National Semiconductor

**ADVANCE INFORMATION**
June 1998

# DS14C202
# Low Power +5V Powered EIA/TIA-232 Dual Driver/Receiver

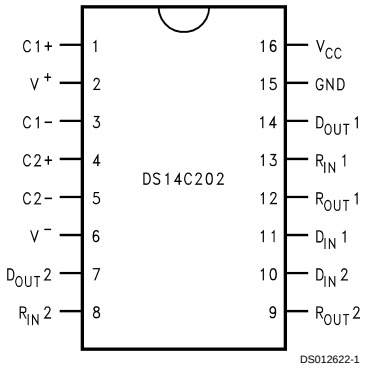
## General Description

The DS14C202 is a low power dual driver/receiver featuring an onboard DC to DC converter. This eliminates the need for ±12V power supplies and requires only a +5V power supply. Only four 0.1 µF capacitors are needed for the DC to DC converter. The drivers maintain greater than ±5V output signal levels at data rates in excess of 128 kbits/sec when loaded in accordance with the EIA/TIA-232-E specification. $I_{CC}$ is specified at 15 mA maximum, making the device ideal for battery and power conscious applications. The drivers' slew rate is set internally, eliminating the need for external slew rate capacitors. The device is designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). The driver inputs and receiver outputs are TTL and CMOS compatible. DS14C202 driver outputs and receiver inputs meet EIA/TIA-232-E and ITU-T V.28 standards. This device is an enhanced version of the DS14C232 that requires smaller external capacitors (0.1 µF) and supports higher data rates of up to 128 kbit/sec.

## Features

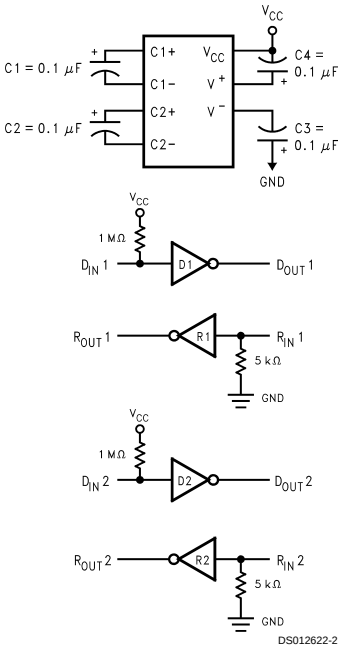
- Uses only four small 0.1 µF capacitors for DC to DC converter
- Operates over 128 kbit/sec
- Pin compatible with MAX202, MAX232A and others
- Single +5V power supply
- Low power
- DS14C202 meets EIA/TIA-232-E and ITU-T V.28 standards
- CMOS technology
- Package efficiency — 2 drivers and 2 receivers
- Available in Plastic DIP and Narrow SOIC packages
- Extended temperature range: −40˚C to +85˚C
- ESD ≥ 6.0 kV HBM

## Connection Diagram




**Order Number DS14C202TN**
**or DS14C202TM**
**See NS Package Number N16A or M16A**

## Functional Diagram



## Absolute Maximum Ratings (Note 1)

**If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.**

| | |
|---|---|
| Supply Voltage ($V_{CC}$) | −0.3V to 6V |
| Supply Voltage ($V^+$) | ($V_{CC}$ − 0.3V) to +14V |
| Supply Voltage ($V^-$) | +0.3V to −14V |
| Short Circuit Duration, $D_{OUT}$ | Continuous |
| Driver Input Voltage | −0.3V to ($V_{CC}$ + 0.3V) |
| Driver Output Voltage | ($V^+$ + 0.3V) to ($V^-$ − 0.3V) |
| Receiver Input Voltage | ±25V |
| Receiver Output Voltage | −0.3V to ($V_{CC}$ + 0.3V) |
| ESD Rating (HBM, 1.5 kΩ, 100 pF) | ≥ 6.0 kV |
| Junction Temperature | +150˚C |
| Maximum Package Power Dissipation @ 25˚C (Note 6) | |
| N Package | TBD |
| M Package | TBD |
| Storage Temperature Range | −65˚C to +150˚C |
| Lead Temperature (Soldering, 4 sec.) | +260˚C |

## Recommended Operating Conditions

| | Min | Max | Units |
|---|---|---|---|
| Supply Voltage, ($V_{CC}$) | 4.5 | 5.5 | V |
| Operating Free Air Temp. ($T_A$) | | | |
| DS14C202T | −40 | +85 | ˚C |

## Electrical Characteristics (Notes 2, 5)

Over recommended operating conditions, unless otherwise specified.

