



TC232*

DUAL RS-232 TRANSMITTER/RECEIVER AND POWER SUPPLY

FEATURES

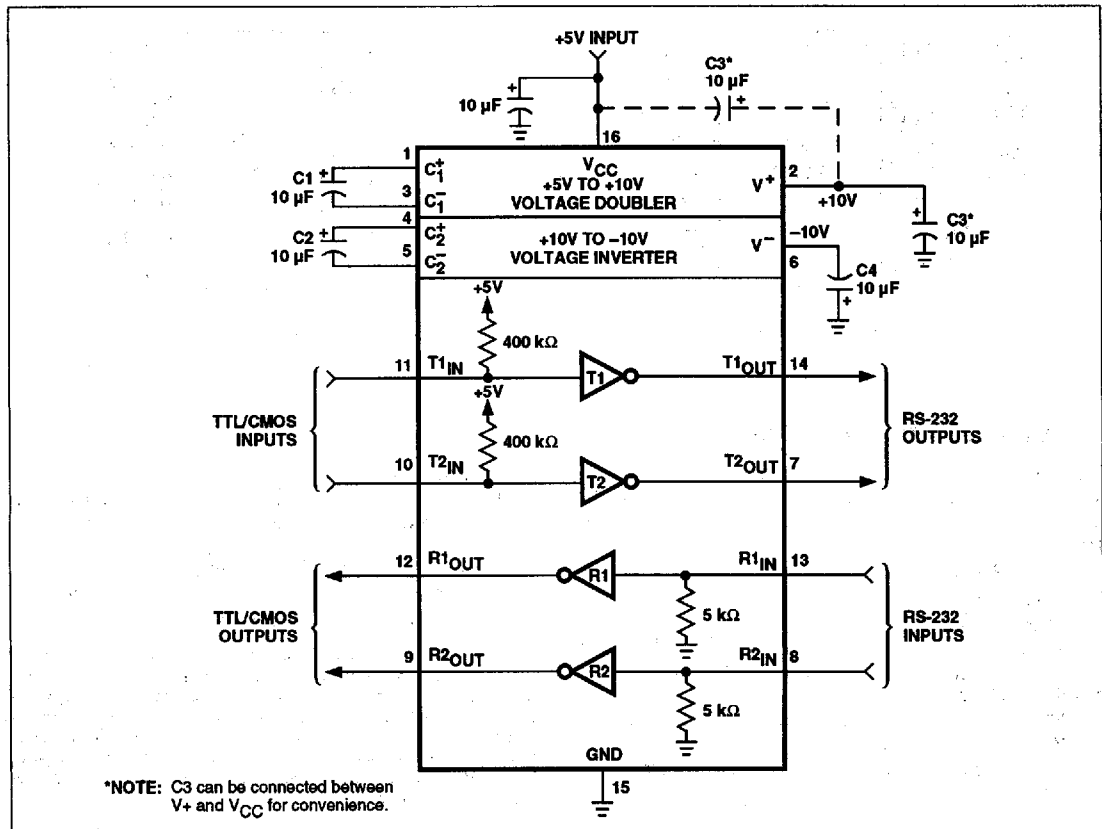
- Meets All RS-232C Specifications
- Operates From Single 5V Power Supply
- 2 Drivers and 2 Receivers
- On-Board Voltage Quadrupler
- Input Levels.....±30V
- Output Swing With +5V Supply±9V
- Low Power CMOS..... 5 mA

GENERAL DESCRIPTION

The TC232 is a dual RS-232 transmitter/receiver that complies with EIA RS-232C guidelines and is ideal for all RS-232C communication links. This device has a 5V power supply and two charge pump voltage converters that produce ±10V power supplies.

The TC232 has four level translators. Two are RS-232 transmitters that convert TTL/CMOS input levels to 9V RS-232 outputs. The other two translators are RS-232 receivers that convert RS-232 inputs to 5V TTL/CMOS output levels. The receivers have a nominal threshold of 1.3V, a typical hysteresis of 0.5V, and can operate with up to ±30V inputs.

