MAXIM

+5V Powered RS-232 Drivers/Receivers

MAX230-241*

General Description

Maxim's family of line drivers/receivers are intended for all RS-232 and V.28/V.24 communications interfaces, and in particular, for those applications where ±12V is not available. The MAX230, MAX236, MAX240 and MAX241 are particularly useful in battery powered systems since their low power shutdown mode reduces power dissipation to less than 5μW. The MAX233 and MAX235 use no external components and are recommended for applications where printed circuit board space is critical.

All members of the family except the MAX231 and MAX239 need only a single +5V supply for operation. The RS-232 drivers/receivers have on-board charge pump voltage converters which convert the +5V input power to the ±10V needed to generate the RS-232 output levels. The MAX231 and MAX239, designed to operate from +5V and +12V, contain a +12V to -12V charge pump voltage converter.

Since nearly all RS-232 applications need both line drivers and receivers, the family includes both receivers and drivers in one package. The wide variety of RS-232 applications require differing numbers of drivers and receivers. Maxim offers a wide selection of RS-232 driver/receiver combinations in order to minimize the package count (see table below).

Both the receivers and the line drivers (transmitters) meet all EIA RS-232C and CCITT V.28 specifications.

Features

- **Operates from Single 5V Power Supply (+5V and +12V — MAX231 and MAX239)**
- **Meets All RS-232C and V.28 Specifications**
- **Multiple Drivers and Receivers**
- **Onboard DC-DC Converters**
- **±9V Output Swing with +5V Supply**
- **Low Power Shutdown — <1μA (typ)**
- **3-State TTL/CMOS Receiver Outputs**
- **±30V Receiver Input Levels**

Datasheet.Directory

Applications

Computers
Peripherals
Modems
Printers
Instruments

Selection Table

Part Number	Power Supply Voltage	No. of RS-232 Drivers	No. of RS-232 Receivers	External Components	Low Power Shutdown /TTL 3-State	No. of Pins
MAX230	+5V	5	0	4 capacitors	Yes/No	20
MAX231	+5V and +7.5V to 13.2V	2	2	2 capacitors	No/No	14
MAX232	+5V	2	2	4 capacitors	No/No	16
MAX233	+5V	2	2	None	No/No	20
MAX234	+5V	4	0	4 capacitors	No/No	16
MAX235	+5V	5	5	None	Yes/Yes	24
MAX236	+5V	4	3	4 capacitors	Yes/Yes	24
MAX237	+5V	5	3	4 capacitors	No/No	24
MAX238	+5V	4	4	4 capacitors	No/No	24
MAX239	+5V and +7.5V to 13.2V	3	5	2 capacitors	No/Yes	24
MAX240	+5V	5	5	4 capacitors	Yes/Yes	44 (Flatpak)
MAX241	+5V	4	5	4 capacitors	Yes/Yes	28 (Small Outline)

* Patent Pending

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+5V Powered RS-232 Drivers/Receivers

ABSOLUTE MAXIMUM RATINGS

V_{CC} .... -0.3V to +6V
V^+ .... (V_{CC} - 0.3V) to +14V
V^- .... +0.3V to -14V
Input Voltages
T_{IN} .... -0.3 to (V_{CC} + 0.3V)
R_{IN} .... ±30V
Output Voltages
T_{OUT} .... (V^+ + 0.3V) to (V^- - 0.3V)
R_{OUT} .... -0.3V to (V_{CC} + 0.3V)
Short Circuit Duration
T_{OUT} .... continuous
Power Dissipation
CERDIP 675mW
(derate 9.5mW/°C above +70°C)
Plastic DIP 375mW
(derate 7mW/°C above +70°C)
Small Outline (SO) 375mW
(derate 7mW/°C above +70°C)
Lead Temperature (soldering 10 seconds) .... +300°C
Storage Temperature .... -65°C to +160°C

Stresses above 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 above 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

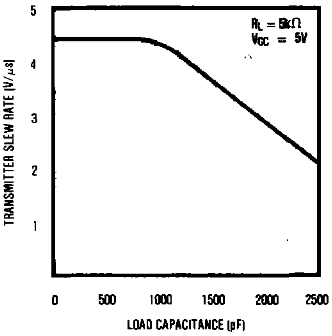
(MAX232, 234, 236, 237, 238, 240, 241 V_{CC} = 5V ± 10%; MAX233, 235 V_{CC} = 5V ± 5%; MAX231, 239 V_{CC} = 5V ± 10%, V^+ = 7.5V to 13.2V; T_A = Operating Temperature Range, Figures 3-14, unless otherwise noted.)

PARAMETER	CONDITIONS		MIN.	TYP.	MAX.	UNITS
Output Voltage Swing	All Transmitter Outputs loaded with 3kΩ to Ground		±5	±9		V
V_{CC} Power Supply Current	No load, T_A = +25°C			5	10	mA
	MAX231, MAX239			0.4	1	
V^+ Power Supply Current	No load, MAX231 and MAX239 only	MAX231		1.8	5	mA
		MAX239		5	15	
Shutdown Supply Current	Figure 1, T_A = +25°C			1	10	µA
Input Logic Threshold Low	T_{IN}, $\overline{EN}$, Shutdown				0.8	V
Input Logic Threshold High	T_{IN}		2 0			V
	$\overline{EN}$, Shutdown		2.4			
Logic Pullup Current	T_{IN} = 0V			15	200	µA
RS-232 Input Voltage Operating Range			-30		+30	V
RS-232 Input Threshold Low	V_{CC} = 5V, T_A = +25°C (MAX231, 239 V^- = 0V)		0.8	1.2		V
RS-232 Input Threshold High	V_{CC} = 5V, T_A = +25°C (MAX231, 239 V^+ = 12V)			1.7	2.4	V
RS-232 Input Hysteresis	V_{CC} = 5V		0 2	0.5	1.0	V
RS-232 Input Resistance	T_A = +25°C, V_{CC} = 5V		3	5	7	kΩ
TTL/CMOS Output Voltage Low	I_{OUT} = 1.6mA (MAX231-233, I_{OUT} = 3.2mA)				0.4	V
TTL/CMOS Output Voltage High	I_{OUT} = -1.0mA		3.5			V
TTL/CMOS Output Leakage Current	$\overline{EN}$ = V_{CC}, 0V ≤ R_{OUT} ≤ V_{CC}			0.05	±10	µA
Output Enable Time (Figure 2)	MAX235, MAX236, MAX239, MAX240, 241			400		ns
Output Disable Time (Figure 2)	MAX235, MAX236, MAX239, MAX240, 241			250		ns
Propagation Delay	RS-232 to TTL			0.5		µs
Instantaneous Slew Rate	C_L = 10pF, R_L = 3-7kΩ T_A = +25°C (Note 1)				30	V/µs
Transition Region Slew Rate	R_L = 3kΩ, C_L = 2500pF Measured from +3V to -3V or -3V to +3V			3		V/µs
Output Resistance	V_{CC} = V^+ = V^- = 0V, V_{OUT} = ±2V		300			Ω
RS-232 Output Short Circuit Current				±10		mA

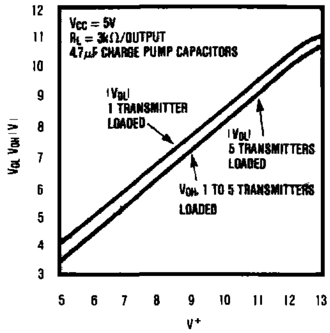
Note 1: Sample tested.

