SERTECH LABS
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TSC396
Line Driver/Receiver
• Dual Differential

Features

Differential Inputs and Outputs

Internal Bias, Reference and Hysteresis Sources

Low Output Impedance

Useful for Single-Wire Input/Output Applications

MOS Compatible Inputs

Power Supply Range of 11V to 16V

Applications

Differential Line Driver or Line Receiver

Line Repeater

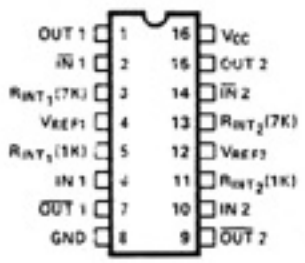
Single-Ended Line Driver or Line Receiver

Alternate to Motorola MC696

General Description

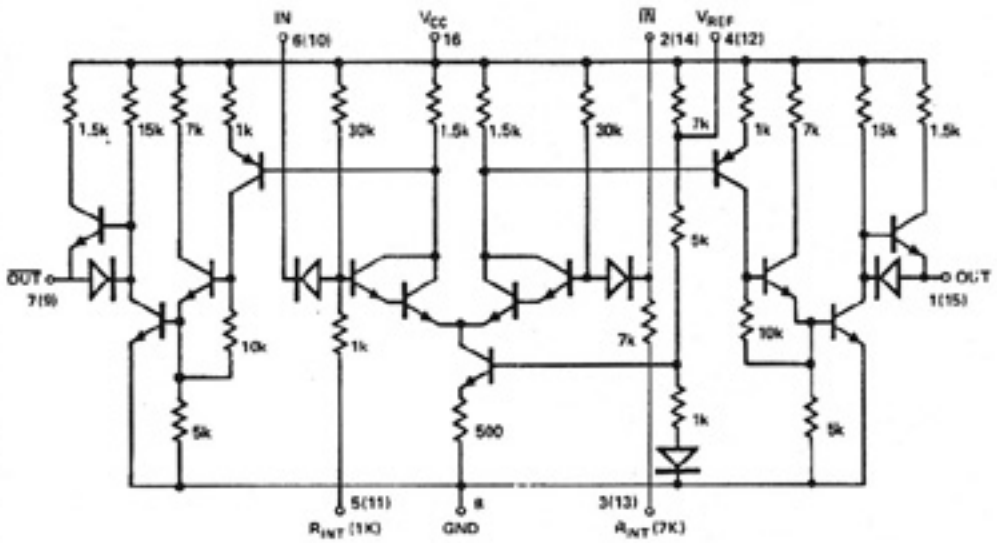
The 396 dual differential line driver/receiver is designed for industrial logic applications requiring high immunity to electrical noise. The 396 has an extremely flexible hysteresis capability, allowing the user to adjust the switching threshold. Thus the 396 is also useful for single-wire input/output applications.

Connection Diagram

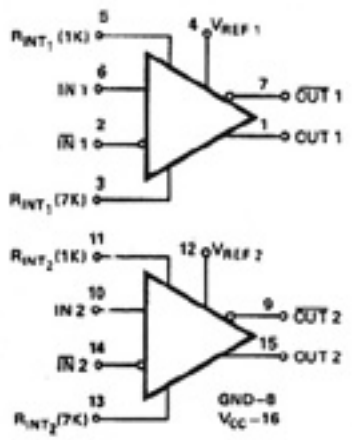


16-LEAD DIP

Schematic Diagram



Block Diagram



Absolute Maximum Ratings

Continuous Supply Voltage	16.5V
Pulsed Supply Voltage (less than 100ms)	18V
Input Voltage (any input)	-0.5 to +18V
Storage Temperature	-65°C to +150°C
Lead Temperature (1/16 inch from case 10 sec max.)	300°C

Recommended Operating Conditions

(Normal operating range is 12 to 15 volts ±1 volt)

Parameter	Min.	Typ.	Max.	Unit
Supply Voltage	11		16	V
Operating Free-Air Temperature, T_A	-30		85	°C

