

# DESIGN NOTES

## Interfacing to V.35 Networks – Design Note 94

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### What is V.35?

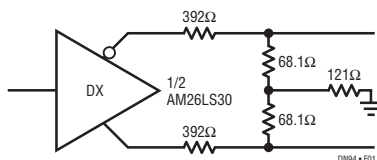
V.35 is a CCITT recommendation for data transmission at 48kbs. The electrical interface between data communication equipment (DCE) and data terminal equipment (DTE) includes a set of balanced differential circuits conforming to Appendix II of Recommendation V.35 and a set of control circuits conforming to Recommendation V.28 (equivalent to RS232). A typical V.35 interface uses five differential signals and five single-ended handshaking signals. The V.35 electrical specifications are summarized in Table 1.

**Table 1**

Specification	Condition	Transmitter	Receiver
Source Impedance	Differential Measurement	50Ω to 150Ω	100Ω ±10Ω
Common-Mode Impedance	Terminals Shorted	150Ω ±15Ω	150Ω ±15Ω
Voltage Swing	100Ω Load	0.55V ±20%	
Common-Mode Swing	100Ω Load	0.6V Max	
Common-Mode Range	Between Dx and Rx Grounds	±4V	±4V

### Problems with Traditional Implementations

The tight tolerance of the transmitter's impedance and voltage swing specifications makes the implementation of the transmitter a little tricky. The traditional approach is to use an RS422 differential driver such as the AM26LS30 (Figure 1). Because the chip has a voltage output, the signal must go through a resistive divider to meet the 0.55V swing specification. The problem is that the output voltage is a function of supply voltage, temperature and IC processing, making the 20% tolerance of the swing hard to meet for all conditions. Another problem is meeting the common-mode imped-



**Figure 1. Traditional V.35 Implementation**

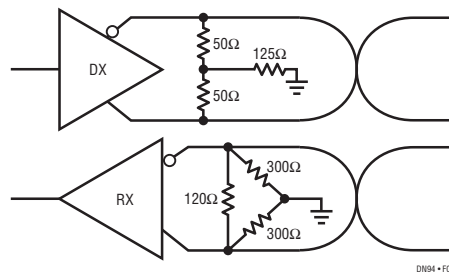
ance specification of 150Ω ±15Ω because the output impedance of the driver is not well controlled. For the interface to meet the CCITT specifications under all conditions, another approach is needed.

### LTC®1345

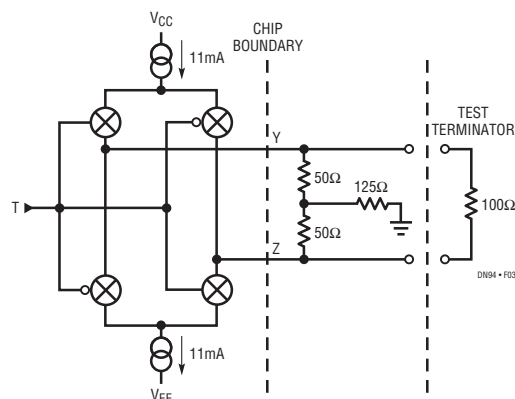
The LTC1345 is a single 5V V.35 transceiver with three drivers and three receivers that are fully compliant with the V.35 electrical specifications. The chip can be configured for DTE or DCE operation or shutdown using two select pins. In the shutdown mode, supply current is reduced to 1μA.

Each driver or receiver is terminated by an external Y or Δ resistor network (Figure 2), guaranteeing compliance with the V.35 impedance specification. The transmitter

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**Figure 2. Y and Δ Termination Networks**



**Figure 3. Simplified Transmitter Schematic**

output consists of complementary switched-current sources of 11mA as shown in Figure 3. With a 100Ω test termination resistor, the differential output voltage is set at 0.55V (11mA × 50Ω), and the common-mode voltage is set to 0V, thus meeting the V.35 voltage swing specifications under all conditions. A five Y-termination resistor network in a single narrow body S14 package is available from Beckman Industrial (part number: Beckman 627T500/1250, phone: 714-447-2357).