Typical Operating Characteristics

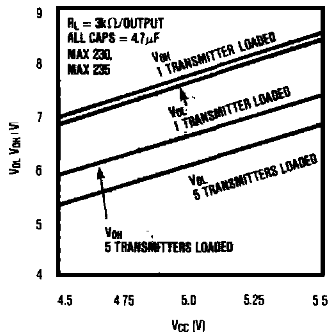
TRANSMITTER SLEW RATE vs. LOAD CAPACITANCE



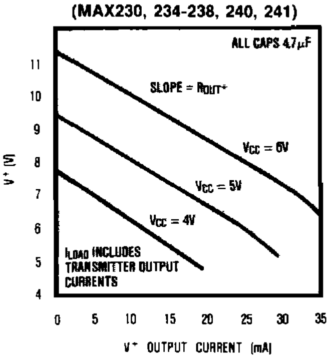
MAX239 TRANSMITTER OUTPUT VOLTAGE vs. V+ VOLTAGE



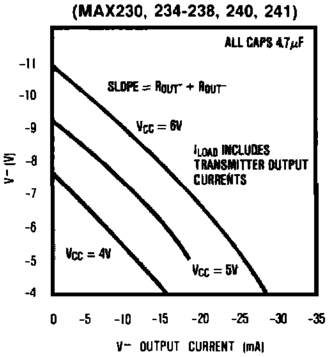
TRANSMITTER OUTPUT VOLTAGE vs. V_{CC} VOLTAGE



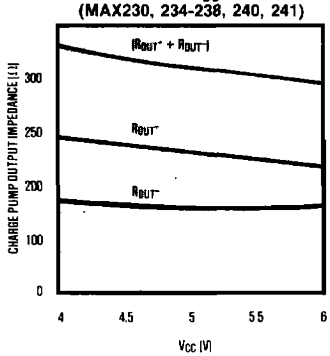
V+ SUPPLY VOLTAGE vs. LOAD CURRENT (MAX230, 234-238, 240, 241)



V- SUPPLY VOLTAGE vs. LOAD CURRENT (MAX230, 234-238, 240, 241)



CHARGE PUMP OUTPUT IMPEDANCE vs. V_{CC} (MAX230, 234-238, 240, 241)



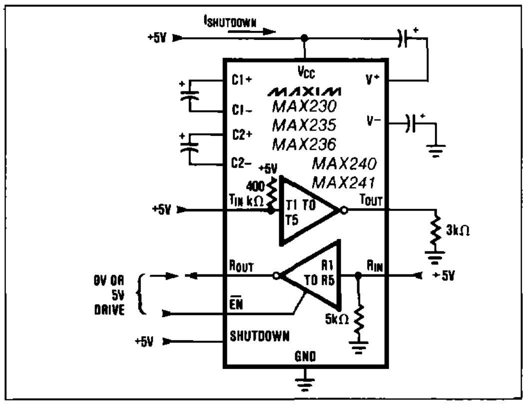


Figure 1. Shutdown Current Test Circuit

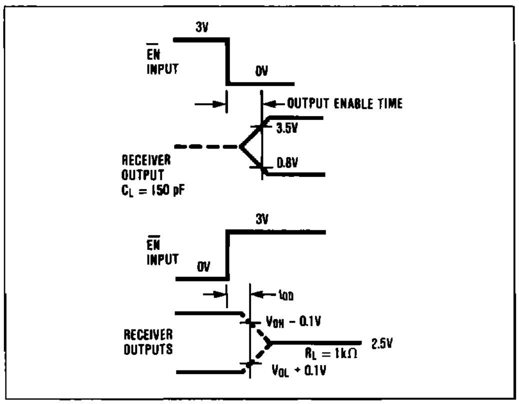


Figure 2. Receiver Output Enable and Disable Timing

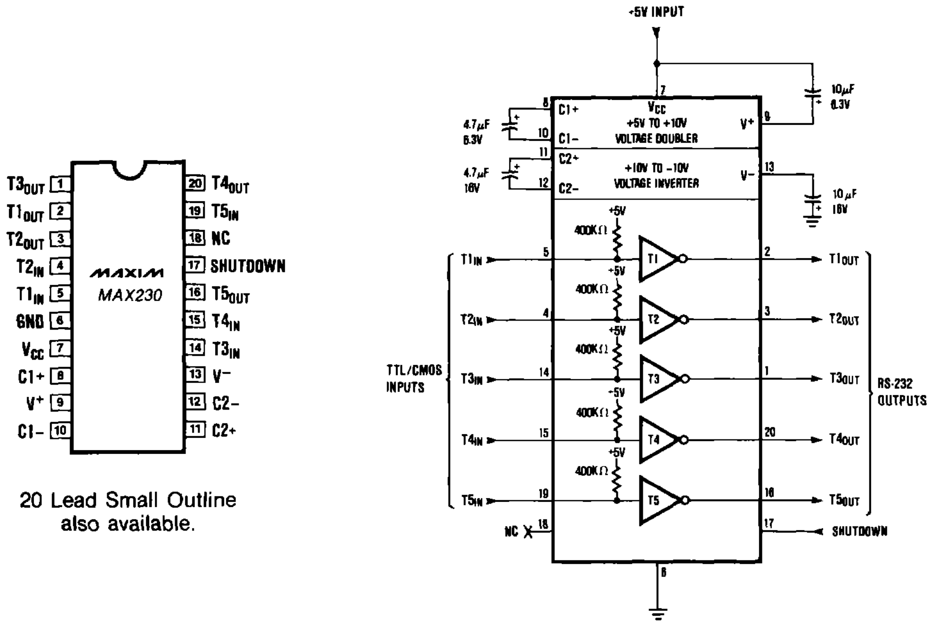


Figure 3. MAX230 Typical Operating Circuit

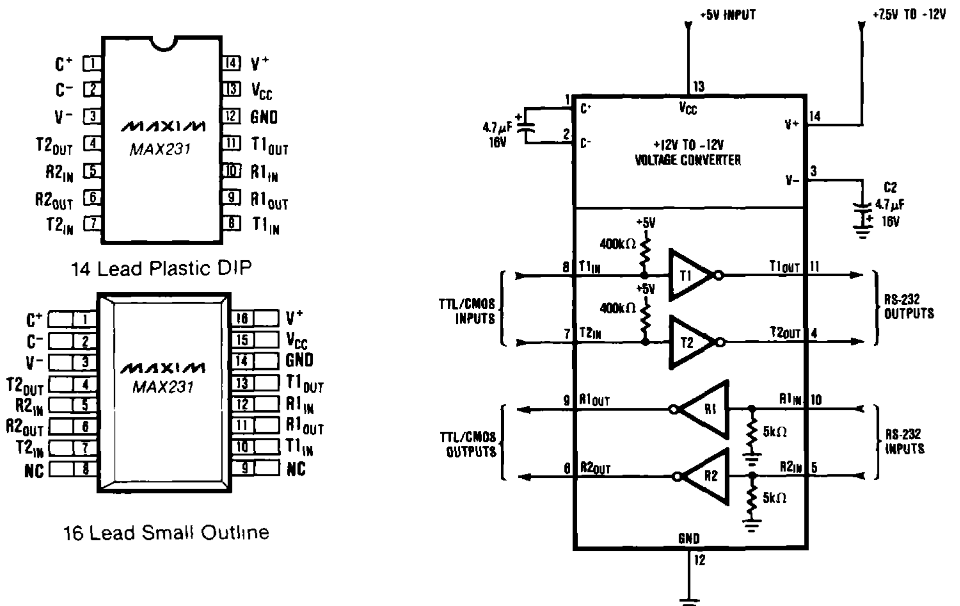
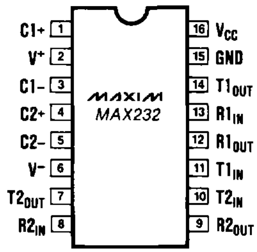