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **DEVICE CHARACTERISTICS** | | | | | | | |
| $V^+$ | Positive Power Supply | $R_L$ = 3 kΩ, C1–C4 = 0.1 µF, $D_{IN}$ = 0.8V | | | 9.0 | | V |
| $V^-$ | Negative Power Supply | $R_L$ = 3 kΩ, C1–C4 = 0.1 µF, $D_{IN}$ = 2.0V | | | −8.5 | | V |
| $I_{CC}$ | $V_{CC}$ Supply Current | No Load | | | | 15 | mA |
| **DRIVER CHARACTERISTICS** | | | | | | | |
| $V_{IH}$ | High Level Input Voltage | | | 2.0 | | $V_{CC}$ | V |
| $V_{IL}$ | Low Level Input Voltage | | | GND | | 0.8 | V |
| $I_{IH}$ | High Level Input Current | $V_{IN}$ ≥ 2.0V | | −30 | | +30 | µA |
| $I_{IL}$ | Low Level Input Current | $V_{IN}$ ≤ 0.8V | | −30 | | +30 | µA |
| $V_{OH}$ | High Level Output Voltage | $R_L$ = 3 kΩ | | 5.0 | 8.0 | | V |
| $V_{OL}$ | Low Level Output Voltage | $R_L$ = 3 kΩ | | | −7.0 | −5.0 | V |
| $I_{OS}^+$ | Output High Short Circuit Current | $V_{OUT}$ = 0V, $V_{IN}$ = 0.8V | (Note 3) | −5.0 | −15 | −30 | mA |
| $I_{OS}^-$ | Output Low Short Circuit Current | $V_{OUT}$ = 0V, $V_{IN}$ = 2.0V | | 5.0 | 11 | 30 | mA |
| $R_O$ | Output Resistance | −2V ≤ $V_{OUT}$ ≤ +2V, $V_{CC}$ = 0V = GND or Open | | 300 | | | Ω |
| **RECEIVER CHARACTERISTICS** | | | | | | | |
| $V_{TH}$ | Input High Threshold Voltage | | | | 1.7 | 2.4 | V |
| $V_{TL}$ | Input Low Threshold Voltage | | | 0.8 | 1.5 | | V |
| $V_{HY}$ | Hysteresis | | | 0.2 | 0.4 | 1.0 | V |
| $R_{IN}$ | Input Resistance | −15V ≤ $V_{IN}$ ≤ +15V | | 3.0 | 4.7 | 7.0 | kΩ |
| $I_{IN}$ | Input Current | $V_{IN}$ = +15V | | +2.14 | +3.5 | +5.0 | mA |
| | | $V_{IN}$ = +3V | | +0.43 | +0.6 | +1.0 | mA |
| | | $V_{IN}$ = −3V | | −0.43 | −0.6 | −1.0 | mA |
| | | $V_{IN}$ = −15V | | −2.14 | −3.5 | −5.0 | mA |
| $V_{OH}$ | High Level Output Voltage | $V_{IN}$ = −3V, $I_{OH}$ = −3.2 mA | | 3.5 | 4.5 | | V |
| | | $V_{IN}$ = −3V, $I_{OH}$ = −20 µA | | 4.0 | 4.9 | | V |
| $V_{OL}$ | Low Level Output Voltage | $V_{IN}$ = +3V, $I_{OL}$ = +3.2 mA | | | 0.15 | 0.4 | V |

## Switching Characteristics (Note 5)

Over recommended operating conditions, unless otherwise specified.

