Inter-Operation of the DS14C335 with +5V UARTs

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This application brief describes the inter-operation between the DS14C335 (+3.3V supply TIA/EIA-232 3 x 5 Driver/ Receiver) and a +5V UART. The DS14C335, illustrated in *Figure 1*, is ideally suited for notebook and laptop computer applications which either employ one uniform +3.3V supply for all internal components or mixed +3.3V and +5V power supplies. In mixed supply applications, the DS14C335 does NOT require a +5V to +3.3V translator device between it and the UART. This application brief describes how this is accomplished.

Figure 2 illustrates a typical application where the DS14C335 provides the interface between the +5V UART and the RS-232 port. The drivers provide translation from TTL/CMOS voltage levels on the driver input pins to RS-232 compliant driver output voltage levels (>|5V|), while the receivers accept standard RS-232 input levels and translate them back to TTL/CMOS compatible output voltage levels.

Because this application specifies a +5V UART, care must be taken to consider the characteristics of three pins on the DS14C335. They are the:

D_{IN} Driver Input,
SD Shutdown,
R_{OUT} Receiver Output

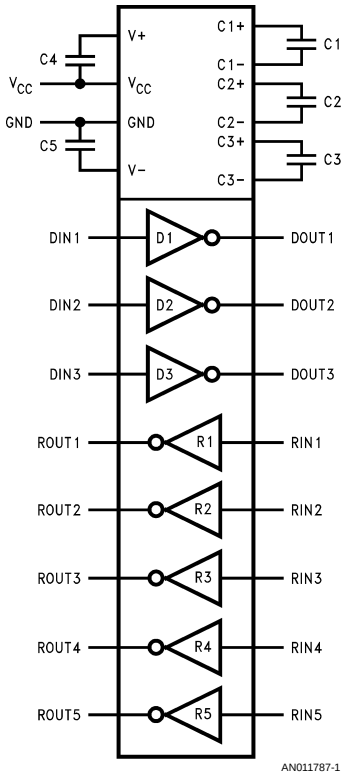

FIGURE 1. DS14C335 Functional Diagram

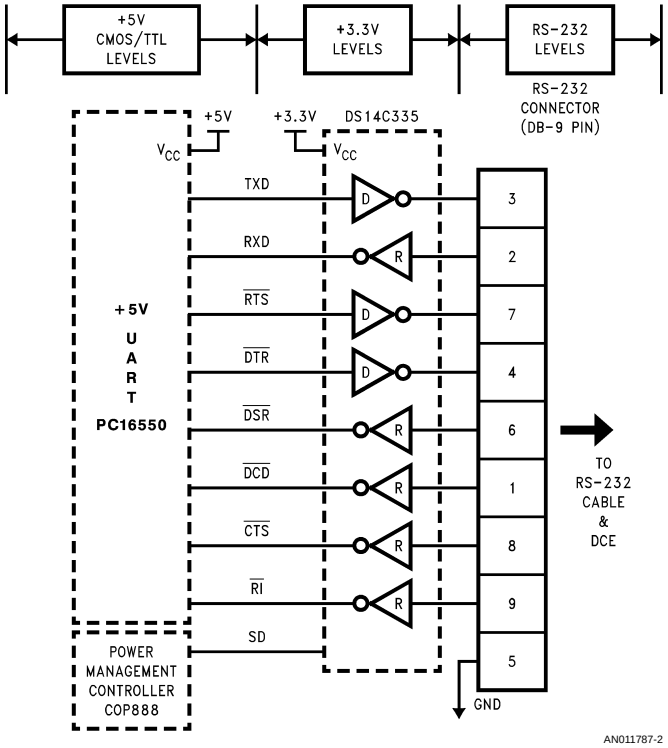

FIGURE 2. Typical Mixed Supply (3V/5V) DTE Application

Let us first examine the input structures of the $D_{IN}$and SD input pins, as these structures are very similar. The common circuitry is illustrated in *Figure 3* and is composed of two input protection diodes (D1 and D2). In addition, a third diode (D3) exists between the V_{CC} and V+ pins and is normally reversed biased. Diode D1 is situated between the input (D_{IN} or SD) pin and GND to clamp negative input voltages. Diode D2 is situated between the input pin and the V+ pin. When the DS14C335 is active (ON), the V+ pin is typically greater than +9V. External charge pump capacitor C4, holds 6V of charge, and is referenced to the V_{CC} (+3.3V) pin. This creates a potential of greater than +9V on the V+ pin, and is used to power the driver outputs. The input pins (D_{IN} and SD) present standard input current loading to the driving device (UART) since D1 and D2 remain reversed biased between −0.3V and one diode above the V+ pin potential (typically greater than +9V).

