



# SP507

## 5V Single Chip WAN Multi-Mode Serial Transceiver

### Interface Modes Supported:

- ✓ RS-232 (V.28)      ✓ X.21/RS-422 (V.11)
- ✓ EIA-530 (V.10 & V.11)    ✓ EIA-530A (V.10 & V.11)
- ✓ RS-449 (V.10 & V.11)    ✓ V.35 (V.35 & V.28)

### Software Selectable Protocols

### Highest Differential Transmission Rates

available at over 20Mbps

### +5V Only Operation

### Seven (7) Drivers and Seven (7) Receivers

### Driver and Receiver Tri-state Control

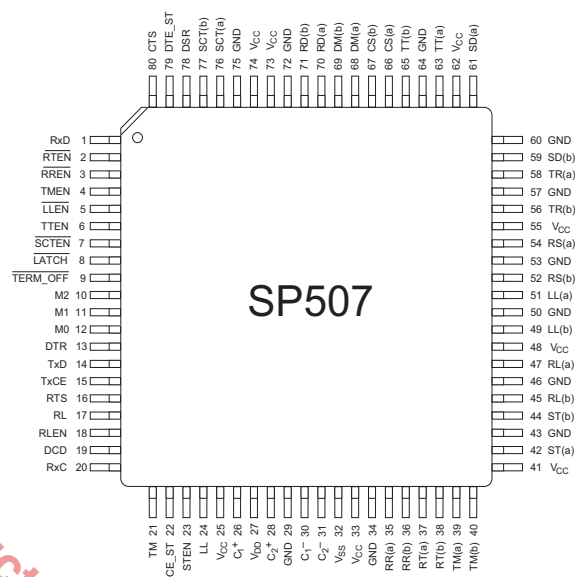
### Internal Transceiver Termination Resistors for V.11 and V.35 Protocols

### Improved ESD Tolerance for Analog I/Os

### Compliant to NET1/2 and TBR2 Physical Layer Requirements

### Used in WAN Serial Ports in Routers Switches, DSU/CSU's and other Access Devices

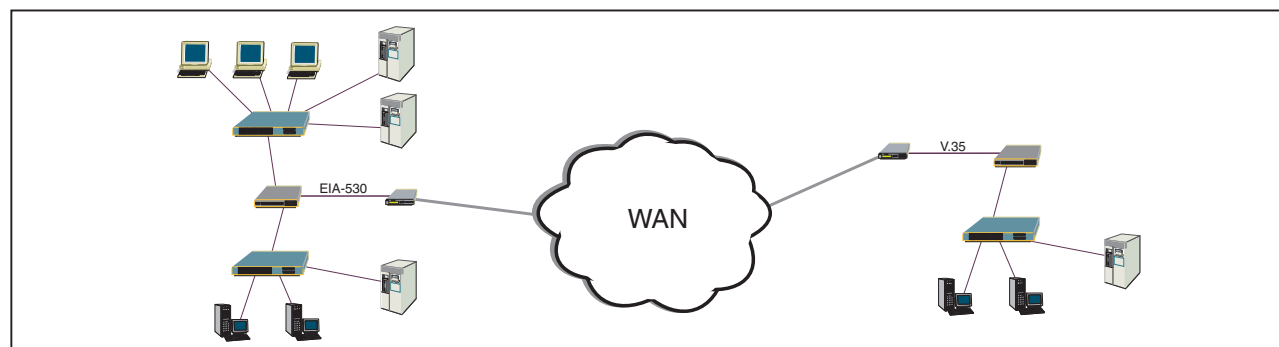
### Available in 80-Lead LQFP



## DESCRIPTION

The SP507 is a monolithic IC that supports seven (7) popular serial interface standards for DTE/DCE connectivity. The seven (7) drivers and seven (7) receivers transmit and receive signals at over 20Mbps. The SP507 requires no additional external components for compliant operation for all seven (7) modes of operation. All necessary termination is integrated within the SP507 and is switchable when V.35 drivers, V.35 receivers, and V.11 receivers are used. The SP507 can operate as either a DTE or DCE.

Additional features include a latch enable pin with the driver and receiver address decoder. Tri-state ability for the driver and receiver outputs is controlled by supplying a 3-bit word into the address decoder. Four (4) drivers and four (4) receivers in the SP507 include separate enable pins for added convenience.



## ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

$V_{CC}$ .....+7V

Input Voltages:

Logic.....-0.3V to ( $V_{CC}$ +0.5V)

Drivers.....-0.3V to ( $V_{CC}$ +0.5V)

Receivers.....±15.5V

Output Voltages:

Logic.....-0.3V to ( $V_{CC}$ +0.5V)

Drivers.....±15V

Receivers.....-0.3V to ( $V_{CC}$ +0.5V)

Storage Temperature.....-65°C to +150°C

Power Dissipation per package

80-pin QFP (derate 18.3mW/°C above +70°C)..1500mW

## STORAGE CONSIDERATIONS

Due to the relatively large package size of the 80-pin quad flat-pack, storage in a low humidity environment is preferred. Large high density plastic packages are moisture sensitive and should be stored in Dry Vapor Barrier Bags. Prior to usage, the parts should remain bagged and stored below 40°C and 60%RH. If the parts are removed from the bag, they should be used within 48 hours or stored in an environment at or below 20%RH. If the above conditions cannot be followed, the parts should be baked for four hours at 125°C in order to remove moisture prior to soldering. Exar ships the 80-pin LQFP in Dry Vapor Barrier Bags with a humidity indicator card and desiccant pack. The humidity indicator should be below 30%RH.

## SPECIFICATIONS

$T_A$  = +25°C and  $V_{CC}$  = +4.75V to +5.25V unless otherwise noted.

|                         | MIN. | TYP. | MAX. | UNITS | CONDITIONS                       |
|-------------------------|------|------|------|-------|----------------------------------|
| <b>LOGIC INPUTS</b>     |      |      |      |       |                                  |
| $V_{IL}$                |      |      | 0.8  | Volts |                                  |
| $V_{IH}$                | 2.0  |      |      | Volts |                                  |
| <b>LOGIC OUTPUTS</b>    |      |      |      |       |                                  |
| $V_{OL}$                |      |      | 0.4  | Volts | $I_{OUT} = -3.2mA$               |
| $V_{OH}$                | 2.4  |      |      | Volts | $I_{OUT} = 1.0mA$                |
| <b>V.28 DRIVER</b>      |      |      |      |       |                                  |
| <u>DC Parameters</u>    |      |      |      |       |                                  |
| Outputs                 |      |      |      |       |                                  |
| Open Circuit Voltage    |      |      | ±15  | Volts | per Figure 1                     |
| Loaded Voltage          | ±5.0 |      | ±15  | Volts | per Figure 2                     |
| Short-Circuit Current   |      |      | ±100 | mA    | per Figure 4                     |
| Power-Off Impedance     | 300  |      |      | Ω     | per Figure 5                     |
| <u>AC Parameters</u>    |      |      |      |       | $V_{CC} = +5V$ for AC parameters |
| Outputs                 |      |      |      |       |                                  |
| Transition Time         |      |      | 1.5  | μs    | per Figure 6; +3V to -3V         |
| Instantaneous Slew Rate |      |      | 30   | V/μs  | per Figure 3                     |
| Propagation Delay       |      |      |      |       |                                  |
| $t_{PHL}$               | 0.5  | 1    | 5    | μs    |                                  |
| $t_{PLH}$               | 0.5  | 1    | 5    | μs    |                                  |
| Max.Transmission Rate   | 120  | 230  |      | kbps  |                                  |
| <b>V.28 RECEIVER</b>    |      |      |      |       |                                  |
| <u>DC Parameters</u>    |      |      |      |       |                                  |
| Inputs                  |      |      |      |       |                                  |
| Input Impedance         | 3    |      | 7    | kΩ    | per Figure 7                     |
| Open-Circuit Bias       |      |      | +2.0 | Volts | per Figure 8                     |
| HIGH Threshold          |      | 1.7  | 3.0  | Volts |                                  |
| LOW Threshold           | 0.8  | 1.2  |      | Volts |                                  |
| <u>AC Parameters</u>    |      |      |      |       | $V_{CC} = +5V$ for AC parameters |
| Propagation Delay       |      |      |      |       |                                  |
| $t_{PHL}$               | 50   | 100  | 500  | ns    |                                  |
| $t_{PLH}$               | 50   | 100  | 500  | ns    |                                  |

# SPECIFICATIONS

T<sub>A</sub> = +25°C and V<sub>CC</sub> = +4.75V to +5.25V unless otherwise noted.

|                                  | MIN.               | TYP. | MAX.                | UNITS | CONDITIONS                                   |
|----------------------------------|--------------------|------|---------------------|-------|----------------------------------------------|
| <b>V.28 RECEIVER (continued)</b> |                    |      |                     |       |                                              |
| <u>AC Parameters (cont.)</u>     |                    |      |                     |       |                                              |
| Max.Transmission Rate            | 120                | 230  |                     | kbps  |                                              |
| <b>V.10 DRIVER</b>               |                    |      |                     |       |                                              |
| <u>DC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Outputs</u>                   |                    |      |                     |       |                                              |
| Open Circuit Voltage             | ±4.0               |      | ±6.0                | Volts | per Figure 9                                 |
| Test-Terminated Voltage          | 0.9V <sub>OC</sub> |      |                     | Volts | per Figure 10                                |
| Short-Circuit Current            |                    |      | ±150                | mA    | per Figure 11                                |
| Power-Off Current                |                    |      | ±100                | µA    | per Figure 12                                |
| <u>AC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Outputs</u>                   |                    |      |                     |       |                                              |
| Transition Time                  |                    |      | 200                 | ns    | V <sub>CC</sub> = +5V for AC parameters      |
| Propagation Delay                |                    |      |                     |       | per Figure 13; 10% to 90%                    |
| t <sub>PHL</sub>                 | 50                 | 100  | 500                 | ns    |                                              |
| t <sub>PLH</sub>                 | 50                 | 100  | 500                 | ns    |                                              |
| Max.Transmission Rate            | 120                |      |                     | kbps  |                                              |
| <b>V.10 RECEIVER</b>             |                    |      |                     |       |                                              |
| <u>DC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Inputs</u>                    |                    |      |                     |       |                                              |
| Input Current                    | -3.25              |      | +3.25               | mA    | per Figures 14 and 15                        |
| Input Impedance                  | 4                  |      |                     | kΩ    |                                              |
| Sensitivity                      |                    |      | ±0.3                | Volts |                                              |
| <u>AC Parameters</u>             |                    |      |                     |       |                                              |
| Propagation Delay                |                    |      |                     |       | V <sub>CC</sub> = +5V for AC parameters      |
| t <sub>PHL</sub>                 | 50                 | 120  | 250                 | ns    |                                              |
| t <sub>PLH</sub>                 | 50                 | 120  | 250                 | ns    |                                              |
| Max.Transmission Rate            | 120                |      |                     | kbps  |                                              |
| <b>V.11 DRIVER</b>               |                    |      |                     |       |                                              |
| <u>DC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Outputs</u>                   |                    |      |                     |       |                                              |
| Open Circuit Voltage             |                    |      | ±5.0                | Volts | per Figure 16                                |
| Test Terminated Voltage          | ±2.0               |      |                     | Volts | per Figure 17                                |
|                                  | 0.5V <sub>OC</sub> |      | 0.67V <sub>OC</sub> | Volts |                                              |
| Balance                          |                    |      | ±0.4                | Volts | per Figure 17                                |
| Offset                           |                    |      | +3.0                | Volts | per Figure 17                                |
| Short-Circuit Current            |                    |      | ±150                | mA    | per Figure 18                                |
| Power-Off Current                |                    |      | ±100                | µA    | per Figure 19                                |
| <u>AC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Outputs</u>                   |                    |      |                     |       |                                              |
| Transition Time                  |                    |      | 20                  | ns    | V <sub>CC</sub> = +5V for AC parameters      |
| Propagation Delay                |                    |      |                     |       | per Figures 21 and 36; 10% to 90%            |
| t <sub>PHL</sub>                 | 50                 | 65   | 85                  | ns    | per Figures 33 and 36, C <sub>L</sub> = 50pF |
| t <sub>PLH</sub>                 | 50                 | 65   | 85                  | ns    | per Figures 33 and 36, C <sub>L</sub> = 50pF |
| Differential Skew                |                    | 10   | 20                  | ns    | per Figures 33 and 36, C <sub>L</sub> = 50pF |
| Max.Transmission Rate            | 20                 |      |                     | Mbps  | per Figure 33, C <sub>L</sub> = 50pF         |
| <b>V.11 RECEIVER</b>             |                    |      |                     |       |                                              |
| <u>DC Parameters</u>             |                    |      |                     |       |                                              |
| <u>Inputs</u>                    |                    |      |                     |       |                                              |
| Common Mode Range                | -7                 |      | +7                  | Volts |                                              |
| Sensitivity                      |                    |      | ±0.3                | Volts |                                              |

## SPECIFICATIONS

T<sub>A</sub> = +25°C and V<sub>CC</sub> = +4.75V to +5.25V unless otherwise noted.

|                                     | MIN.  | TYP. | MAX.   | UNITS | CONDITIONS                                                           |
|-------------------------------------|-------|------|--------|-------|----------------------------------------------------------------------|
| <b>V.11 RECEIVER (continued)</b>    |       |      |        |       |                                                                      |
| <u>DC Parameters (cont.)</u>        |       |      |        |       |                                                                      |
| Input Current                       | -3.25 |      | ±3.25  | mA    | per Figure 20 and 22                                                 |
| Current w/100Ω Termination          |       |      | ±60.75 | mA    | per Figure 23 and 24                                                 |
| Input Impedance                     | 4     |      |        | kΩ    |                                                                      |
| <u>AC Parameters</u>                |       |      |        |       |                                                                      |
| Propagation Delay                   |       |      |        |       | V <sub>CC</sub> = +5V for AC parameters                              |
| t <sub>PHL</sub>                    | 30    | 65   | 85     | ns    | per Figures 33 and 38; C <sub>L</sub> = 50pF                         |
| t <sub>PLH</sub>                    | 30    | 65   | 85     | ns    | per Figures 33 and 38; C <sub>L</sub> = 50pF                         |
| Differential Skew                   |       | 10   |        | ns    | per Figure 33; C <sub>L</sub> = 50pF                                 |
| Max.Transmission Rate               | 20    |      |        | Mbps  | per Figure 33; C <sub>L</sub> = 50pF<br>f <sub>IN</sub> = 10MHz      |
| <b>V.35 DRIVER</b>                  |       |      |        |       |                                                                      |
| <u>DC Parameters</u>                |       |      |        |       |                                                                      |
| <u>Outputs</u>                      |       |      |        |       |                                                                      |
| Open Circuit Voltage                |       |      | ±1.20  | Volts | per Figure 16                                                        |
| Test Terminated Voltage             | ±0.44 |      | ±0.66  | Volts | per Figure 25                                                        |
| Offset                              |       |      | ±0.6   | Volts | per Figure 25                                                        |
| Source Impedance                    | 50    |      | 150    | Ω     | per Figure 27; Z <sub>S</sub> = V <sub>2</sub> /V <sub>1</sub> x 50Ω |
| Short-Circuit Impedance             | 135   |      | 165    | Ω     | per Figure 28                                                        |
| <u>AC Parameters</u>                |       |      |        |       |                                                                      |
| <u>Outputs</u>                      |       |      |        |       |                                                                      |
| Transition Time                     |       | 30   | 40     | ns    | per Figure 29; 10% to 90%                                            |
| Propagation Delay                   |       |      |        |       |                                                                      |
| t <sub>PHL</sub>                    | 50    | 70   | 90     | ns    | per Figures 33 and 36; C <sub>L</sub> = 20pF                         |
| t <sub>PLH</sub>                    | 50    | 70   | 90     | ns    | per Figures 33 and 36; C <sub>L</sub> = 20pF                         |
| Differential Skew                   |       | 7    | 10     | ns    | per Figures 33 and 36; C <sub>L</sub> = 20pF                         |
| Max.Transmission Rate               | 20    |      |        | Mbps  | per Figure 33; C <sub>L</sub> = 20pF<br>f <sub>IN</sub> = 10MHz      |
| <b>V.35 RECEIVER</b>                |       |      |        |       |                                                                      |
| <u>DC Parameters</u>                |       |      |        |       |                                                                      |
| <u>Inputs</u>                       |       |      |        |       |                                                                      |
| Sensitivity                         |       | ±80  |        | mV    |                                                                      |
| Source Impedance                    | 90    |      | 110    | Ω     | per Figure 30; Z <sub>S</sub> = V <sub>2</sub> /V <sub>1</sub> x 50Ω |
| Short-Circuit Impedance             | 135   |      | 165    | Ω     | per Figure 31                                                        |
| <u>AC Parameters</u>                |       |      |        |       |                                                                      |
| Propagation Delay                   |       |      |        |       | V <sub>CC</sub> = +5V for AC parameters                              |
| t <sub>PHL</sub>                    | 30    | 75   | 90     | ns    | per Figures 33 and 38; C <sub>L</sub> = 20pF                         |
| t <sub>PLH</sub>                    | 30    | 75   | 90     | ns    | per Figures 33 and 38; C <sub>L</sub> = 20pF                         |
| Differential Skew                   |       | 10   |        | ns    | per Figure 33; C <sub>L</sub> = 20pF                                 |
| Max.Transmission Rate               | 20    |      |        | Mbps  | per Figure 33; C <sub>L</sub> = 20pF<br>f <sub>IN</sub> = 10MHz      |
| <b>TRANSCEIVER LEAKAGE CURRENTS</b> |       |      |        |       |                                                                      |
| Driver Output 3-State Current       |       | 500  |        | μA    | per Figure 32; Drivers disabled                                      |
| Rcvr Output 3-State Current         |       | 1    | 10     | μA    | Mx = 111, 0.4V - V <sub>O</sub> - 2.4V                               |