| Symbol | Parameter | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **DRIVER CHARACTERISTICS** | | | | | | | |
| $t_{PLH}$ | Propagation Delay Low to High | $R_L$ = 3 kΩ<br>$C_L$ = 50 pF<br>(*Figure 1*) | | | 1.0 | 4.0 | µs |
| $t_{PHL}$ | Propagation Delay High to Low | | | | 1.0 | 4.0 | µs |
| $t_{SK}$ | Skew $\lvert t_{PLH} - t_{PHL} \rvert$ | | | | 0.1 | 1.0 | µs |
| SR1 | Output Slew Rate | $R_L$ = 3 kΩ to 7 kΩ, $C_L$ = 50 pF | (Note 7) | 4.0 | 10 | 30 | V/µs |
| SR2 | Output Slew Rate | $R_L$ = 3 kΩ to 7 kΩ, $C_L$ = 2500 pF | | 4.0 | 10 | 30 | V/µs |
| **RECEIVER CHARACTERISTICS** | | | | | | | |
| $t_{PLH}$ | Propagation Delay Low to High | Input Pulse Width > 10 µs<br>$C_L$ = 50 pF<br>(*Figure 2*) | | | | 2.0 | µs |
| $t_{PHL}$ | Propagation Delay High to Low | | | | | 2.0 | µs |
| $t_{SK}$ | Skew $\lvert t_{PLH} - t_{PHL} \rvert$ | | | | | 300 | ns |
| $t_r$ | Output Rise Time | | | | | 15 | ns |
| $t_f$ | Output Fall Time | | | | | 15 | ns |
| **DATA RATES** | | | | | | | |
| $f_{MAX}$ | Maximum Data Rate | $R_L$ = 3 kΩ to 7 kΩ, $C_L$ = 50 pF to 1000 pF (Note 8) | | 128 | TBD | | kbps |

**Note 1:** Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of Electrical Characteristics specify conditions for device operation.

**Note 2:** Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground unless otherwise specified. For current, minimum and maximum values are specified as an absolute value and the sign is used to indicate direction. For voltage logic levels, the more positive value is designated as maximum. For example, if −6V is a maximum, the typical value of −6.8V is more negative.

**Note 3:** $I_{OS}^+$ and $I_{OS}^-$ values are for one output at a time.

**Note 4:** Receiver AC input waveform for test purposes: $t_r = t_f$ = 160 ns (10% to 90%), $V_{IH}$ = 3V, $V_{IL}$ = −3V, f = 64 kHz, 50% duty cycle. Driver AC input waveform for test purposes: $t_r = t_f$ = 10 ns (10% to 90%), $V_{IH}$ = 3V, $V_{IL}$ = 0V, f = 64 kHz, 50% duty cycle.

**Note 5:** All typicals are given for $V_{CC}$ = 5.0V, +25˚C.

**Note 6:** Ratings apply to ambient temperature at +25˚C. Above this temperature derate: N Package TBD and M Package TBD.

**Note 7:** Slew rate is defined as ΔV/Δt, measured between ±3V level.

**Note 8:** $f_{MAX}$ criteria is either 60%–40% duty cycle or a waveform that is ⅓ rise, ⅓ fall, ⅓ logic level (driver ±5V and receiver 3.5V/0.4V).

## Parameter Measurement Information

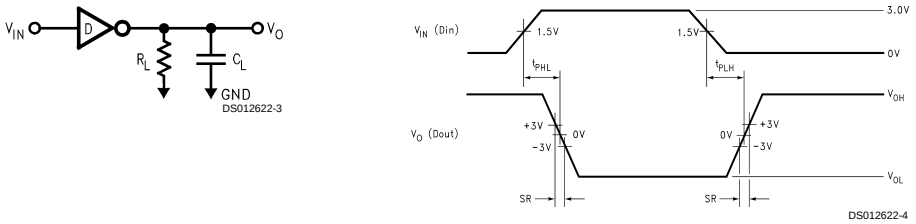
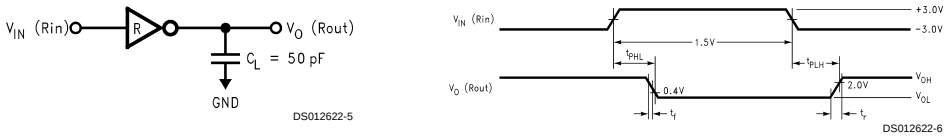



**FIGURE 1. Driver Load Circuit and Switching Waveform** (Note 4)




$t_r$ and $t_f$ measured between 20% and 80% of the waveform.

**FIGURE 2. Receiver Load Circuit and Switching Waveform** (Note 4)

## Pin Descriptions

**$V_{CC}$ (Pin 16)**

Power supply pin for the device, +5V (±10%).

