19-1801; Rev 1; 1/01

MAXIM

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

General Description

The MAX3172/MAX3174 contain five software-selectable multiprotocol cable termination networks. Each network is capable of terminating V.11 (RS-422, RS-530, RS-530A, RS-449, V.36, and X.21) with a 100Ω differential load, V.35 with a T-network load, or V.28 (RS-232) and V.10 (RS-423) with an open circuit load for use with transceivers having on-chip termination. The devices replace discrete resistor termination networks and expensive relays required for multiprotocol termination. The MAX3172/MAX3174, along with the MAX3170 and MAX3171/MAX3173, form a complete +3.3V software-selectable DTE or DCE interface port supporting V.11/RS-422, RS-530, RS-530A, V.36/RS-449, V.35, V.28/RS-232, V.10/RS-423, and X.21 serial interfaces.

In addition to the five multiprotocol cable termination networks, the MAX3172/MAX3174 contain a 1Tx/1Rx multiprotocol transceiver designed to use V+ and V- generated by the MAX3171/MAX3173 charge pump. The MAX3172/MAX3174 transceiver is software selectable between V.10 and V.28 modes of operation. The MAX3172 features 10µs deglitching on the V.10/V.28 receiver input to facilitate unterminated operation, while the MAX3174 is used in applications that do not require deglitching on the serial handshake signals. These devices are available in a 28-pin SSOP package.

Applications

Data Networking
CSU and DSU
Data Routers
PCI Cards
Telecommunications

Features

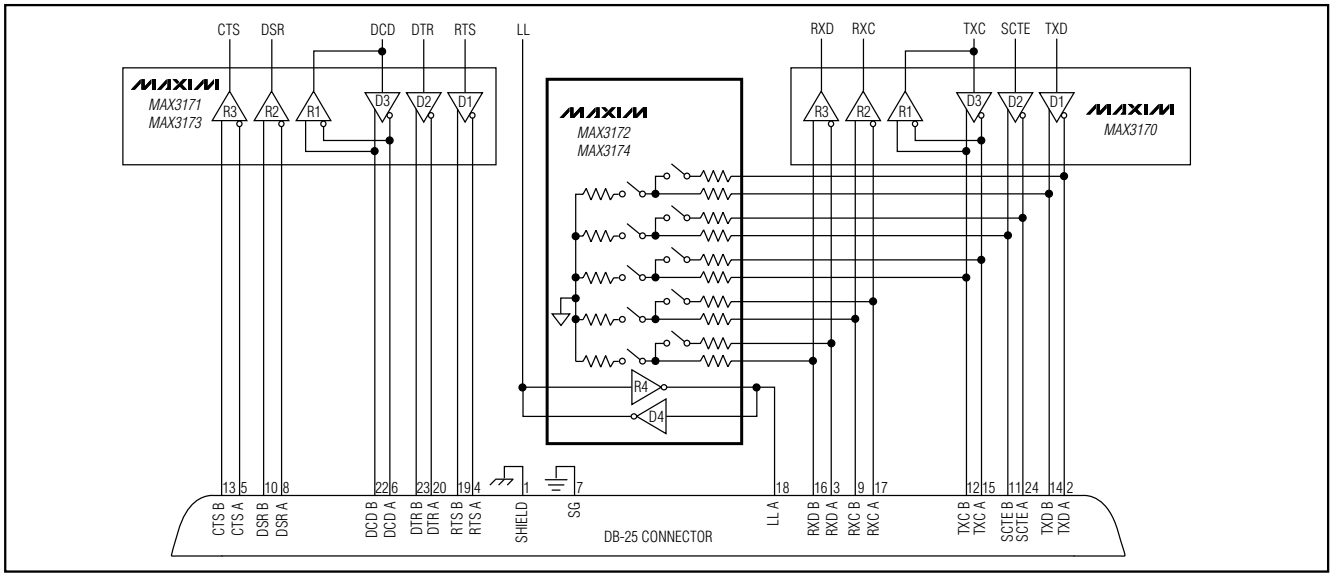
- **Industry's First +3.3V Multiprotocol Termination Networks and Transceivers**
- **Certified TBR-1 and TBR-2 Compliant (NET1 and NET2)**
- **Support V.28 (RS-232), V.11 (RS-422, RS-530, RS-530A, RS-449, V.36, and X.21), V.10 and V.35**
- **3V/5V Logic-Compatible I/O**
- **Software-Selectable DTE/DCE**
- **Replace Discrete Resistor Termination Networks and Expensive Relays**
- **10µs Receiver Input Deglitching (MAX3172 only)**
- **Available in Small 28-Pin SSOP Package**
- **Transmitter Output Fault Protected to ±15V, Tolerates Cable Miswiring**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX3172CAI	0°C to +70°C	28 SSOP
MAX3174CAI	0°C to +70°C	28 SSOP

Pin Configuration appears at end of data sheet.

Typical Operating Circuit



+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

ABSOLUTE MAXIMUM RATINGS

(All voltages referenced to GND unless otherwise noted.)
Supply Voltages
- V_{CC} ..... -0.3V to +4V
- V+ (Note 1) ..... -0.3V to +7V
- V- (Note 1) ..... +0.3V to -7V
- V+ to V- (Note 1) 13V

Logic Input Voltages
- M0, M1, M2, DCE/$\overline{DTE}$, INVERT, T4IN ..... -0.3V to +6V

Logic Output Voltages
- R4OUT ..... -0.3V to (V_{CC} + 0.3V)
- Short-Circuit Duration ..... Continuous

Transmitter Outputs
- T4OUT ..... -15V to +15V
- Short-Circuit Duration 60s

Receiver Input
- R4INA ..... -15V to +15V

Termination Network Inputs (applied individually)
- R_A, R_B ..... -15V to +15V

Continuous Power Dissipation (T_A = +70°C)
- 28-Pin SSOP (derate 9.52mW/°C above +70°C) 762mW

Operating Temperature Range
- MAX3172CAI/MAX3174CAI ..... 0°C to +70°C

Junction Temperature ..... +150°C
Storage Temperature Range ..... -65°C to +150°C
Lead Temperature (soldering, 10s) ..... +300°C

Note 1: V+ and V- can have maximum magnitudes of 7V, but their absolute difference cannot exceed 13V.

Stresses beyond 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 beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +3.3V ± 5%, T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted. See Note 2 for V+ and V- input voltage conditions.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS						
Supply Current (Digital Inputs = GND or V_{CC})	I_{CC}	All modes V.10 receiver inactive		80	200	µA
		All modes V.10 receiver active		400	750	
V+ Supply Current (T4IN = GND)	I_{V+}	No-cable mode		0.2	1.0	mA
		V.10/V.11/V.28/V.35 modes unloaded		0.5	2.5	
		V.10/V.11 modes T4OUT loaded		11.0	14.0	
		V.28/V.35 modes T4OUT loaded		3.0	5.0	
V- Supply Current ($T4IN = V_{CC}$)	I_{V-}	No-cable mode		-0.4	-1.0	mA
		V.10/V.11/V.28/V.35 modes unloaded		-0.8	-2.5	
		V.10/V.11 modes T4OUT loaded		-11.0	-14.0	
		V.28/V.35 modes T4OUT loaded		-3.0	-5.0	
TERMINATOR NETWORKS (R_A, R_B)						
Differential-Mode Impedance V.35 Mode		Figure 1, $-2V \le V_{CM} \le +2V$	90	104	110	Ω
Common-Mode Impedance V.35 Mode		Figure 2, $-2V \le V_{CM} \le +2V$	135	153	165	Ω
Differential-Mode Impedance V.11 Mode		Figure 1, $-7V \le V_{CM} \le +7V$	100	104	110	Ω
Network OFF Impedance	I_Z	Switches open, $-15V \le V_A \le +15V$, $V_B = V_A$, V_B = GND or V_B floating	50	150		kΩ
LOGIC INPUTS (M0, M1, M2, INVERT, DCE/$\overline{DTE}$, T4IN)						
Input High Voltage	V_{IH}		2.0			V
Input Low Voltage	V_{IL}				0.8	V
Logic Input Current	I_{IH}, I_{IL}	$V_{IN} = V_{CC}$ or GND			±1	µA