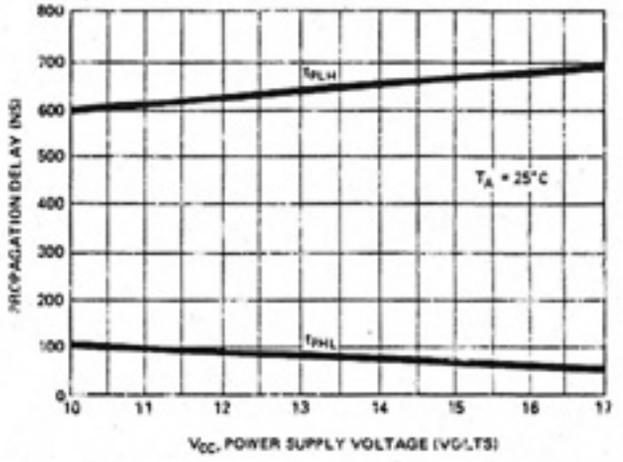
Electrical Characteristics

Over Recommended Operating Conditions Unless Otherwise Noted.
(L and J package temperature range is -30 to +85°C)

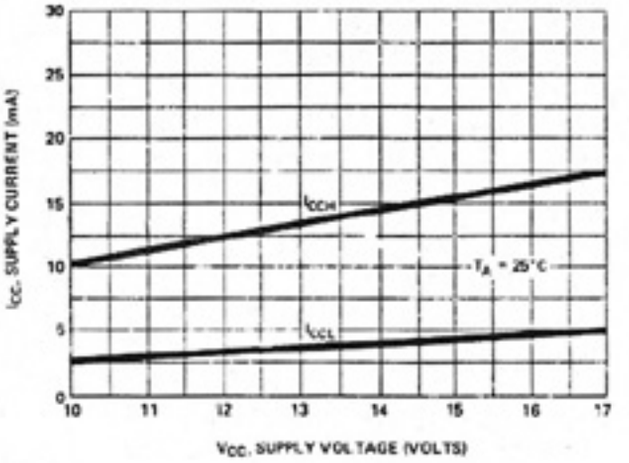
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Output High Voltage	V_{OH}	I_{OH} = -30μA, V_{IL} = 4V, V_{CC} = 11V	8.5			V
		I_{OH} = -30μA, V_{IL} = 6.5V, V_{CC} = 16V	14.5			V
Output Low Voltage	V_{OL}	I_{OL} = 12mA, V_{IL} = 6.0V, V_{CC} = 11V			1.5	V
		I_{OL} = 15mA, V_{IH} = 8.5V, V_{CC} = 14V			1.5	V
Reference Voltage	V_{REF}	I_{REF} = 0μA, V_{CC} = 12V	4.0		6.0	V
		I_{REF} = 0μA, V_{CC} = 15V	6.5		8.5	V
Input High Current	I_{IH}	V_{IH} = 16V, V_{CC} = 16V			10	μA
Input Low Current	I_{IL}	V_{IL} = 0.4V, V_{CC} = 11V			-0.4	mA
		V_{IL} = 1.5V, V_{CC} = 16V			-1.0	mA
Output Leakage Current	I_{CEX}	V_{CEX} = 16, V_{CC} = 16V			25	μA
Output Short Circuit Current (High state only)	I_{SC}	V_{CC} = 11V	-3.9		-10	mA
		V_{CC} = 16V	-6.5		-16	mA
Supply Current	I_{CCL}	V_{CC} = 16V, All Inputs Grounded			12	mA
Supply Current	I_{CCH}	V_{CC} = 16V (Inverting Inputs Tied to V_{REF})			25	mA
Common Mode Voltage Range			1.5		V_{CC} -1.5	V
Differential Voltage Range			±12			V
Switching Characteristics	t_{PHL}	T_A = 25°C, R_L = 1.5K, C_L = 100pf		80		nsec
	t_{PLH}	T_A = 25°C, R_L = 1.5K, C_L = 100pf		650		nsec