**$V^+$ (Pin 2)**

Positive supply for EIA/TIA-232-E drivers. Recommended external capacitor: C4 = 0.1 µF (≥ 6.3V). Capacitor value should not be less than 0.1 µF. This supply is not intended to be loaded externally. (Note 9)

**$V^-$ (Pin 6)**

Negative supply for EIA/TIA-232-E drivers. Recommended external capacitor: C3 = 0.1 µF (≥ 16V). Capacitor value should not be less than 0.1 µF. This supply is not intended to be loaded externally. (Note 9)

**C1+, C1− (Pins 1, 3)**

External capacitor connection pins. Recommended capacitor: C1 = 0.1 µF (≥ 6.3V). Capacitor value should not be less than 0.1 µF. (Note 9)

**C2+, C2− (Pins 4, 5)**

External capacitor connection pins. Recommended capacitor: C2 = 0.1 µF (≥ 16V). Capacitor value should not be less than 0.1 µF. (Note 9)

**$D_{IN}1$, $D_{IN}2$ (Pins 11, 10)**

Driver input pins are TTL/CMOS compatible. Inputs of unused drivers may be left open, an internal active pull-up resistor (500 kΩ minimum, typically 1 MΩ) pulls input HIGH. Output will be LOW for input pins.

**$D_{OUT}1$, $D_{OUT}2$ (Pins 14, 7)**

Driver output pins conform to EIA/TIA-232-E levels.

**$R_{IN}1$, $R_{IN}2$ (Pins 13, 8)**

Receiver input pins accept EIA/TIA-232-E input voltages (±25V). Receivers feature guaranteed hysteresis of 200 mV. Unused receiver input pins may be left open. Internal input resistor (5 kΩ) pulls input LOW, providing a fail-safe HIGH output.

**$R_{OUT}1$, $R_{OUT}2$ (Pins 12, 9)**

Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

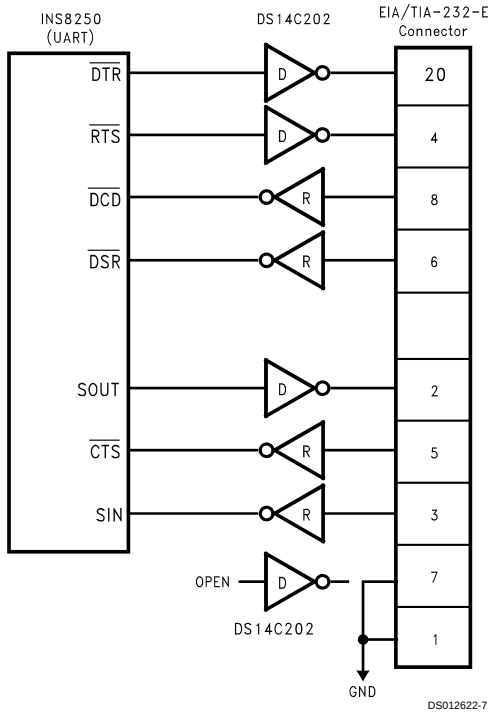
**GND (Pin 15)**

Ground Pin.