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +3.3V ± 5%, T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted. See Note 2 for V+ and V- input voltage conditions.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
LOGIC OUTPUT (R4OUT)							
Output High Voltage	V_{OH}	I_{SOURCE} = 1.0mA		V_{CC} - 1.0			V
Output Low Voltage	V_{OL}	I_{SINK} = 1.6mA				0.4	V
Rise or Fall Time	t_r, t_f	10% to 90%, C_L = 15pF			15		ns
Output Leakage Current (Receiver Output Three-Stated)		R4OUT = GND		30	50	100	µA
		R4OUT = V_{CC}			0.1	1	
TRANSMITTER OUTPUT (T4OUT)							
Output Leakage Current	I_Z	-0.25V < V_{T4OUT} < +0.25V, power-off or no-cable mode		-100		100	µA
Data Rate		V.10/V.28			240		kbps
RECEIVER INPUT (R4INA)							
Receiver Glitch Rejection (MAX3172 only)		Minimum pulse width passed		5			µs
		Maximum pulse width rejected				15	
Receiver Input Resistance	R_{IN}	V.10 enabled, -10V ≤ V_{R4INA} ≤ +10V		20	40		kΩ
		V.28 enabled, -15V ≤ V_{R4INA} ≤ +15V		3	5	7	
Data Rate		MAX3172			64		kbps
		MAX3174			240		
V.10 TRANSMITTER							
Output Voltage Swing	V_{ODO}	R_L = 3.9kΩ, Figure 3		±4.0	±4.4	±6.0	V
Loaded Output Voltage Swing	V_{ODL}	R_L = 450Ω, Figure 3		0.9 × V_{ODO}			V
Short-Circuit Current	I_{SC}	T4OUT = GND			±100	±150	mA
Rise or Fall Time	t_r, t_f	10% to 90%, R_L = 450Ω, C_L = 100pF, Figure 3			2		µs
Transmitter Propagation Delay	t_{PHL}, t_{PLH}	R_L = 450Ω, C_L = 100pF, Figure 3			2		µs
Data Skew	$\lvert t_{PHL} - t_{PLH} \rvert$	R_L = 450Ω, C_L = 100pF, Figure 3			50		ns
V.10 RECEIVER							
Threshold Voltage	V_{TH}			25	100	250	mV
Input Hysteresis	ΔV_{TH}				15		mV
Receiver Propagation Delay	t_{PHL}, t_{PLH}	Figure 4	MAX3172	5	10	15	µs
			MAX3174		60	120	ns
Data Skew	$\lvert t_{PHL} - t_{PLH} \rvert$	Figure 4	MAX3172		0.5	4	µs
			MAX3174		5	16	ns

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +3.3V ± 5%, T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = +3.3V, T_A = +25°C, unless otherwise noted. See Note 2 for V+ and V- input voltage conditions.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
V.28 TRANSMITTER							
Output Voltage Swing	V_O	R_L = 3kΩ, Figure 3		±5.0	±5.4		V
		Open circuit, Figure 3				±6.5	
Short-Circuit Current	I_{SC}	T4OUT = GND			±25	±60	mA
Output Slew Rate	SR	R_L = 3kΩ, C_L = 2500pF measured from +3V to -3V or -3V to +3V, Figure 3		4		30	V/µs
		R_L = 7kΩ , C_L = 150pF measured from +3V to -3V or -3V to +3V, Figure 3		6		30	
Transmitter Propagation Delay	t_{PHL}, t_{PLH}				1		µs
Data Skew	$\lvert t_{PHL} - t_{PLH} \rvert$				100		ns
V.28 RECEIVER							
Input Threshold Low	V_{IL}				1.1	0.8	V
Input Threshold High	V_{IH}			2.0	1.6		V
Input Hysteresis	V_{HYS}				0.5		V
Receiver Propagation Delay	t_{PHL}, t_{PLH}	Figure 4	MAX3172	5	10	15	µs
			MAX3174		200		ns
Data Skew	$\lvert t_{PHL} - t_{PLH} \rvert$	Figure 4	MAX3172		0.5	4	µs
			MAX3174		100		ns

Note 2: The charge pump on the MAX3171/MAX3173 can supply V+ and V- to the MAX3172/MAX3174. The V+ and V- input levels vary with the mode of chipset operation as follows:

V.35/V.28 modes: +5.55V ≤ V+ ≤ +6.50V, -6.50V ≤ V- ≤ -5.45V
Typical operation: V+ = +5.90V, V- = -5.80V

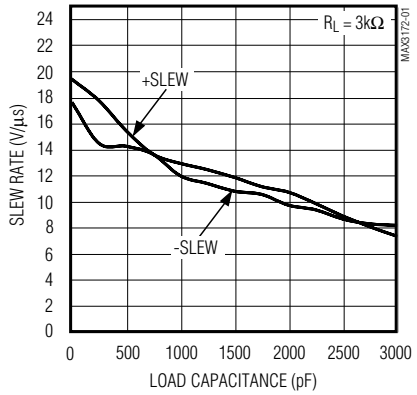
V.10/V.11 modes: +4.20V ≤ V+ ≤ +5.0V, -4.60V ≤ V- ≤ -3.80V
Typical operation: V+ = +4.60V, V- = -4.20V

The MAX3171/MAX3173 are guaranteed to provide these V+/V- supply levels.

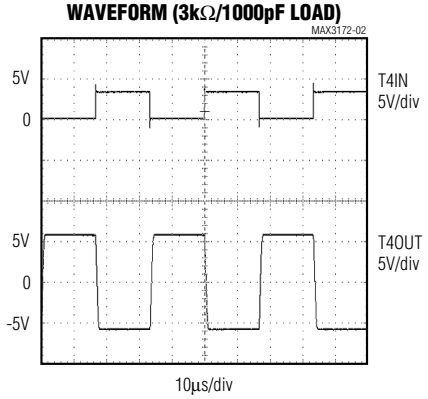
Typical Operating Characteristics

(V_{CC} = +3.3V (see Note 2 in *Electrical Characteristics* table), T_A = +25°C, unless otherwise noted.)

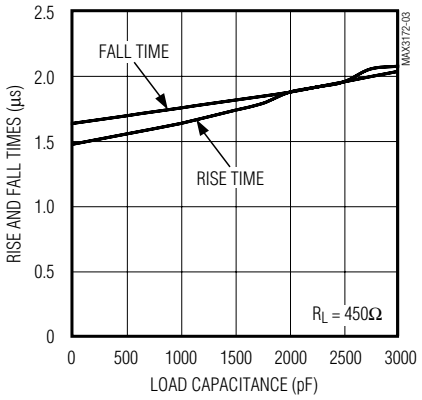
V.28 SLEW RATE vs. LOAD CAPACITANCE



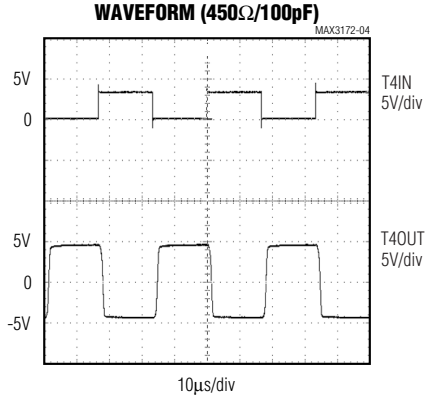
V.28 60kbps TRANSMITTER WAVEFORM (3kΩ/1000pF LOAD)



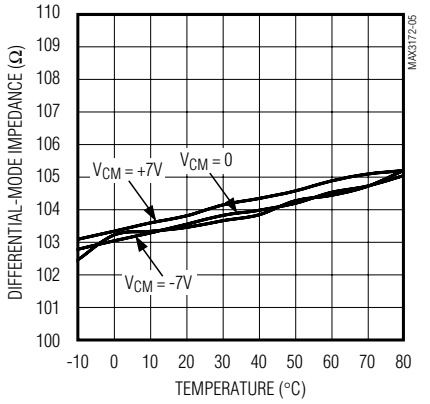
V.10 RISE AND FALL TIMES vs. LOAD CAPACITANCE



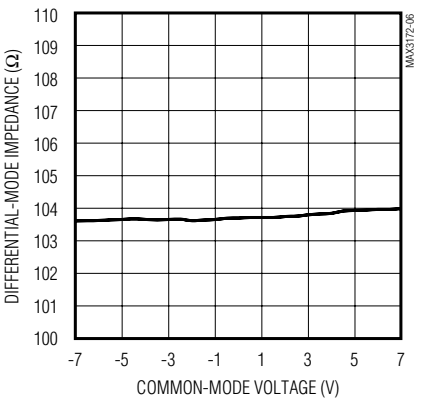
V.10 60kbps TRANSMITTER WAVEFORM (450Ω/100pF)



V.11/V.35 DIFFERENTIAL-MODE IMPEDANCE vs. TEMPERATURE



V.11/V.35 DIFFERENTIAL-MODE IMPEDANCE vs. COMMON-MODE VOLTAGE

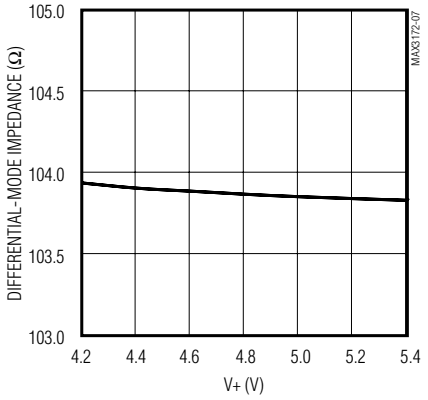


+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

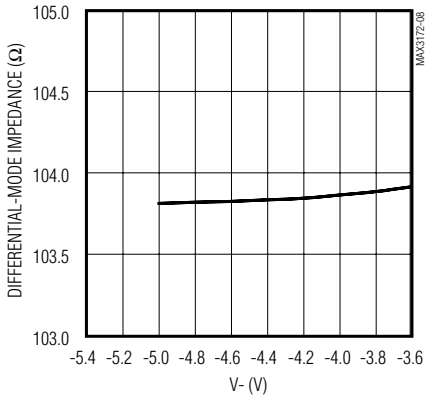
Typical Operating Characteristics (continued)

(V_{CC} = +3.3V (see Note 2 in *Electrical Characteristics* table), T_A = +25°C, unless otherwise noted.)