## OTHER AC CHARACTERISTICS

$T_A = +25^\circ\text{C}$  and  $V_{CC} = +5.0\text{V}$  unless otherwise noted.

| PARAMETER                                                  | MIN. | TYP. | MAX. | UNITS         | CONDITIONS                                        |
|------------------------------------------------------------|------|------|------|---------------|---------------------------------------------------|
| DRIVER DELAY TIME BETWEEN ACTIVE MODE AND TRI-STATE MODE   |      |      |      |               |                                                   |
| RS-232/V.28<br>$t_{PZL}$ ; Tri-state to Output LOW         |      | 0.70 | 5.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.40 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.20 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_1$ closed |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.40 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_2$ closed |
| RS-423/V.10<br>$t_{PZL}$ ; Tri-state to Output LOW         |      | 0.15 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.20 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.20 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_1$ closed |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.15 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 40; $S_2$ closed |
| RS-422/V.11<br>$t_{PZL}$ ; Tri-state to Output LOW         |      | 2.80 | 10.0 | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 37; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 37; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 15\text{pF}$ , Fig. 34 & 37; $S_1$ closed  |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 15\text{pF}$ , Fig. 34 & 37; $S_2$ closed  |
| V.35<br>$t_{PZL}$ ; Tri-state to Output LOW                |      | 2.60 | 10.0 | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 37; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 34 & 37; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 15\text{pF}$ , Fig. 34 & 37; $S_1$ closed  |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.15 | 2.0  | $\mu\text{s}$ | $C_L = 15\text{pF}$ , Fig. 34 & 37; $S_2$ closed  |
| RECEIVER DELAY TIME BETWEEN ACTIVE MODE AND TRI-STATE MODE |      |      |      |               |                                                   |
| RS-232/V.28<br>$t_{PZL}$ ; Tri-state to Output LOW         |      | 0.12 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_1$ closed |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_2$ closed |
| RS-423/V.10<br>$t_{PZL}$ ; Tri-state to Output LOW         |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_1$ closed |
| $t_{PZH}$ ; Tri-state to Output HIGH                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_2$ closed |
| $t_{PLZ}$ ; Output LOW to Tri-state                        |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_1$ closed |
| $t_{PHZ}$ ; Output HIGH to Tri-state                       |      | 0.10 | 2.0  | $\mu\text{s}$ | $C_L = 100\text{pF}$ , Fig. 35 & 38; $S_2$ closed |

## OTHER AC CHARACTERISTICS (Continued)

T<sub>A</sub> = +25°C and V<sub>CC</sub> = +5.0V unless otherwise noted.

| PARAMETER                                                | MIN. | TYP. | MAX. | UNITS | CONDITIONS                                                                      |
|----------------------------------------------------------|------|------|------|-------|---------------------------------------------------------------------------------|
| RS-422/V.11                                              |      |      |      |       |                                                                                 |
| t <sub>PZL</sub> ; Tri-state to Output LOW               |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 100pF, Fig. 35 & 39; S <sub>1</sub> closed                     |
| t <sub>PZH</sub> ; Tri-state to Output HIGH              |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 100pF, Fig. 35 & 39; S <sub>2</sub> closed                     |
| t <sub>PLZ</sub> ; Output LOW to Tri-state               |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 15pF, Fig. 35 & 39; S <sub>1</sub> closed                      |
| t <sub>PHZ</sub> ; Output HIGH to Tri-state              |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 15pF, Fig. 35 & 39; S <sub>2</sub> closed                      |
| V.35                                                     |      |      |      |       |                                                                                 |
| t <sub>PZL</sub> ; Tri-state to Output LOW               |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 100pF, Fig. 35 & 39; S <sub>1</sub> closed                     |
| t <sub>PZH</sub> ; Tri-state to Output HIGH              |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 100pF, Fig. 35 & 39; S <sub>2</sub> closed                     |
| t <sub>PLZ</sub> ; Output LOW to Tri-state               |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 15pF, Fig. 35 & 39; S <sub>1</sub> closed                      |
| t <sub>PHZ</sub> ; Output HIGH to Tri-state              |      | 0.10 | 2.0  | μs    | C <sub>L</sub> = 15pF, Fig. 35 & 39; S <sub>2</sub> closed                      |
| TRANSCEIVER TO TRANSCEIVER SKEW (per Figures 33, 36, 38) |      |      |      |       |                                                                                 |
| V.28 Driver                                              |      | 100  |      | ns    | [ (t <sub>phl</sub> ) <sub>Tx1</sub> - (t <sub>phl</sub> ) <sub>Tx6,7</sub> ]   |
|                                                          |      | 100  |      | ns    | [ (t <sub>plh</sub> ) <sub>Tx1</sub> - (t <sub>plh</sub> ) <sub>Tx6,7</sub> ]   |
| V.28 Receiver                                            |      | 20   |      | ns    | [ (t <sub>phl</sub> ) <sub>Rx1</sub> - (t <sub>phl</sub> ) <sub>Rx2,7</sub> ]   |
|                                                          |      | 20   |      | ns    | [ (t <sub>plh</sub> ) <sub>Rx1</sub> - (t <sub>plh</sub> ) <sub>Rx2,7</sub> ]   |
| V.11 Driver                                              |      | 2    |      | ns    | [ (t <sub>phl</sub> ) <sub>Tx1</sub> - (t <sub>phl</sub> ) <sub>Tx6,7</sub> ]   |
|                                                          |      | 2    |      | ns    | [ (t <sub>plh</sub> ) <sub>Tx1</sub> - (t <sub>plh</sub> ) <sub>Tx6,7</sub> ]   |
| V.11 Receiver                                            |      | 3    |      | ns    | [ (t <sub>phl</sub> ) <sub>Rx1</sub> - (t <sub>phl</sub> ) <sub>Rx2,7</sub> ]   |
|                                                          |      | 3    |      | ns    | [ (t <sub>plh</sub> ) <sub>Rx1</sub> - (t <sub>plh</sub> ) <sub>Rx2,7</sub> ]   |
| V.10 Driver                                              |      | 5    |      | ns    | [ (t <sub>phl</sub> ) <sub>Tx2</sub> - (t <sub>phl</sub> ) <sub>Tx3,4,5</sub> ] |
|                                                          |      | 5    |      | ns    | [ (t <sub>plh</sub> ) <sub>Tx2</sub> - (t <sub>plh</sub> ) <sub>Tx3,4,5</sub> ] |
| V.10 Receiver                                            |      | 5    |      | ns    | [ (t <sub>phl</sub> ) <sub>Rx2</sub> - (t <sub>phl</sub> ) <sub>Rx3,4,5</sub> ] |
|                                                          |      | 5    |      | ns    | [ (t <sub>plh</sub> ) <sub>Rx2</sub> - (t <sub>plh</sub> ) <sub>Rx3,4,5</sub> ] |
| V.35 Driver                                              |      | 4    |      | ns    | [ (t <sub>phl</sub> ) <sub>Tx1</sub> - (t <sub>phl</sub> ) <sub>Tx6,7</sub> ]   |
|                                                          |      | 4    |      | ns    | [ (t <sub>plh</sub> ) <sub>Tx1</sub> - (t <sub>plh</sub> ) <sub>Tx6,7</sub> ]   |
| V.35 Receiver                                            |      | 6    |      | ns    | [ (t <sub>phl</sub> ) <sub>Rx1</sub> - (t <sub>phl</sub> ) <sub>Rx2,7</sub> ]   |
|                                                          |      | 6    |      | ns    | [ (t <sub>plh</sub> ) <sub>Rx1</sub> - (t <sub>plh</sub> ) <sub>Rx2,7</sub> ]   |

## POWER REQUIREMENTS

| PARAMETER                          | MIN. | TYP. | MAX. | UNITS | CONDITIONS                                                                                                                                                                                                                                                                                                   |
|------------------------------------|------|------|------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V <sub>CC</sub>                    | 4.75 | 5.00 | 5.25 | Volts |                                                                                                                                                                                                                                                                                                              |
| I <sub>CC</sub> (No Mode Selected) |      | 30   |      | mA    | All I <sub>CC</sub> values are with V <sub>CC</sub> = +5V<br>f <sub>IN</sub> = 120kbps; Drivers active & loaded.<br>f <sub>IN</sub> = 10Mbps; Drivers active & loaded.<br>f <sub>IN</sub> = 10Mbps; Drivers active & loaded.<br>V.35 @ f <sub>IN</sub> = 10Mbps, V.28 @ 120kbps;<br>Drivers active & loaded. |
| (V.28/RS-232)                      |      | 65   |      | mA    |                                                                                                                                                                                                                                                                                                              |
| (V.11/X.21)                        |      | 175  |      | mA    |                                                                                                                                                                                                                                                                                                              |
| (EIA-530 & RS-449)                 |      | 250  |      | mA    |                                                                                                                                                                                                                                                                                                              |
| (V.35)                             |      | 100  |      | mA    |                                                                                                                                                                                                                                                                                                              |