Figure 4. MAX231 Typical Operating Circuit



16 Lead Small Outline also available.

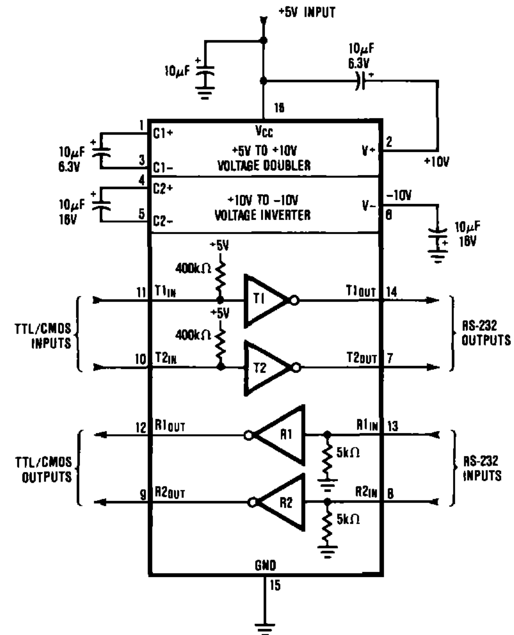
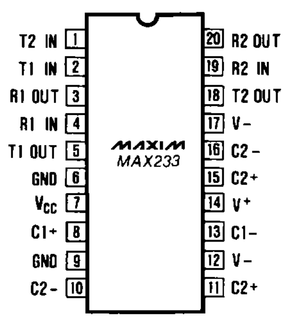


Figure 5. MAX232 Typical Operating Circuit



Small Outline Not Available

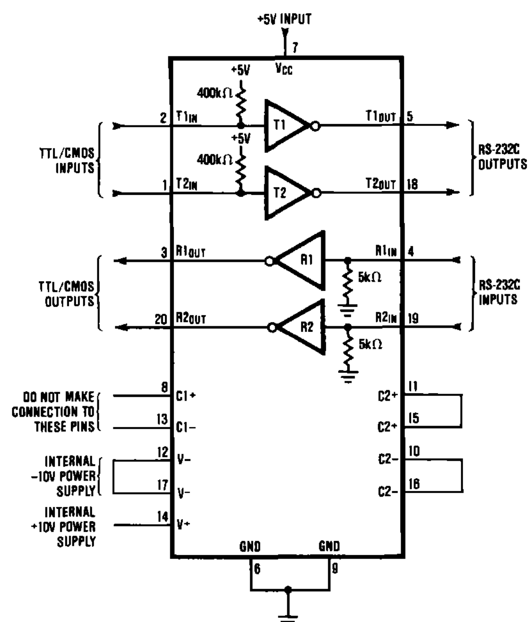
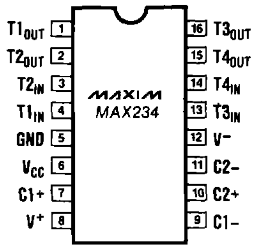


Figure 6. MAX233 Typical Operating Circuit



16 Lead Small Outline also available.

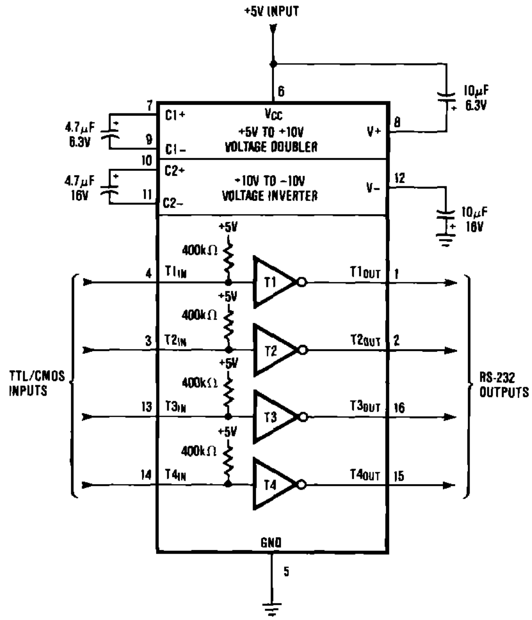
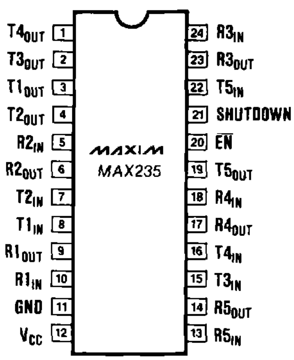


Figure 7. MAX234 Typical Operating Circuit



0.600" Wide Package Only

Small Outline Not Available

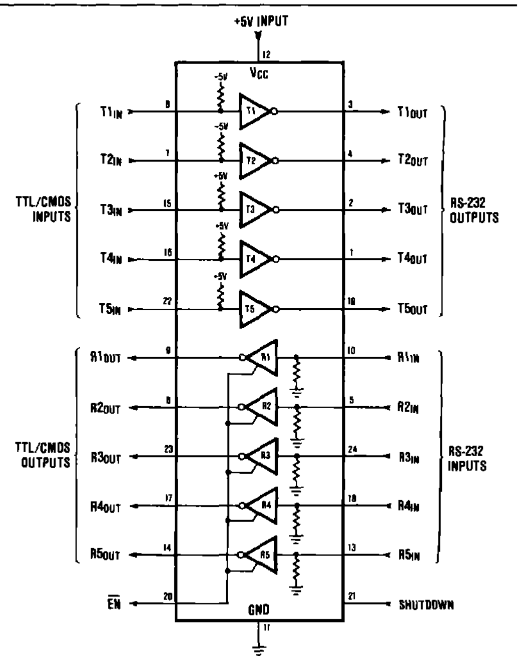
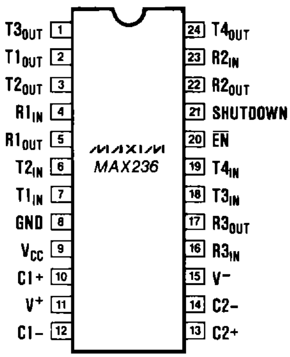


Figure 8. MAX235 Typical Operating Circuit



24 Lead Small Outline also available.

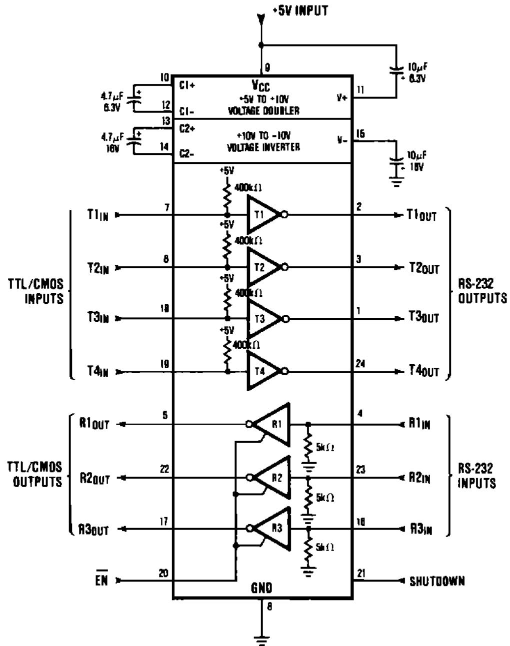
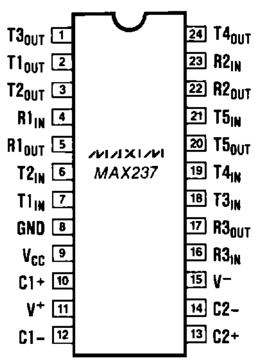