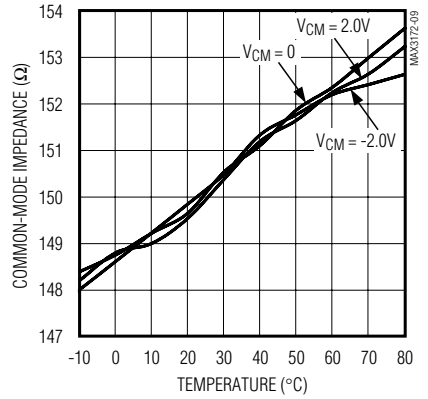
V.11/V.35 DIFFERENTIAL-MODE IMPEDANCE vs. V+



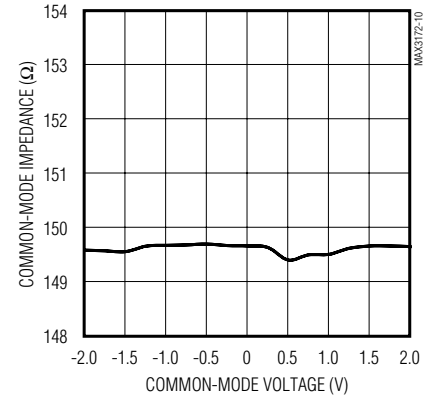
V.11/V.35 DIFFERENTIAL-MODE IMPEDANCE vs. V-



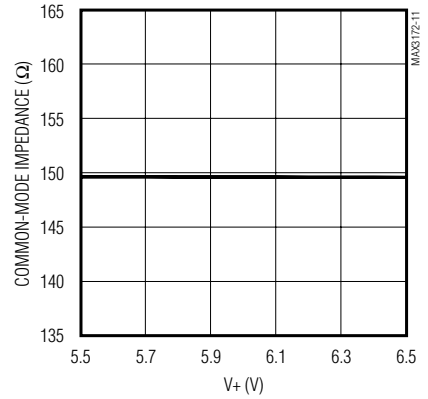
V.35 COMMON-MODE IMPEDANCE vs. TEMPERATURE



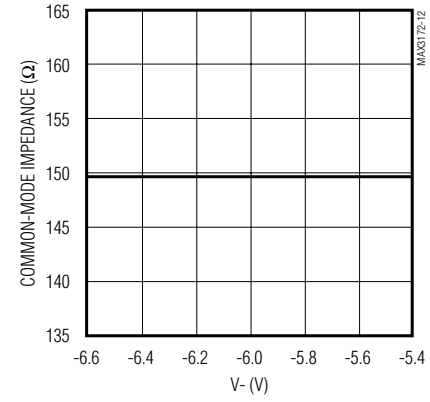
V.35 COMMON-MODE IMPEDANCE vs. COMMON-MODE VOLTAGE



