MAXIM

+3.3V-Powered, EIA/TIA-562 Dual Transceiver with Receivers Active in Shutdown

MAX563

General Description

The MAX563 is a +3.3V-powered EIA/TIA-562 transceiver with two transmitters and two receivers. Because it implements the EIA/TIA-562 standard, the MAX563 communicates with RS-232 transceivers, yet consumes far less power; this makes it ideal for battery-powered, hand-held computers. And, the MAX563 guarantees a 116kbps data rate while maintaining ±3.7V EIA/TIA-562 signal levels, which makes it compatible with LapLink™ software.

An on-board charge pump converts the +3.3V supply to the ±6.6V needed to produce the EIA/TIA-562 output voltage levels. Four 0.1µF charge-pump capacitors and a bypass capacitor of similar size are the only external components required.

When the MAX563's charge pumps and transmitters are shut down to save power, the receivers remain active to continuously monitor signals from external devices (for example, ring indicator from modems). The two receivers' outputs can be enabled and disabled independently of the shutdown function to allow two ports—generally of different types—to be wire-OR connected at the UART.

Applications

Handiterminals

Battery-Powered Equipment

Bar-Code Readers

Notebook and Palmtop Computers

Typical Operating Circuit
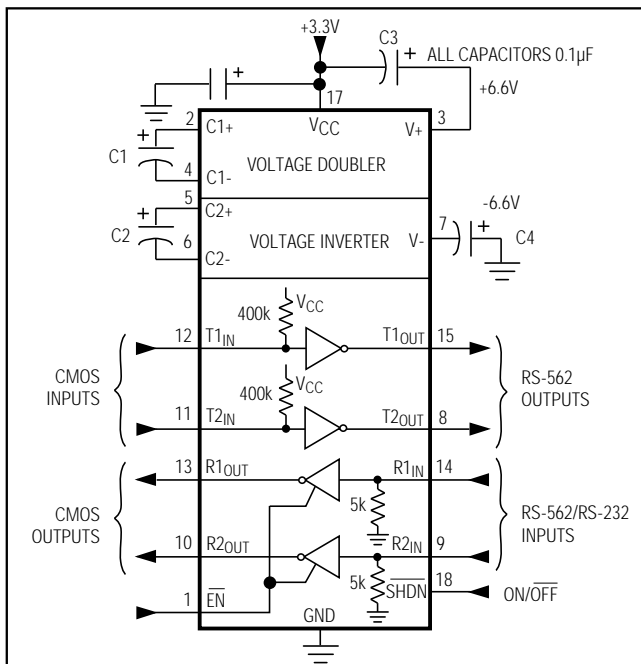
™ *LapLink is a registered trademark of Traveling Software, Inc.*

Features

♦ **Guaranteed Interoperability with RS-232**

♦ **Operates from a Single +3.0V to +3.6V Supply**

♦ **2 Drivers, 2 Receivers**

♦ **Receivers Active in Shutdown Mode**

♦ **Low-Power Shutdown: 10µA Max**

♦ **Small Package—18-Pin Wide SO**

♦ **Three-State TTL/CMOS Receiver Outputs**

♦ **116kbps Guaranteed Data Rate**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX563CPN	0°C to +70°C	18 Plastic DIP
MAX563CWN	0°C to +70°C	18 Wide SO
MAX563C/D	0°C to +70°C	Dice *

* *Dice are specified at T_A = +25°C.*

Pin Configuration

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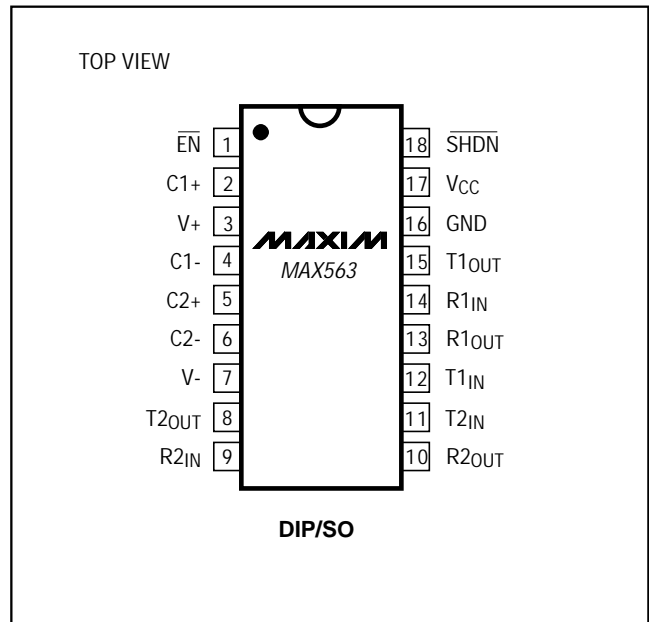
Call toll free 1-800-998-8800 for free samples or literature.

