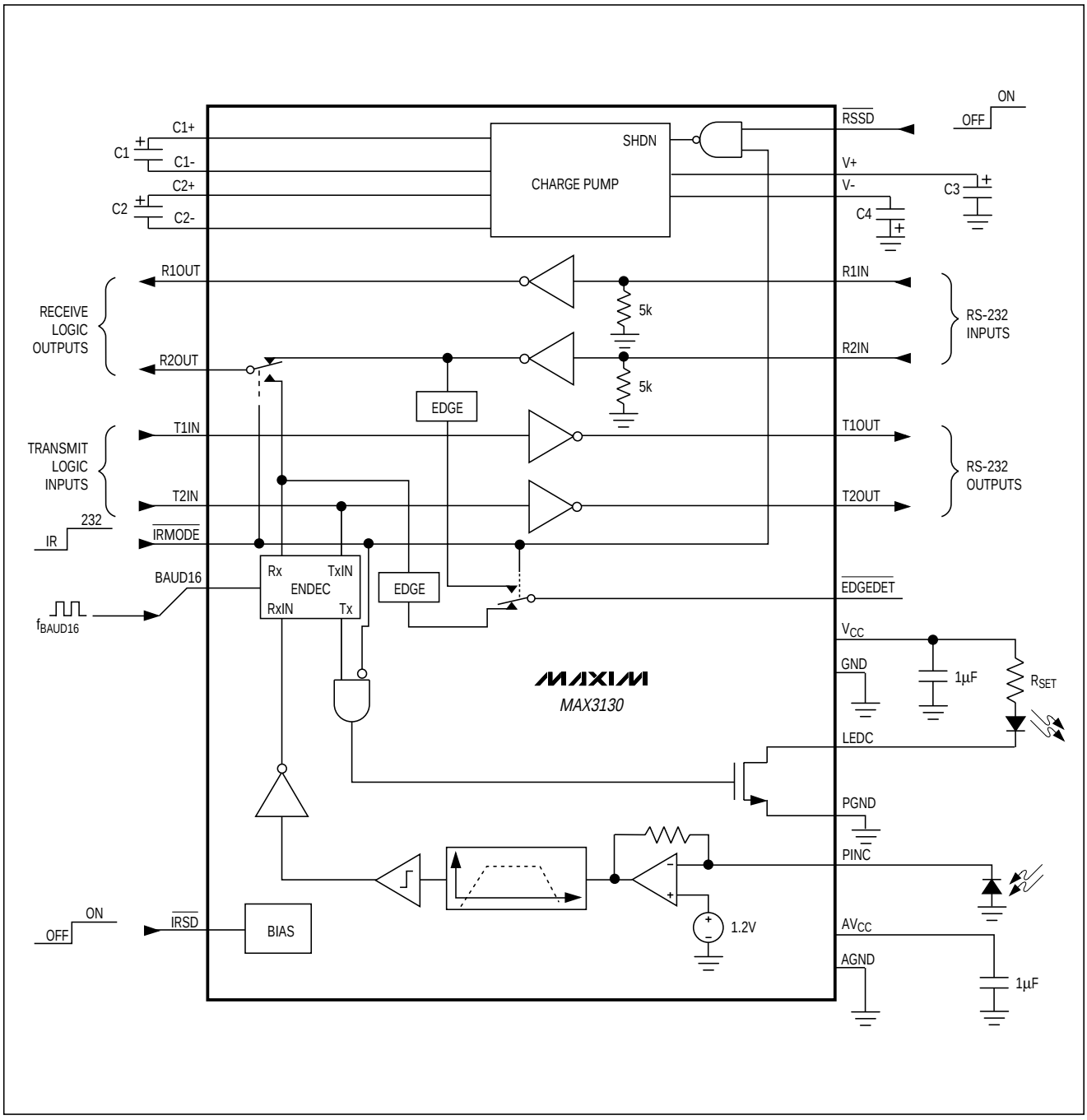

Figure 1. MAX3130 Functional Diagram

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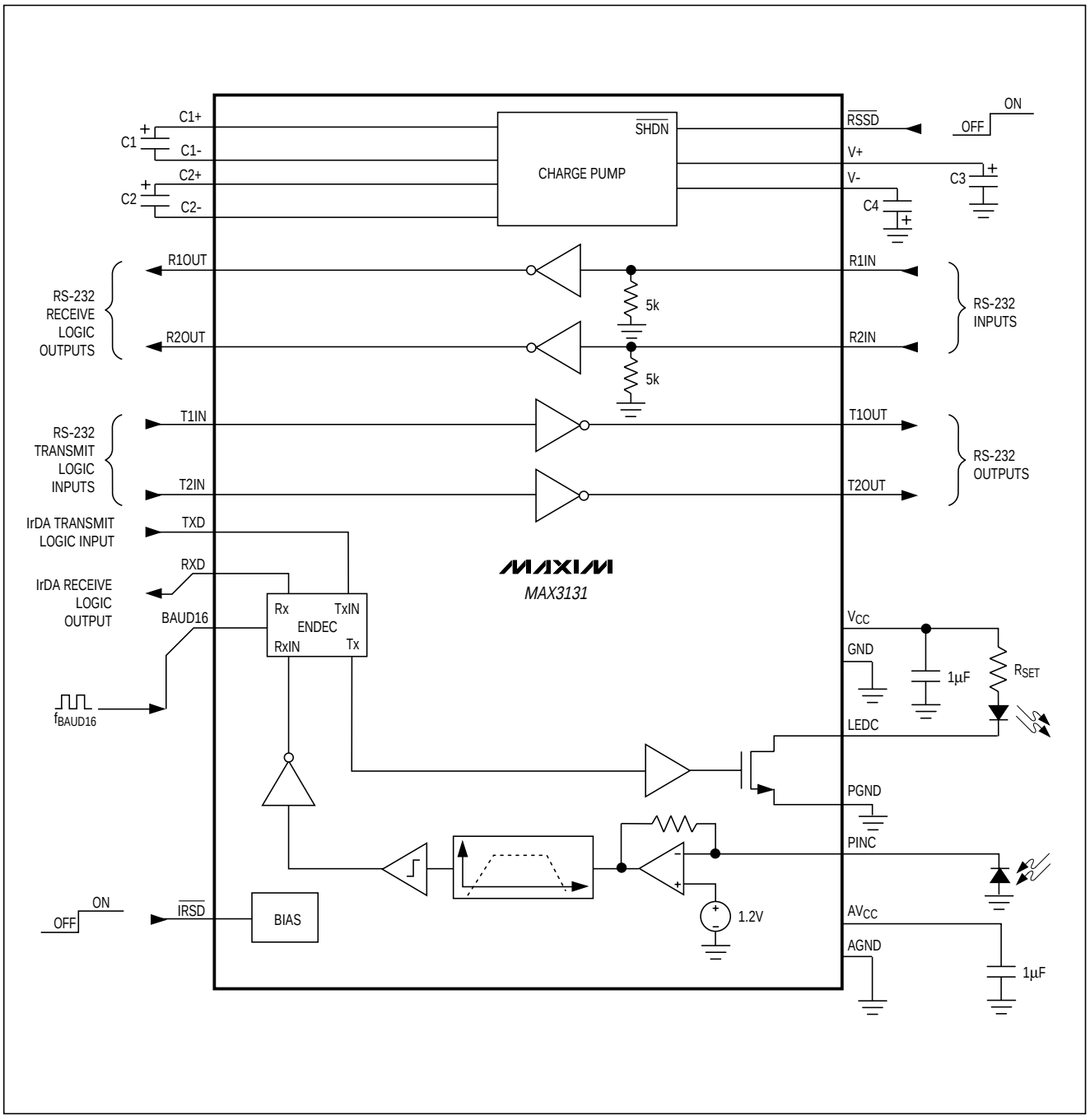

Figure 2. MAX3131 Functional Diagram

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IR Transmitter

The infrared transmitter consists of an internal high-power, open-drain MOSFET switch. This switch has an on-resistance of less than 2Ω and is capable of switching 200mA of current. Internal buffering keeps the input capacitance of the TXD pin extremely low to ease user drive requirements. Connect an IR LED in series with a current-setting resistor to select the appropriate IR output power (see the *Powering the IR LED* section). The transmitter is not current limited so do not exceed the power dissipation of the external components during high duty-cycle transmit schemes.