## TEST CIRCUITS

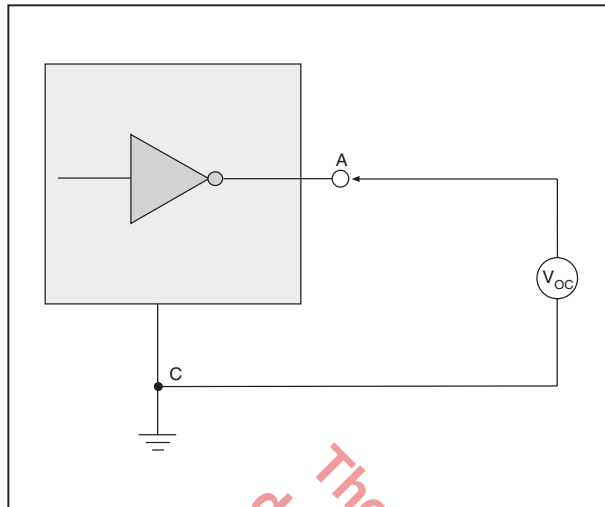


Figure 1. V.28 Driver Output Open Circuit Voltage

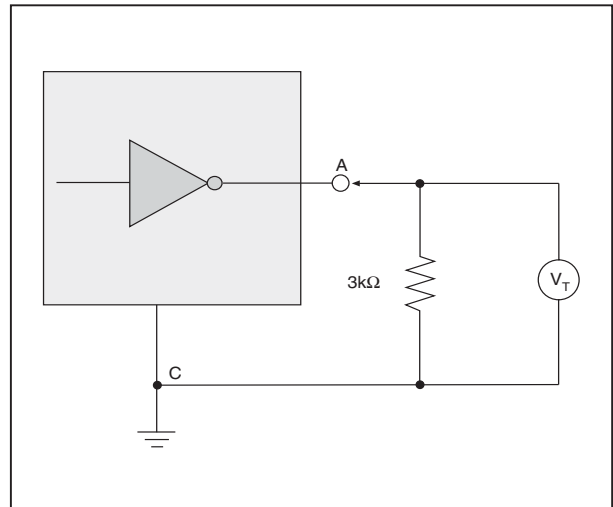


Figure 2. V.28 Driver Output Loaded Voltage

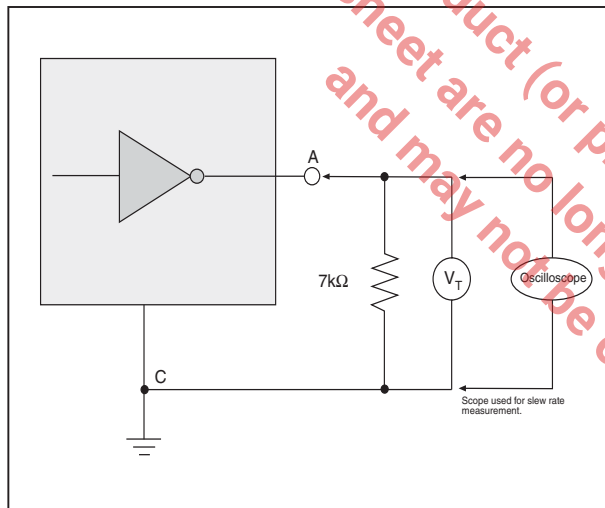


Figure 3. V.28 Driver Output Slew Rate

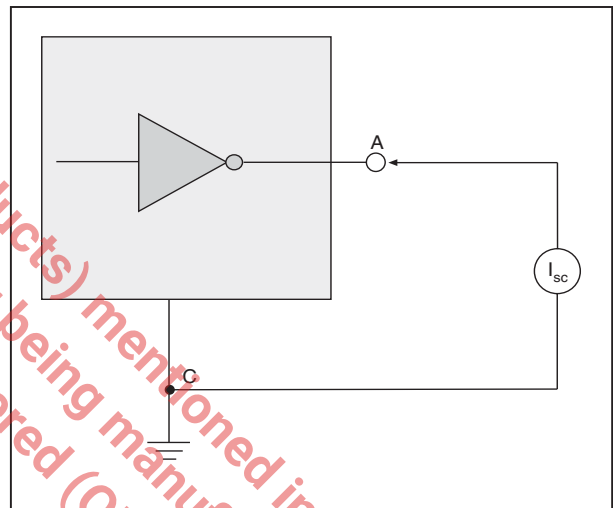


Figure 4. V.28 Driver Output Short-Circuit Current

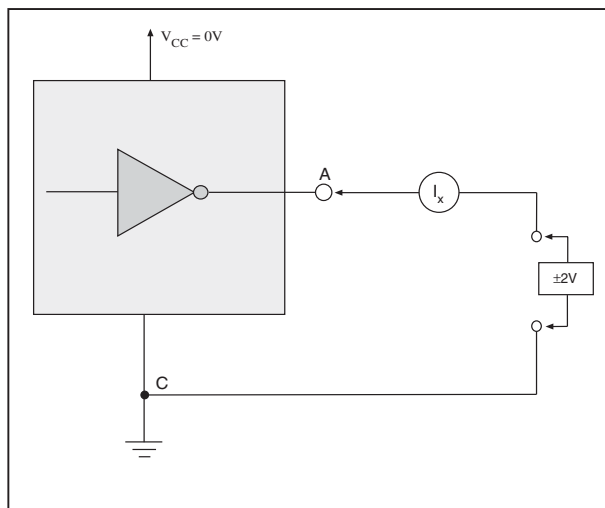


Figure 5. V.28 Driver Output Power-Off Impedance

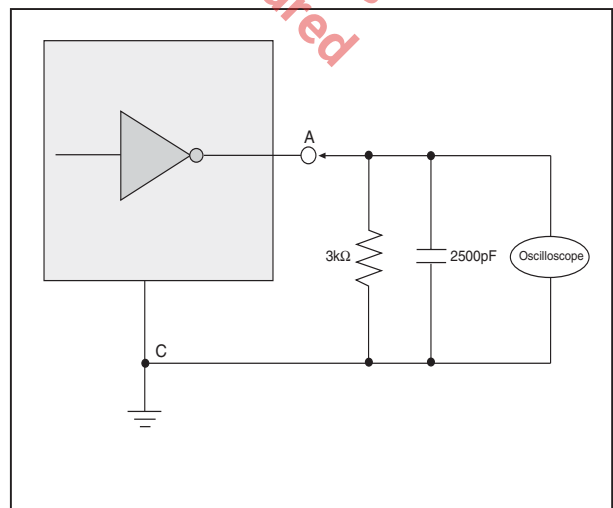


Figure 6. V.28 Driver Output Rise/Fall Times

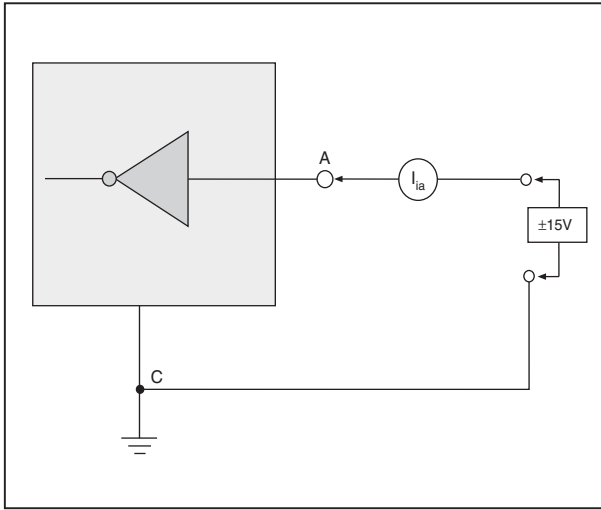


Figure 7. V.28 Receiver Input Impedance

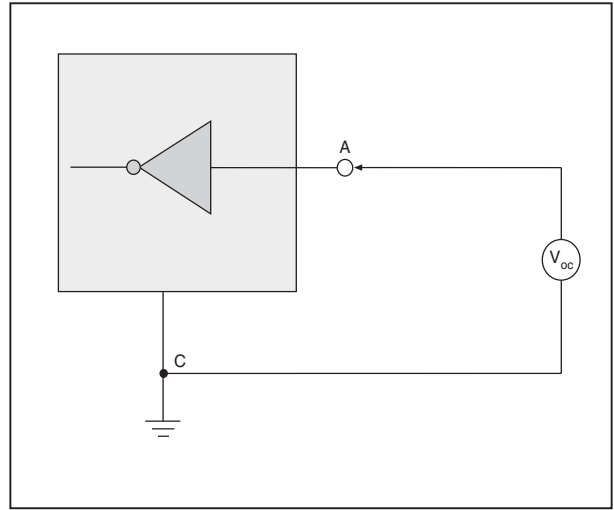


Figure 8. V.28 Receiver Input Open Circuit Bias

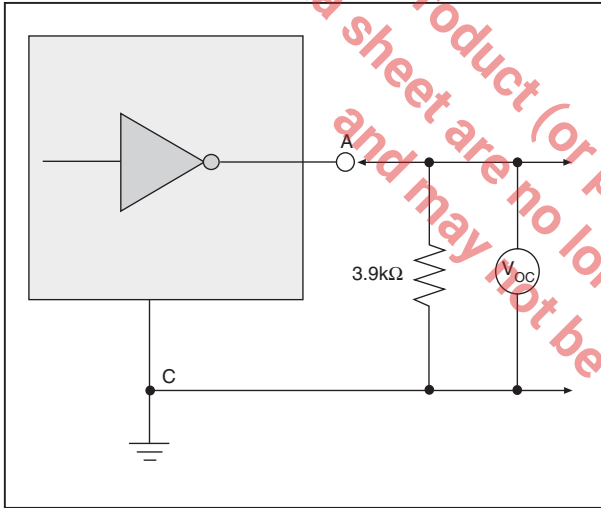


Figure 9. V.10 Driver Output Open-Circuit Voltage

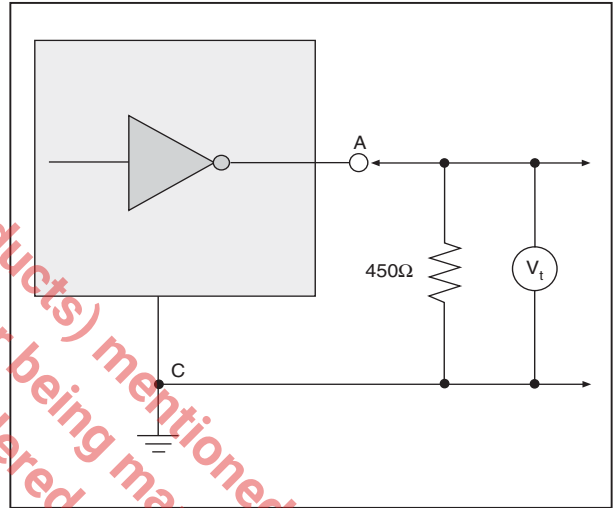


Figure 10. V.10 Driver Output Test Terminated Voltage

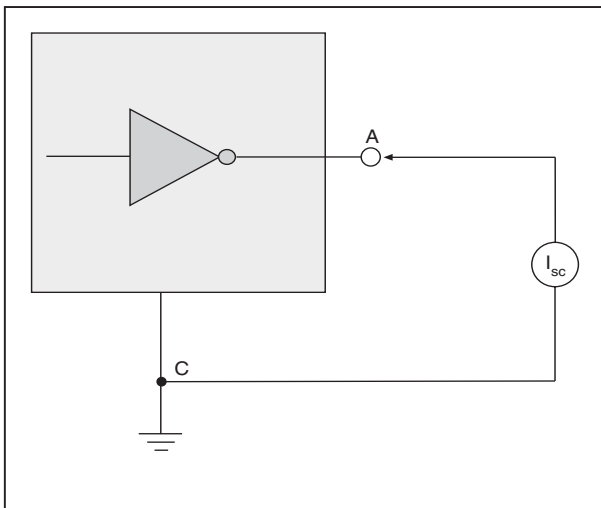


Figure 11. V.10 Driver Output Short-Circuit Current

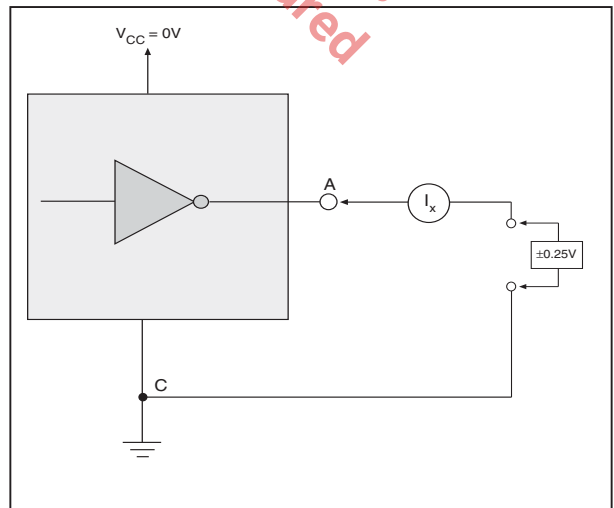


Figure 12. V.10 Driver Output Power-Off Current

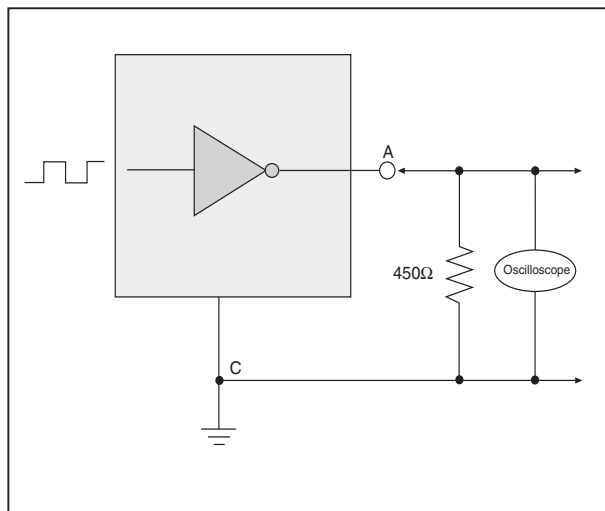


Figure 13. V.10 Driver Output Transition Time

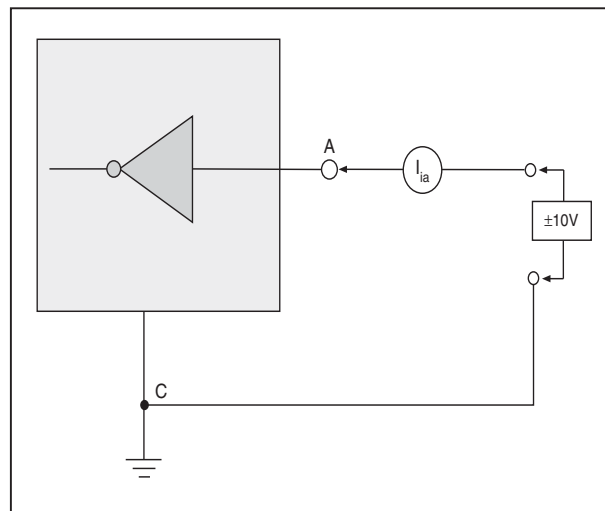


Figure 14. V.10 Receiver Input Current

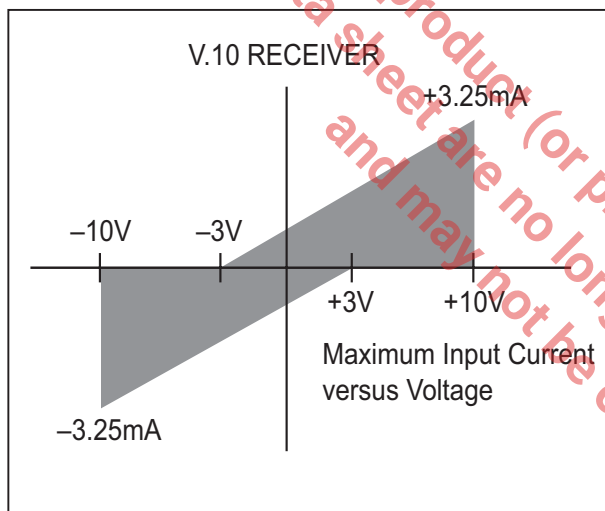


Figure 15. V.10 Receiver Input IV Graph

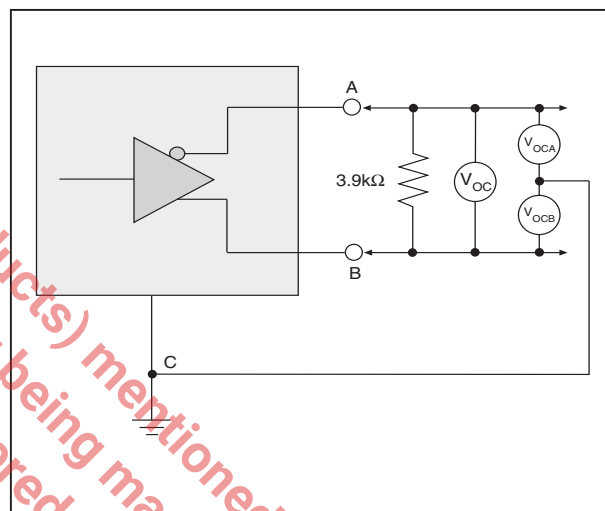