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ABSOLUTE MAXIMUM RATINGS

Power Supply Ranges
  Supply Voltage (V_{CC}) ....-0.3V to +6V
Input Voltages
  T_{IN}..-0.3V to (V_{CC} -0.3V)
  R_{IN} ....±25V
T_{OUT} (Note 1)...±15V
Output Voltages
  T_{OUT}..±15V
  R_{OUT}...-0.3V to (V_{CC} +0.3V)
Driver/Receiver Output Short Circuit to GND.........Continuous

Continuous Power Dissipation (T_A = +70°C)
  Plastic DIP 889mW
  Wide SO 762mW
Operating Temperature Range.............................0°C to +70°C
Storage Temperature Range ....-65°C to +160°C
Lead Temperature (soldering, 10sec) ....+300°C

Note 1: Input voltage measured with T_{OUT} in high-impedance state. $\overline{SHDN}$ or V_{CC} = 0V.

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} = 3.0V to 3.6V, C1-C4 = 0.1µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
RS-562 TRANSMITTERS						
Output Voltage Swing		All transmitter outputs loaded with 3kΩ to GND	±3.7	±4.5		V
Data Rate		R_L = 3kΩ, C_L = 1000pF, T_A = +25°C		200	116	kbps
Input Logic Threshold Low	V_{IL}				0.6	V
Input Logic Threshold High	V_{IH}		2.4			V
Logic Pull-Up/Input Current		$\overline{SHDN}$ = V_{CC}		2	20	µA
		$\overline{SHDN}$ = 0V		±0.01	±1	
Output Leakage Current		V_{CC} = 3.6V, $\overline{SHDN}$ = 0V, V_{OUT} = ±15V		±0.01	±10	µA
		V_{CC} = $\overline{SHDN}$ = 0V, V_{OUT} = ±15V		±0.01	±10	
Transmitter Output Resistance		V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V	300	10M		Ω
Output Short-Circuit Current		V_{OUT} = 0V		±15	±60	mA
RS-232/RS-562 RECEIVERS						
Input Voltage Operating Range					±25	V
Input Threshold Low	V_{IL}	V_{CC} = 3.3V			0.4	V
Input Threshold High	V_{IH}	V_{CC} = 3.3V	2.4			V
Input Hysteresis		$\overline{SHDN}$ = V_{CC} = 3.3V (no hysteresis when $\overline{SHDN}$ = 0V)	0.1	0.5	1.0	V
Input Resistance	R_{IN}		3	5	7	kΩ
Output Voltage Low	V_{OL}	I_{OUT} = 3.2mA		0.2	0.4	V
Output Voltage High	V_{OH}	I_{OUT} = -0.5mA	V_{CC}-0.6	V_{CC}-0.2		V
Output Leakage Current		$\overline{EN}$ = V_{CC}, 0V ≤ V_{OUT} ≤ V_{CC}		±0.05	±10	µA
$\overline{EN}$ Input Threshold Low	V_{IL}				0.6	V
$\overline{EN}$ Input Threshold High	V_{IH}		2.4			V