Figure 9. MAX236 Typical Operating Circuit



24 Lead Small Outline also available.

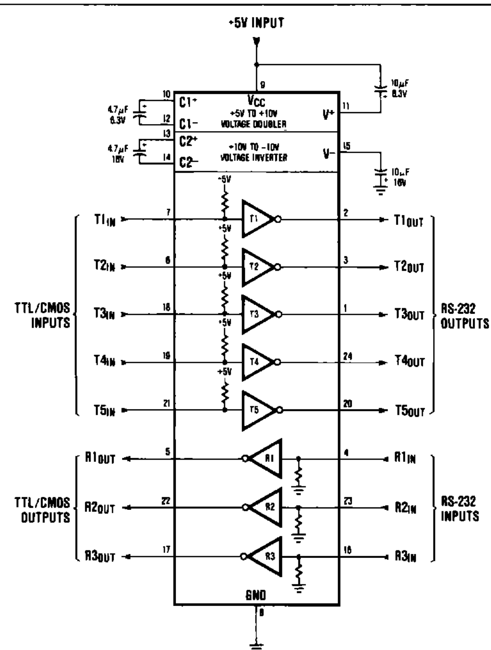
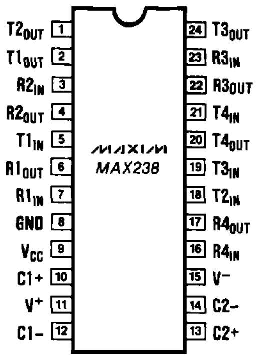


Figure 10. MAX237 Typical Operating Circuit



24 Lead Small Outline also available.

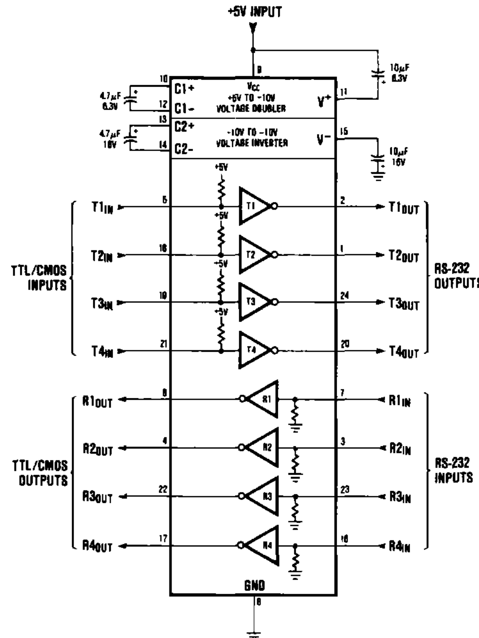
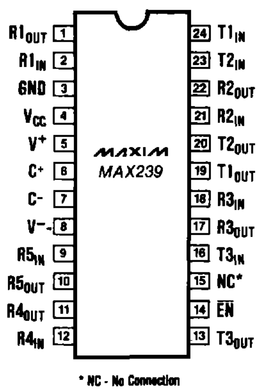


Figure 11. MAX238 Typical Operating Circuit



24 Lead Small Outline also available.

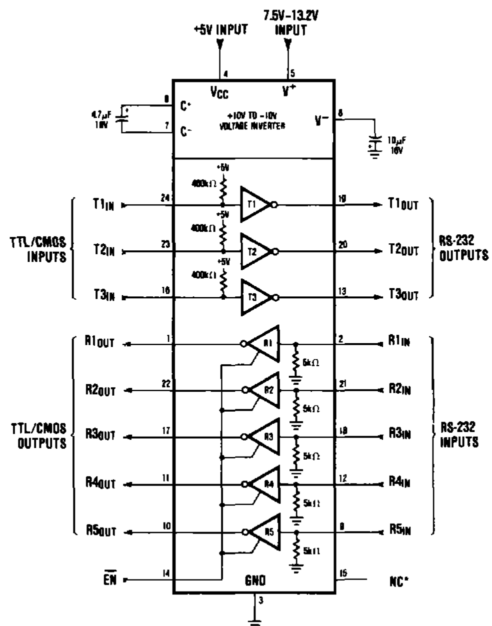
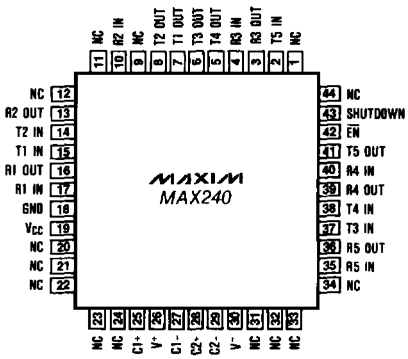


Figure 12. MAX239 Typical Operating Circuit



44 Lead Plastic Flatpak Only

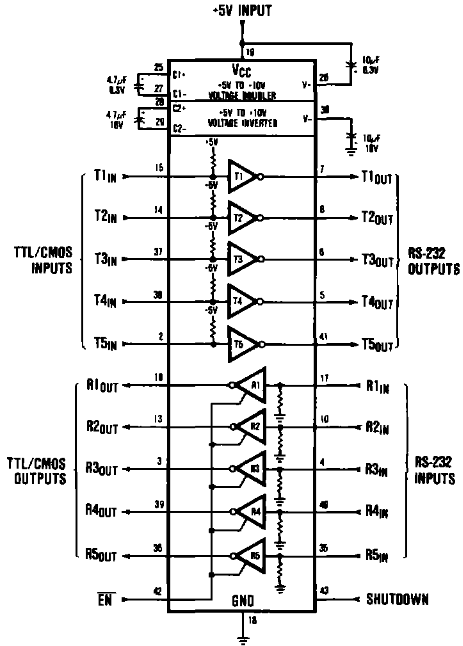
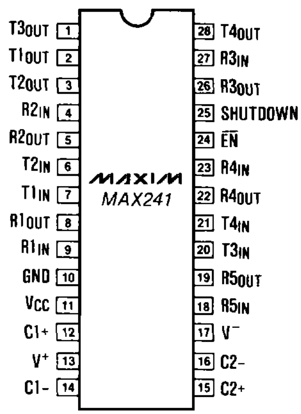


Figure 13. MAX240 Typical Operating Circuit.



28 Lead Wide Small Outline Only

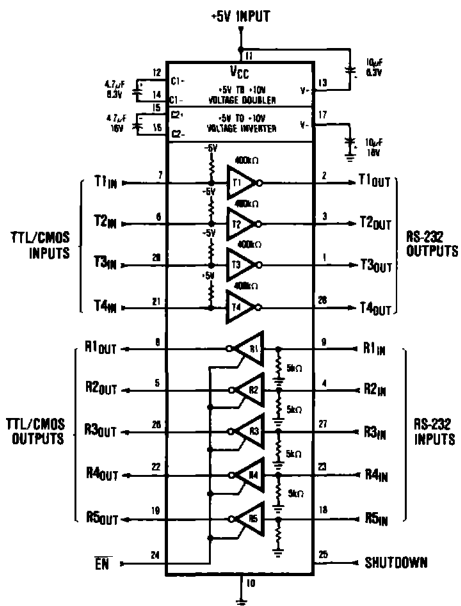


Figure 14. MAX241 Typical Operating Circuit.

+5V Powered RS-232 Drivers/Receivers

Typical Applications

Figures 3 through 14 show typical applications. The capacitor values are non-critical. Reducing the capacitors C1 and C2 to 1μF will slightly increase the impedance of the charge pump, lowering the RS-232 driver output voltages by about 100mV. Lower values of C3 and C4 increase the ripple on the V^+ and V^- outputs.