V.35 COMMON-MODE IMPEDANCE vs. V+



V.35 COMMON-MODE IMPEDANCE vs. V-



Test Circuits

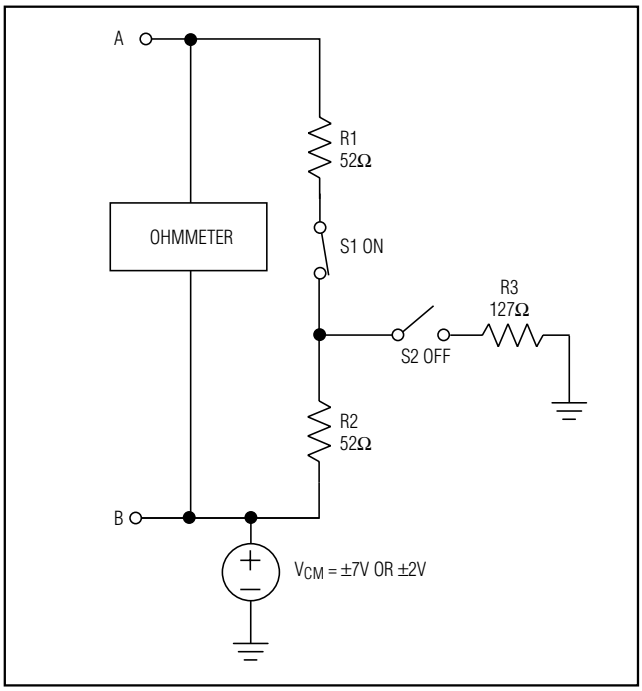


Figure 1. V.11 or V.35 Differential Impedance Measurement

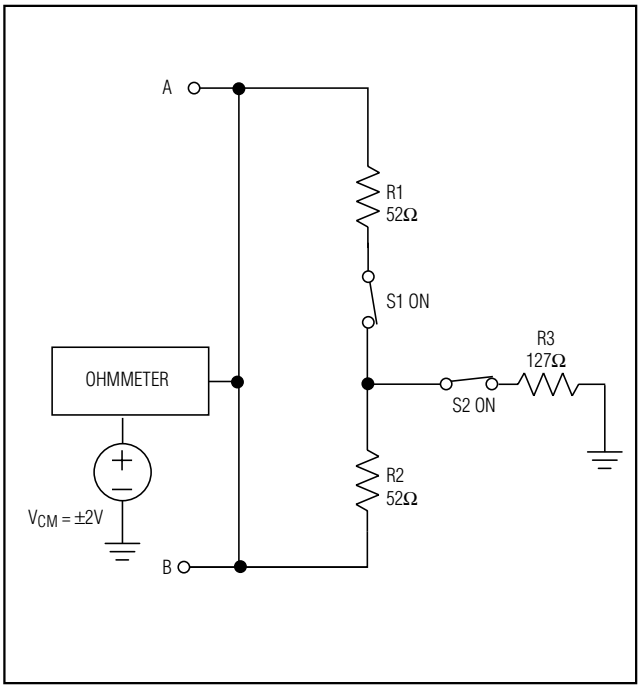


Figure 2. V.35 Common-Mode Impedance Measurement

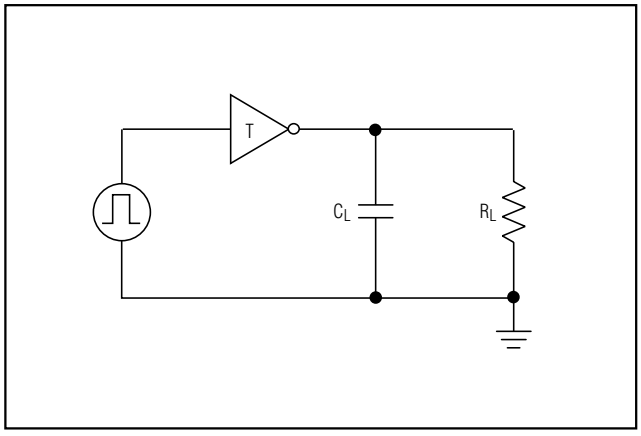


Figure 3. V.10/V.28 Driver Test Circuit

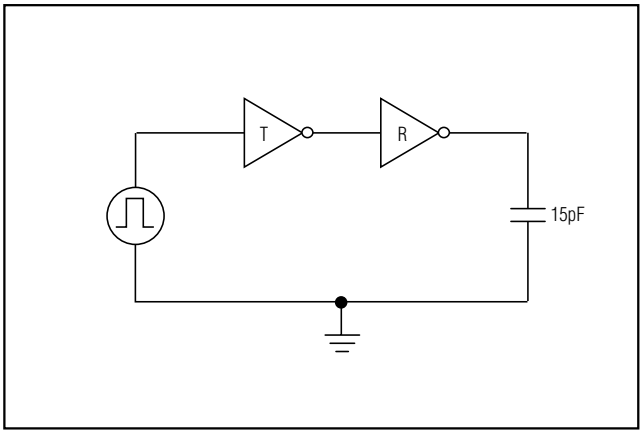


Figure 4. V.10/V.28 Receiver Test Circuit

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

Pin Description

PIN	NAME	FUNCTION
1	M2	Mode-Select Pin (see Tables 1 and 3 for detailed information)
2	M1	Mode-Select Pin (see Tables 1 and 3 for detailed information)
3	M0	Mode-Select Pin (see Tables 1 and 3 for detailed information)
4	V_{CC}	+3.3V Supply Voltage (±5%). Bypass V_{CC} to GND with a 0.1µF capacitor.
5	R5A	Termination Network 5 Node A
6	R5B	Termination Network 5 Node B
7	T4IN	Transmitter CMOS Input
8	R4OUT	Receiver CMOS Output
9,18, 22	GND	Ground
10	R4B	Termination Network 4 Node B
11	R4A	Termination Network 4 Node A
12	R3C	Termination Network 3 Node C
13	R3B	Termination Network 3 Node B
14	R3A	Termination Network 3 Node A
15	R1A	Termination Network 1 Node A
16	R1B	Termination Network 1 Node B
17	R1C	Termination Network 1 Node C
19	R2C	Termination Network 2 Node C
20	R2B	Termination Network 2 Node B
21	R2A	Termination Network 2 Node A
23	R4INA	Inverting Receiver Input
24	V-	Negative Supply (connect to V- pin of MAX3171/MAX3173). Bypass V- to GND with a 0.1µF capacitor.
25	T4OUT	Inverting Transmitter Output
26	V+	Positive Supply (connect to V+ pin of MAX3171/MAX3173). Bypass V+ to GND with a 0.1µF capacitor.
27	DCE/$\overline{\text{DTE}}$	DCE/$\overline{\text{DTE}}$ Mode-Select Pin. Logic level LOW selects DTE interface. See Tables 1 and 3 for detailed information.
28	INVERT	Mode-Select Pin (inverts functionality of DCE/$\overline{\text{DTE}}$ input for T4/R4). See Tables 1 and 3 for detailed information.

Table 1. Termination Mode Selection

MODE	M2	M1	M0	DCE/$\overline{\text{DTE}}$	INVERT	R1	R2	R3	R4	R5
V.10/RS-423	0	0	0	0	X	Z	Z	Z	Z	Z
RS-530A	0	0	1	0	X	Z	Z	V.11	V.11	V.11
RS-530	0	1	0	0	X	Z	Z	V.11	V.11	V.11
X.21	0	1	1	0	X	Z	Z	V.11	V.11	V.11
V.35	1	0	0	0	X	V.35	V.35	V.35	V.35	V.35
RS-449/V.36	1	0	1	0	X	Z	Z	V.11	V.11	V.11
V.28/RS-232	1	1	0	0	X	Z	Z	Z	Z	Z
No Cable	1	1	1	0	X	V.11	V.11	V.11	V.11	V.11
V.10/RS-423	0	0	0	1	X	Z	Z	Z	Z	Z
RS-530A	0	0	1	1	X	Z	Z	Z	V.11	V.11
RS-530	0	1	0	1	X	Z	Z	Z	V.11	V.11
X.21	0	1	1	1	X	Z	Z	Z	V.11	V.11
V.35	1	0	0	1	X	V.35	V.35	V.35	V.35	V.35
RS-449/V.36	1	0	1	1	X	Z	Z	Z	V.11	V.11
V.28/RS-232	1	1	0	1	X	Z	Z	Z	Z	Z
No Cable	1	1	1	1	X	V.11	V.11	V.11	V.11	V.11

Detailed Description

The MAX3172/MAX3174 contain five software-selectable multiprotocol cable termination networks. Each network is capable of terminating V.11 transceivers (RS-422, RS-530, RS-530A, RS-449, V.36, and X.21) with a 100Ω differential load, V.35 transceivers with a T-network load, or V.28 (RS-232) and V.10 transceivers (RS-423) with an open circuit load. The MAX3172/MAX3174, along with the MAX3170 and MAX3171/MAX3173, form a complete +3.3V software-selectable DTE or DCE interface port supporting V.11/RS-422, RS-530, RS-530A, V.36/RS-449, V.35, V.28/RS-232, V.10/RS-423, and X.21 serial interfaces.

The MAX3172/MAX3174 also contain a multiprotocol transceiver that is software-selectable between V.10 and V.28 operation modes. This transceiver is intended as the handshake signal I/O in a DCE/DTE port application, and is designed to use V+ and V- levels generated by the MAX3171/MAX3173 charge pump. The MAX3172 features 10µs deglitching on the V.10/V.28 receiver input to allow unterminated operation. The MAX3174 is used in applications that do not require deglitching on the serial handshake signals.

No-Cable Mode

The MAX3172/MAX3174 enter no-cable mode when the mode-select inputs are all HIGH (M0 = M1 = M2 = 1). In this mode, the driver, receiver, and bias circuitry are disabled, and the supply current drops to less than 200µA.

Table 2. Switch Configuration by Mode

MODE	SW1	SW2
V.35	ON	ON
V.11	ON	OFF
V.28/V.10 (Z)	OFF	OFF

In no-cable mode, all five termination networks are placed in the V.11 mode of operation (shorting pins R_A and R_B with a 100Ω resistor). The receiver output enters a high-impedance state in no-cable mode, allowing this output line to be shared with other receivers (the receiver output has an internal pullup resistor to pull the output HIGH if not driven). Also, in no-cable mode, the transmitter output enters a high-impedance state so that this output can be shared with other devices.

Cable Termination

The MAX3172/MAX3174 software-selectable resistor networks are intended for use with the MAX3170 clock/data transceiver chip. The termination network is used for the V.11, V.35, and V.28 transmitters. The MAX3172/MAX3174 provide the advantage of not having to build expensive termination networks from resistors and relays, manually changing termination modules, or building termination networks into custom cables.

Each termination network can be in one of three modes: V.35, V.11, or high impedance (high-Z) as shown in Figure 5 (see Table 2). For example, in V.35 mode, all five

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

Table 3. R4/T4 Mode-Select Table

PROTOCOL	M2	M1	M0	DCE/$\overline{\text{DTE}}$	INVERT	T4	R4
Not Used (Default V.11)	0	0	0	0	0	Z	V.10
RS-530A	0	0	1	0	0	Z	V.10
RS-530	0	1	0	0	0	Z	V.10
X.21	0	1	1	0	0	Z	V.10
V.35	1	0	0	0	0	Z	V.28
RS-449/V.36	1	0	1	0	0	Z	V.10
V.28/RS-232	1	1	0	0	0	Z	V.28
No Cable	1	1	1	0	0	Z	Z
Not Used (Default V.11)	0	0	0	1	0	V.10	Z
RS-530A	0	0	1	1	0	V.10	Z
RS-530	0	1	0	1	0	V.10	Z
X.21	0	1	1	1	0	V.10	Z
V.35	1	0	0	1	0	V.28	Z
RS-449/V.36	1	0	1	1	0	V.10	Z
V.28/RS-232	1	1	0	1	0	V.28	Z
No Cable	1	1	1	1	0	Z	Z
Not Used (Default V.11)	0	0	0	0	1	V.10	Z
RS-530A	0	0	1	0	1	V.10	Z
RS-530	0	1	0	0	1	V.10	Z
X.21	0	1	1	0	1	V.10	Z
V.35	1	0	0	0	1	V.28	Z
RS-449/V.36	1	0	1	0	1	V.10	Z
V.28/RS-232	1	1	0	0	1	V.28	Z
No Cable	1	1	1	0	1	Z	Z
Not Used (Default V.11)	0	0	0	1	1	Z	V.10
RS-530A	0	0	1	1	1	Z	V.10
RS-530	0	1	0	1	1	Z	V.10
X.21	0	1	1	1	1	Z	V.10
V.35	1	0	0	1	1	Z	V.28
RS-449/V.36	1	0	1	1	1	Z	V.10
V.28/RS-232	1	1	0	1	1	Z	V.28
No Cable	1	1	1	1	1	Z	Z

networks are configured to provide 100Ω differential impedance and 150Ω common-mode impedance to terminate the MAX3170 V.35 transmitter outputs and receiver inputs.

Termination Mode Selection

The mode-select pins M0, M1, M2, and DCE/$\overline{\text{DTE}}$ control the state of the five termination networks (Table 1). The mode-select table of the MAX3172/MAX3174 is compatible with the MAX3170 mode-select table so that the M0, M1, M2, and DCE/$\overline{\text{DTE}}$ pins can be connected to the corresponding pins on the MAX3170. For example, M2 = 1, M1 = 0, M0 = 0 corresponds to V.35 mode for both the MAX3172/MAX3174 and the MAX3170 clock/data transceiver chip.