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ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = 3.0V to 3.6V, C1-C4 = 0.1µF, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
POWER SUPPLY							
Operating Supply Voltage	V_{CC}			3.0		3.6	V
V_{CC} Supply Current	I_{CC}	No load			3	8	mA
		R_L = 3kΩ on both outputs, inputs static			8		
Shutdown Supply Current	I_{CC}	Figure 1	T_A = +25°C		0.1	10	µA
			T_A = T_{MIN} to T_{MAX}		2	50	
$\overline{SHDN}$ Input Leakage Current					0.1	±1	µA
$\overline{SHDN}$ Threshold Low	V_{IL}					0.6	V
$\overline{SHDN}$ Threshold High	V_{IH}			2.4			V
AC CHARACTERISTICS							
Transition Slew Rate		C_L = 50pF to 2500pF, R_L = 3kΩ to 7kΩ, V_{CC} = 3.3V, T_A = +25°C, measured from +3V to -3V or -3V to +3V (Note 2)		4	6	30	V/µs
Transmitter Propagation Delay	t_{PHLT}	Figure 2			1.3	3.5	µs
	t_{PLHT}				1.5	3.5	
Receiver Propagation Delay (Normal Operation)	t_{PHLR}	Figure 3			0.5	1.0	µs
	t_{PLHR}				0.6	1.0	
Receiver Propagation Delay (Shutdown)	t_{PHLS}	Figure 3			0.5	10.0	µs
	t_{PLHS}				2.5	10.0	
Receiver-Output Enable Time	t_{ER}	Figure 4			125	500	ns
Receiver-Output Disable Time	t_{DR}	Figure 4			160	500	ns
Transmitter-Output Enable Time	t_{ET}	Includes charge pump start-up			300		µs
Transmitter-Output Disable Time	t_{DT}	Figure 5			600		ns
Transmitter Propagation Delay Skew	$t_{PHLT} - t_{PLHT}$				300		ns
Receiver Propagation Delay Skew (Normal Operation)	$t_{PHLR} - t_{PLHR}$				100		ns

Note 2: Minimum slew rate is specified with C_L = 1000pF for data rates above 20kbps, corresponding with EIA/TIA-562.

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_____Pin Description

PIN	NAME	FUNCTION
1	$\overline{EN}$	Receiver enable. Connect $\overline{EN}$ to GND to enable receivers, and take $\overline{EN}$ high to disable receivers.
2	C1+	Positive terminal of positive charge-pump capacitor.
3	V+	+2V_{CC} voltage generated by the positive charge pump. The voltage on V+ collapses to V_{CC} when $\overline{SHDN}$ is low.
4	C1-	Negative terminal of positive charge-pump capacitor.
5	C2+	Positive terminal of inverting charge-pump capacitor.
6	C2-	Negative terminal of inverting charge-pump capacitor.
7	V-	-2V_{CC} voltage generated by the inverting charge pump. The voltage on V- collapses to GND when $\overline{SHDN}$ is low.
8, 15	T2$_{OUT}$, T1$_{OUT}$	EIA/TIA-562 voltage-level transmitter outputs. These outputs are disabled (Hi-Z) when $\overline{SHDN}$ is low.
9, 14	R2$_{IN}$, R1$_{IN}$	EIA/TIA-562 and EIA/TIA-232 voltage-level receiver inputs.
10, 13	R2$_{OUT}$, R1$_{OUT}$	CMOS receiver outputs. These outputs are active regardless of the state of $\overline{SHDN}$. They are enabled when $\overline{EN}$ is low, and disabled (Hi-Z) when $\overline{EN}$ is high.
11, 12	T2$_{IN}$, T1$_{IN}$	CMOS driver inputs.
16	GND	Ground.
17	V$_{CC}$	+3.0V to +3.6V supply voltage.
18	$\overline{SHDN}$	Shutdown control. Connect to GND to shut down the charge pumps and the transmitters. Take high to turn on the charge pumps and to enable the transmitters.

_____Detailed Description

The MAX563 consists of three sections: charge-pump voltage converters, transmitters (drivers), and receivers. Both the transmitters and the receivers are inverting.

+3V to ±6V, Dual Charge-Pump Voltage Converter

Two charge pumps either invert or double the incoming V_{CC} to generate the voltages required by the transmitters. The first charge pump uses capacitor C1 to double V_{CC}; the resulting voltage is stored on the V+ reservoir capacitor. The second charge pump uses capacitor C2 to invert V+; this negative voltage is stored on the V- capacitor.

When $\overline{SHDN}$ is low, the charge pumps are turned off, V+ is pulled down to V_{CC} by a 1kΩ resistor, and V- rises to GND.

It is possible to draw some power from the V+ and V- pins for external use. However, doing so diminishes the charge-pump output voltages and reduces noise margins, so it is not recommended.

EIA/TIA-562 Transmitters

The MAX563's drivers are inverting level translators that convert +3V logic inputs to EIA/TIA-562 voltage levels. With a VCC supply of only 3.0V, the driver outputs deliver the EIA/TIA-562 ±3.7V minimum specification under worst-case conditions—when both transmitters are loaded with 3kΩ receivers (either EIA/TIA-232 or EIA/TIA-562).