The TXD input controls the IR LED for the MAX3131. The T2IN input controls the IR LED for the MAX3130 ($\overline{IRMODE}$ = low). With the ENDEC disabled (see *IrDA Encoder/Decoder (ENDEC)* section), the IR LED is turned on by a logic-high signal at the TXD or T2IN input, for the MAX3131 and MAX3130 respectively.

$\overline{IRMODE}$: Multiplexed RS-232 Operation and IrDA Operation (MAX3130)

The MAX3130 has the capability to multiplex R2OUT and T2IN between the IrDA infrared interface and the RS-232 electrical interface. The state of the $\overline{IRMODE}$ input determines which interface (infrared or RS-232) is multiplexed to R2OUT and T2IN. When $\overline{IRMODE}$ is low, R2OUT acts as the infrared receiver output and T2IN acts as the infrared transmitter input. Also, while $\overline{IRMODE}$ is low, the RS-232 charge pumps are shut down and the RS-232 transmitters are disabled (see *Shutdown* section). When $\overline{IRMODE}$ is high, R2OUT and T2IN assume their functions as the RS-232 data receive output and transmit input, respectively. Also, while $\overline{IRMODE}$ is high, the IR transmitter is disabled (turned off).

$\overline{EDGEDET}$: Edge-Detection Circuitry (MAX3130)

The MAX3130 has internal edge-detection circuitry that monitors the RS-232 R2OUT line when $\overline{IRMODE}$ is low and monitors the IrDA receive channel when $\overline{IRMODE}$ is high. $\overline{EDGEDET}$ goes low when a positive or negative edge is detected on either the RS-232 R2OUT line or the IrDA receive channel (depending on the $\overline{IRMODE}$ pin). This edge-detection feature is useful for initiating an interrupt when data is received on the deselected line. The $\overline{EDGEDET}$ signal is cleared when $\overline{IRMODE}$ is toggled. Table 1 shows $\overline{EDGEDET}$ operation.

IrDA Encoder/Decoder (ENDEC)

The MAX3130 and MAX3131 provide an on-board ENDEC to communicate with UARTs that are not IrDA compatible. The ENDEC is enabled by applying a clock with a frequency 16 times the baud rate to the BAUD16 input. This BAUD16 clock is commonly provided on UARTs that do not have IrDA ENDEC capability. Figure 3 illustrates the operation of the ENDEC. The ENDEC stretches the incoming infrared pulse (a pulse between

Table 1. $\overline{EDGEDET}$ Operation

$\overline{IRSD}$	$\overline{RSSD}$	$\overline{IRMODE}$	R2IN	IrDA RxIN	$\overline{EDGEDET}$*
X	X	0	↑	X	↓
X	X	0	↓	X	↓
X	X	1	X	↑	↓
X	X	1	X	↓	↓