If the power supply input to the device has a very fast rate-of-rise (as would occur if a PCB were to be plugged into a card cage with power already on), use the simple RC filter shown in Figure 15. This bypass network is not needed if the V_{CC} rate-of-rise is below 1V/μs.

All receivers and drivers are inverting. The $\overline{EN}$able control of the MAX235, MAX236, MAX239, MAX240 and MAX241 enables the receiver TTL/CMOS outputs when it is at a low level, and places the TTL/CMOS outputs of the receivers into a high impedance state when it is a high level.

When the Shutdown control of the MAX230, MAX235, MAX236, MAX240 and MAX241 is at a logic 1 the charge pump is turned off, the receiver outputs are put into the high impedance state, V^+ is pulled down to V_{CC}, V^- is pulled up to ground, and the transmitter outputs are disabled. The supply current drops to less than 10μA.

Detailed Description

The following sections provide supplementary information for those designers with non-standard applications and for those with interest in the internal operation of the devices.

The devices consist of 3 sections: the transmitters, the receivers, and the charge pump DC-DC voltage converter.

+5V to ±10V Dual Charge Pump Voltage Converter

All but the MAX231 and MAX239 convert +5V to ±10V. This conversion is performed by two charge pump voltage converters. The first uses capacitor C1 to double the +5V to +10V, storing the +10V on the V^+ output filter capacitor, C3. The second charge pump voltage converter uses capacitor C2 to invert the +10V to -10V, storing the -10V on the V^- output filter capacitor, C4. The equivalent circuit of the charge pump section is shown in Figure 16.

A small amount of power may be drawn from the +10V (V^+) and -10V (V^-) outputs to power external circuitry. The typical characteristics graphs show the typical output voltage vs. load current characteristics.

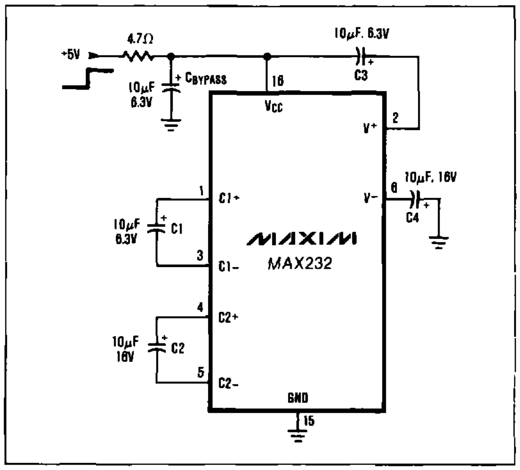


Figure 15. Protection from High $\frac{dV}{dT}$

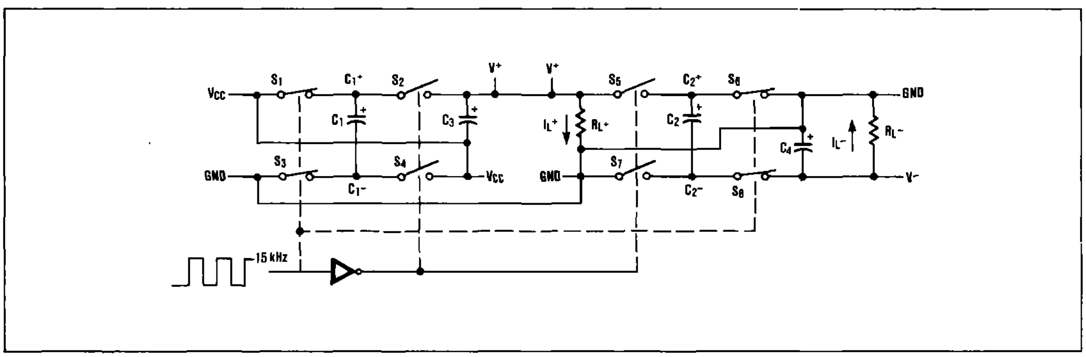


Figure 16. Charge Pump Diagram.

For applications needing only the +5V to ±10V charge pump voltage converter, the MAX680 is available.

The capacitor values for C1 through C4 are non-critical. At the 15kHz typical switching frequency of the voltage converter, a 1μF capacitor has approximately 10Ω impedance, and replacing the 4.7μF and 10μF capacitors shown in the typical applications with 1μF for C1 and C2 will increase the output impedance of the V^+ output by about 10Ω and the output impedance of V^- by about 20Ω. Lowering the value of C3 and C4 increases the ripple on the V^+ and V^- outputs. Where operation to the upper temperature limit is not required, or V_{CC} will not go below 4.75V, C1 and C2 can be 1μF, and C3 and C4 can be 1μF per output channel (1μF if one transmitter is used, 5μF if five transmitters are used).

There are parasitic diodes which become forward biased if V^+ goes below V_{CC} or V^- goes above ground. When in the shutdown mode (MAX230, MAX235, MAX236, MAX240 and MAX241 only), V^+ is internally connected to V_{CC} by a 1kΩ pulldown, and V^- is internally connected to ground via a 1kΩ pullup.

The MAX233 and MAX235 contain all charge pump components, including the capacitors, and operate with NO external components.

The MAX231 and MAX239 include only the V^+ to V^- charge pump, and are intended for applications which have a +5V supply and either a +12V ± 10% supply or a 7.5V to 13.2V battery voltage. When operating with V^+ greater than 8.0V, both capacitors can be 1μF.

Driver (Transmitter) Section

The transmitters or line drivers are inverting level translators which convert the CMOS or TTL input levels to RS-232 or V.28 voltage levels. With +5V V_{CC}, the typical output voltage swing is ±9V when loaded with the nominal 5kΩ input resistance of an RS-232 receiver. The output swing is guaranteed to meet the RS-232/V.28 specification of ±5V minimum output swing under the worst case conditions of all transmitters driving the 3kΩ minimum allowable load impedance, V_{CC} = 4.5V, and maximum operating ambient temperature. The open circuit output voltage swing is from (V^+ - 0.6V) to V^-.

The input thresholds are both CMOS and TTL compatible, with a logic threshold of about 25% of V_{CC}. The inputs of unused drivers sections can be left unconnected; an internal 400kΩ input pullup resistor to V_{CC} will pull the inputs high, forcing the unused transmitter outputs low. The input pullup resistors source about 12μA, and the driver inputs should be driven high or open circuited to minimize power supply current in the shutdown mode.

When in the low power shutdown mode, the driver outputs are turned off and their leakage current is less than 1μA with the driver output pulled to ground. The driver output leakage remains less than 1μA, even if the transmitter output is backdriven between 0V and (V_{CC} + 6V). Below -0.5V the transmitter is diode clamped to ground with 1kΩ series impedance. The transmitter is also zener clamped to approximately V_{CC} + 6V, with a series impedance of 1kΩ. As required by the RS232 and V.28, the slew rate is limited to less than 30V/μs. This limits the maximum usable baud rate to 19,200 baud.

Receiver Section

All but the MAX230 and MAX234 contain RS-232/V.28 receivers. These receivers convert the ±5V to ±15V RS-232 signals to 5V TTL/CMOS outputs. Since the RS-232C/V.28 specifications define a voltage level greater than +3V as a 0, the receivers are inverting. Maxim has set the guaranteed input thresholds of the receivers to 0.8V minimum and 2.4V maximum, which are significantly tighter than the -3.0V minimum and +3.0V maximum required by the RS-232 and V.28 specifications. This allows the receivers to respond both to RS-232/V.28 levels and TTL level inputs. The receivers are protected against input overvoltage up to ±30V.