The transmitters are fast: the guaranteed data rate with standard loads is 116kbps, which is the highest rate commonly used by PC-to-PC communication software, such as LapLink. The highest practical data rate may be reduced if the other communicating device (RS-562 or RS-232) is not as fast, or if the cables present an excessive capacitive load (>1000pF). Each transmitter is designed to drive a single receiver; transmitters can be paralleled to drive multiple receivers.

When $\overline{SHDN}$ is low, the driver outputs are turned off. Their output leakage currents are less than 10µA when pulled to GND or when driven to ±15V. This enables two transmitters to be connected to the same line, provided that one of them is always disabled by taking $\overline{SHDN}$ low.

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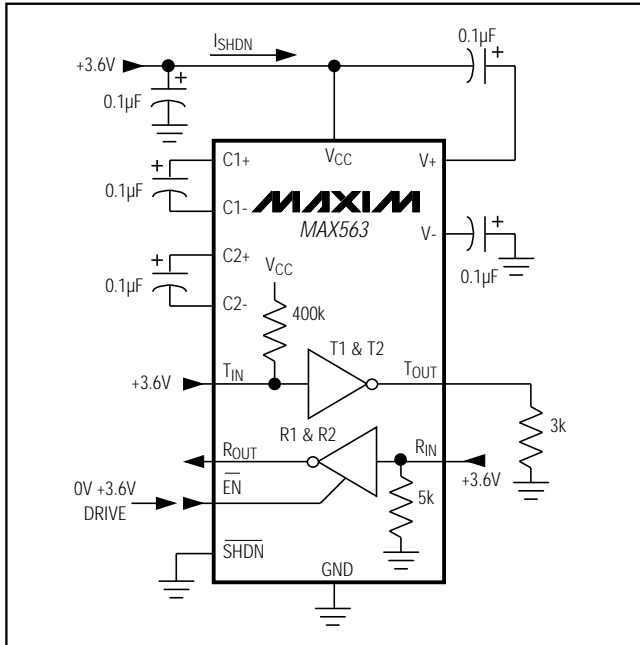
Figure 1. Shutdown Current Test Circuit

Figure 2. Transmitter Propagation Delay Timing
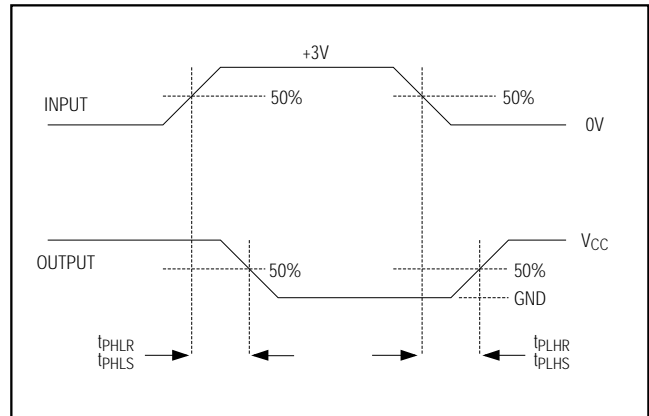
Figure 3. Receiver Propagation Delay Timing

The inputs of unused drivers may be left unconnected because they have internal 400kΩ pull-ups to V_{CC}. Unused inputs may also be connected to GND or V_{CC}, but V_{CC} provides lower power consumption because of the internal pull-ups.

EIA/TIA-562 and EIA/TIA-232 Receivers

The MAX563's receivers convert ±3.7V to ±13.2V EIA/TIA-562 signal levels into +3V logic levels; they are rated to receive signals up to ±25V to accommodate EIA/TIA-232 signals as well. Both receivers invert. Their inputs are each equipped with an internal 5kΩ (nominal) terminating resistor connected to ground, and the input logic thresholds are 0.4V and 2.4V. The positive logic-low threshold (V_{IL}) ensures the receiver outputs remain high whenever their inputs are left open.

The receivers are active when $\overline{EN}$ is low, and have high-impedance outputs when $\overline{EN}$ is high.

When $\overline{SHDN}$ is high, the receivers have hysteresis. This produces clean output transitions, even with slow-moving input signals that exhibit moderate amounts of noise and ringing. When shut down, the receivers have no hysteresis, and the propagation delay increases.