Figure 16. V.11 and V.35 Driver Output Open-Circuit Voltage

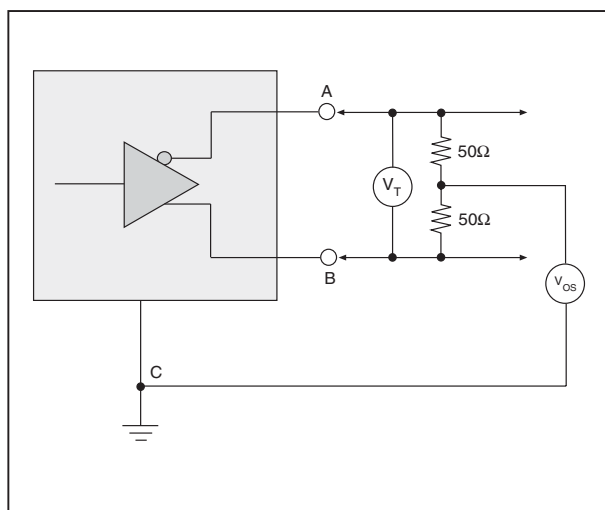


Figure 17. V.11 Driver Output Test Terminated Voltage

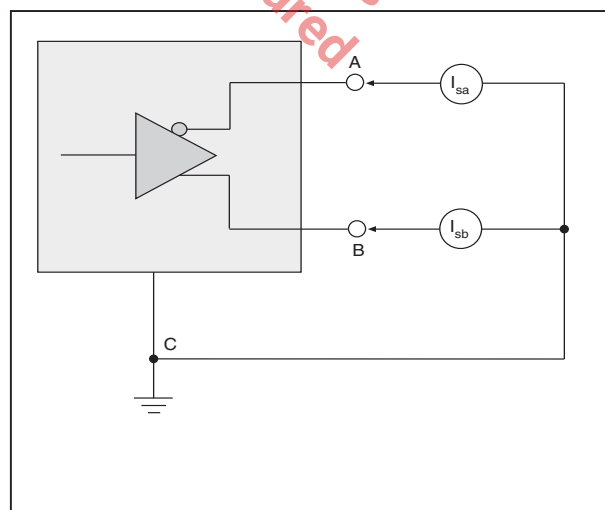


Figure 18. V.11 Driver Output Short-Circuit Current

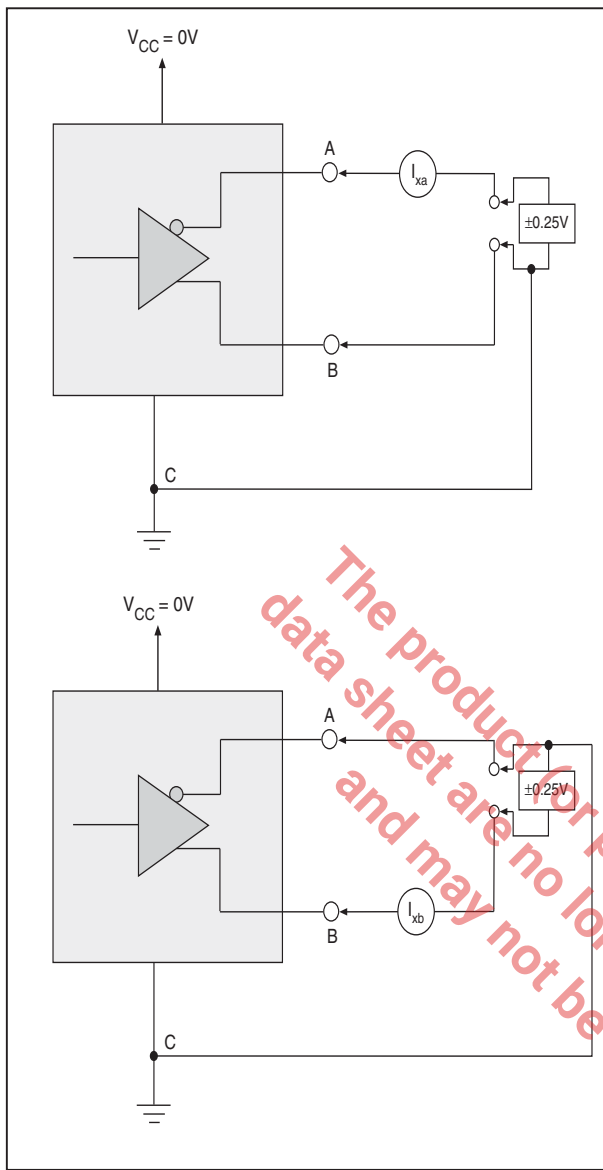


Figure 19. V.11 Driver Output Power-Off Current

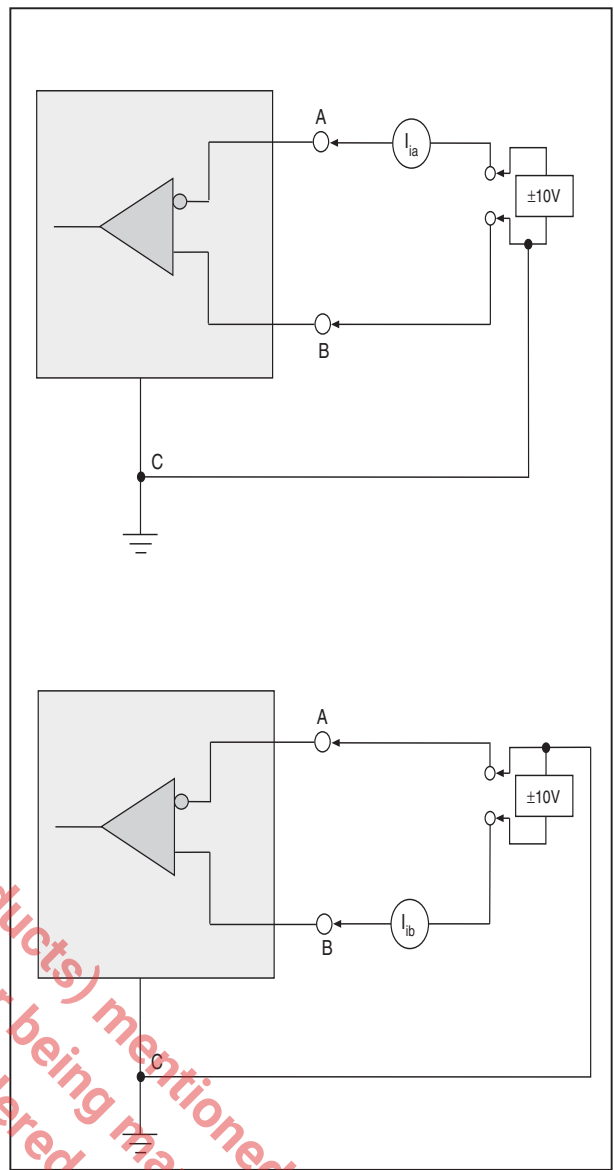


Figure 20. V.11 Receiver Input Current

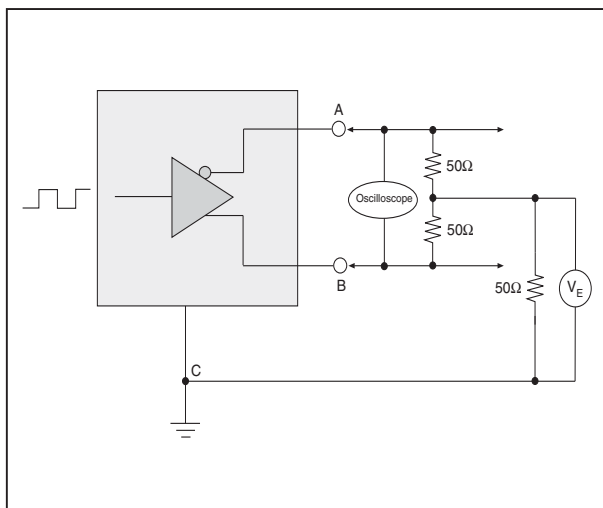


Figure 21. V.11 Driver Output Rise/Fall Time

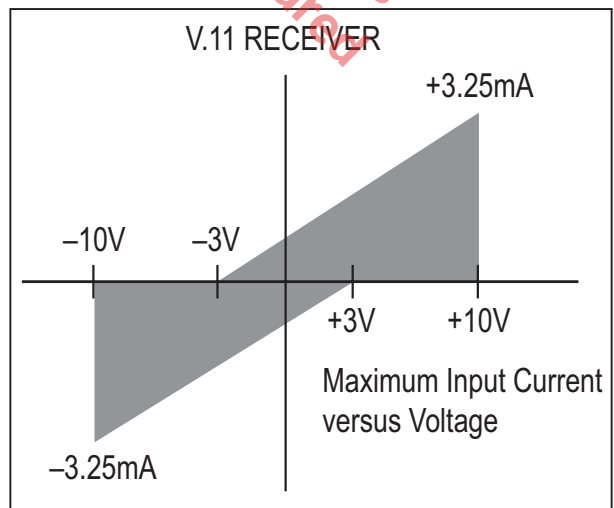


Figure 22. V.11 Receiver Input IV Graph

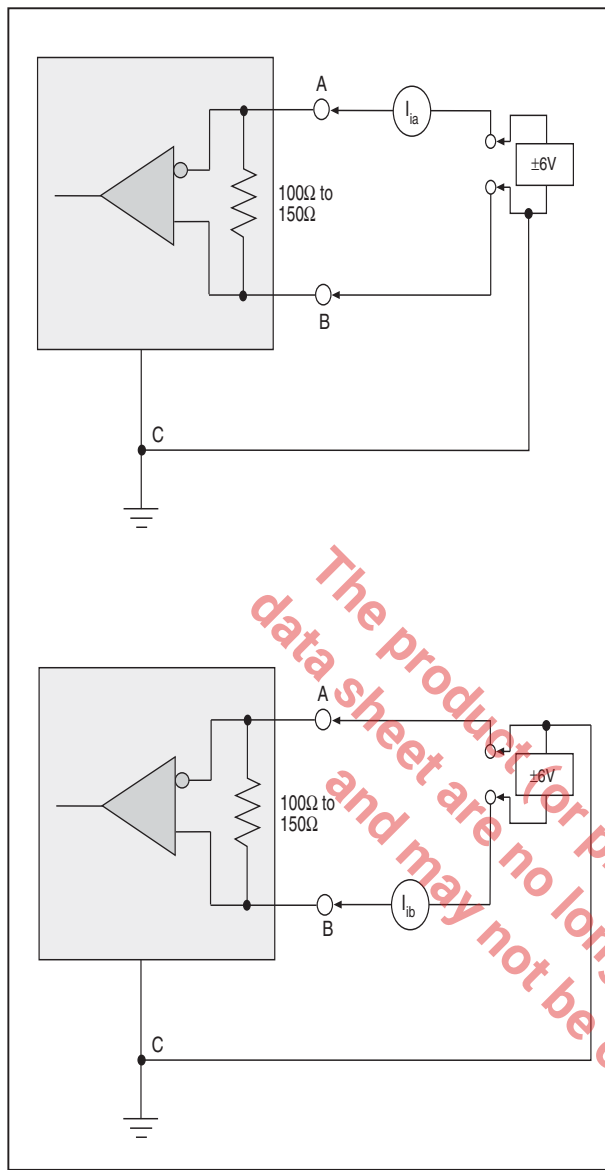


Figure 23. V.11 Receiver Input Current w/ Termination

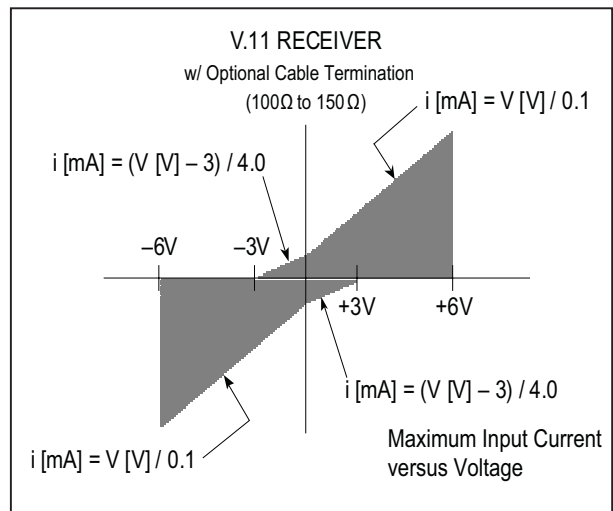


Figure 24. V.11 Receiver Input Graph w/ Termination

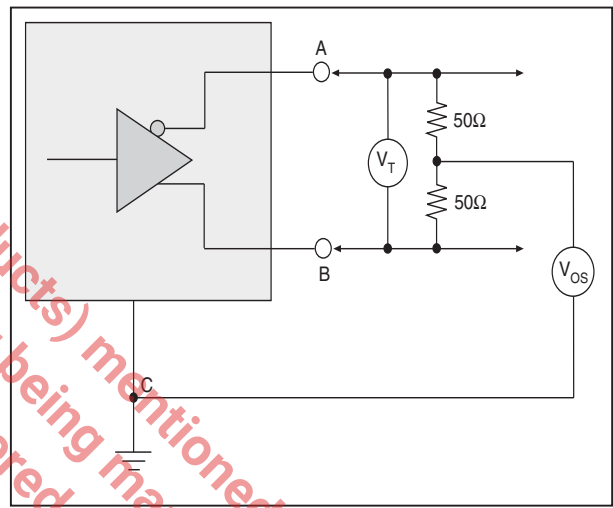


Figure 25. V.35 Driver Output Test Terminated Voltage

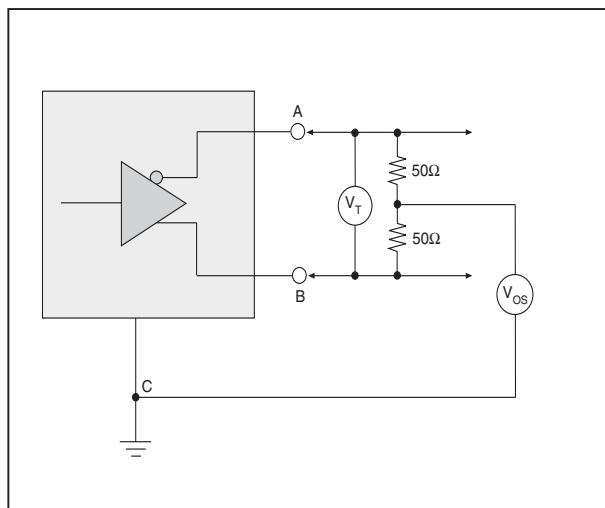


Figure 26. V.35 Driver Output Offset Voltage

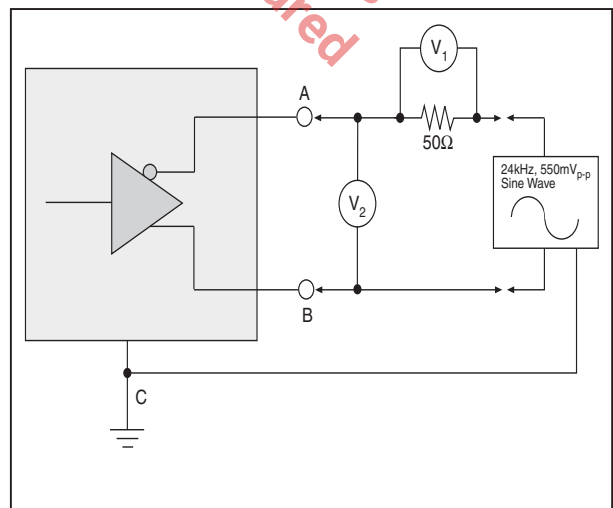


Figure 27. V.35 Driver Output Source Impedance

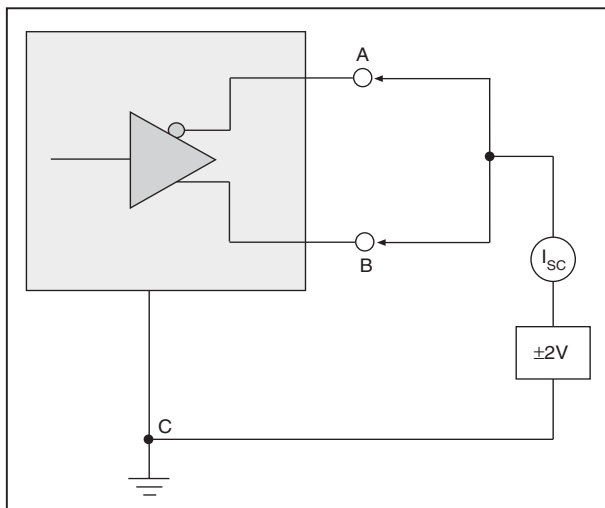


Figure 28. V.35 Driver Output Short-Circuit Impedance

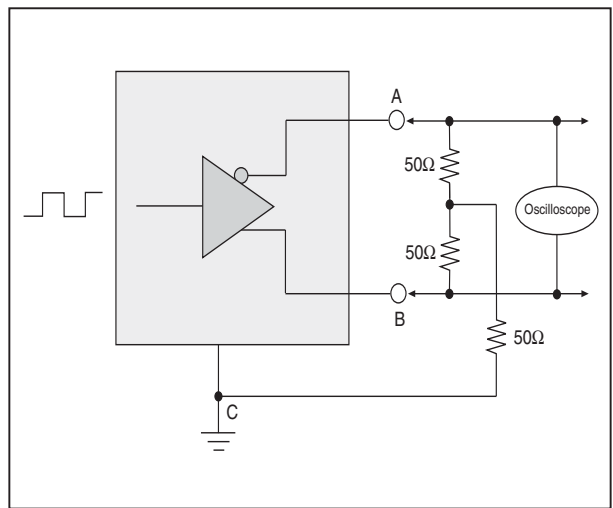


Figure 29. V.35 Driver Output Rise/Fall Time

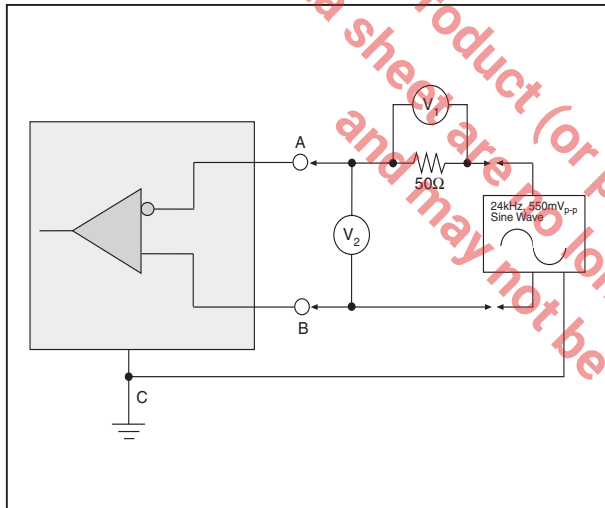


Figure 30. V.35 Receiver Input Source Impedance

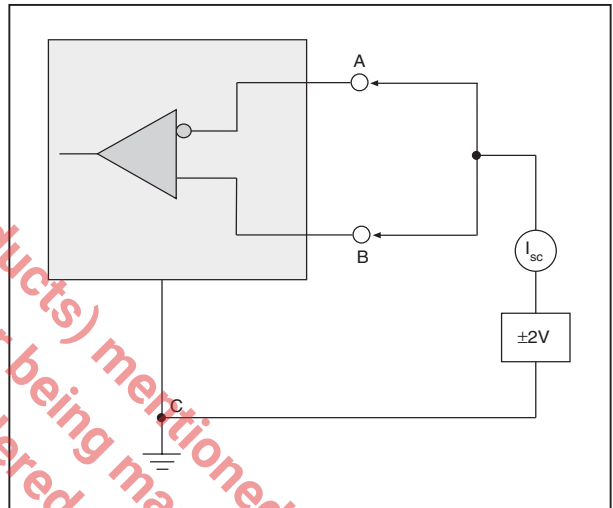