The 0.8V guaranteed lower threshold is important to ensure that the receivers will have a logic 1 output if the receiver is not being driven because the equipment containing the line driver is turned off or disconnected, or if the connecting cable has an open circuit or short circuit. In other words, the receiver implements Type 1 interpretation of fault conditions (§7 of V.28, §2.5 of RS-232C). While a 0V or even a -3V receiver threshold would be acceptable for the data lines, these lower thresholds would not give proper indication on the control lines such as DTR and DSR. The receivers, on the other hand, have a full 0.8V noise margin for detecting the power-down or cable-disconnected states.

The receivers have a hysteresis of approximately 0.5V, with a minimum guaranteed hysteresis of 200mV. This aids in obtaining clean output transitions, even with slow rise and fall time input signals with moderate amounts of noise and ringing. The propagation delays of the receivers are 350ns for negative-going input signals, and 650ns for positive-going input signals (see Typical Characteristics graphs).

The MAX239 has a receiver 3-state control line, and the MAX235, MAX236, MAX240 and MAX241 have both a receiver 3-state control line and a low power shutdown control. The receiver TTL/CMOS outputs are in a high impedance 3-state mode whenever the 3-state $\overline{EN}$able line is high, and are also high impedance whenever the Shutdown control line is high.

Review of EIA Standard RS-232-C and CCITT Recommendations V.28 and V.24

The most common serial interface between electronic equipment is the "RS232" interface. This serial interface has been found to be particularly useful for the interface between units made by different manufacturers since the voltage levels are defined by the EIA Standard RS-232-C and CCITT Recommendation V.28. The RS-232 specification also contains signal circuit definitions and connector pin assignments, while CCITT circuit definitions are contained in a separate document, Recommendation V.24. Originally intended to interface modems to computers and terminals, these standards have many signals which are not used for computer-to-computer or computer-to-peripheral communication.

Serial interfaces can be used with a variety of transmission formats. The most popular by far is the asynchronous format, generally at one of the standard baud rates of 300, 600, 1200, etc. The maximum recommended baud rate for RS-232 and V.28 is 20,000 baud, and the fastest commonly used baud rate is 19,200 baud. Asynchronous serial links use a variety of combinations of the number of data bits, what type (if any) of parity bit, and the number of stop bits. A typical combination is 7 data bits, even parity, and 1 stop bit.

RS232/V.28 physical links are also suitable for synchronous transmission protocols. These higher level protocols often use the standard RS-232C/V.28 voltage levels. Note that one type of physical link (such as RS-232/V.28 voltage levels) can be used for a variety of higher level protocols. Table 2 summarizes the voltage levels and other requirements of V.28 and RS-232.

Comparison of RS-232C/V.28 with other Standards

The other two most common serial interface specifications are the EIA RS423 and RS422/RS485 (CCITT recommendations V.10 and V.11). While the RS-232 or V.28/V.24 interface is the most common interface for communication between equipment made by different manufacturers, the RS423/V.10 interface and RS422/V.11 interfaces can operate at higher baud rates. In addition, the RS485 interface can be used for low cost local area networks.

The RS423 and V.10 interfaces are unbalanced or "single-ended" interfaces which use a differential receiver. This standard is intended for data signaling rates up to 100 kbit/s (100 kilobaud). It achieves this higher baud rate through more precise requirements on the waveshape of the transmitters and through the use of differential receivers to compensate for ground potential variations beween the transmitting and receiving equipment. With certain limitations, this interface is compatible with RS-232 and V.28. The limitations are:

1) less than 20,000 baud rate,
2) maximum cable lengths determined by RS-232 performance,
3) RS423/V.10 DTE and DCE signal return paths must be connected to the the RS232/V.28 signal ground,
4) the RS-232 transmitter output voltages must be limited to ±12V, or additional protection must be provided for the RS423/V.10 receivers, and
5) not all RS232/V.28 receivers will show proper power-off detection of V.10 transmitter outputs.

Maxim's MAX230 and MAX232-MAX238, MAX240 and MAX241 meet restrictions 4 and 5 over the entire range of recommended operating conditions. The MAX231 and MAX239 meet restrictions 4 and 5 provided that the V^+ voltage is 12.5V or less.

The RS422, RS485, and V.11 interfaces are balanced double-current interchanges suitable for baud rates up to 10 Mbit/s. These interfaces are not compatible with RS-232 or V.28 voltage levels.

Application Hints

Operation at High Baud Rates

V.28 states that "the time required for the signal to pass through the transition region during a change in state shall not exceed 1 millisecond or 3 percent of the nominal element period on the interchange circuit, whichever is less." RS-232C allows the transition time to be 4 percent of the duration of a signal element. At 19,200 baud, the "nominal element period" is approximately 50µs, of which 3 percent is 1.5µs. Since the transition region is from -3V to +3V, this means the V.28 slew rate would ideally be faster than 6V/1.5µs = 4V/µs at 19.2 kbaud and 2V/µs at 9600 baud. The RS-232 requirement is equivalent to 3V/µs at 19.2 kbaud, 1.5V/µs at 9600 baud, etc. The slew rate of the MAX230 series devices is about 3V/µs with the maximum recommended load of 2500pF. In practice, the effect of less than optimum slew rate is a distortion of the recovered data, where the 1's and 0's no longer have equal width. This distortion generally has negligible effect and the devices can be reliably used for 19.2 kbaud serial links when the cable capacitance is kept below 2500pF. With very low capacitance loading, the MAX230 and MAX234-239, MAX240 and MAX241 may even be used at 38.4 kbaud, since the typical slew rate is 5V/µs when loaded with 500pF in parallel with 5kΩ. Under no circumstance will the

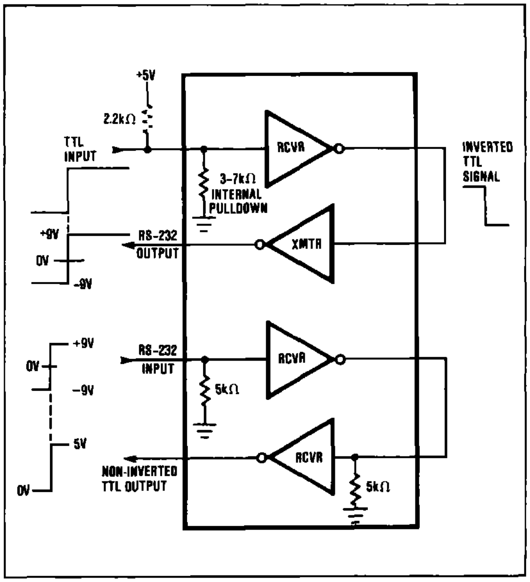


Figure 17. Non-inverting RS-232 Transmitters and Receivers.

slew rate exceed the RS-232/V.28 maximum spec of 30V/μs and, unlike the 1488 driver, no external compensation capacitors are needed under any load condition.

Driving Long Cables

The RS-232 standard states that "The use of short cables (each less than approximately 50 feet or 15 meters) is recommended; however, longer cables are permissible, provided that the load capacitance . . . does not exceed 2500pF."

Baud rate and cable length can be traded off: use lower baud rates for long cables, use short cables if high baud rates are desired. For both long cables and high baud rates, use RS422/V.11. The maximum cable length for a given baud rate is determined by several factors, including the capacitance per meter of cable, the slew rate of the driver under high capacitive loading, the receiver threshold and hysteresis, and the acceptable bit error rate. The receivers have 0.5V of hysteresis, and the drivers are designed such that the slew rate reduction caused by capacitive loading is minimized (see Typical Characteristics).