TYPICAL APPLICATION



**DUAL RS-232 TRANSMITTER/
RECEIVER AND POWER SUPPLY**

T-75-45-05

TC232

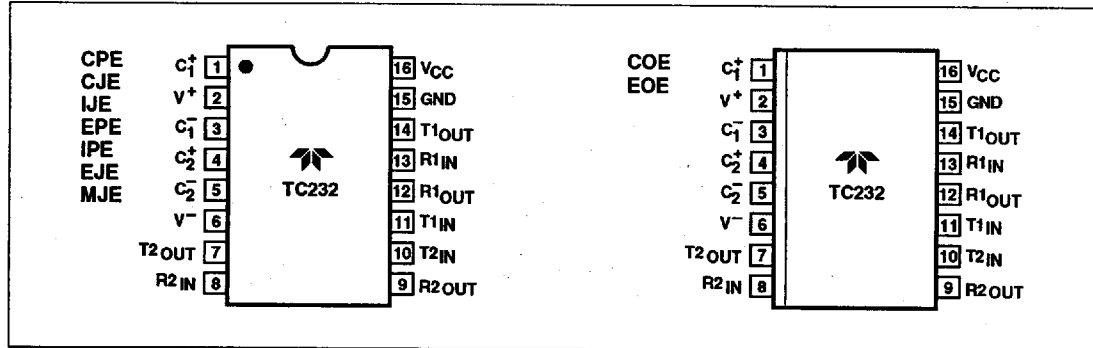
APPLICATIONS

The TC232 is ideal for all RS-232C communication links: Battery-powered systems, computers, instruments, modems, and peripherals. It can run without the 12V power supplies other RS-232 devices require.

ORDERING INFORMATION

| Part No. | Package | Temperature Range |
|----------|----------------|-------------------|
| TC232CPE | 16-Pin Plastic | 0°C to +70°C |
| TC232CJE | 16-Pin CerDIP | 0°C to +70°C |
| TC232IJE | 16-Pin CerDIP | -25°C to +85°C |
| TC232EPE | 16-Pin Plastic | -40°C to +85°C |
| TC232IPE | 16-Pin Plastic | -25°C to +85°C |
| TC232EJE | 16-Pin CerDIP | -40°C to +85°C |
| TC232COE | 16-Pin SO | 0°C to +70°C |
| TC232EOE | 16-Pin SO | -40°C to +85°C |
| TC232MJE | 16-Pin CerDIP | -55°C to +125°C |

PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS

| | |
|---|--|
| V _{CC} | +6V |
| V ⁺ | +12V |
| V ⁻ | +12V |
| Input Voltages | |
| T _{1IN} , T _{2IN} | -0.3 to (V _{CC} +0.3V) |
| R _{1IN} , R _{2IN} | ±30V |
| Output Voltages | |
| T _{1OUT} , T _{2OUT} | (V ⁺ +0.3V) to (V ⁻ -0.3V) |
| R _{1OUT} , R _{2OUT} | -0.3 to (V _{CC} +0.3V) |
| Short Circuit Duration | |
| V ⁺ | 30 sec |
| V ⁻ | 30 sec |
| T _{1OUT} , T _{2OUT} | Continuous |

Power Dissipation

| | |
|------------------------------|--------|
| CerDIP | 675 mW |
| Derate 9.5 mW/°C Above +70°C | |
| Plastic DIP | 375 mW |
| Derate 7 mW/°C Above +70°C | |
| Small Outline (SO) | 375 mW |
| Derate 7 mW/°C Above +70°C | |

Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. 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 operation sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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ELECTRICAL CHARACTERISTICS: $V_{CC} = 5V \pm 10\%$, T_A = operating temperature range, test circuit unless otherwise noted.

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|--|---|---------|----------|----------|------------|
| Output Voltage Swing | T1 _{OUT} , T2 _{OUT} Loaded With 3 k Ω to Ground | ± 5 | ± 9 | ± 10 | V |
| Power Supply Current | | | 5 | 10 | mA |
| Input Logic Threshold Low | T1 _{IN} , T2 _{IN} | | | 0.8 | V |
| Input Logic Threshold High | T1 _{IN} , T2 _{IN} | 2 | | | V |
| Logic Pull-Up Current | T1 _{IN} , T2 _{IN} = 0V | | 15 | 200 | μ A |
| RS-232 Input Voltage Operating Range | | -30 | | +30 | V |
| RS-232 Input Threshold Low | $V_{CC} = 5V$ | 0.8 | 1.2 | | V |
| RS-232 Input Threshold High | $V_{CC} = 5V$ | | 1.7 | 2.4 | V |
| RS-232 Input Hysteresis | | 0.2 | 0.5 | 1 | V |
| RS-232 Input Resistance | $T_A = +25^\circ\text{C}$, $V_{CC} = 5V$ | 3 | 5 | 7 | k Ω |
| TTL/CMOS Output Voltage Low | I _{OUT} = 3.2 mA | | | 0.4 | V |
| TTL/CMOS Output Voltage High | I _{OUT} = -1 mA | 3.5 | | | V |
| Propagation Delay | RS-232 to TTL or TTL to RS-232 | | 0.5 | | μ s |
| Instantaneous Slew Rate | C _L = 10 pF, R _L = 3 k Ω to 7 k Ω , $T_A = +25^\circ\text{C}$ (Note 1) | | | 30 | V/ μ s |
| Transition Region Slew Rate | R _L = 3 k Ω , C _L = 2500 pF Measured From +3V to -3V or -3V to +3V | | 3 | | V/ μ s |
| Output Resistance | $V_{CC} = V^+ = V^- = 0V$, $V_{OUT} = \pm 2V$ | 300 | | | Ω |
| RS-232 Output Short-Circuit Current | | | ± 10 | | mA |

NOTE 1. Sample tested.