Figure 31. V.35 Receiver Input Short-Circuit Impedance

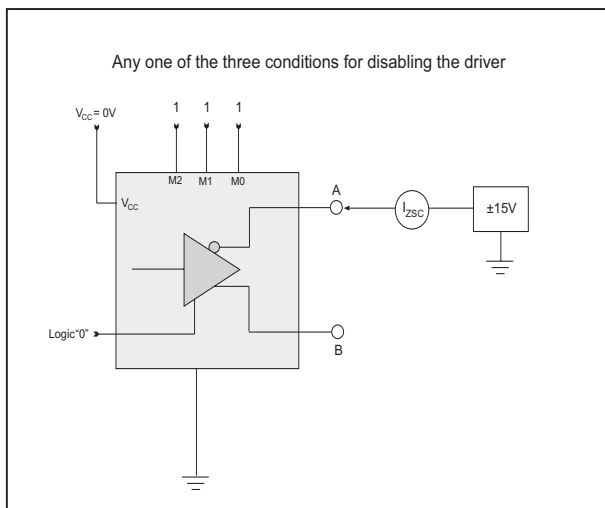


Figure 32. Driver Output Leakage Current Test

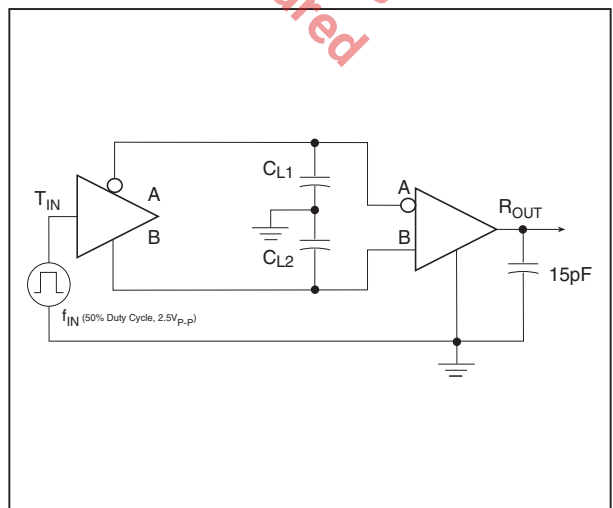


Figure 33. Driver/Receiver Timing Test Circuit

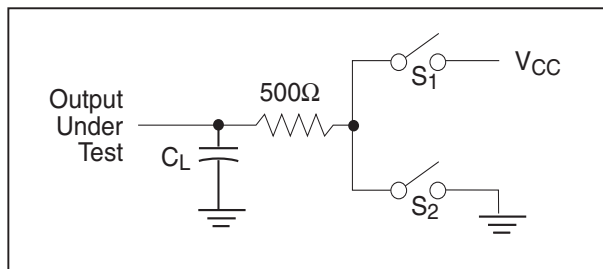


Figure 34. Driver Timing Test Load Circuit

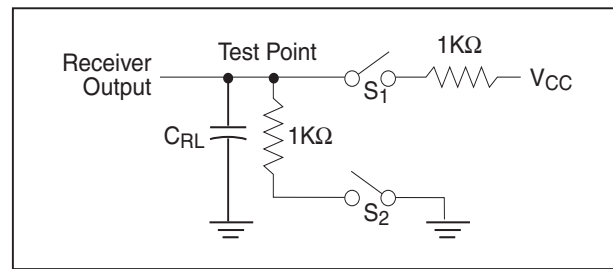


Figure 35. Receiver Timing Test Load Circuit

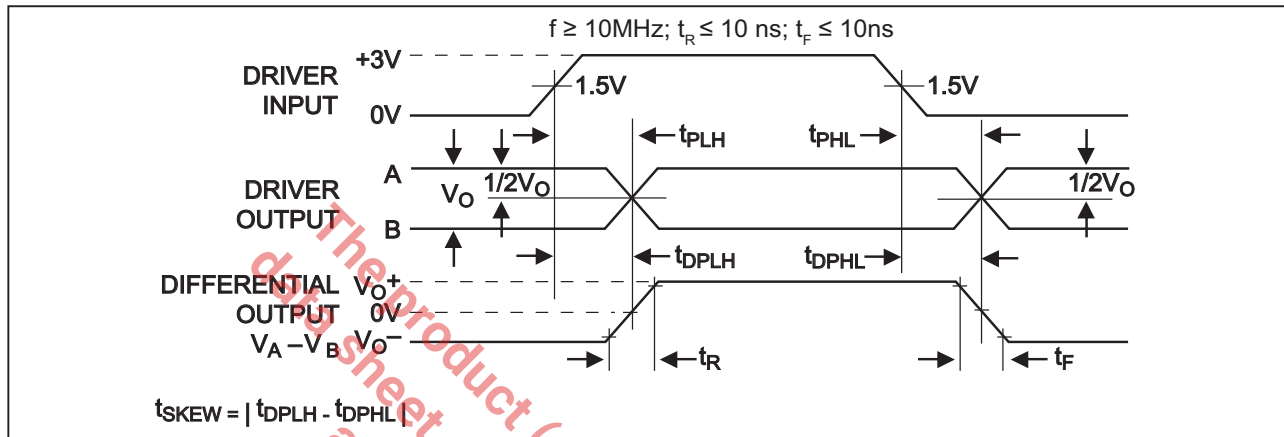


Figure 36. Driver Propagation Delays

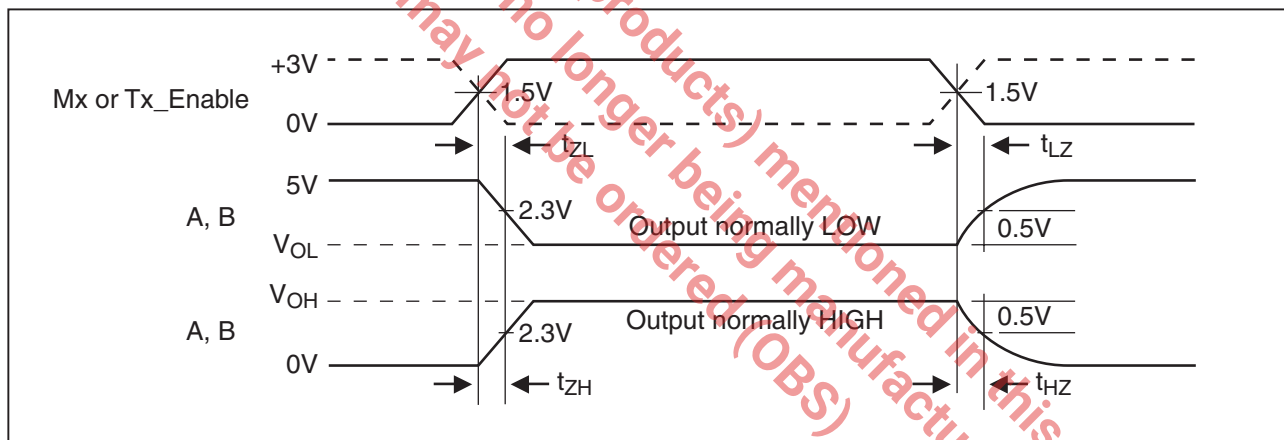


Figure 37. Driver Enable and Disable Times

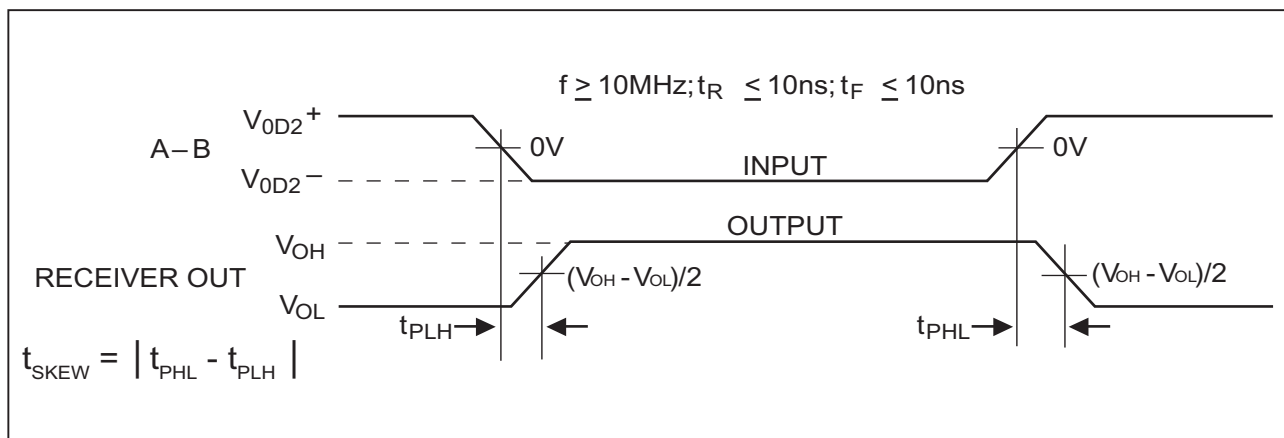


Figure 38. Receiver Propagation Delays

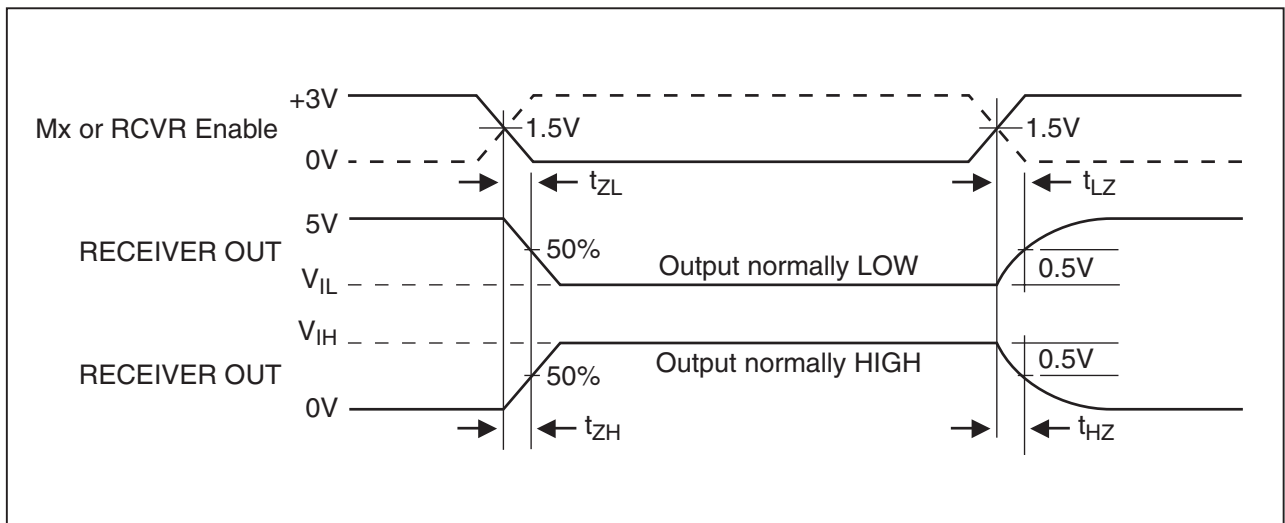


Figure 39. Receiver Enable and Disable Times

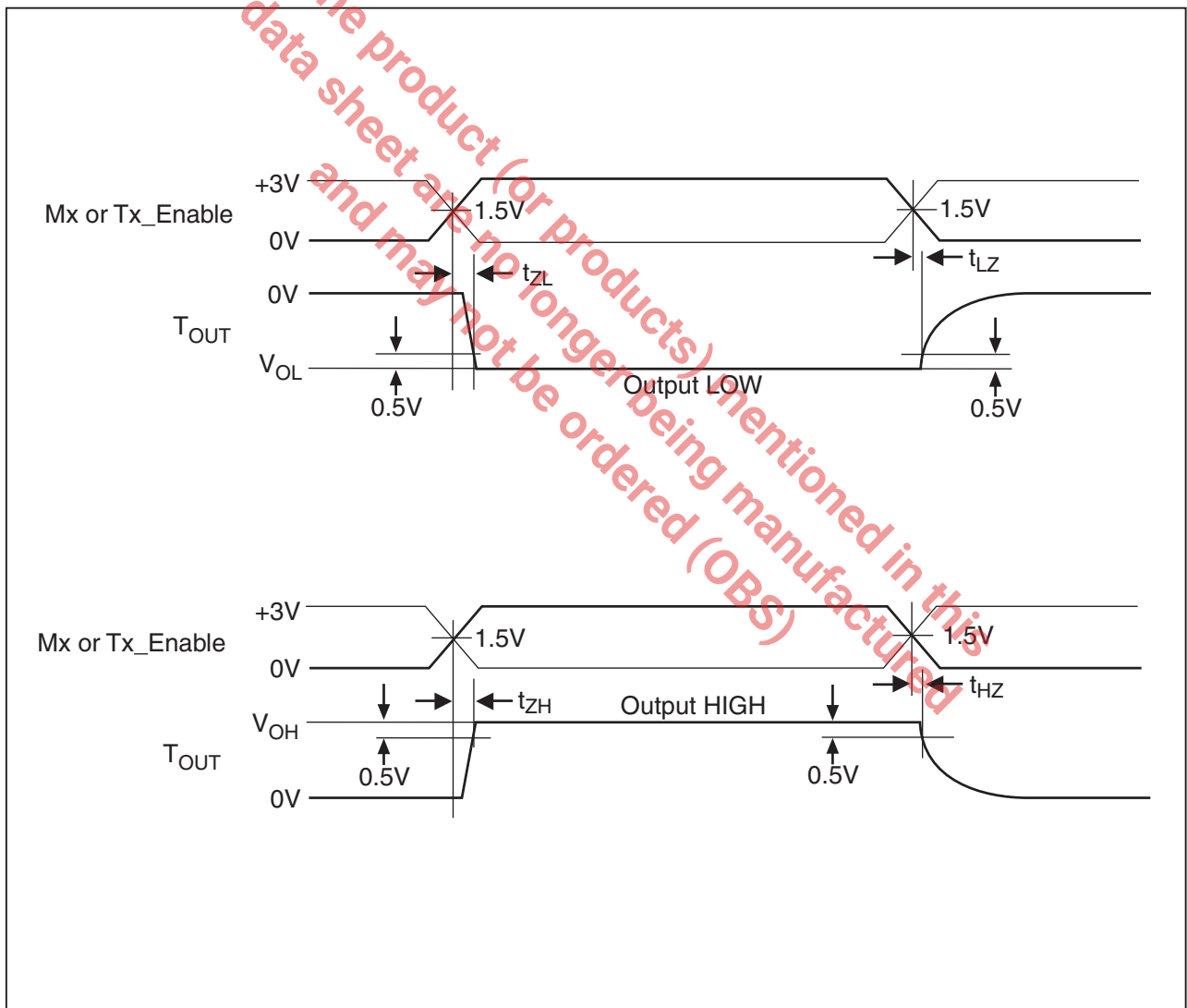


Figure 40. V.28 (RS-232) and V.10 (RS-423) Driver Enable and Disable Times

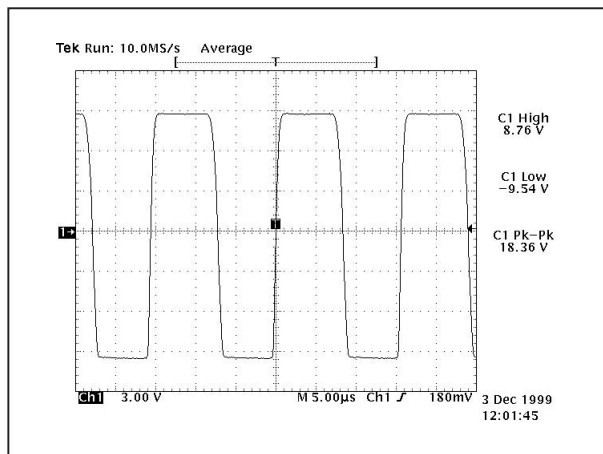


Figure 41. Typical V.28 Driver Output Waveform

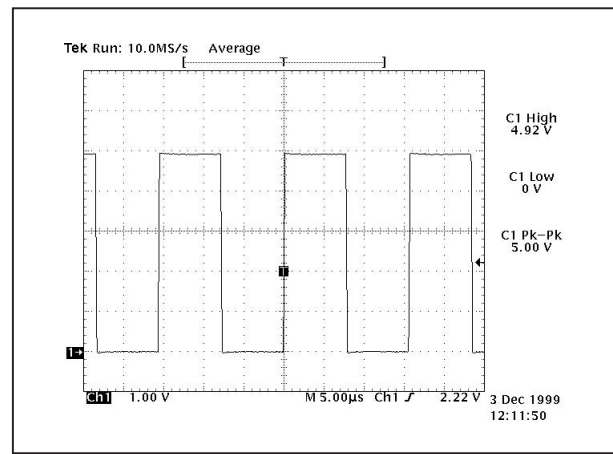


Figure 42. Typical V.10 Driver Output Waveform

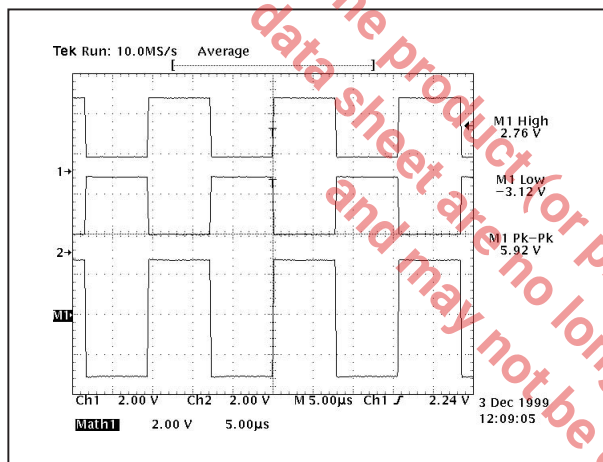


Figure 43. Typical V.11 Driver Output Waveforms

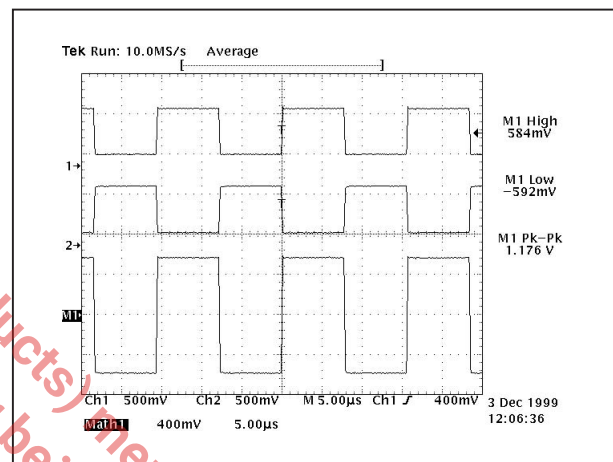
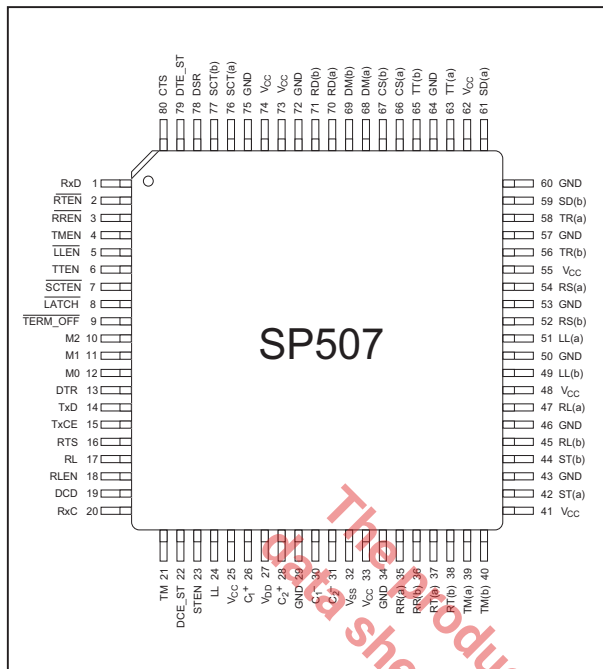


Figure 44. Typical V.35 Driver Output Waveforms

## PINOUT (LQFP)



## PIN ASSIGNMENTS

### CLOCK AND DATA GROUP

Pin 1 — RxD — Receive Data; TTL output, sourced from RD(a) and RD(b) inputs.