R4/T4 Mode Selection

The MAX3172/MAX3174 include a transceiver for use in applications requiring an extra serial handshake signal (for example, local loopback). The transceiver can be

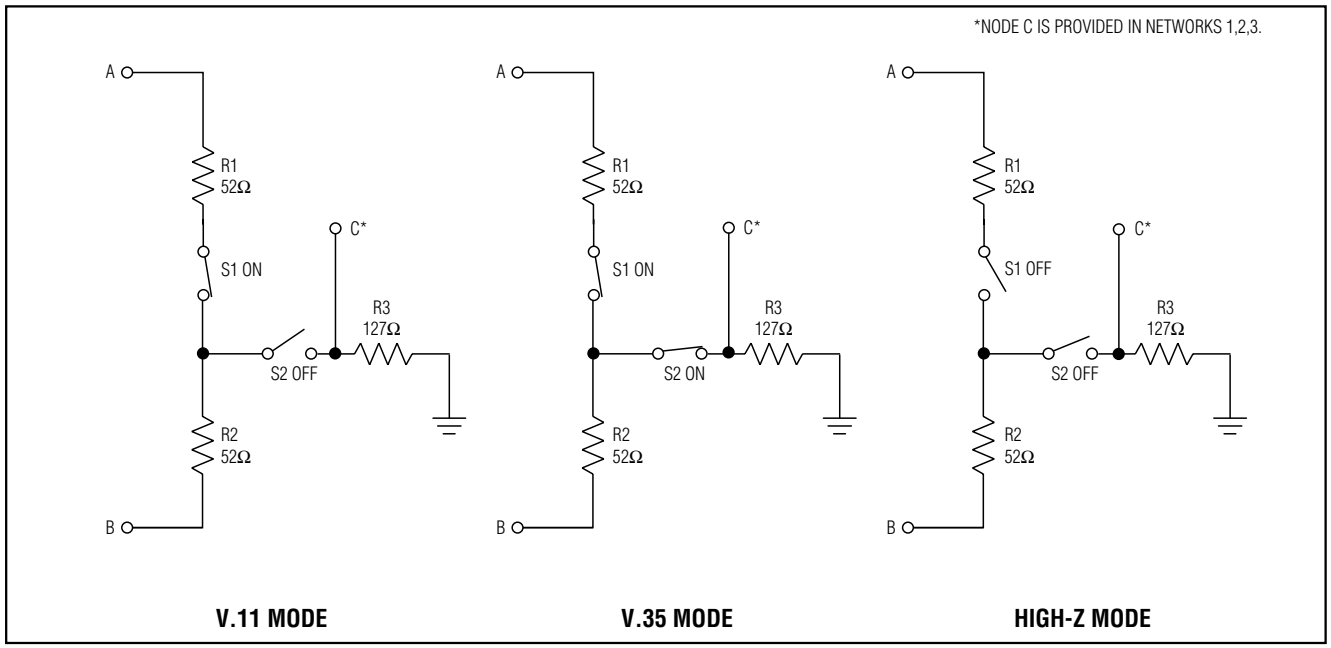


Figure 5. MAX3172/MAX3174 Termination Network Configurations

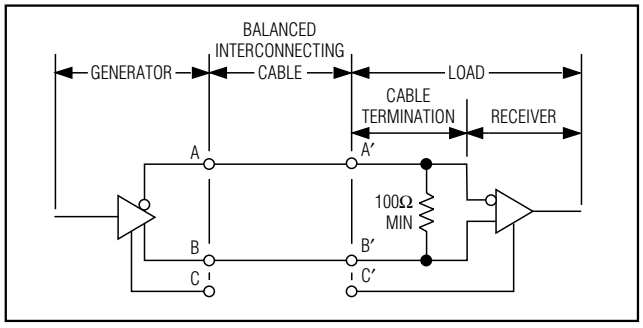


Figure 6. Typical V.11 Interface

configured for V.10 or V.28 operation as a driver or receiver (Table 3). This mode-selection table is compatible for use with the MAX3170 (clock/data transceiver) and the MAX3171/MAX3173 (control transceiver). For example, if X.21 mode is selected in DCE mode (M2 = 0, M1 = 1, M0 = 1, and DCE/$\overline{DTE}$ = 1), the MAX3170, MAX3171/MAX3173, and MAX3172/MAX3174 transceivers will all be placed in X.21 DCE mode.

Fail-Safe

The MAX3172/MAX3174 guarantee a logic HIGH receiver output when the receiver input is shorted to GND or when it is connected to a terminated transmission line with the driver disabled. The V.10 receiver threshold is between +25mV and +250mV. If the V.10 receiver input voltage is less than +25mV, R4OUT is logic HIGH. If the V.10 receiver input is greater than +250mV, R4OUT is logic LOW.

The V.28 receiver threshold is between +0.8V and +2.0V. If the V.28 receiver input voltage is less than +0.8V, R4OUT is logic HIGH. If the receiver input is greater than +2.0V, R4OUT is logic LOW. If the driving transmitter is disabled or disconnected, the receiver's input voltage is pulled to zero by its internal termination. With the receiver thresholds of the MAX3172/MAX3174, this results in a logic HIGH.

Applications Information

Older multiprotocol cable termination implementations have been constructed using expensive relays with discrete resistors, custom cables with built-in termination, or complex circuit board configurations to route signals to the correct termination. The MAX3172/MAX3174 provide a simple solution to this termination problem. All required termination configurations are software selectable using four mode-control input pins (M2, M1, M0, and DCE/$\overline{DTE}$).

V.11 Termination

For high-speed data transmission, the V.11 specification recommends terminating the cable at the receiver

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

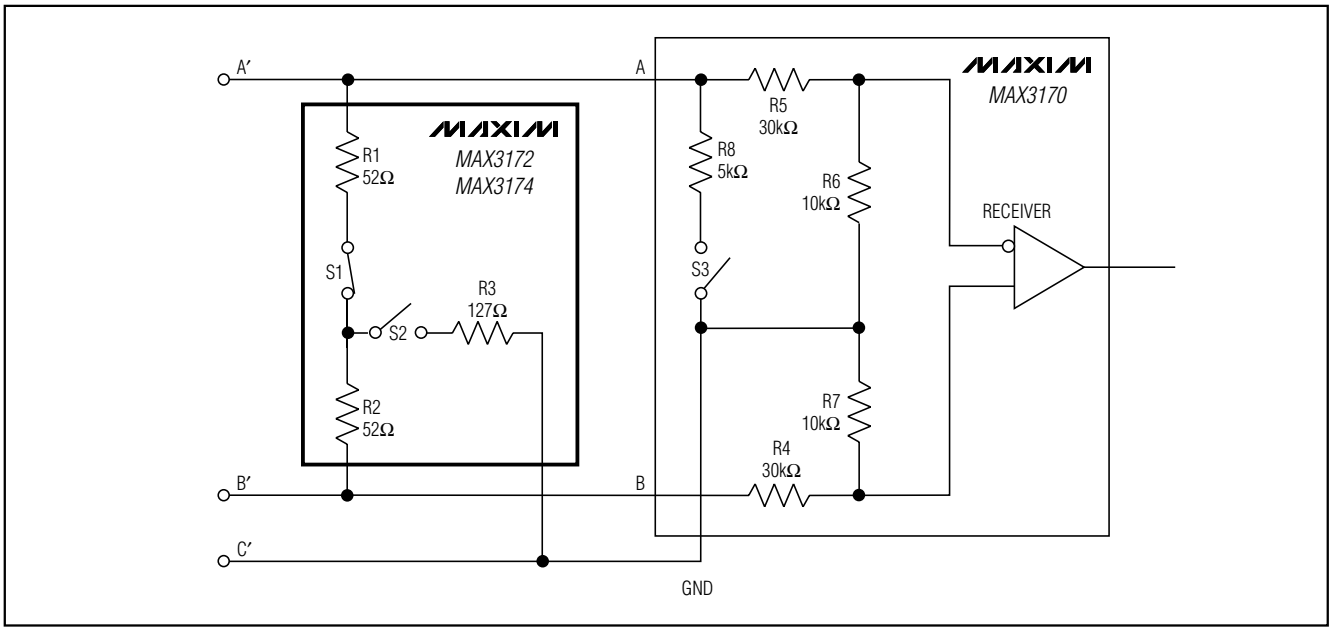


Figure 7. V.11 Termination and Internal Resistance Networks

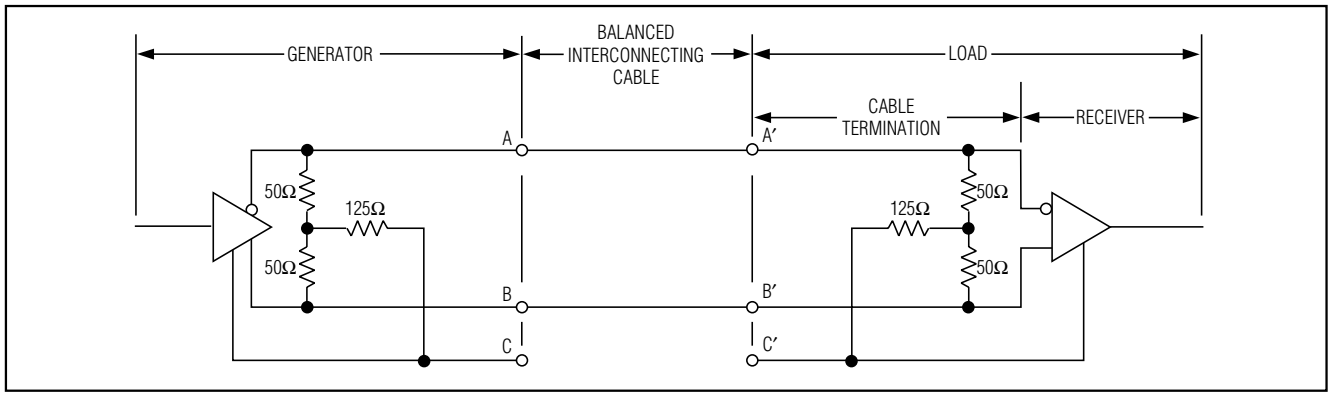


Figure 8. Typical V.35 Interface

with a minimum of a 100Ω resistor (Figure 6). This resistor, although not required, prevents reflections from corrupting transmitted data.