**Note 9:** All capacitor values have tolerances of less than ±20%.

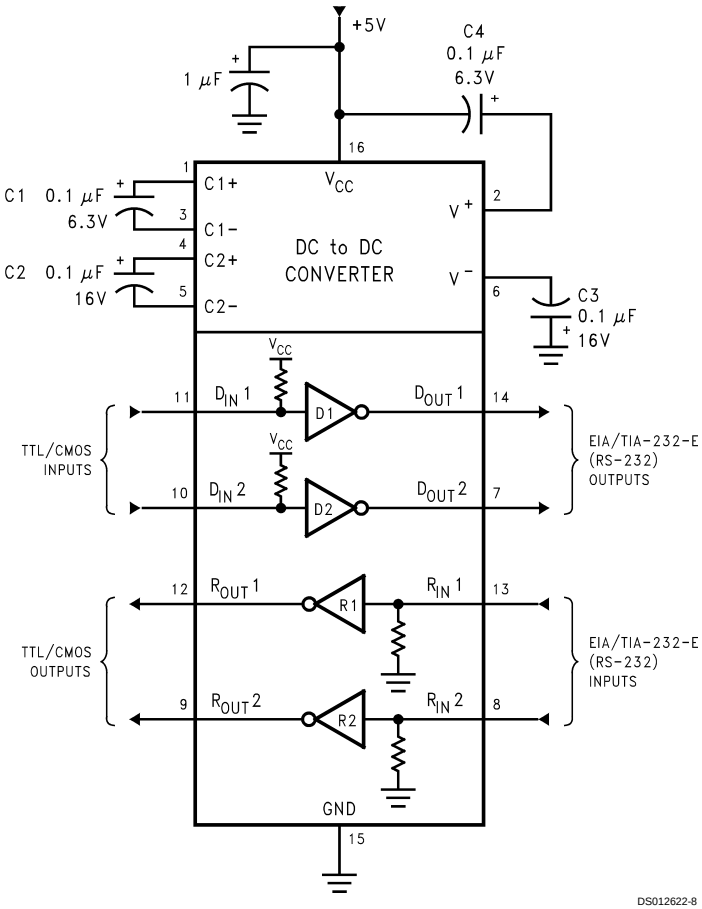
## Typical Application Information

**Application of DS14C202 and INS8250**

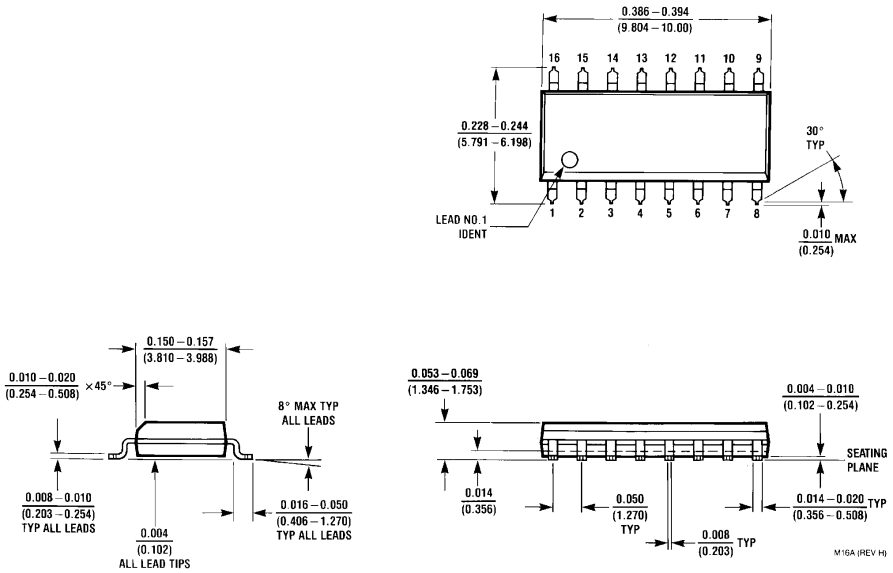



Book
Extract
End

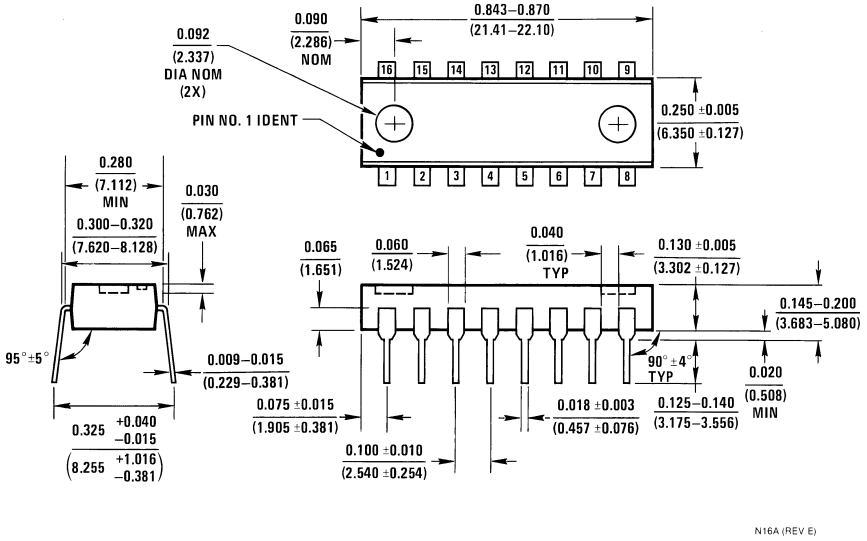
## Typical Connection Diagram



## Physical Dimensions inches (millimeters) unless otherwise noted




**Order Number DS14C202TM**
**NS Package Number M16A**




**Order Number DS14C202TN**
**NS Package Number N16A**

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**National Semiconductor Corporation**
Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

www.national.com

**National Semiconductor Europe**
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80-530 85 85
English Tel: +49 (0) 1 80-532 78 32
Français Tel: +49 (0) 1 80-532 93 58
Italiano Tel: +49 (0) 1 80-534 16 80

**National Semiconductor Asia Pacific Customer Response Group**
Tel: 65-2544466
Fax: 65-2504466
Email: sea.support@nsc.com

**National Semiconductor Japan Ltd.**
Tel: 81-3-5620-6175
Fax: 81-3-5620-6179