X = *Don't care*

* *$\overline{EDGEDET}$ is cleared by any transition on $\overline{IRMODE}$.*

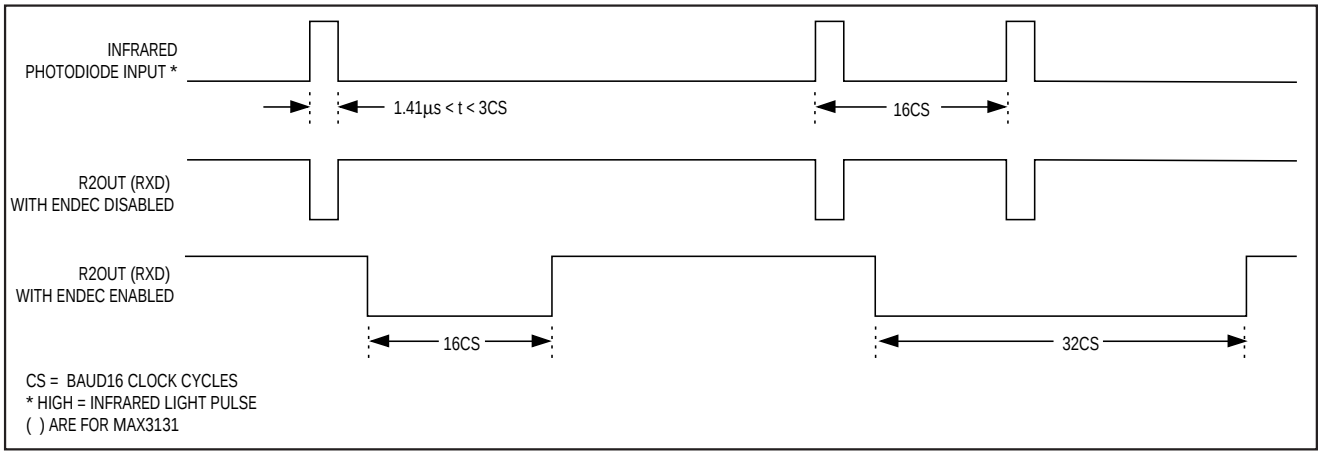

Figure 3a. ENDEC Operation, Receiving Infrared

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3V to 5.5V, IrDA Infrared Transceiver with Integrated RS-232 Interface

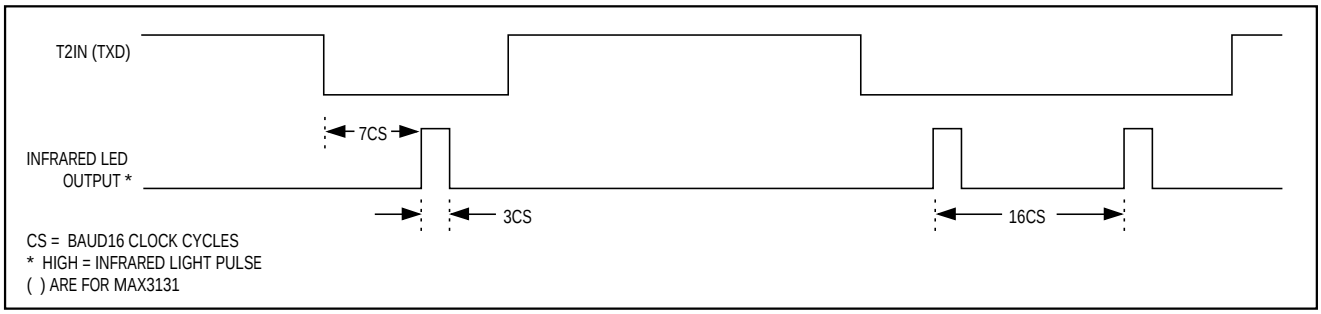

Figure 3b. ENDEC Operation, Transmitting Infrared

1µs and three BAUD16 clock cycles) into a full baud period (Figure 3a). Signals applied to TXD are inverted and compressed to three BAUD16 clock cycles by the ENDEC before being transmitted (Figure 3b). The ENDEC is disabled by connecting the BAUD16 input to V_{CC} or GND.

Dual Charge-Pump Voltage Converter

The MAX3130/MAX3131's internal power supply consists of a regulated dual charge pump that provides output voltages of +5.5V (doubling charge pump) and -5.5V (inverting charge pump) for supply voltages from +3.0V to +5.5V. The charge pump operates in a discontinuous mode: if the output voltages are less than 5.5V, the charge pumps are enabled; if the output voltages exceed 5.5V, the charge pumps stop switching. Each charge pump requires a flying capacitor (C1, C2) and a reservoir capacitor (C3, C4) to generate the V+ and V- supplies (Figures 1 and 2). If $\overline{RSSD}$ (or $\overline{IRMODE}$ for MAX3130) is low, both charge pumps shut down.

RS-232 Transmitters

The RS-232 transmitters are inverting level translators that convert CMOS-logic levels to ±5.0V EIA/TIA-232 levels. The MAX3130/MAX3131 transmitters are guaranteed for data rates of 120kbps, providing compatibility with PC-to-PC communication software, such as LapLink™. These RS-232 transmitters typically operate at data rates of 235kbps. The RS-232 transmitter outputs are high impedance when either $\overline{IRMODE}$ or $\overline{RSSD}$ are low.