Shutdown and Enable Control

The $\overline{SHDN}$ and $\overline{EN}$ controls are independent. Both receivers are always active when $\overline{EN}$ is low. With $\overline{EN}$ low and $\overline{SHDN}$ high, the receivers operate at full speed

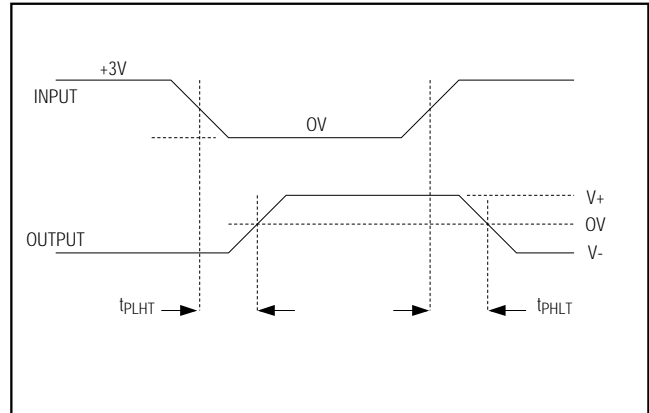and have hysteresis. When active in shutdown mode ($\overline{EN} = \overline{SHDN}$ = low), the receivers operate at reduced power and speed, and without hysteresis.

The charge pumps and transmitters operate only when $\overline{SHDN}$ is high; they are unaffected by $\overline{EN}$. When shut down ($\overline{SHDN}$ = low) or unpowered (V_{CC} = 0V), the transmitter outputs are high impedance if they are backdriven with voltages not exceeding ±15V. The pull-up resistors at the driver inputs are disconnected in shutdown mode to save power. During shutdown, V+ is pulled down to V_{CC}, and V- rises to GND.

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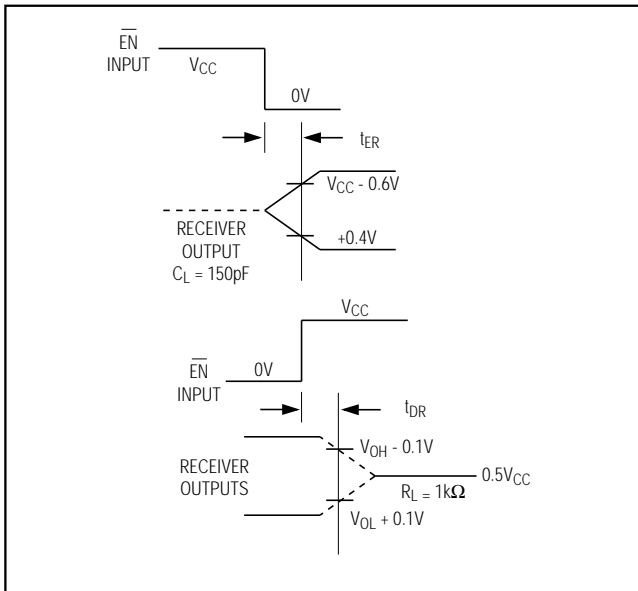
Figure 4. Receiver Output Enable and Disable Timing