The DS14C335 supports another unique feature that allows the CPU to disable the device to save power when RS-232 communication is not required. The DS14C335 is put into shutdown mode, by asserting the SD pin high. This disables the internal charge pump circuit, the drivers, and also 4 of the 5 receivers, droping I_{CC} to typically 1.0 µA (10 µA maximum). One receiver remains active to monitor the Ring Indicator (RI) modem control line, to inform the CPU that a call is coming in from a remote site. In the shutdown mode, the charge pump is disabled, and the charge on C4 eventually drops to one diode below V_{CC}, or the input voltage, whichever is greater. If C4 has discharged to one diode below V_{CC}, and an input voltage is applied that is greater than V_{CC}, C4 will charge up to one diode below that level. However, no DC current flows between the input pin and the +3.3V power supply. The D_{IN} and SD pins still present standard DC loading to the driving logic. Blocking diode D3 prevents a large DC current from flowing between the input pins and the +3.3V supply when the input pin is taken above the device's +3.3V (V_{CC}) power supply pin. This is the classical problem that can occur when directly interfacing a +5V device to some +3.3V devices. A minimal amount of noise is coupled onto the V_{CC} (+3.3V) supply rail if the driver input pin is switched (0V to 5V) while the DS14C335 is in the shutdown mode. However, the magnitude is small, and power supply bypassing capacitors effectively filter out the noise. To prevent noise from coupling onto the V_{CC} rail to begin with, simply hold the driver inputs at a V_{IL} (voltage input low), since with a V_{IL} applied both diodes (D1 and D2) will remain off.

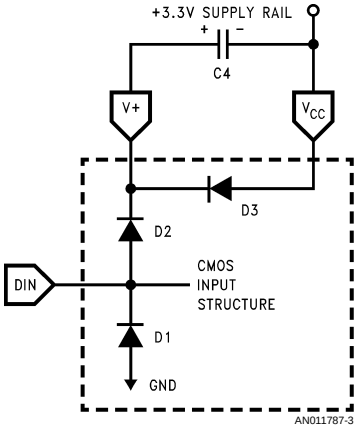

FIGURE 3. Input Protection Circuitry

This unique input structure allows the driver input pins and shutdown pin to accept any standard TTL/CMOS levels regardless of the DS14C335 mode (active or shutdown) or the fact that the DS14C335 is powered from a +3.3V power supply. The input pins (D_{IN} and SD) present standard loading to the driving logic with input voltages ranging from 0V to +5.5V, in magnitude.

The last pin of concern is the receiver output (R_{OUT}) pin. The R_{OUT} pin must have the drive capability to meet standard TTL/CMOS requirements. The R_{OUT} V_{OH} is specified to be greater than 2.4V at 1 mA. This drive capability should meet all standard TTL/CMOS requirements.

SUMMARY

The DS14C335's unique input structure allows the driver input (D_{IN}) and shutdown (SD) pins to present standard steady state input loading to the driving logic. Valid input voltages can range from −0.3V to greater than +5.5V, thereby enabling the device to be driven by a +5V UART in applications that employ mixed power supplies. The high drive capability of the receiver output meets the requirements of +5V logic levels, or CMOS compliant JEDEC +3.3V levels. These features make the DS14C335 the optimal single chip solution for RS-232 serial ports in +3.3V/+5V or pure +3.3V power supply laptop and notebook computer applications.

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