The MAX3130/MAX3131 RS-232 receivers translate RS-232 signal levels to CMOS-level logic. The RS-232 receivers also perform a logic inversion from input to output. The receivers are always active and are not affected by the RS-232 shutdown input ($\overline{RSSD}$).

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Applications Information

Shutdown

The MAX3130/MAX3131 have split analog and digital supplies (V_{CC} and AV_{CC}) with separate shutdown modes. When $\overline{IRSD}$ is pulled low, the IR receiver is disabled and AV_{CC} current reduces to <1µA. When $\overline{RSSD}$ or $\overline{IRMODE}$ is pulled low, the RS-232 charge pumps are disabled and the RS-232 transmitter outputs become high impedance. In this mode, the V_{CC} current reduces to <10µA.

IR LED Selection

The IrDA specification calls for an IR transmitter with a peak wavelength between 850nm and 900nm. Within a ±15° half-cone angle, the output intensity of the IR LED must be between 40mW/sr and 500mW/sr. Outside a ±30° half-cone angle, the output intensity of the IR LED must fall below 40mW/sr. Within these cases, the optical rise and fall times of the IR LED must be less than 600ns. Based on these system requirements the HP HSDL-4220, the Temic TSHF5400, or equivalent IR LEDs are appropriate choices.

Powering the IR LED

Set the current in the IR LED with an external resistor. Using the IR LED manufacturer's data sheet, select a forward current that meets the IrDA specifications discussed in the *IR LED Selection* section. Determine the forward bias voltage of the IR LED (V_{IRLED}) and the voltage drop across the MAX3130/MAX3131 LED driver (see LEDC Voltage vs. LEDC Current graph in the *Typical Operating Characteristics*) and choose the current-setting resistor based on the following equation:

$$R_{SET} = (V_{CC} - V_{IRLED} - V_{LEDC}) / I_{SET}$$

Using the HP HSDL-4220 IR LED as an example:

$$V_{CC} = 5V,\ I_{SET} = 100mA,\ V_{IRLED} = 1.67V$$
$$V_{LEDC} = 90mV$$
$$R_{SET} = (5V - 1.67V - 90mV) / 0.1A = 32.4\Omega$$

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Power dissipation of the MAX3130/MAX3131, IR LED, and R_{SET} are based on the maximum LED current and duty cycle.

Use the following equations to calculate the power dissipation in each component:

MAX3130 power dissipation = $I_{SET} \cdot V_{DRV} \cdot$ duty cycle

IR LED power dissipation = $I_{SET} \cdot V_{IRLED} \cdot$ duty cycle

R_{SET} power dissipation = $I_{SET}^2 \cdot R_{SET} \cdot$ duty cycle

For reliable operation, do not exceed maximum power dissipation of the components.

PIN Photodiode Selection

PIN photodiode selection is extremely important to system performance. The PIN diode must generate at least 200nA (minimum sensitivity of the MAX3130/MAX3131) of current when aimed ±15° off-axis with an incident irradiance of 4µW/cm^2. The following equation determines if the Temic BPV22NF meets these requirements:

I_{PIN} = (4µW/cm^2) (0.075cm^2) (0.95) (0.95) (1.8) (0.6A/W)

= 292nA

The first term (4mW/cm^2) is the minimum guaranteed irradiance in the ±15° angular range. The second term (0.075cm^2) is the sensitive area of the PIN diode. The first 0.95 factor normalizes the sensitivity to the 875nm wavelength and the second 0.95 factor adjusts for the decreased receiver efficiency at ±15° off-axis. The 1.8 factor accounts for the round lens which increases the effective PIN diode area. The last term (0.6A/W) is the sensitivity of the PIN diode. Based on this example, the Temic BPV22NF is an appropriate selection.

The final important factor in selecting a PIN diode is the effective diode capacitance. It is important to keep this capacitance below 70pF at 1.2V reverse bias. Higher input capacitance compromises the noise performance of the system by increasing the noise gain of the input transimpedance amplifier.