In Figure 7, the MAX3172/MAX3174 are used to terminate the V.11 receiver. Internal to the MAX3172/MAX3174, S1 is closed and S2 is open to present a 104Ω typical differential resistance and high-Z common-mode impedance. S3 opens to disable the MAX3170's internal V.28 termination.

The V.11 specification allows for signals with common-mode variations of ±7V with differential signal amplitudes from 2V to 6V. Also, data rates may be as high as 10Mbps. The MAX3172/MAX3174 maintain steady termination impedance between 100Ω and 110Ω over these conditions.

V.35 Termination

Figure 8 shows a standard V.35 interface. The generator and the load must both present a 100Ω ±10Ω differential impedance and a 150Ω ±15Ω common-mode impedance (as shown by the resistive T-networks in Figure 8). The V.35 driver generates a current output (typically ±11mA) that develops an output voltage between 440mV and 660mV across the load termination networks.

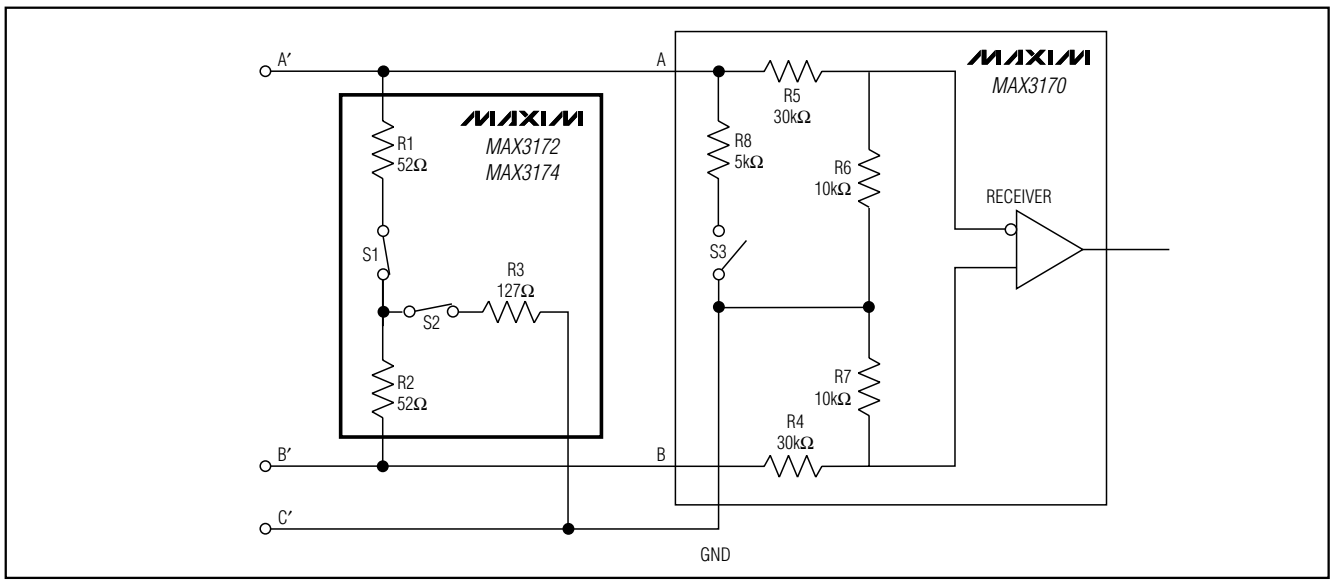


Figure 9. V.35 Termination and Internal Resistance Networks

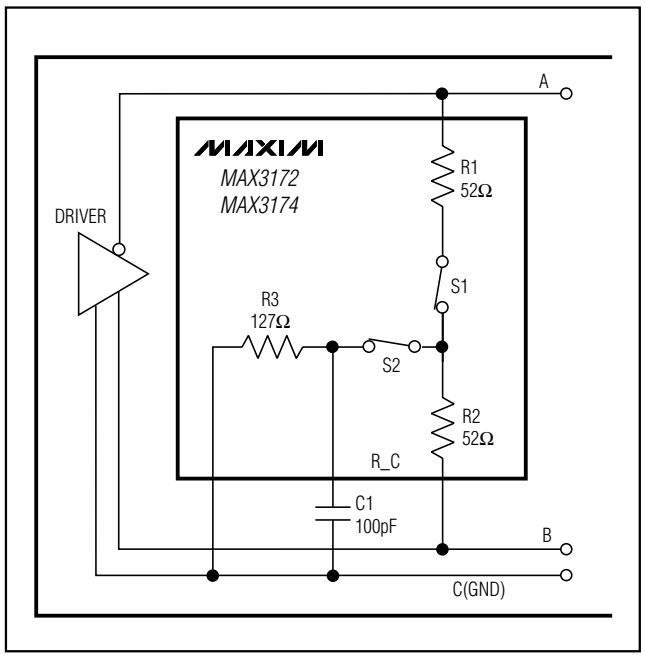


Figure 10. V.35 Driver

In Figure 9, the MAX3172/MAX3174 are used to implement the resistive T-network that is needed to properly terminate the V.35 driver and receiver. Internal to the MAX3172/MAX3174, S1 and S2 are closed to connect the T-network resistors to the circuit. The V.28 termination resistor, internal to the MAX3170, is disabled by opening S3 to avoid interference with the T-network impedance.

The V.35 specification allows for ±4V of ground difference between the V.35 generator and V.35 load. The V.35 data rates may be as high as 10Mbps. The MAX3172/MAX3174 maintain correct terminal impedances over these conditions.

V.35 EMI Reduction

For applications where EMI reduction is especially important, the MAX3172/MAX3174 termination networks provide a pin for shunting common-mode driver currents to GND (Figure 10). Mismatches between A and B driver output propagation delays create a common-mode disturbance on the cable. This common-mode energy can be shunted to GND by placing a 100pF capacitor (C1 to GND) from the center point of the T-network termination (R1C, R2C, and R3C).

V.28 Termination

Most industry-standard V.28 receivers (including the MAX3170) do not require external termination because the receiver includes an internal 5kΩ termination resistor. When the MAX3172/MAX3174 are placed in V.28 mode, all five of the termination networks are placed in a high-Z mode. In high-Z mode, the MAX3172/MAX3174 termination networks will not interfere with the MAX3170's internal 5kΩ termination.