Typical Performance Curves

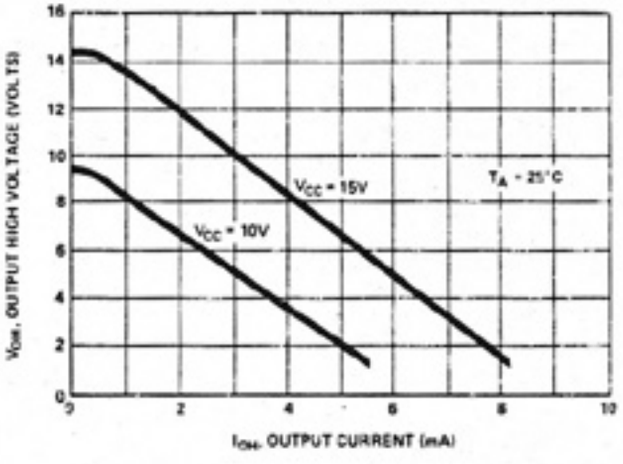
PROPAGATION DELAY TIME VS. POWER SUPPLY VOLTAGE



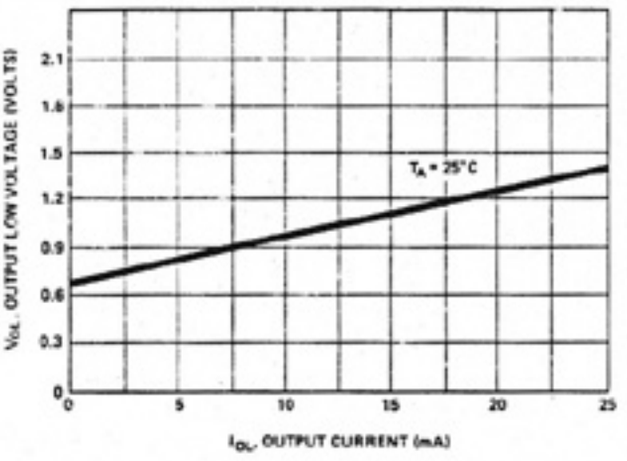
SUPPLY CURRENT VS. SUPPLY VOLTAGE



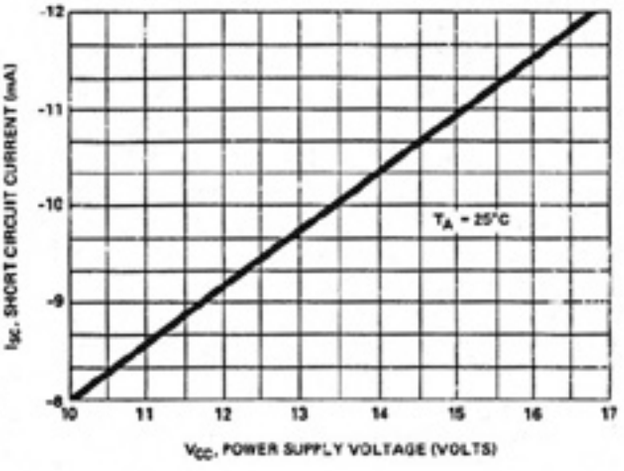
OUTPUT HIGH VOLTAGE VS. OUTPUT CURRENT



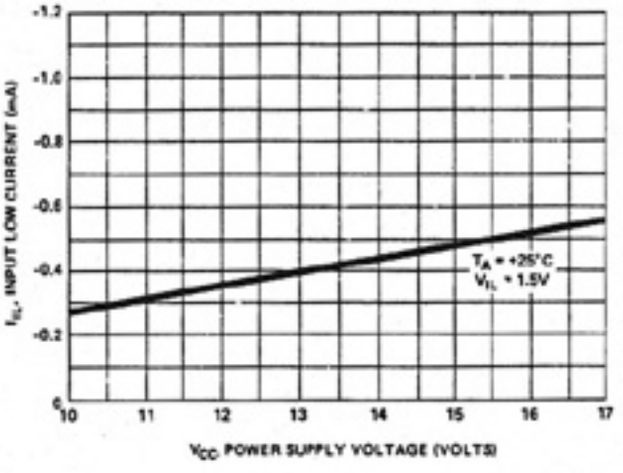
OUTPUT LOW VOLTAGE VS. OUTPUT CURRENT



OUTPUT SHORT CIRCUIT CURRENT VS. POWER SUPPLY VOLTAGE

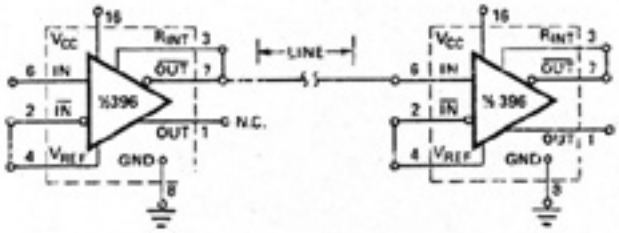


INPUT LOW CURRENT VS. POWER SUPPLY VOLTAGE

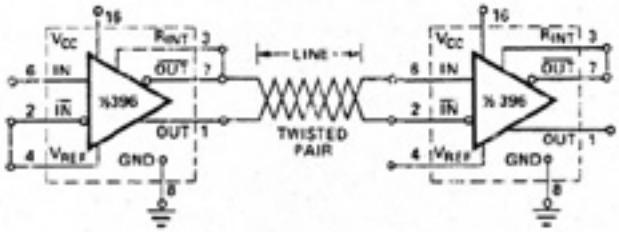


Applications Information

CONNECTION DIAGRAMS



Single Ended



Differential

Hysteresis Modes of the 396

The 396 has very flexible hysteresis capability, enabling the designer to adjust the switching thresholds (and thus the noise immunity) of the device to suit his needs. The hysteresis thresholds (V_{IL}, V_{IH}) and widths (V_{HW}) for various feedback resistor values of the test circuit shown in Figure 1 are plotted in Figure 2. The power supply is set at 15V, so that with the inverting input tied to the internal reference voltage of the circuit (approximately 1/2 V_{CC}), the high level and low level switching points of the device are centered about the 7.5 volt level.