Capacitor Selection

The capacitor type used for C1–C4 is not critical for proper operation; either polarized or nonpolarized capacitors are good choices. The charge pump requires 0.1µF capacitors for 3.3V operation. For other supply voltages, refer to Table 2 for suggested capacitor values. Do not use values smaller than those listed in Table 2. Increasing the capacitor values (e.g., by a factor of 2) reduces ripple on the transmitter outputs and slightly reduces power consumption. C2, C3, and C4 can be increased without changing C1's value. **However, do not increase C1 without also increasing the values of C2, C3, and C4.**

When using the minimum required capacitor values, make sure the capacitor value does not degrade excessively with temperature. If in doubt, use capacitors with a larger nominal value. The capacitor's equivalent series resistance (ESR) usually rises at low temperatures and increases the amount of ripple on V+ and V-.

Power-Supply Noise Rejection

Because of the extremely sensitive nature of photodiode amplifiers, it is important to maintain a low-noise supply voltage. Use a separate analog supply voltage where possible. Place a 1µF ceramic bypass capacitor as close as possible to the AV_{CC} and V_{CC} pins. In especially noisy systems, connect a small (10Ω) resistor in series with V_{CC}, in addition to the normal bypass capacitors.

IrDA or RS-232 Application Circuit

Figure 4 shows how the MAX3130 is used to multiplex between RS-232 and IrDA communication while using only one UART. By using the $\overline{IRMODE}$ input, the type of communication (infrared or RS-232) is controlled by the I/O of a µP. The internal MAX3130 ENDEC is used to translate between UART-type and IrDA-type bitstreams. If the UART has this capability, connect BAUD16 of the MAX3130 to GND.

Figure 5 shows the MAX3131 used with two UARTs to perform simultaneous IrDA and RS-232 communication. UART1 is a software UART used to perform infrared IrDA communication. The internal ENDEC on the MAX3131 translates between UART-type and IrDA-type bit-streams. The MAX3100 is implemented as UART2 and communicates via the RS-232 interface. The MAX3100 interfaces to the µP using a SPI interface.

Layout Considerations

The MAX3130/MAX3131 require careful layout techniques to minimize parasitic signals coupling to the PINC input. Keep the lead length between the photodiode and PINC as short as possible. Keep PC board traces to the PIN diode away from other noisy traces. To minimize coupling, run the AGND trace adjacent to the PINC trace on both sides. To prevent oscillation, avoid routing the RXD trace near the PINC trace. Connect the anode of the PIN diode, GND, and the ground lead of the AV_{CC} bypass capacitor in a star-connection. Keep the output pins RXD and TXD as short as possible to minimize coupling back to the input via parasitic capacitance.

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Table 2. Required Capacitor Values

V_{CC} (V)	C1 (µF)	C2, C3, C4 (µF)
3.0 to 3.6	0.1	0.1
4.5 to 5.5	0.047	0.33
3.0 to 5.5	0.1	0.47