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

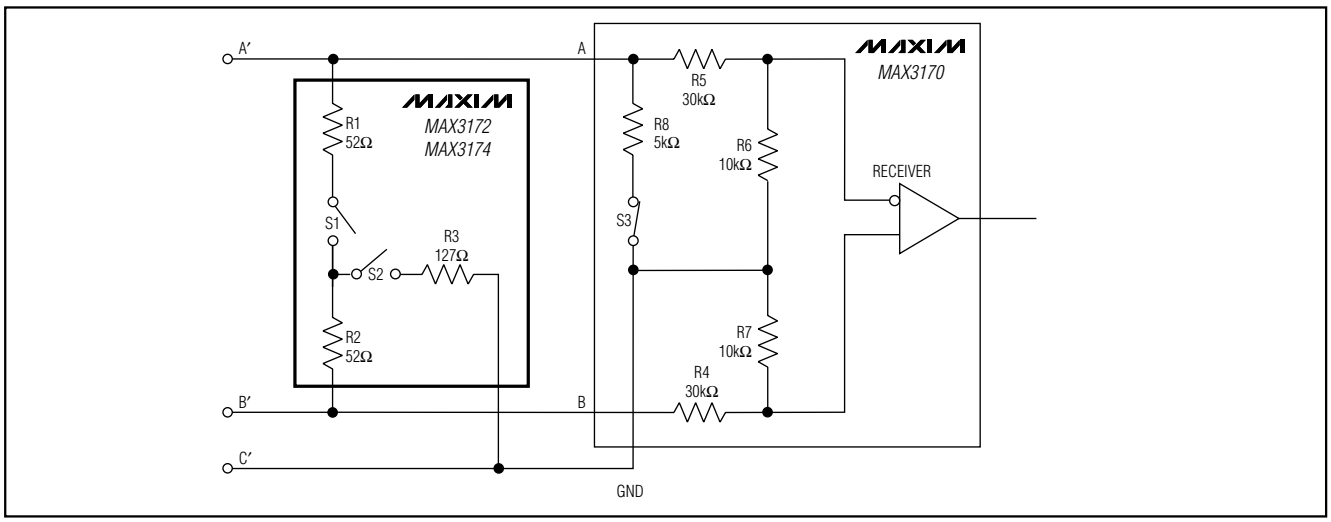


Figure 11. V.28 Termination and Internal Resistance Networks

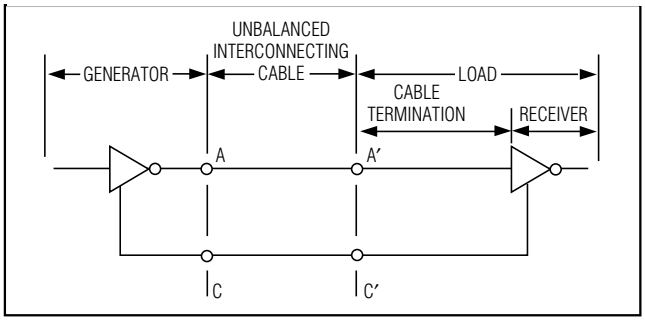


Figure 12. Typical V.28 and V.10 Interface

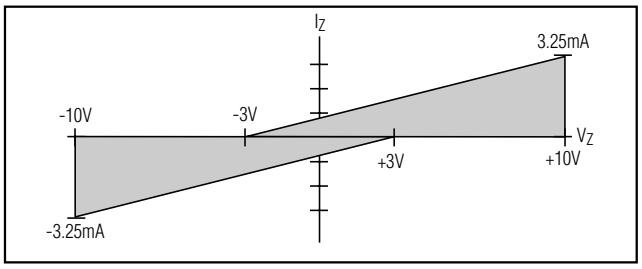


Figure 13. V.10 Receiver Input Impedance

In Figure 11, the MAX3170 and MAX3172/MAX3174 are placed in V.28 mode. Switches S1 and S2 are opened on the MAX3172/MAX3174 to place the network in high-Z mode. Switch S3 is closed on the MAX3170 to enable the 5kΩ terminating resistor.

V.28 Interface

The V.28 interface is an unbalanced single-ended interface (Figure 12). The V.28 driver generates a minimum of ±5V across the load impedance between A' and C'. The V.28 receiver specification calls for input trip points at ±3V. To aid in rejecting system noise, the MAX3170 V.28 receiver has a typical hysteresis of 0.5V. Also, the MAX3172/MAX3174 have more tightly specified input trip points to guarantee fail-safe operation (see *Fail-Safe*).

The MAX3172/MAX3174 V.28 receiver provides an internal 5kΩ termination resistance.

V.10 Interface

The V.10 interface (Figure 12) is an unbalanced single-ended interface capable of driving a 450Ω load. The V.10 driver generates a minimum voltage of ±4V (V_{ODO}) across A' and C' when unloaded and a minimum voltage of ±0.9 × V_{ODO} when loaded with 450Ω. The V.10 receiver input trip threshold is defined between +300mV and -300mV with input impedance characteristics shown in Figure 13.

The MAX3172/MAX3174 V.10 mode receiver has a threshold between +25mV and +250mV to ensure that the receiver has proper fail-safe operation (see *Fail-Safe*). To aid in rejecting system noise, the MAX3172/MAX3174 V.10 receiver has a typical hysteresis of 15mV. Switch S3 in Figure 14 is open in V.10 mode to disable the 5kΩ V.28 termination at the receiver input.

Receiver Glitch Rejection

To allow operation in an unterminated or otherwise noisy system, the MAX3172 features 10µs of receiver input glitch rejection. The glitch-rejection circuitry blocks the reception of high-frequency noise with a bit period less than 5µs while receiving low-frequency signals with a bit period greater than 15µs, allowing glitch-free operation in unterminated systems at up to 64kbps.

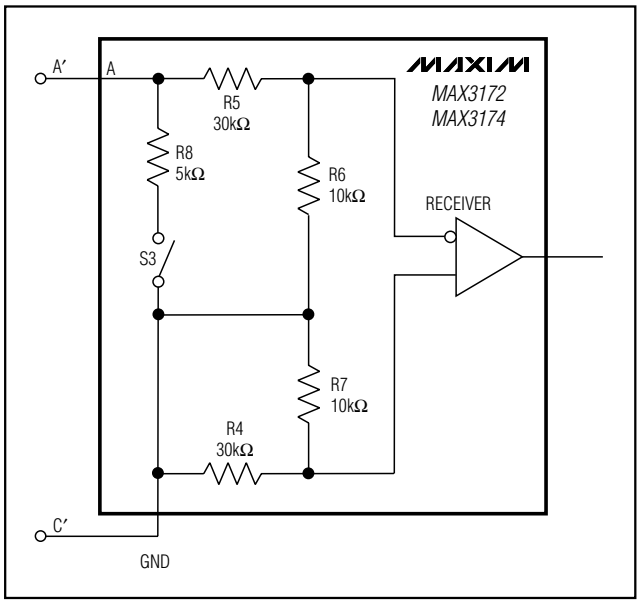


Figure 14. V.10 Internal Resistance Networks

The MAX3174 does not have this glitch rejection and can be operated at frequencies up to 240kbps if properly terminated.

DCE vs. DTE Operation

Figure 15 illustrates a DCE or DTE controller-selectable interface. The DCE/$\overline{\text{DTE}}$ input switches the MAX3172/MAX3174s' mode of operation. Logic high selects DCE, which enables driver 4 on the MAX3172/MAX3174 (INVERT = 0), driver 3 on the MAX3171/MAX3173, and driver 3 on the MAX3170. A logic low selects DTE, which enables receiver 4 on the MAX3172/MAX3174 (INVERT = 0), receiver 1 on the MAX3171/MAX3173, and receiver 1 on the MAX3170.

This application requires only one DB-25 connector. See Figure 15 for complete signal routing in DCE and DTE modes. For example, driver 4 routes the LL(DCE) signal to pin 18 in DCE mode, while in DTE mode, receiver 4 routes pin 18 to the LL(DTE) signal.

Complete Multiprotocol X.21 Interface

A complete DTE-to-DCE interface operating in X.21 mode is shown in Figure 16. The MAX3172/MAX3174 terminate the V.11 clock and data signals, and its transceiver carries the local loopback (LL) signal. The MAX3170 carries the clock and data signals, and the MAX3171/MAX3173 carry the control signals. The control signals generally do not require external termination.

Compliance Testing

A European Standard EN45001 test report is available for the MAX3170–MAX3174 chipset. A copy of the test report is available from Maxim upon request.