Note that both switching points change symmetrically about that reference level until the feedback resistor is decreased below 5.5K ohm, giving a very wide range of widths. The variation of hysteresis width with changes in the power supply voltage is quite linear over the operating range as shown in Figure 3; the internal 7.0K resistor is used in that test for the hysteresis feedback.

The hysteresis center point level (V_L) can be changed by varying the reference voltage level as shown in Figure 4, giving complete control over the setting of the hysteresis levels. The only limitation is that the levels must remain within the common-mode range (CMR) of the device (1.5V above ground to 1.5V less than V_{CC}).

The hysteresis widths for the test circuit shown in Figure 4 are plotted in Figure 4A.

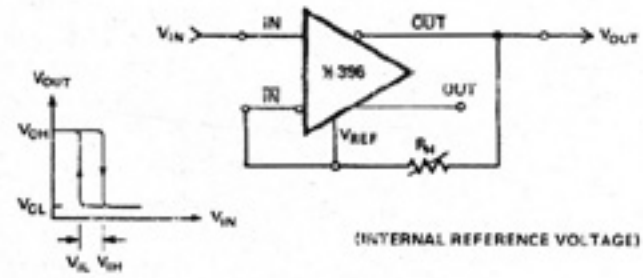


Figure 1. Variable Hysteresis Width Circuit

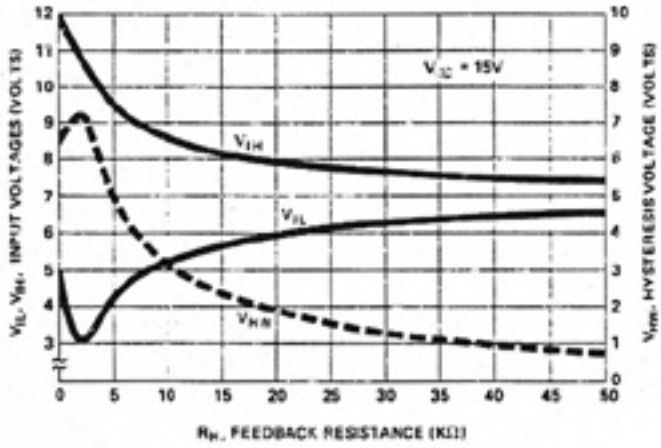


Figure 2. Typical Hysteresis Voltage (V_{IL}, V_{IH}) vs. Feedback Resistance (R_H)