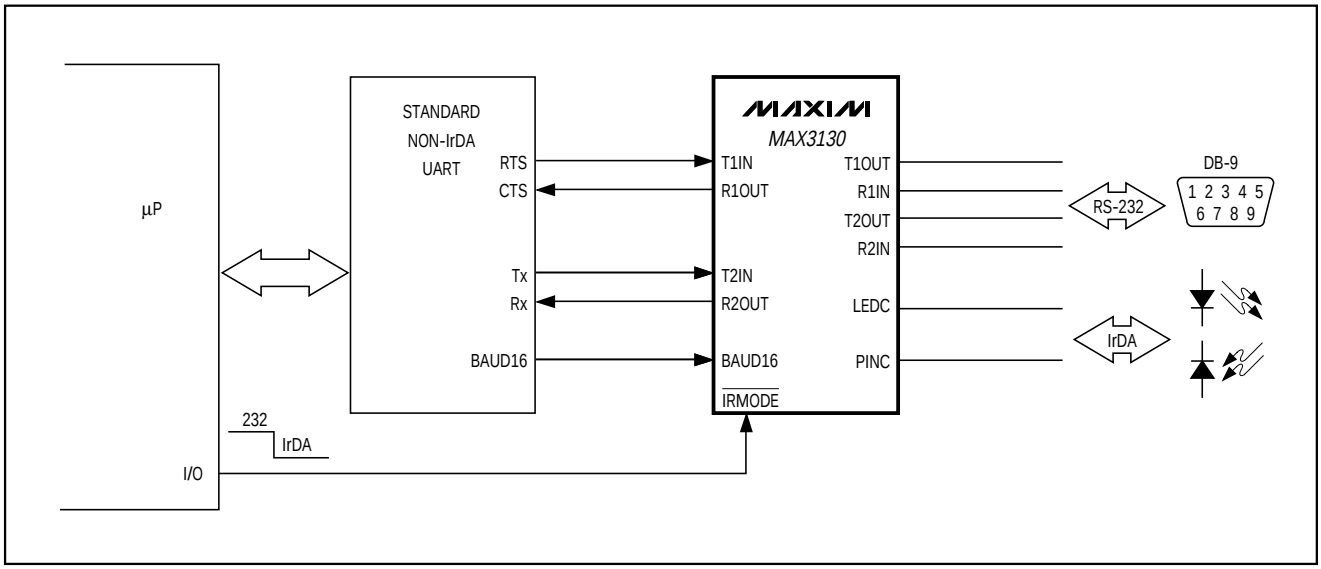

Figure 4. Using the MAX3130 and a Single UART to Perform Both IrDA and RS-232 Communication

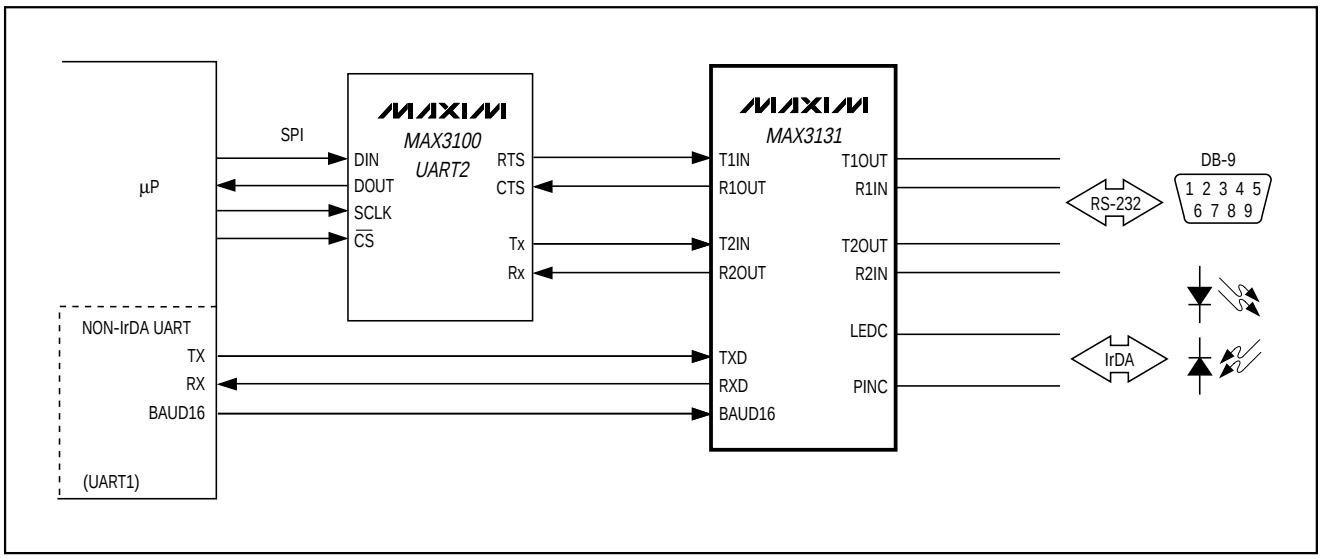

Figure 5. Using the MAX3131 and Two UARTs to Perform Simultaneous IrDA and RS-232 Communication