Pin 14 — TxD — TTL input ; transmit data source for SD(a) and SD(b) outputs.

Pin 15 — TxCE — Transmit Clock; TTL input for TT driver outputs.

Pin 20 — RxC — Receive Clock; TTL output sourced from RT(a) and RT(b) inputs.

Pin 22 — DCE\_ST — Send Timing; TTL input; source for ST(a) and ST(b) outputs.

Pin 37 — RT(a) — Receive Timing; analog input, inverted; source for RxC.

Pin 38 — RT(b) — Receive Timing; analog input, non-inverted; source for RxC.

Pin 42 — ST(a) — Send Timing; analog output, inverted; sourced from DCE\_ST.

Pin 44 — ST(b) — Send Timing; analog output, non-inverted; sourced from DCE\_ST.

Pin 59 — SD(b) — Analog Out — Send data, non-inverted; sourced from TxD.

Pin 61 — SD(a) — Analog Out — Send data, inverted; sourced from TxD.

Pin 63 — TT(a) — Analog Out — Terminal Timing, inverted; sourced from TxCE.

Pin 65 — TT(b) — Analog Out — Terminal Timing, non-inverted; sourced from TxCE.

Pin 70 — RD(a) — Receive Data, analog input; inverted; source for RxD.

Pin 71 — RD(b) — Receive Data; analog input; non-inverted; source for RxD.

Pin 76 — SCT(a) — Serial Clock Transmit; analog input, inverted; source for DCE\_ST.

Pin 77 — SCT(b) — Serial Clock Transmit; analog input, non-inverted; source for DCE\_ST.

Pin 79 — DTE\_ST — Serial Clock Transmit; TTL output; sources from SCT(a) and SCT(b) inputs.

### CONTROL LINE GROUP

Pin 13 — DTR — Data Terminal Ready; TTL input; source for TR(a) and TR(b) outputs.

Pin 16 — RTS — Ready To Send; TTL input; source for RS(a) and RS(b) outputs.

Pin 17 — RL — Remote Loopback; TTL input; source for RL(a) and RL(b) outputs.

Pin 19 — DCD — Data Carrier Detect; TTL output; sourced from RR(a) and RR(b) inputs.

Pin 21 — TM — Ring In; TTL output; sourced from TM(a) and TM(b) inputs.

Pin 24 — LL — Local Loopback; TTL input; source for LL(a) and LL(b) outputs.

Pin 35 — RR(a) — Receiver Ready; analog input, inverted; source for DCD.

Pin 36 — RR(b) — Receiver Ready; analog input, non-inverted; source for DCD.

Pin 39 — TM(a) — Incoming Call; analog input, inverted; source for TM.

Pin 40 — TM(b) — Incoming Call; analog input, non-inverted; source for TM.

Pin 45 — RL(b) — Remote Loopback; analog output, non-inverted; sourced from RL.

Pin 47 — RL(a) — Remote Loopback; analog output inverted; sourced from RL.

Pin 49 — LL(b) — Local Loopback; analog output, non-inverted; sourced from LL.

Pin 51 — LL(a) — Local Loopback; analog output, inverted; sourced from LL.

Pin 52 — RS(b) — Ready To Send; analog output, non-inverted; sourced from RTS.

Pin 54 — RS(a) — Ready To Send; analog output, inverted; sourced from RTS.

Pin 56 — TR(b) — Terminal Ready; analog output, non-inverted; sourced from DTR.

Pin 58 — TR(a) — Terminal Ready; analog output, inverted; sourced from DTR.

Pin 66 — CS(a) — Clear To Send; analog input, inverted; source for CTS.

Pin 67 — CS(b) — Clear To Send; analog input, non-inverted; source for CTS.

Pin 68 — DM(a) — Data Mode; analog input, inverted; source for DSR.

Pin 69 — DM(b) — Data Mode; analog input, non-inverted; source for DSR.

Pin 78 — DSR — Data Set Ready; TTL output; sourced from DM(a) and DM(b) inputs.

Pin 80 — CTS — Clear To Send; TTL output; sourced from CS(a) and CS(b) inputs.

## CONTROL REGISTERS

Pin 2 — RTEN — Enables Rx C receiver, active low; TTL input.

Pin 3 — RREN — Enables DCD receiver, active low; TTL input.

Pin 4 — TMEN — Enables TM receiver, active high; TTL input.

Pin 5 — LLEN — Enables LL driver, active low; TTL input.

Pin 6 — TTEN — Enables Tx CE driver, active high; TTL input.

Pin 7 — SCTEN — Enables DTE\_ST receiver; active low; TTL input.

Pin 8 — LATCH — Latch control for decoder bits (pins 10-12), active low. Logic high input will make decoder transparent.

Pin 9 — TERM\_OFF — Disables receiver termination networks for Rx D, Rx C, and DTE\_ST; TTL input.

Pins 10, 11, 12 — M2, M1, M0 — Transmitter and receiver decode register; configures transmitter and receiver modes; TTL inputs.

Pin 18 — RLEN — Enables RL driver; active high; TTL input.

Pin 23 — STEN — Enables DTE\_ST driver; active high; TTL input.

## POWER SUPPLIES

Pins 25, 33, 41, 48, 55, 62, 73, 74 —  $V_{CC}$  — +5V input.

Pins 29, 34, 43, 46, 50, 53, 57, 60, 64, 72, 75 — GND — Ground.

Pin 27 —  $V_{DD}$  +10V Charge Pump Capacitor — Connects from  $V_{DD}$  to  $V_{CC}$ . Suggested capacitor size is 22 $\mu$ F, 16V.

Pin 32 —  $V_{SS}$  -10V Charge Pump Capacitor — Connects from ground to  $V_{SS}$ . Suggested capacitor size is 22 $\mu$ F, 16V.

Pins 26 and 30 —  $C_1^+$  and  $C_1^-$  — Charge Pump Capacitor — Connects from  $C_1^+$  to  $C_1^-$ . Suggested capacitor size is 22 $\mu$ F, 16V.

Pins 28 and 31 —  $C_2^+$  and  $C_2^-$  — Charge Pump Capacitor — Connects from  $C_2^+$  to  $C_2^-$ . Suggested capacitor size is 22 $\mu$ F, 16V.

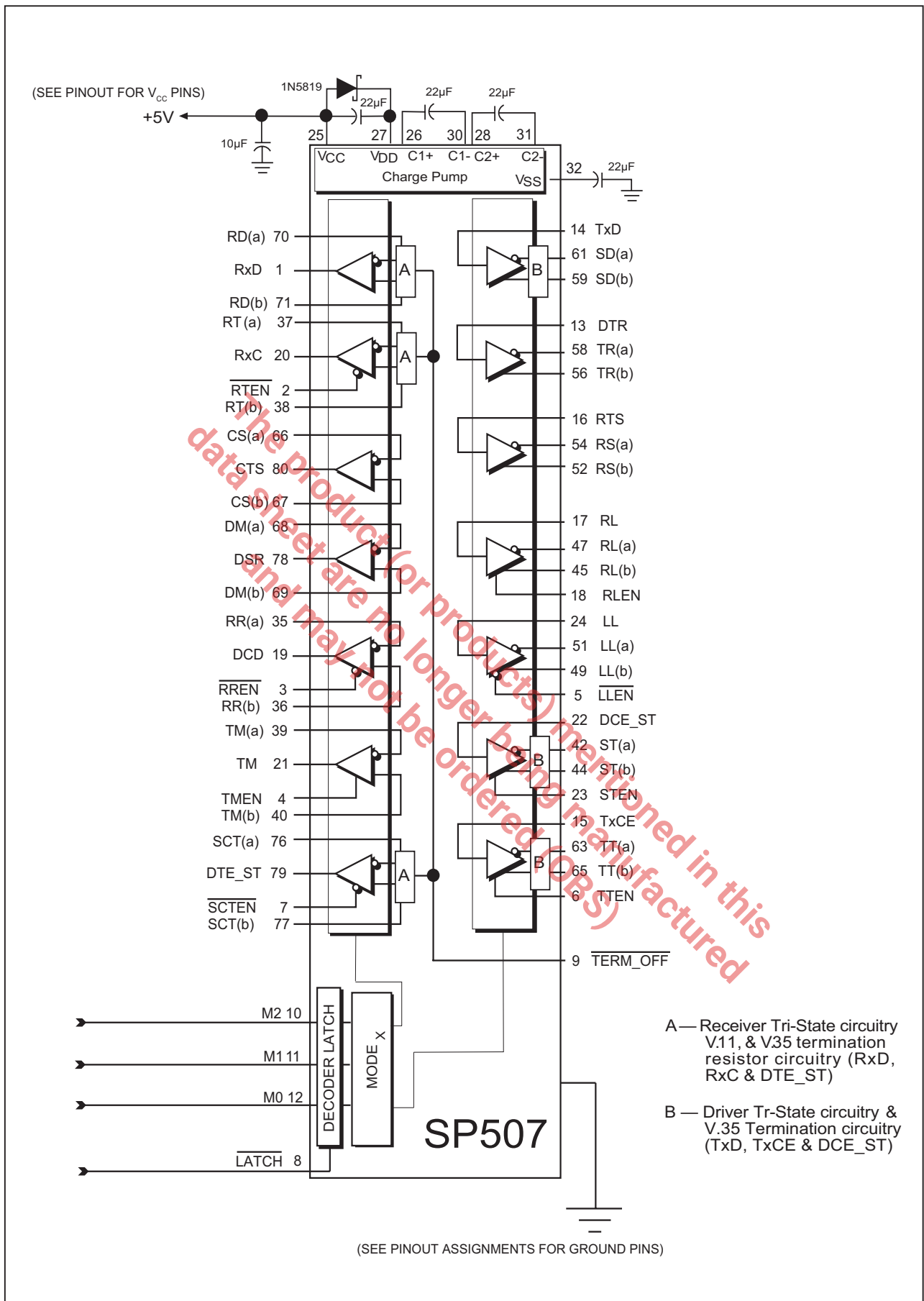


Figure 45. Typical Operating Circuit

## SP507 Driver Mode Selection

| Pin Label | Mode    | V.11    | EIA-530A | EIA-530 | X.21    | V.35                                                                                      | RS-449  | RS-232  |
|-----------|---------|---------|----------|---------|---------|-------------------------------------------------------------------------------------------|---------|---------|
| M2 - M0   | 111     | 000     | 001      | 010     | 011     | 100                                                                                       | 101     | 110     |
| SD(a)     | 3-state | V.11-   | V.11-    | V.11-   | V.11-   | V.35-  | V.11-   | V.28    |
| SD(b)     | 3-state | V.11+   | V.11+    | V.11+   | V.11+   | V.35+  | V.11+   | 3-state |
| TR(a)     | 3-state | V.11-   | V.10     | V.11-   | V.11-   | V.28                                                                                      | V.11-   | V.28    |
| TR(b)     | 3-state | V.11+   | 3-state  | V.11+   | V.11+   | 3-state                                                                                   | V.11+   | 3-state |
| RS(a)     | 3-state | V.11-   | V.11-    | V.11-   | V.11-   | V.28                                                                                      | V.11-   | V.28    |
| RS(b)     | 3-state | V.11+   | V.11+    | V.11+   | V.11+   | 3-state                                                                                   | V.11+   | 3-state |
| RL(a)     | 3-state | V.11-   | V.11-    | V.11-   | V.11-   | V.28                                                                                      | V.11-   | V.28    |
| RL(b)     | 3-state | V.11+   | V.11+    | V.11+   | V.11+   | 3-state                                                                                   | V.11+   | 3-state |
| LL(a)     | 3-state | V.10    | V.10     | V.10    | V.10    | V.28                                                                                      | V.10    | V.28    |
| LL(b)     | 3-state | 3-state | 3-state  | 3-state | 3-state | 3-state                                                                                   | 3-state | 3-state |
| ST(a)     | 3-state | V.11-   | V.11-    | V.11-   | V.11-   | V.35-  | V.11-   | V.28    |
| ST(b)     | 3-state | V.11+   | V.11+    | V.11+   | V.11+   | V.35+  | V.11+   | 3-state |
| TT(a)     | 3-state | V.11-   | V.11-    | V.11-   | V.11-   | V.35-  | V.11-   | V.28    |
| TT(b)     | 3-state | V.11+   | V.11+    | V.11+   | V.11+   | V.35+  | V.11+   | 3-state |

Table 1. SP507 Driver Decoder Table

## SP507 Receiver Mode Selection

| Pin Label | Mode         | V.11                                                                                      | EIA-530A                                                                                  | EIA-530                                                                                   | X.21                                                                                      | V.35                                                                                        | RS-449                                                                                      | RS-232       |
|-----------|--------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------|
| M2 - M0   | 111          | 000                                                                                       | 001                                                                                       | 010                                                                                       | 011                                                                                       | 100                                                                                         | 101                                                                                         | 110          |
| RD(a)     | >10kΩ to GND | V.11-   | V.11-   | V.11-   | V.11-   | V.35-   | V.11-   | V.28         |
| RD(b)     | >10kΩ to GND | V.11+  | V.11+  | V.11+  | V.11+  | V.35+  | V.11+  | >10kΩ to GND |
| RT(a)     | >10kΩ to GND | V.11-  | V.11-  | V.11-  | V.11-  | V.35-  | V.11-  | V.28         |
| RT(b)     | >10kΩ to GND | V.11+  | V.11+  | V.11+  | V.11+  | V.35+  | V.11+  | >10kΩ to GND |
| CS(a)     | >10kΩ to GND | V.11-                                                                                     | V.11-                                                                                     | V.11-                                                                                     | V.11                                                                                      | V.28                                                                                        | V.11-                                                                                       | V.28         |
| CS(b)     | >10kΩ to GND | V.11+                                                                                     | V.11+                                                                                     | V.11+                                                                                     | V.11+                                                                                     | >10kΩ to GND                                                                                | V.11+                                                                                       | >10kΩ to GND |
| DM(a)     | >10kΩ to GND | V.11-                                                                                     | V.10                                                                                      | V.11-                                                                                     | V.11-                                                                                     | V.28                                                                                        | V.11-                                                                                       | V.28         |
| DM(b)     | >10kΩ to GND | V.11+                                                                                     | >10kΩ to GND                                                                              | V.11+                                                                                     | V.11+                                                                                     | >10kΩ to GND                                                                                | V.11+                                                                                       | >10kΩ to GND |
| RR(a)     | >10kΩ to GND | V.11-                                                                                     | V.11-                                                                                     | V.11-                                                                                     | V.11-                                                                                     | V.28                                                                                        | V.11-                                                                                       | V.28         |
| RR(b)     | >10kΩ to GND | V.11+                                                                                     | V.11+                                                                                     | V.11+                                                                                     | V.11+                                                                                     | >10kΩ to GND                                                                                | V.11+                                                                                       | >10kΩ to GND |
| TM(a)     | >10kΩ to GND | V.10                                                                                      | V.10                                                                                      | V.10                                                                                      | V.10                                                                                      | V.28                                                                                        | V.10                                                                                        | V.28         |
| TM(b)     | >10kΩ to GND | >10kΩ to GND                                                                              | >10kΩ to GND                                                                              | >10kΩ to GND                                                                              | >10kΩ to GND                                                                              | >10kΩ to GND                                                                                | >10kΩ to GND                                                                                | >10kΩ to GND |
| SCT(a)    | >10kΩ to GND | V.11-  | V.11-  | V.11-  | V.11-  | V.35-  | V.11-  | V.28         |
| SCT(b)    | >10kΩ to GND | V.11+  | V.11+  | V.11+  | V.11+  | V.35+  | V.11+  | >10kΩ to GND |