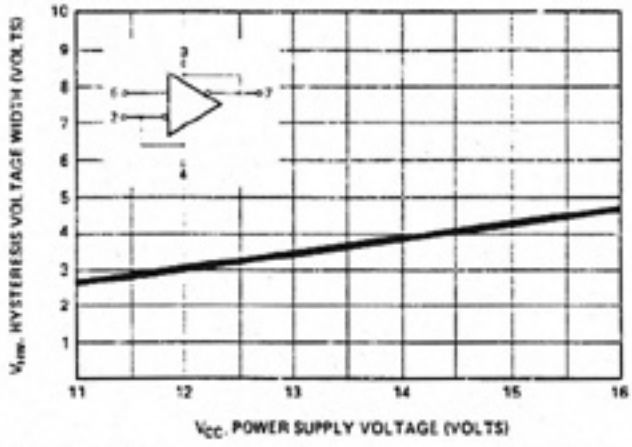


Figure 3. Hysteresis Width vs. Power Supply Voltage (Using Internal 7.0kΩ Resistor)

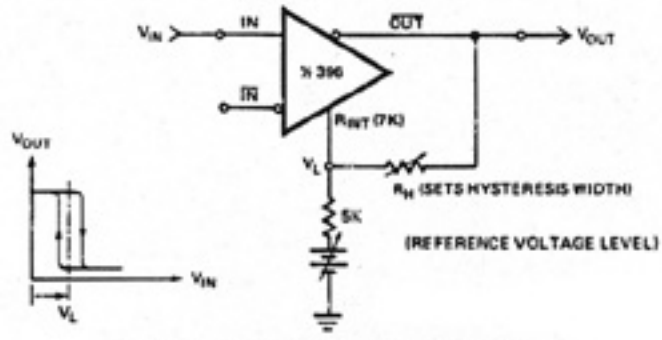


Figure 4. Hysteresis Level Variable

Applications Information

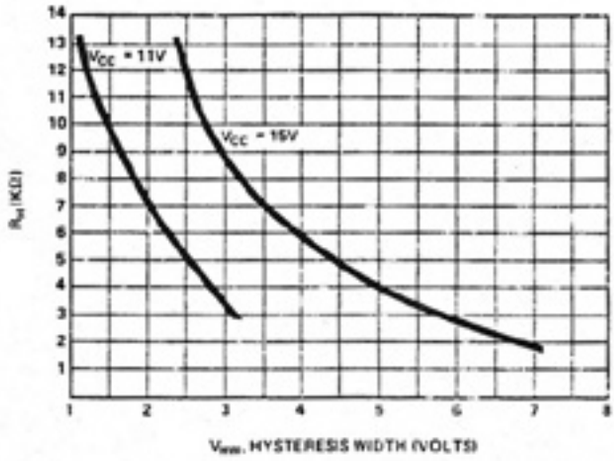
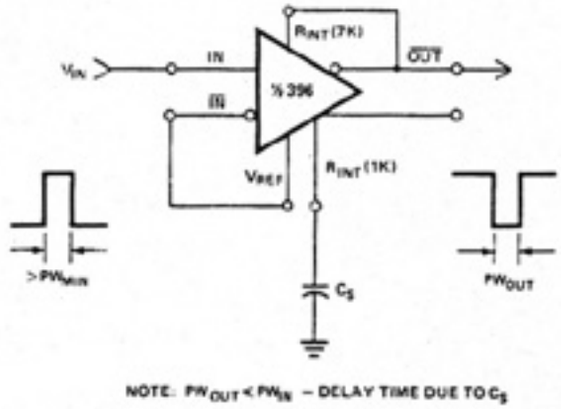


Figure 4A. Feedback Resistances vs. Hysteresis Widths

396 Slow-Down Receiver

The 396 can be used as a single-ended slow-down receiver as shown in Figure 5. By connecting a capacitor to the internal 1.0K resistor, the device can be made insensitive to pulses with widths shorter than a predetermined value. The graph in Figure 6 shows the minimum input signal pulse width necessary to trigger the circuit versus capacitance.