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

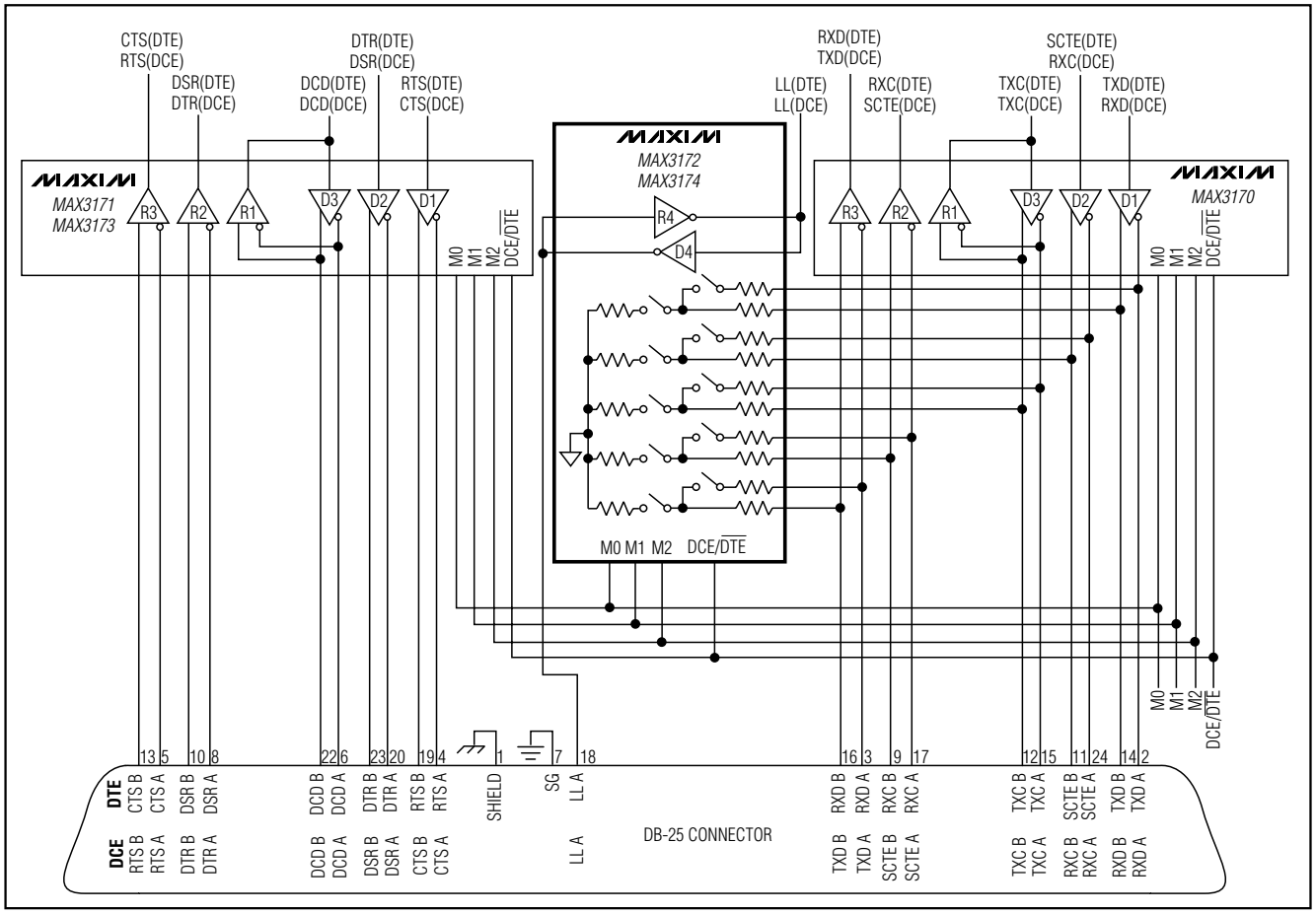


Figure 15. Multiprotocol DCE/DTE Port

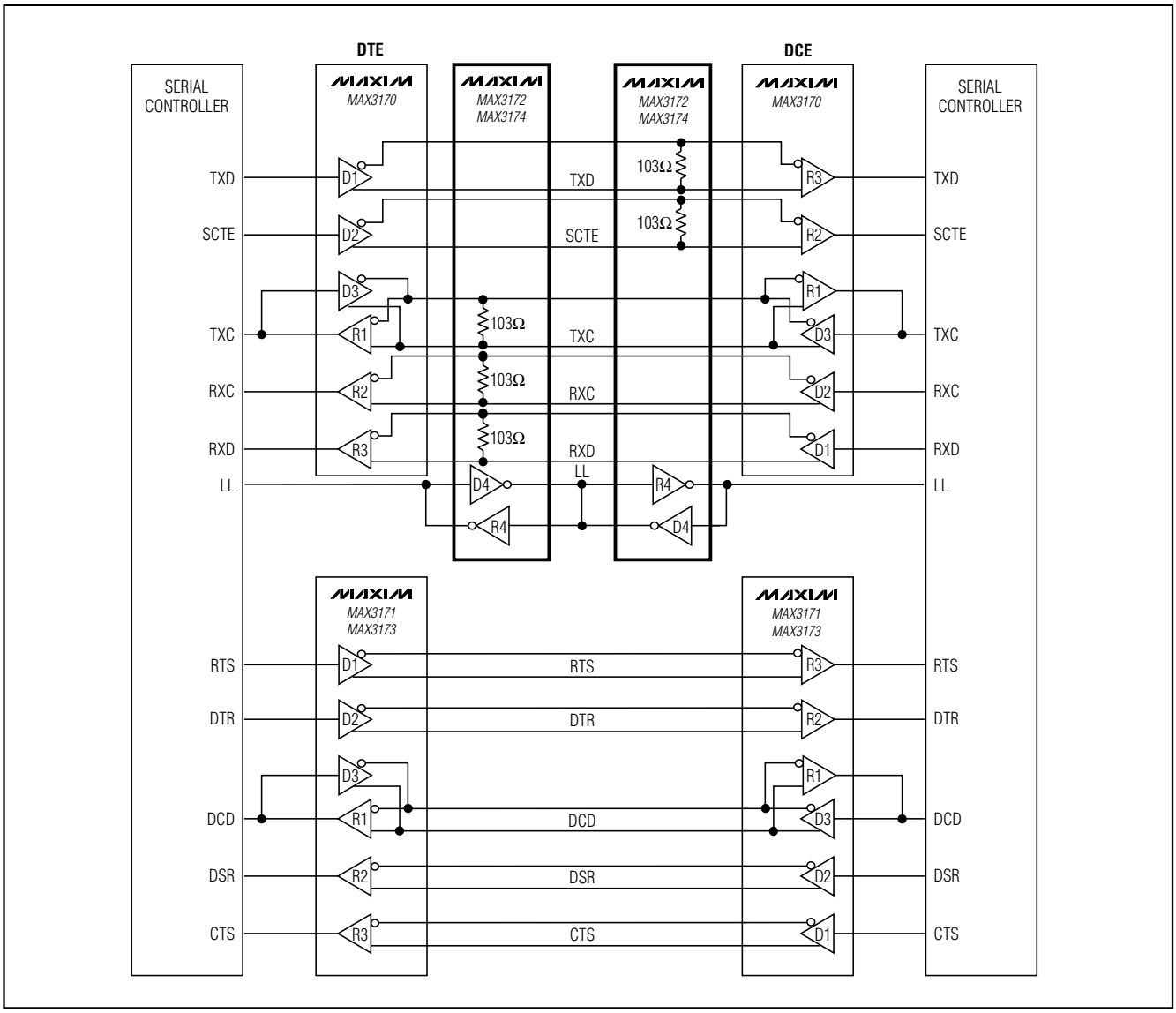
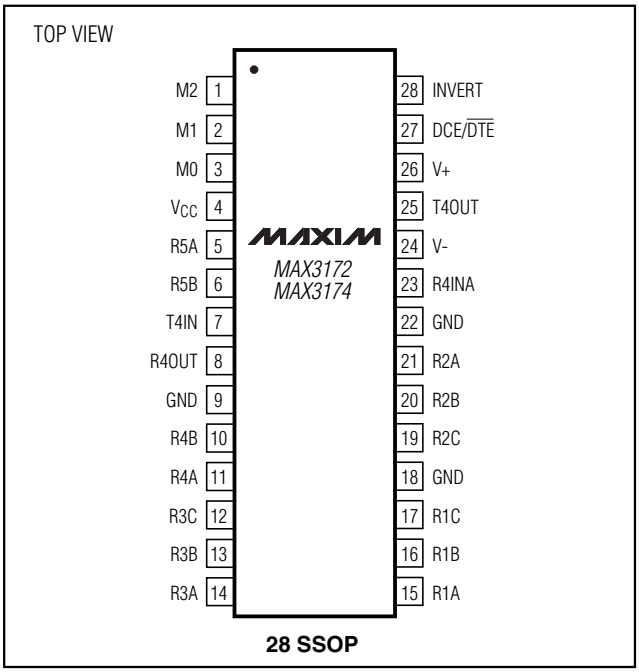


Figure 16. DCE-TO-DTE X.21 Interface

+3.3V Multiprotocol Software-Selectable Cable Terminators and Transceivers

Pin Configuration

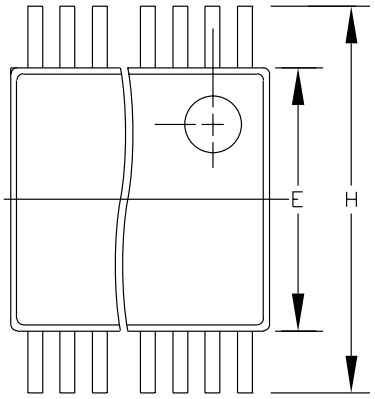


Chip Information

TRANSISTOR COUNT: 2506

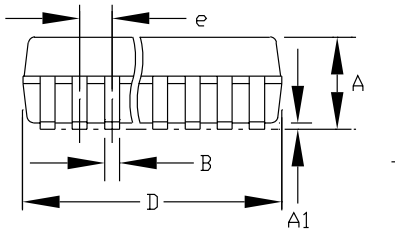
Package Information

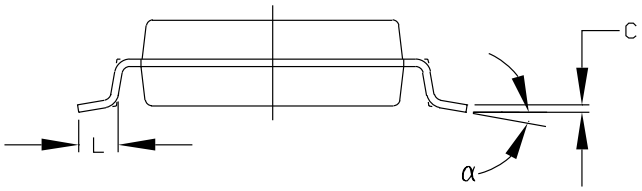
SSOP.EPS



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	0.068	0.078	1.73	1.99
A1	0.002	0.008	0.05	0.21
B	0.010	0.015	0.25	0.38
C	0.004	0.008	0.09	0.20
D	SEE VARIATIONS			
E	0.205	0.209	5.20	5.38
e	0.0256 BSC		0.65 BSC	
H	0.301	0.311	7.65	7.90
L	0.025	0.037	0.63	0.95
α	0°	8°	0°	8°

	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	
D	0.239	0.249	6.07	6.33	14L
D	0.239	0.249	6.07	6.33	16L
D	0.278	0.289	7.07	7.33	20L
D	0.317	0.328	8.07	8.33	24L
D	0.397	0.407	10.07	10.33	28L





NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER

MAXIM
PROPRIETARY INFORMATION

TITLE:
PACKAGE OUTLINE, SSOP, 5.3X.65mm

APPROVAL	DOCUMENT CONTROL NO.	REV	
	21-0056	A	1/1