Table 2. SP507 Receiver Decoder Table

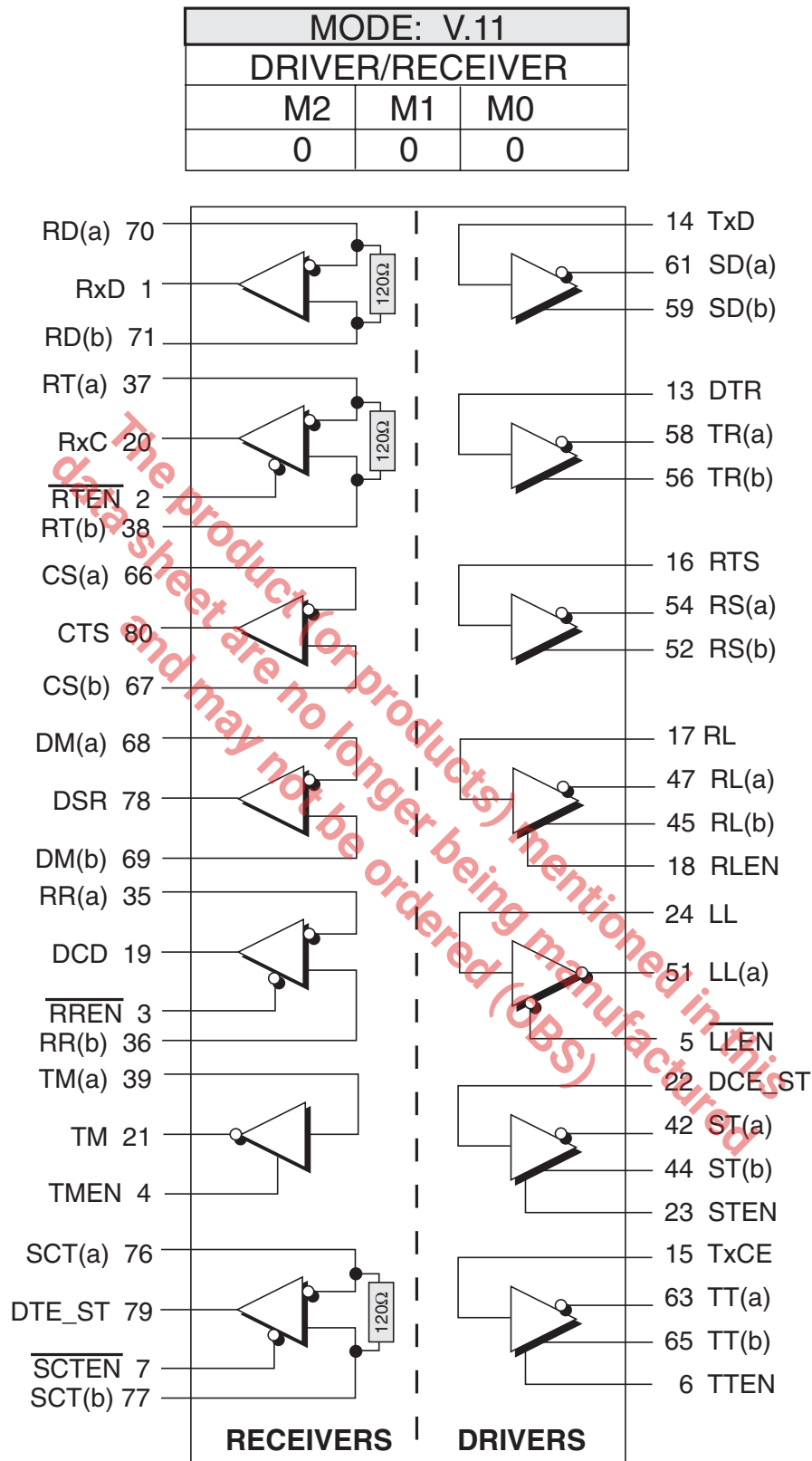


Figure 46. Mode Diagram – V.11

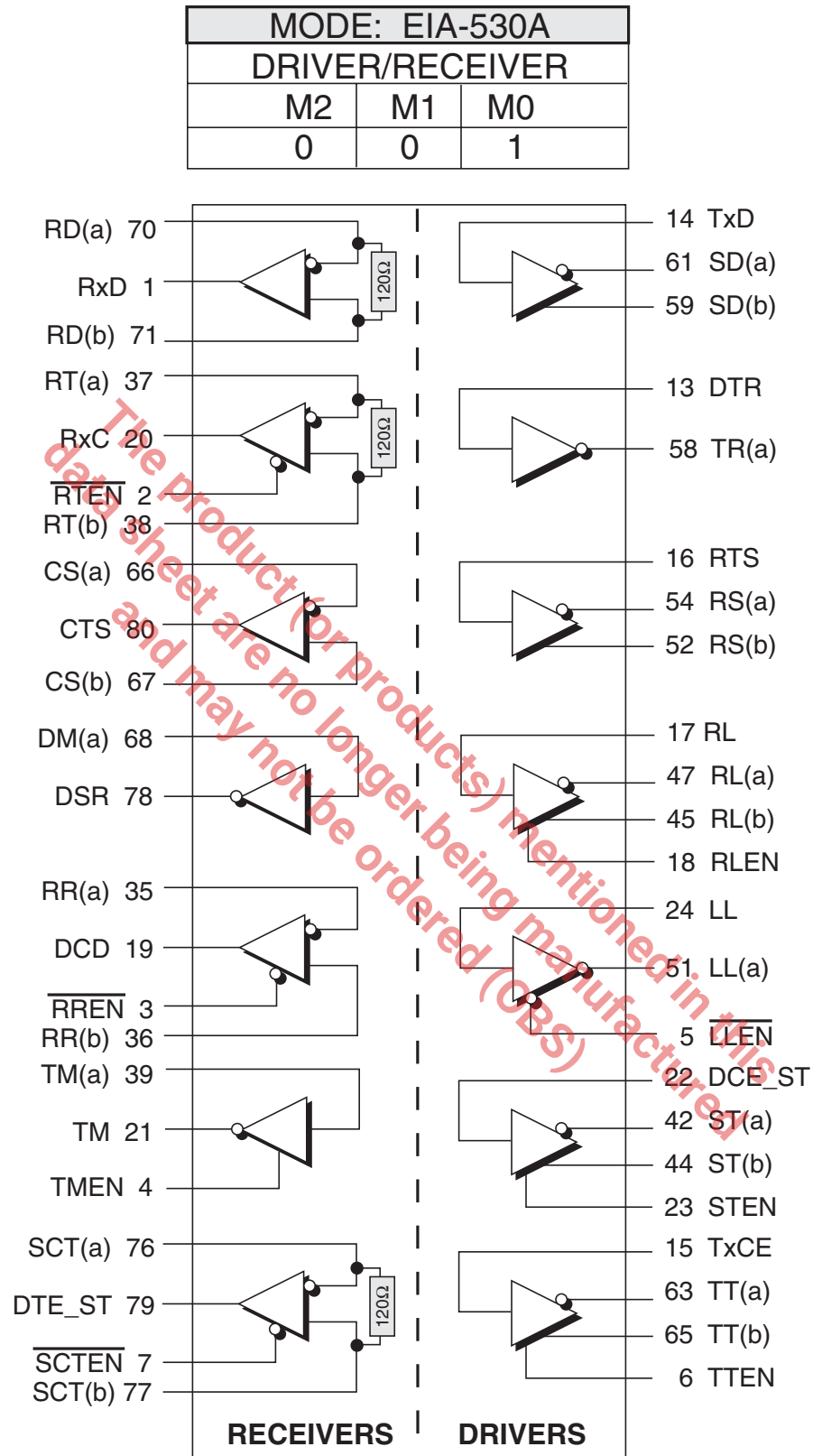


Figure 47. Mode Diagram – EIA-530A

| MODE: EIA-530   |    |    |
|-----------------|----|----|
| DRIVER/RECEIVER |    |    |
| M2              | M1 | M0 |
| 0               | 1  | 0  |