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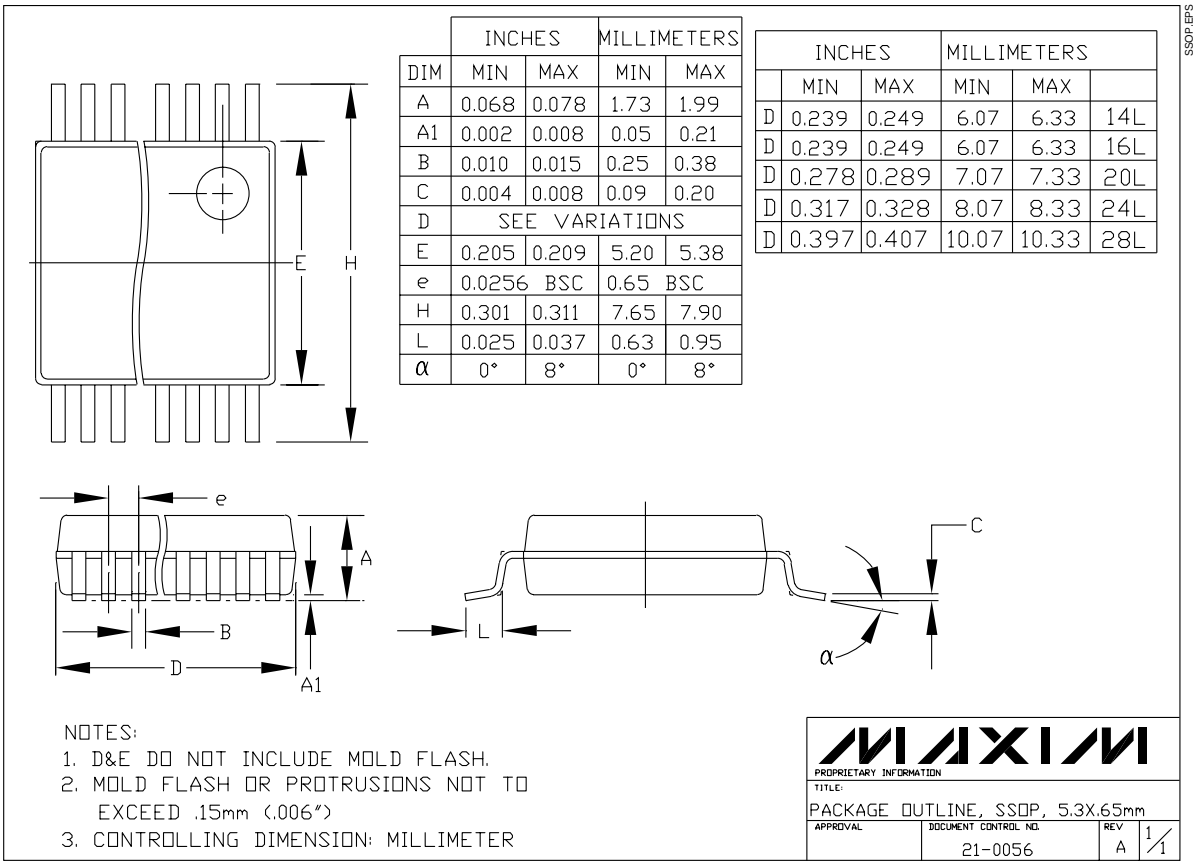
Chip Information

TRANSISTOR COUNT: 1039

Package Information



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.068	0.078	1.73	1.99
A1	0.002	0.008	0.05	0.21
B	0.010	0.015	0.25	0.38
C	0.004	0.008	0.09	0.20
D	SEE VARIATIONS			
E	0.205	0.209	5.20	5.38
e	0.0256 BSC		0.65 BSC	
H	0.301	0.311	7.65	7.90
L	0.025	0.037	0.63	0.95
α	0°	8°	0°	8°

	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	
D	0.239	0.249	6.07	6.33	14L
D	0.239	0.249	6.07	6.33	16L
D	0.278	0.289	7.07	7.33	20L
D	0.317	0.328	8.07	8.33	24L
D	0.397	0.407	10.07	10.33	28L

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NOTES

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