NOTE: $PW_{OUT} < PW_{IN}$ – DELAY TIME DUE TO C_S

Figure 5. 396 as Single-Ended Slow-Down Receiver

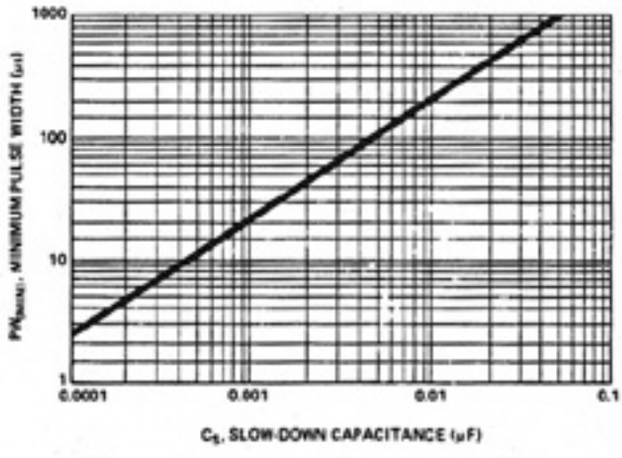


Figure 6. Minimum Pulse Width vs. Slow-Down Capacitance

396 as Line Driver/Receiver/Repeater

One of the best applications of the 396 is, of course, as a line driver/receiver/repeater, and because of its low frequency operation, (<500 kHz), many of the complicated effects associated with line driving and receiving can be ignored and calculations become straight-forward.

In Figure 7, one device is used as a twisted-pair line driver and another as a line receiver. The balanced series resistance, R_S, adds some series damping and limits the current through the line at high power supply levels while setting the voltage levels at the input of the receiver for maximum common-mode noise rejection (i.e., bias the input differential voltage in the middle of the common-mode range). R_O merely terminates the line in its characteristics impedance (≈ 100 ohm for 30 turns/ft, AWG24-2B; twisted pair) so that capacitive effects on the line may effectively be ignored.

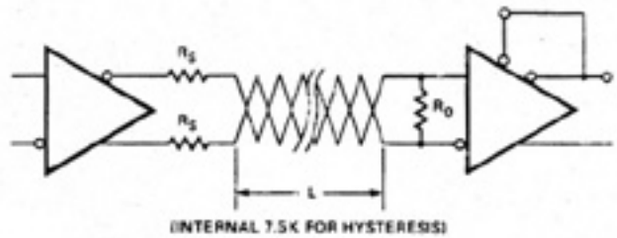


Figure 7. Using 396 as Differential Line Driver/Receiver

The worst-case limits of the series resistor can be calculated roughly by looking at the dc equivalent circuit shown in Figure 8. The three major constraints are:

1. $V_{diff} < V_{diff}$ min. ≈ 50mV
   (For safety margin use V_{diff} = 150mV)
2. $I_L < I_{SC}$ max.
3. Receiver input common-mode voltage centered in common-mode range (1.5V < CMR < V_{CC} — 1.5V)

For V_{CC} = 15V, these constraints require R_S to be about 5.0K.

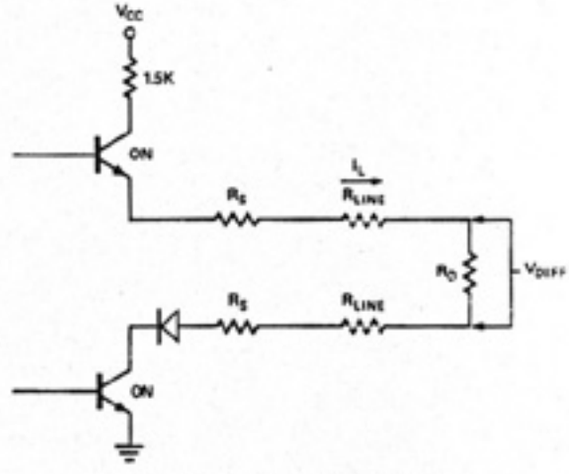


Figure 8. DC Equivalent Circuit

Applications Information

If necessary, hysteresis can be added to the receiver to improve switching characteristics, and for upgrading the signal along extremely long lines, the 396 can be used in a repeater configuration as shown in Figure 9.