A. TIMING DIAGRAM
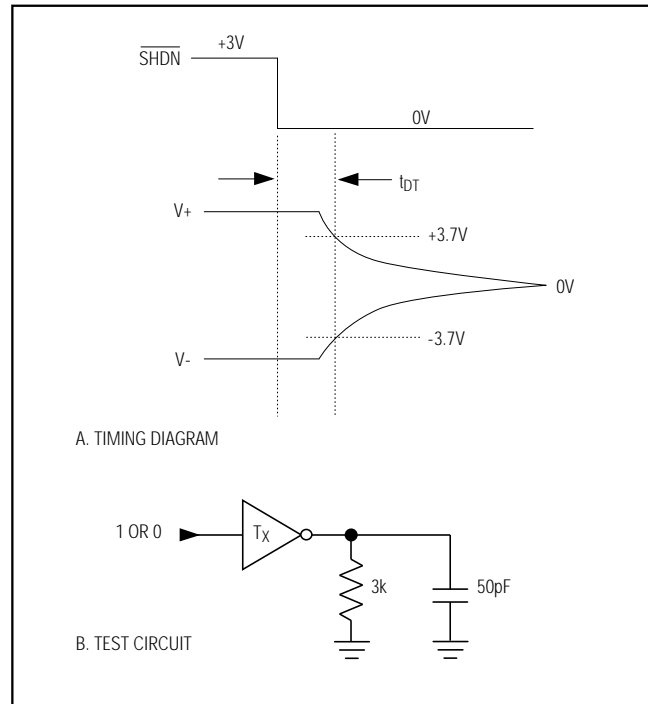
B. TEST CIRCUIT

Figure 5. Transmitter Output Disable Timing

_____Applications Information

Charge-Pump Capacitor Selection

Normally, 0.1µF capacitors can be used for all locations. To reduce output ripple, increase the values of the V+ and V- capacitors. If your capacitors have a very wide tolerance, consider using a nominal value a little larger than 0.1µF to ensure that the actual capacitance does not fall below about 80nF. For circuits designed to operate over a wide range of temperatures, consider using slightly larger capacitors to compensate for any loss of capacitance at temperature extremes. No advantage is gained by using values larger than 10µF.

Power-Supply Decoupling

Use a capacitor with the same value as the charge-pump capacitors.

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Table 1. Summary of EIA/TIA-232E/V.28 and EIA/TIA-562 Specifications

| PARAMETER	CONDITION	EIA/TIA-232E/V.28 SPECIFICATION	EIA/TIA-562 SPECIFICATION
Driver Output Voltage 0 Level	3kΩ to 7kΩ load	5.0V to 15.0V	3.7V to 13.2V
1 Level		-5.0V to -15.0V	-3.7V to -13.2V
Maximum Output Level	No load	±25V	±13.2V
Signal Rate (3kΩ ≤ R_L ≤ 7kΩ)	C_L = 2500pF	Up to 20kbps	Up to 20kbps
	C_L = 1000pF	Not defined	Up to 64kbps
Receiver Input Thresholds 0 Level		3.0V to 15.0V	3.0V to 15.0V
1 Level		-3.0V to -15.0V	-3.0V to -15.0V
Maximum Input Level		±25V	±25V
Maximum Instantaneous Slew Rate		30V/µs	30V/µs
Maximum Driver Output Short-Circuit Current		100mA	60mA
Transition Rate on Driver Output		V.28 1ms or 3% of the period	4V/µs
		RS-232 4% of the period	
Driver Output Resistance with Power Off	-2V < V_{OUT} < 2V	300Ω	300Ω

Table 2. DB9/DB25 Cable Connections Commonly Used for EIA/TIA-232E, EIA/TIA-562 and V.24 Asynchronous Interfaces

DB9 PIN	DB25 PIN	NAME	SYMBOL	FUNCTION
1	8	Received Line Signal Detector (sometimes called Data Carrier Detect)	DCD	Handshake from DCE
2	3	Receiver Data	RxD	Data from DCE
3	2	Transmit Data	TxD	Data from DTE
4	20	Data Terminal Ready	DTR	Handshake from DTE
5	7	Signal Ground	GND	Reference point for signals
6	6	Data Set Ready	DSR	Handshake from DCE
7	4	Request to Send	RTS	Handshake from DTE
8	5	Clear to Send	CTS	Handshake from DCE
9	22	Ring Indicator	RI	Handshake from DCE

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_____**Chip Topography**
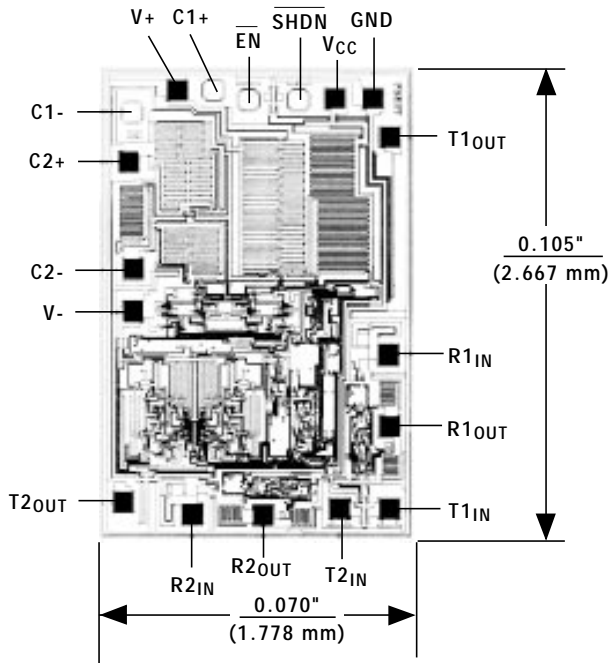
TRANSISTOR COUNT: 189;

SUBSTRATE CONNECTED TO V+.