The differential input receiver has a 40mV input hysteresis to improve noise immunity and a common-mode range from -7V to 12V, allowing the receivers to be used for V.11 (RS422) applications, The output can be forced into high impedance by an output enable ( $\overline{OE}$ )

pin or when the receiver is deselected. The negative supply is required to meet the ±4V common-mode operating range requirement. A charge pump generates the negative supply voltage ( $V_{EE}$ ) with three external 1μF capacitors allowing single 5V operation.

### Complete V.35 Port

Figure 4 shows the schematic of a complete single 5V DTE and DCE V.35 port using three ICs and eight capacitors per port. The LTC1345 with the Beckman 627T500/1250 resistor network is used to transmit and receive the differential clock and data signals. The LT<sup>®</sup>1134 is used to transmit and receive the single-ended control signals.

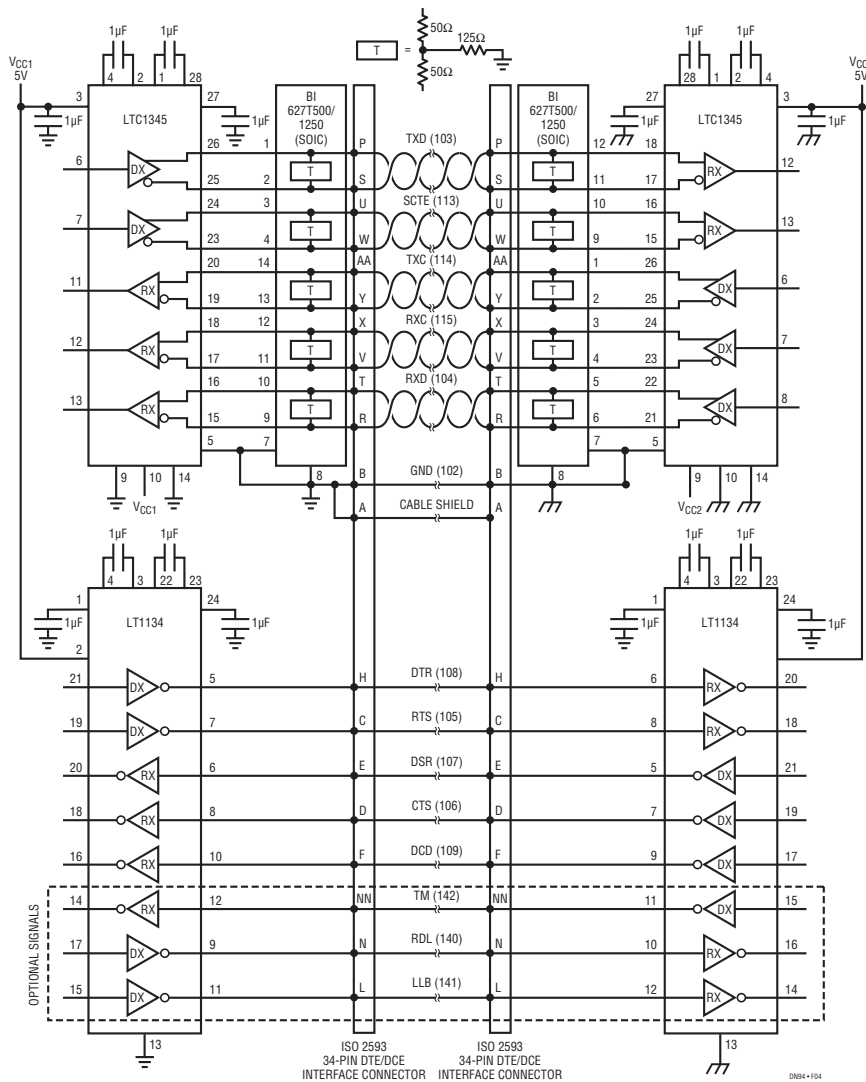


Figure 4. Complete Single 5V V.35 Interface

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