DETAILED DESCRIPTION

The TC232 contains a +5V to $\pm 10V$ dual charge pump voltage converter, a dual transmitter and a dual receiver.

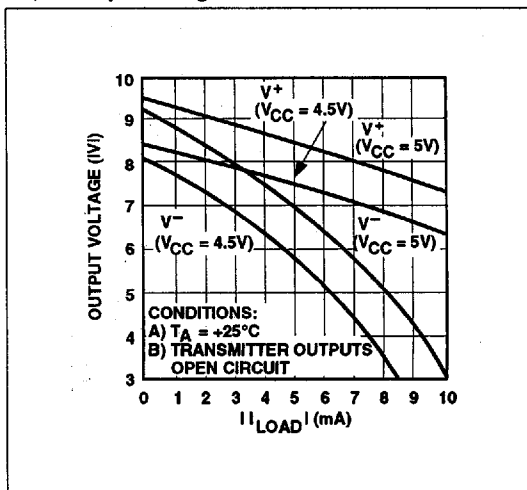
+5V to $\pm 10V$ Dual Charge Pump Voltage Converter

The TC232 power supply consists of two charge pumps. One uses external capacitor C1 to double the +5V input to +10V, with output impedance of about 200 Ω . The other uses C2 to invert +10V to -10V, with overall output impedance of 450 Ω (including effects of +5V to +10V doubler impedance).

The clock in the doubler circuit will start at $\approx 4.2V$ in the typical part, but external loads may make this point rise to as high as 4.5V with a load of 2 k Ω on each of the two output voltages.

Because of this, use of the doubler and inverter to run external circuits should be limited. The maximum current should be no more than 2.5 mA from the +10V and -10V in order to guarantee start-up of the doubler clock.

V⁺, V⁻ Output Voltages vs Load Current



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The test circuit employs 22 μF capacitors for C1 to C4, but the value is not critical. These capacitors usually are low-cost aluminum electrolytic capacitors, or polyester if size is critical.

Increasing C1 and C2 to 47 μF lowers the output impedance of the +10V doubler and the -10V inverter by the change in the ESR of the capacitors.

Increasing C3 and C4 lowers ripple on the $\pm 10\text{V}$ voltage outputs and 16 kHz ripple on the RS-232 outputs. Where size is critical, the value of C1 to C4 can be lowered to 1 μF . The use of a low ESR-value capacitor will help lower the output ripple and keep the output impedance of the $\pm 10\text{V}$ as low as possible.

Dual Transmitter

TC232 transmitters are CMOS inverters driven by $\pm 10\text{V}$ internally-generated voltages. The input is TTL/CMOS compatible, with a logic threshold of about 26% of V_{CC} (1.3V for 5V V_{CC}). The input of an unused transmitter can be left unconnected. An internal 400 k Ω pull-up resistor connected between the transmitter input and V_{CC} pulls the input high and forces the unused transmitter output to the low state.

With V_{CC} at 5V, the outputs will go from ($V^+ - 0.6\text{V}$) to V^- with no load and will swing $\pm 9\text{V}$ when loaded with 3 k Ω . The minimum output voltage swing, with V_{CC} at 4.5V and at maximum ambient temperature, is $\pm 5\text{V}$. This conforms to RS-232 specifications for "worst-case" conditions.

EIA RS-232C specs limit the slew rate at output to less than 30V/ μs .

The powered-down output impedance ($V_{CC} = 0\text{V}$) is a minimum of 300 Ω with $\pm 2\text{V}$ applied to outputs.

The outputs are short-circuit-protected and can be short-circuited to ground indefinitely.

Dual Receiver

TC232 receivers meet RS-232C input specifications. Input impedance is between 3 k Ω and 7 k Ω . Switching thresholds are within the $\pm 3\text{V}$ limits, and the receivers withstand up to $\pm 30\text{V}$ inputs. RS-232 and TTL/CMOS input compatible, the receivers have 0.8V V_{IL} and 2.4V V_{IH} with 0.5V hysteresis to reject noise.

The TTL/CMOS compatible receiver output is low when RS-232 input is greater than 2.4V. It is high when input is floating or between +0.8V and -30V.

TEST CIRCUIT