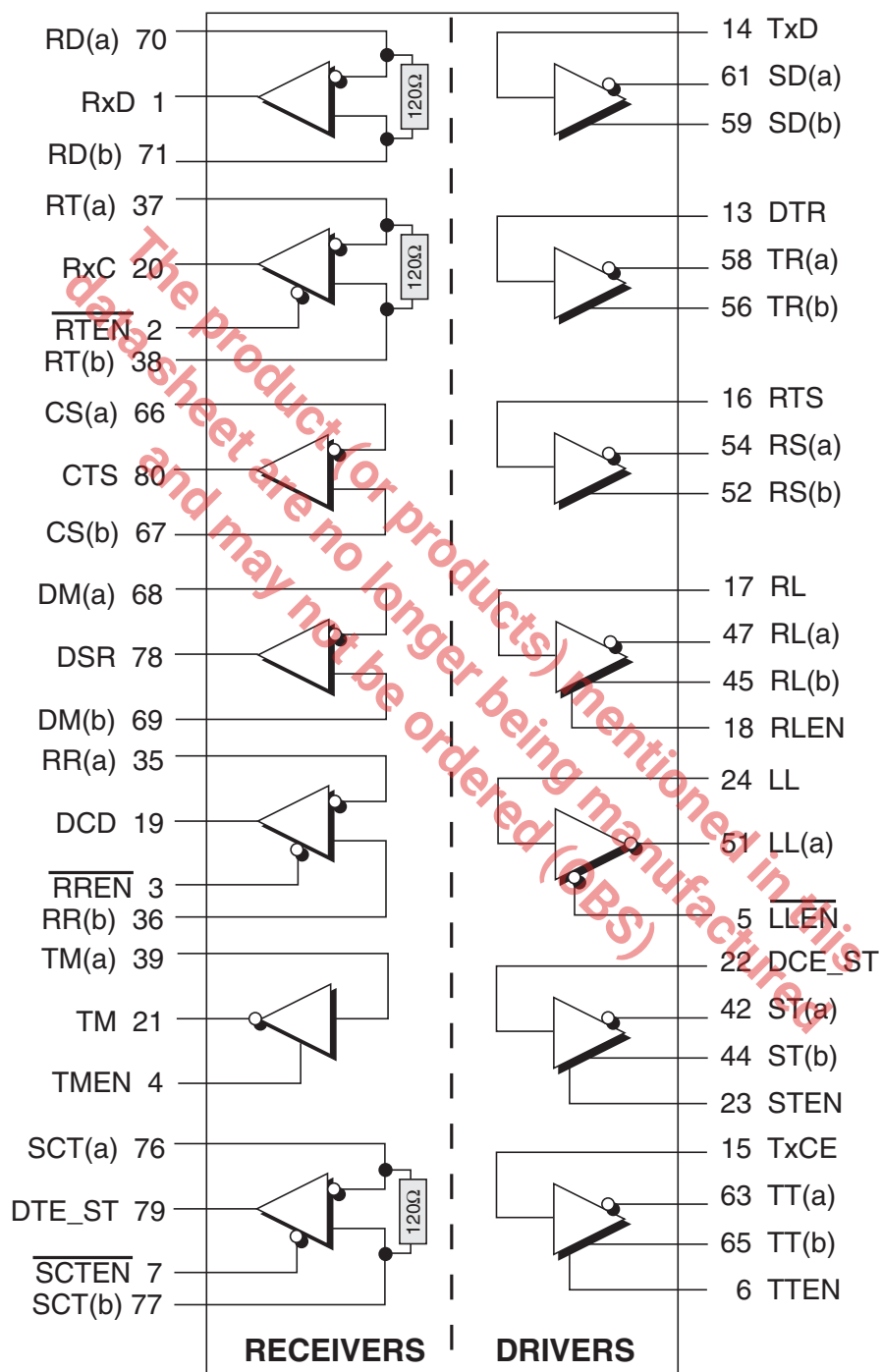


Figure 48. Mode Diagram – EIA-530

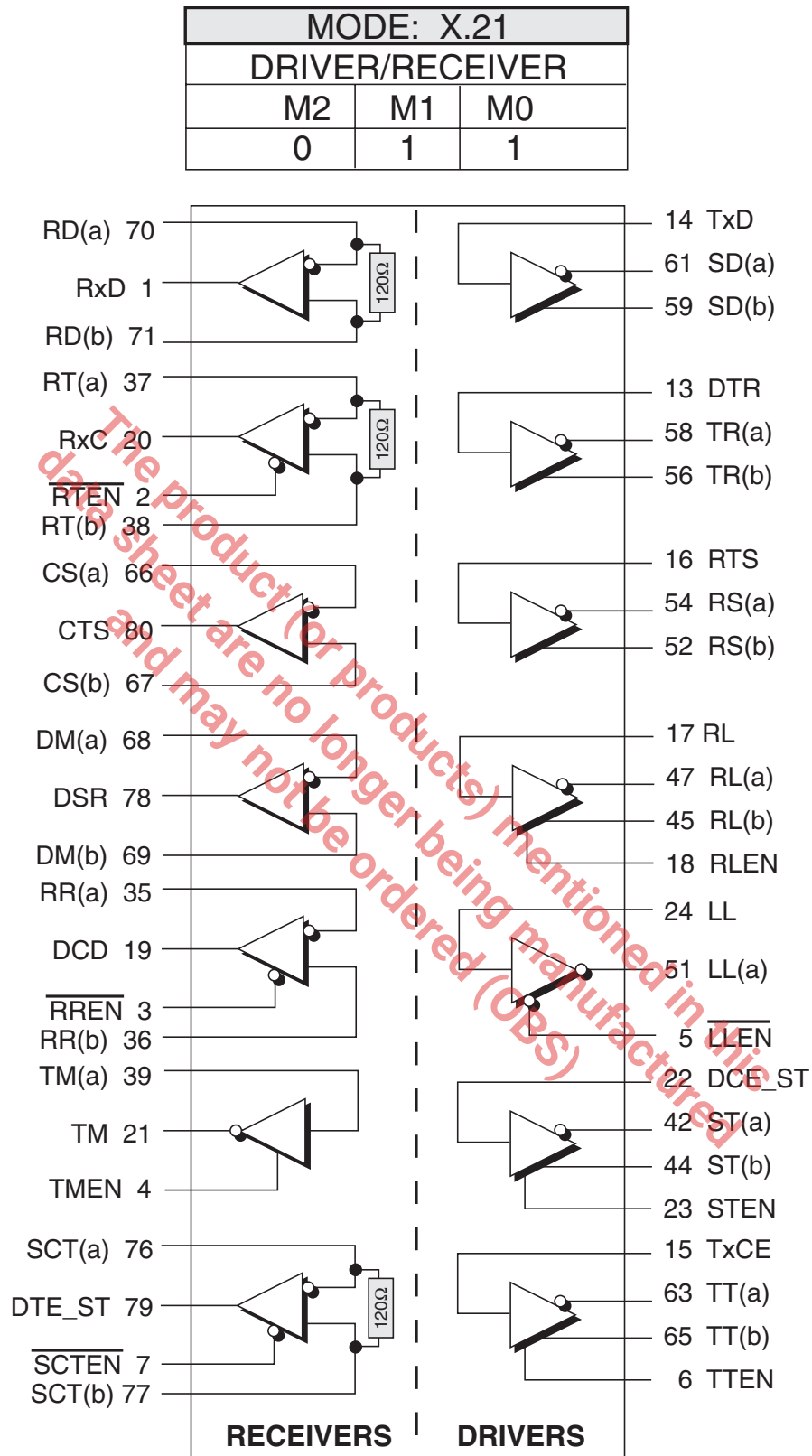


Figure 49. Mode Diagram – X.21

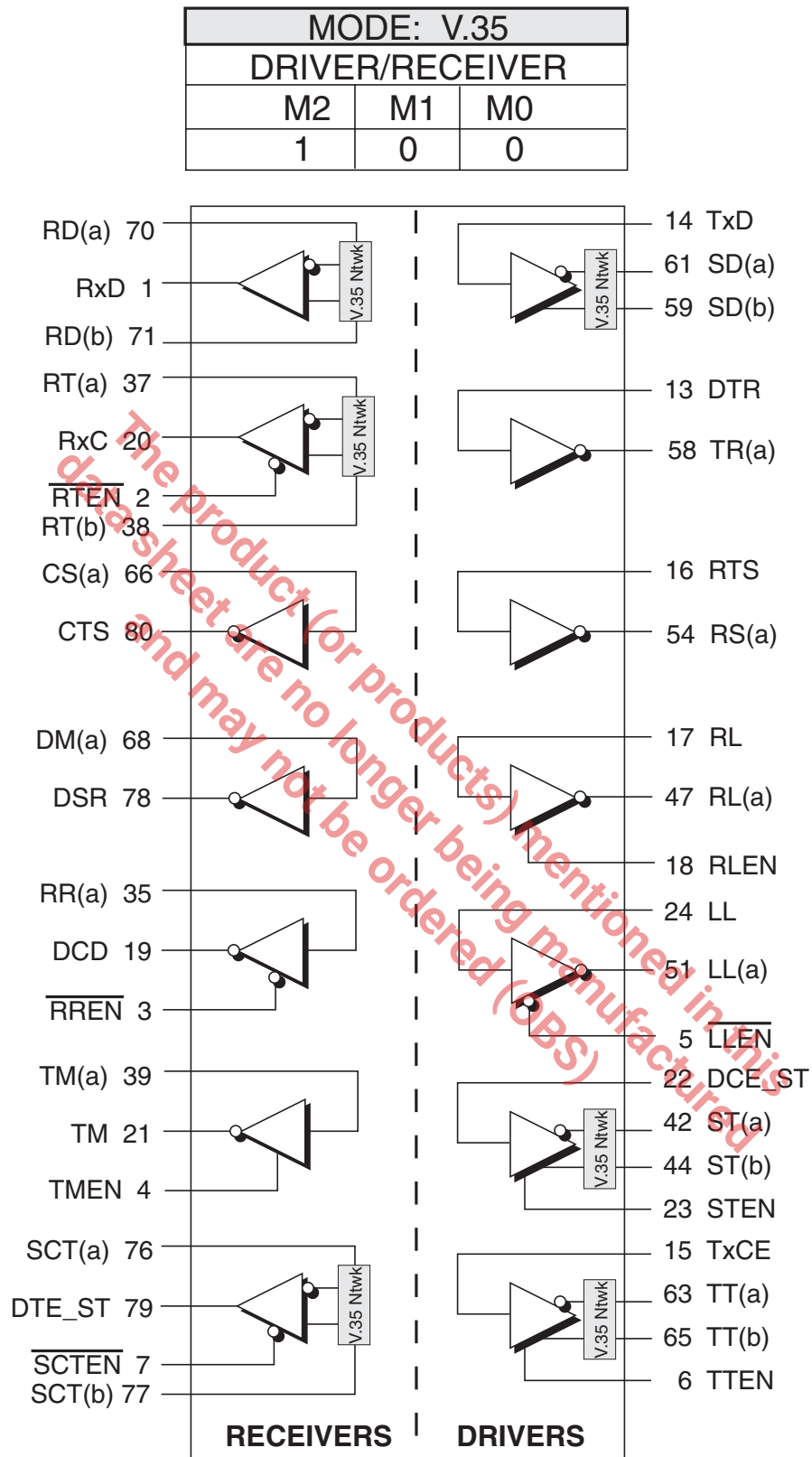


Figure 50. Mode Diagram – V.35

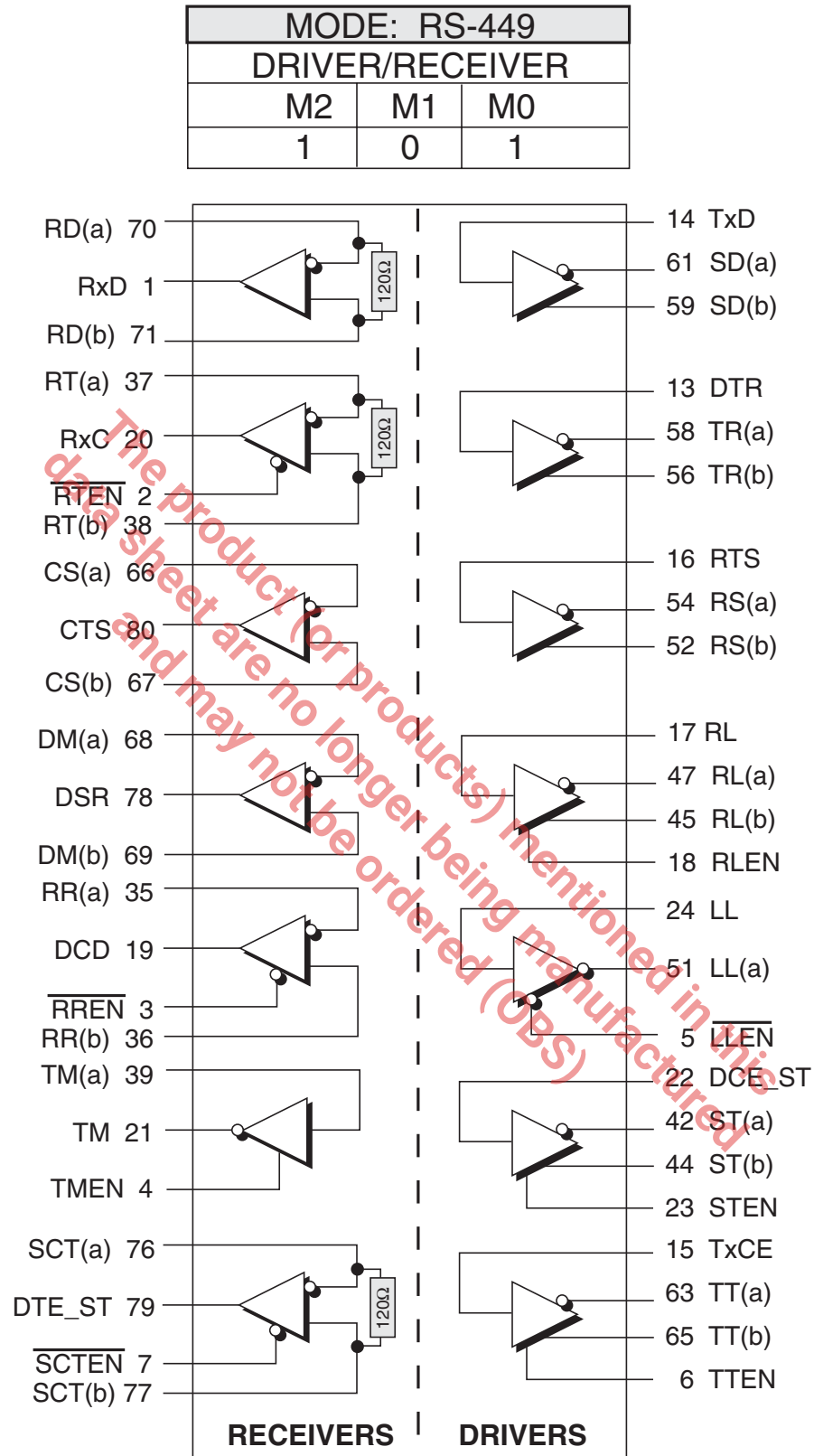


Figure 51. Mode Diagram – RS-449

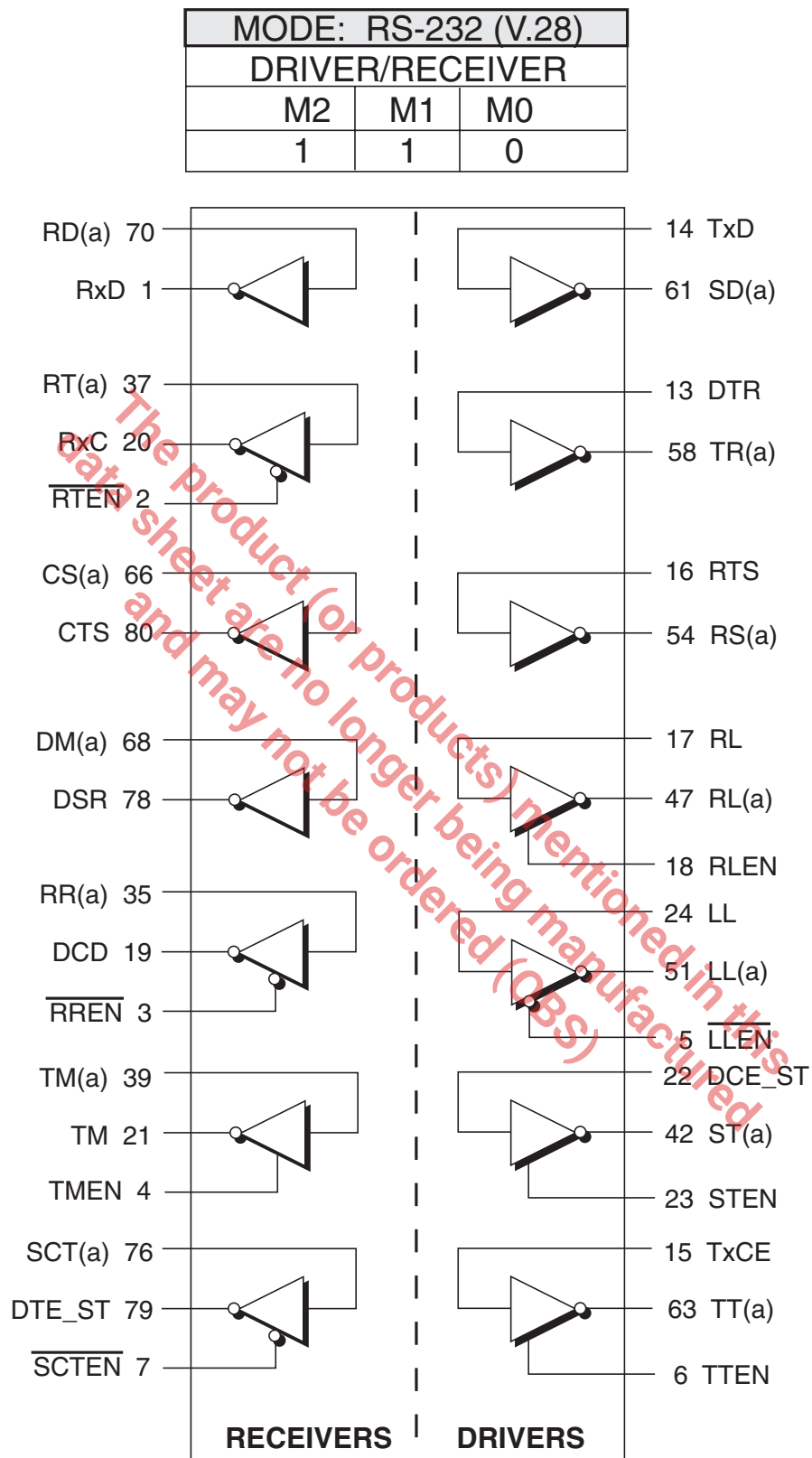
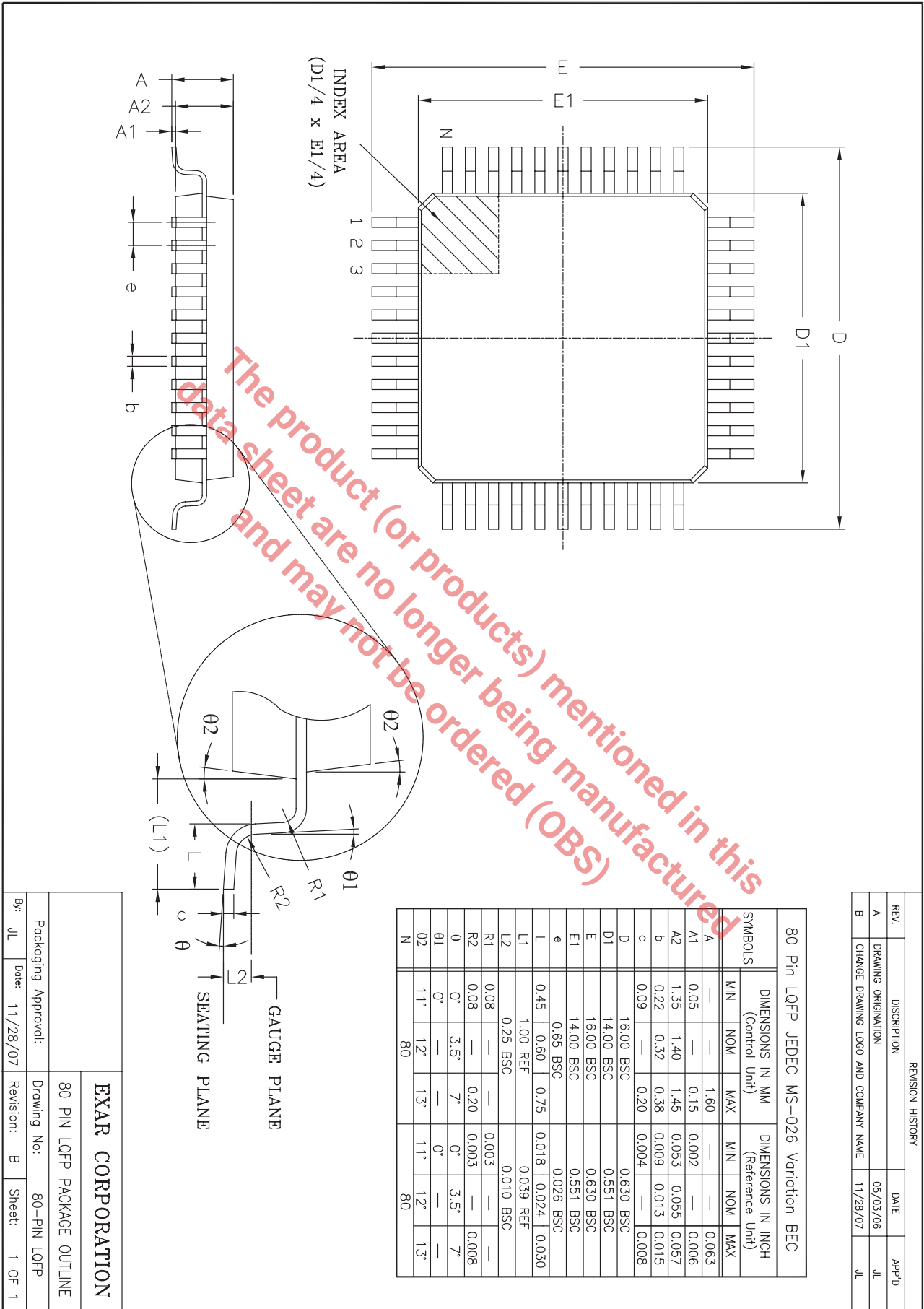


Figure 52. Mode Diagram – RS-232



| ORDERING INFORMATION |                    |                                  |
|----------------------|--------------------|----------------------------------|
| Model                | Temperature Range  | Package Types                    |
| SP507CM-L .....      | 0°C to +70°C ..... | 80-pin JEDEC (BE-2 Outline) LQFP |

Please consult the factory for pricing and availability on a Tape-On-Reel option.

## REVISION HISTORY

| DATE    | REVISION | DESCRIPTION                                                                                                                                                                                                                                                                                                           |
|---------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1/27/04 | A        | Implemented tracking revision.                                                                                                                                                                                                                                                                                        |
| 8/12/08 | 1.0.0    | SP507 is no longer available in MQFP package per PCN 07-1102-06a. In addition, SP507 is now only available in a Pb-Free, RoHS compliant package. MQFP package drawing has been replaced with the LQFP package drawing. Ordering information has been updated. Changed to Exar datasheet format and revision to 1.0.0. |

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