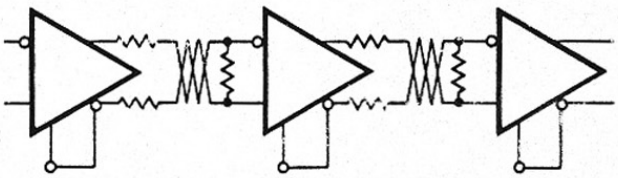


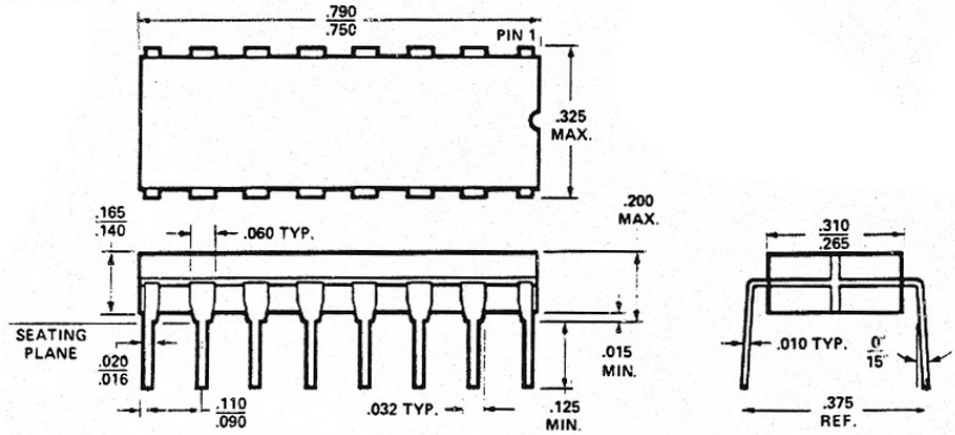
Figure 9. Using 396 as Line Repeaters

Ordering Information

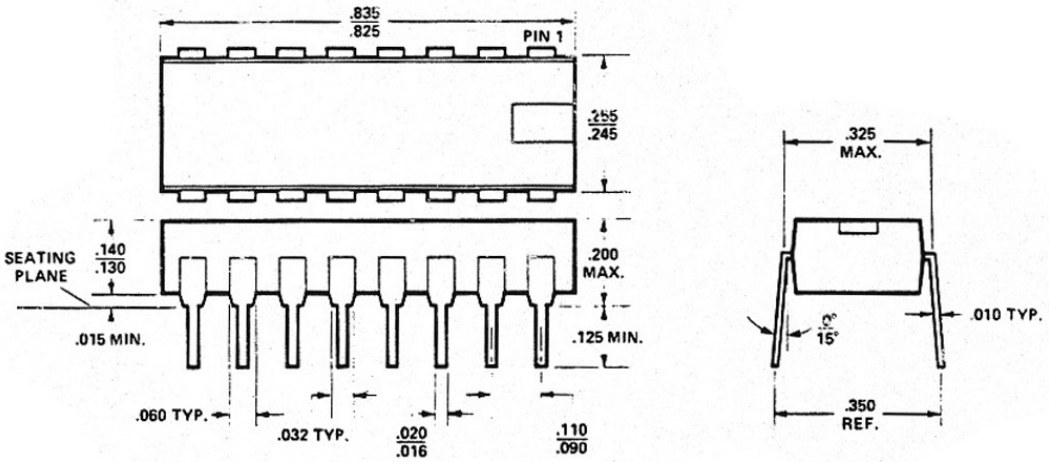
Order Part Numbers:

- L Package 16-Pin Ceramic DIP
  (-30°C ≥ T_A ≤ 85°C) 396AL/CL
- J Package 16-Pin Plastic DIP
  (-30°C ≥ T_A ≤ 85°C) 396AJ/CJ

Physical Dimensions



16-PIN CERAMIC DIP



16-LEAD PLASTIC DIP