Non-Inverting Drivers and Receivers

Occasionally a non-inverting driver or receiver is needed instead of the inverting drivers and receivers of the family. Simply use one of the receivers as a TTL/CMOS inverter to get the desired operation (Figure 17). If the logic output driving the receiver input has less than 1mA of output source capability, then add the 2.2kΩ pullup resistor.

The receiver TTL outputs can directly drive the input of another receiver to form a non-inverting RS-232 receiver.

Protection for Shorts to ±15V Supplies

All driver outputs except on the MAX231, MAX232 and MAX233 are protected against short circuits to ±15V, which is the maximum allowable loaded output voltage of an RS-232/V.28 transmitter. The MAX231, MAX232, and MAX233 can be protected against short circuits to ±15V power supplies by the addition of a series 220Ω resistor in each output. This protection is not needed to protect against short circuits to most RS-232 transmitters such as the 1488, since they have an internal short circuit current limit of 12mA.

The power dissipation of the MAX230 and MAX234-MAX239, MAX240 and MAX241 is about 200mW with all transmitters shorted to ±15V.

Isolated RS-232 Interfaces

RS-232 and V.28 specifications require a common ground connection between the two units communicating via the RS-232/V.28 interface. In some cases, there may be large differences in ground potential between the two units, and in other cases it may be desired to avoid ground loop currents by isolating the two grounds. In other cases, a computer or control system must be protected against accidental connection of the RS-232/V.28 signal lines to 110/220VAC power lines. Figure 18 shows a circuit with this isolation. The power for the MAX233 is generated by a MAX635 DC-DC converter. When the MAX635 regulates point "A" to -5V, the isolated output at point "B" will be semi-regulated to +5V. The two optocouplers maintain isolation between the system ground and the RS-232 ground while transferring the data across the isolation barrier. While this circuit will not withstand 110VAC between the RS-232 ground and either the receiver or transmitter lines, the voltage difference between the two grounds is only limited by the optocoupler and DC-DC converter transformer breakdown ratings.

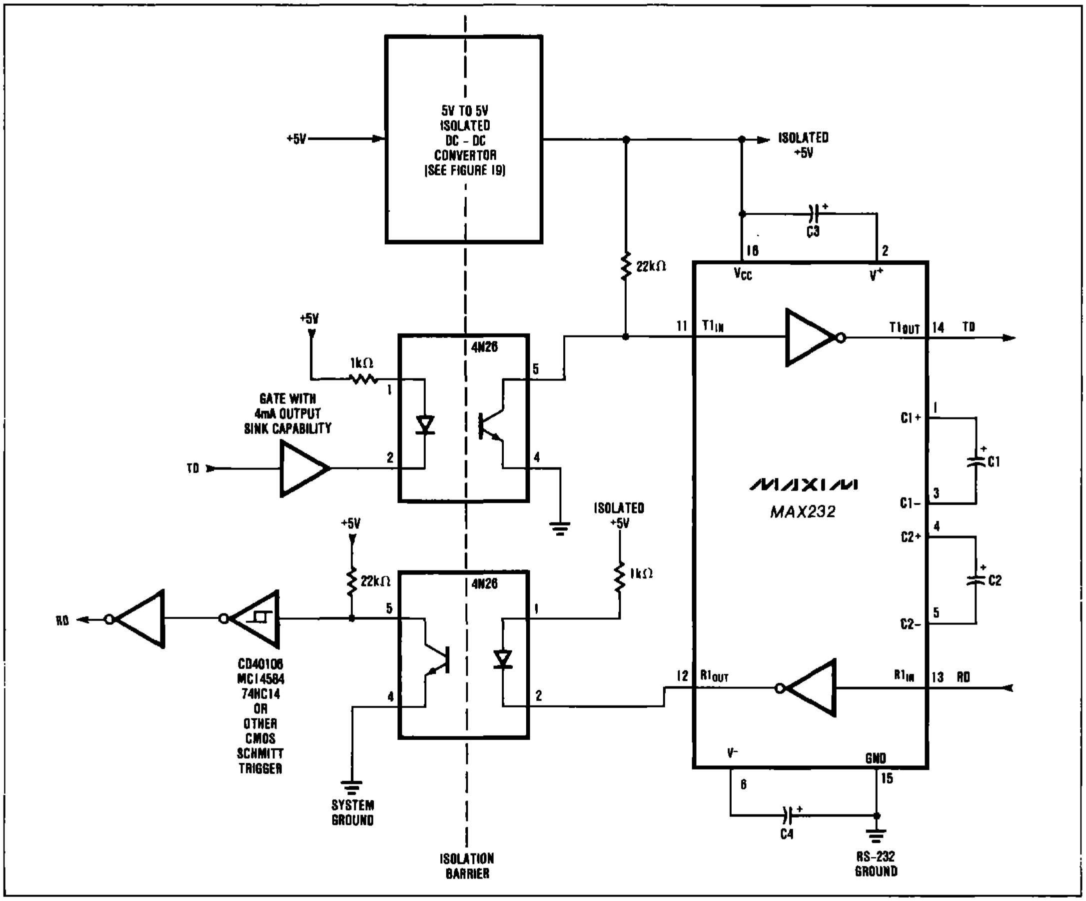


Figure 18. Optically isolated RS-232 Interface.

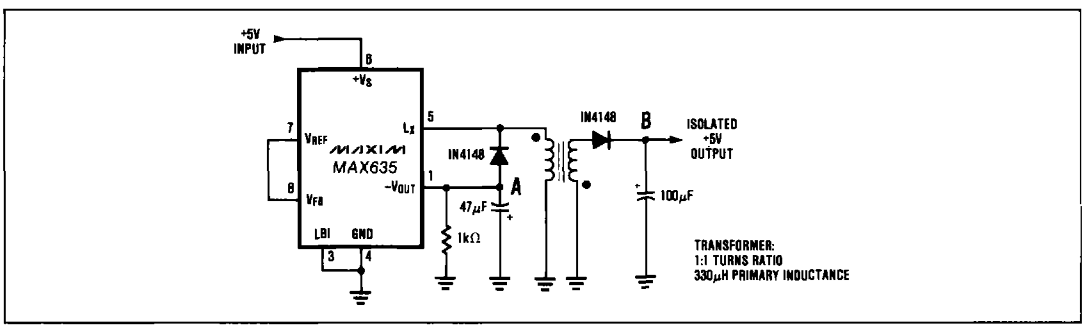


Figure 19. +5V Isolated Power Supply For Optically Isolated RS-232 Interface.

Ordering Information

PART	TEMP. RANGE	PACKAGE
MAX230		**0.3" Wide**
MAX230CPP	0°C to +70°C	20 Lead Plastic DIP
MAX230CWP	0°C to +70°C	20 Lead Wide S.O.
MAX230C/D	0°C to +70°C	Dice
MAX230EPP	-40°C to +85°C	20 Lead Plastic DIP
MAX230EWP	-40°C to +85°C	20 Lead Wide S O
MAX230EJP	-40°C to +85°C	20 Lead CERDIP
MAX230MJP	-55°C to +125°C	20 Lead CERDIP
MAX231		**0.3" Wide**
MAX231CPD	0°C to +70°C	14 Lead Plastic DIP
MAX231CWE	0°C to +70°C	16 Lead Wide S.O.
MAX231C/D	0°C to +70°C	Dice
MAX231EPD	-40°C to +85°C	14 Lead Plastic DIP
MAX231EWE	-40°C to +85°C	16 Lead Wide S.O.
MAX231EJD	-40°C to +85°C	14 Lead CERDIP
MAX231MJD	-55°C to +125°C	14 Lead CERDIP
MAX232		**0.3" Wide**
MAX232CPE	0°C to +70°C	16 Lead Plastic DIP
MAX232CWE	0°C to +70°C	16 Lead Wide S.O
MAX232C/D	0°C to +70°C	Dice
MAX232EPE	-40°C to +85°C	16 Lead Plastic DIP
MAX232EJE	-40°C to +85°C	16 Lead CERDIP
MAX232EWE	-40°C to +85°C	16 Lead Wide S O
MAX232MJE	-55°C to +125°C	16 Lead CERDIP
MAX233		**0.3" Wide**
MAX233CPP	0°C to +70°C	20 Lead Plastic DIP
MAX233EPP	-40°C to +85°C	20 Lead Plastic DIP
MAX234		**0.3" Wide**
MAX234CPE	0°C to +70°C	16 Lead Plastic DIP
MAX234CWE	0°C to +70°C	16 Lead Wide S.O.
MAX234C/D	0°C to +70°C	Dice
MAX234EPE	-40°C to +85°C	16 Lead Plastic DIP
MAX234EWE	-40°C to +85°C	16 Lead Wide S O.
MAX234EJE	-40°C to +85°C	16 Lead CERDIP
MAX234MJE	-55°C to +125°C	16 Lead CERDIP
MAX235		**0.6" Wide**
MAX235CPG	0°C to +70°C	24 Lead Plastic DIP*
MAX235EPG	-40°C to +85°C	24 Lead Plastic DIP*
MAX235EDG	-40°C to +85°C	24 Lead Ceramic*
MAX235MDG	-55°C to +125°C	24 Lead Ceramic*
MAX236		**0.3" Wide**
MAX236CNG	0°C to +70°C	24 Lead Plastic DIP
MAX236CWG	0°C to +70°C	24 Lead Wide S O
MAX236C/D	0°C to +70°C	Dice
MAX236ENG	-40°C to +85°C	24 Lead Plastic DIP
MAX236EWG	-40°C to +85°C	24 Lead Wide S O
MAX236ERG	-40°C to +85°C	24 Lead CERDIP
MAX236MRG	-55°C to +125°C	24 Lead CERDIP
MAX237		**0.3" Wide**
MAX237CNG	0°C to +70°C	24 Lead Plastic DIP
MAX237CWG	0°C to +70°C	24 Lead Wide S O
MAX237C/D	0°C to +70°C	Dice
MAX237ENG	-40°C to +85°C	24 Lead Plastic DIP
MAX237EWG	-40°C to +85°C	24 Lead Wide S O
MAX237ERG	-40°C to +85°C	24 Lead CERDIP
MAX237MRG	-55°C to +125°C	24 Lead CERDIP
MAX238		**0.3" Wide**
MAX238CNG	0°C to +70°C	24 Lead Plastic DIP
MAX238CWG	0°C to +70°C	24 Lead Wide S O.
MAX238C/D	0°C to +70°C	Dice
MAX238ENG	-40°C to +85°C	24 Lead Plastic DIP
MAX238EWG	-40°C to +85°C	24 Lead Wide S O
MAX238ERG	-40°C to +85°C	24 Lead CERDIP
MAX238MRG	-55°C to +125°C	24 Lead CERDIP
MAX239		**0.3" Wide**
MAX239CNG	0°C to +70°C	24 Lead Plastic DIP
MAX239CWG	0°C to +70°C	24 Lead Wide S O
MAX239C/D	0°C to +70°C	Dice
MAX239ENG	-40°C to +85°C	24 Lead Plastic DIP
MAX239EWG	-40°C to +85°C	24 Lead Wide S O
MAX239ERG	-40°C to +85°C	24 Lead CERDIP
MAX239MRG	-55°C to +125°C	24 Lead CERDIP
MAX240		**Flatpak**
MAX240CMH MAX240EMH	0°C to +70°C -40°C to +85°C	44 Lead Flatpak 44 Lead Flatpak
MAX241		**0.3" Wide**
MAX241CWI MAX241EWI	0°C to +70°C -40°C to +85°C	28 Lead Wide S O 28 Lead Wide S O

** = 0.600" package*

+5V Powered RS-232 Drivers/Receivers

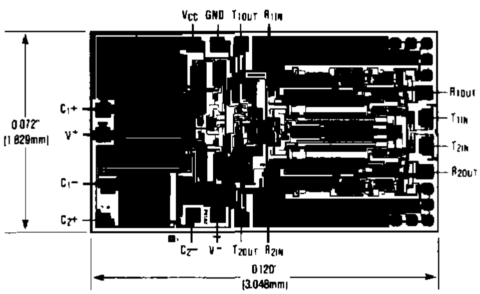
Table 1. Circuits Commonly Used for RS-232C and V.24 Asynchronous Interfaces

PIN	CIRCUIT	
1	Protective Ground	Connect to Earth Ground
2	Transmit Data (TD)	Data from DTE
3	Receive Data (RD)	Data from DCE
4	Request To Send (RTS)	Handshake from DTE
5	Clear to Send (CTS)	Handshake from DCE
6	Data Set ready (DSR)	Handshake from DCE
7	Signal Ground	Reference Point for Signals
8	Received Line Signal Detector (sometimes called Carrier Detect, DCD)	Handshake from DCE
11	Printer Busy Signal	Handshake from Printer
20	Data Terminal Ready	Handshake from DTE
22	Ring Indicator	Handshake from DCE

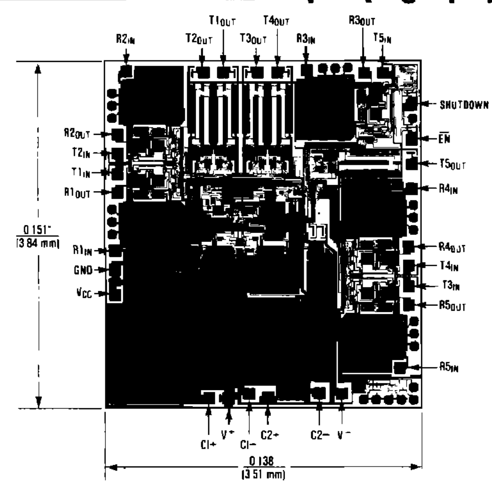
Table 2. Summary of RS-232C and V.28 Electrical Specifications

PARAMETER	SPECIFICATION	COMMENTS
Driver Output Voltage		
0 level	+5V to +15V	With 3-7kΩ load
1 level	-5V to -15V	With 3-7kΩ load
Max output	±25V Max	No Load
Receiver Input Thresholds (data and clock signals)		
0 level	+3V to +25V	
1 level	-3V to -25V	
Receiver Thresholds RTS, DSR, DTR		
On level	+3V to +25V	
Off level	Open Circuit or -3V to -25V	Detects Power Off Condition at Driver
Receiver Input Resistance	3kΩ to 7kΩ	
Driver Output Resistance, power off condition	300Ω Min.	$V_{OUT} < \pm 2V$
Driver Slew Rate	30V/μs Max	$3k\Omega < R_L < 7k\Omega$; $0pF < C_L < 2500pF$
Signalling Rate	Up to 20kbits/sec.	
Cable Length	50'/15 m Recommended Max Length	Longer cables permissible, if $C_{LOAD} \leq 2500pF$

Chip Topography



MAX231, MAX232 and MAX233



MAX230 and MAX234-239, MAX240, MAX241

Note: Connect substrate to V+.

Notes:
1. Shutdown pin of MAX234, MAX237, MAX238, MAX239, MAX240 and MAX241 are internally connected to ground
2. Connect substrate to V+

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