

## Features

- Operates from single or dual power supply
- MH89726 extends transmission performance for the MT8972 (DNIC) at 160kbit/s line rate
- MH89728 extends transmission performance for the MT8972 (DNIC) at 80kbit/s line rate
- MH89726 and MH89728 are pin for pin compatible with each other
- Compact SIL package
- Over 6km loop range on 24 AWG

## Applications

- Digital subscriber lines
- Digital PABX line cards and telephone sets
- High speed, limited distance modem
- ISDN U - Interface

ISSUE 2

November 1990

### Ordering Information

MH89726/728 10 Pin SIL Package

**0°C to 70°C**

## Description

The MH89728 and MH89726 are thick film hybrid devices which may be used to extend the operating range of the MT8972 (DNIC). The hybrids combine signal equalization and amplification for the receive and transmit paths on each device.

The small size of these hybrids makes them suitable for line card or terminal use with the MT8972. The gain of the transmit signal may be adjusted through the use of an external resistor.

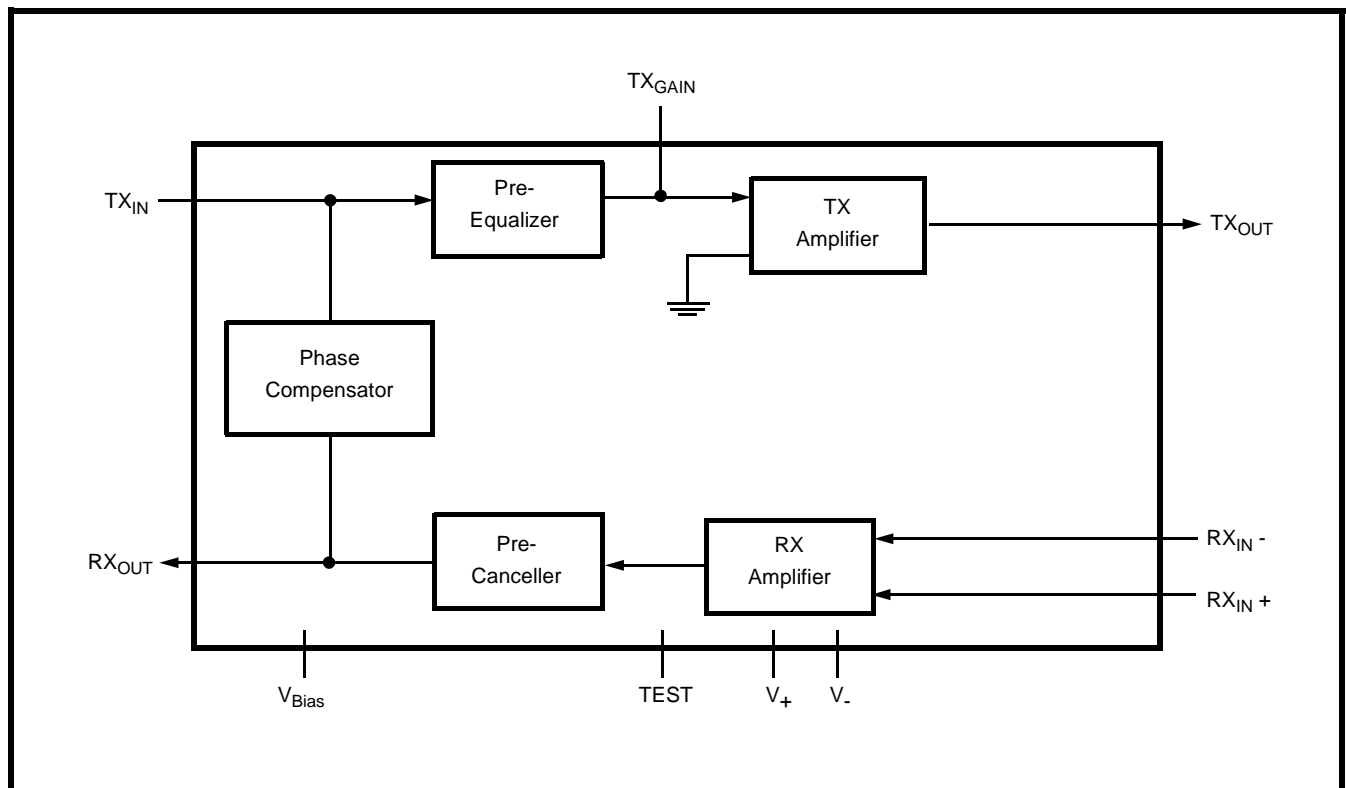


Figure 1 - Functional Block Diagram

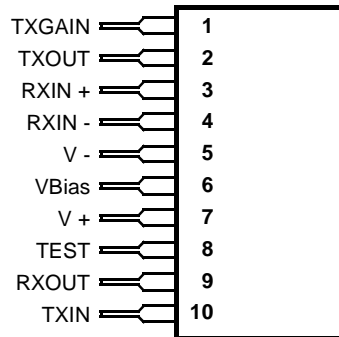


Figure 2 - Pin Connections

## Pin Description

| Pin # | Pin Name           | Description  |
|-------|--------------------|--|
| 1     | TX <sub>GAIN</sub> | <b>Transmit Gain.</b> To be connected to Pin 2. An increase in gain can be achieved by connecting an external resistor R <sub>EXT</sub> between Pin 1 and Pin 2. The resultant gain is calculated using; $A = (R/24) + 2.8$ , where A=Gain and R= R <sub>EXT</sub> (kΩ). |
| 2     | TX <sub>OUT</sub>  | <b>Transmit Output.</b> Connect to the termination network.  |
| 3     | RX <sub>IN-</sub>  | <b>Negative Receive Signal.</b> Connect to TX <sub>OUT</sub> , Pin 2.  |
| 4     | RX <sub>IN+</sub>  | <b>Positive Receive Signal.</b> Connected to line transformer.   |
| 5     | V-                 | <b>Negative power supply.</b>  |
| 6     | V <sub>Bias</sub>  | <b>Internal Bias Voltage.</b> Connect to GND through 0.33 μF for single power supplies. Connect to GND directly for split power supplies.  |
| 7     | V+                 | <b>Positive power supply.</b>  |
| 8     | TEST               | <b>Test.</b> Used for production testing. Leave unconnected.   |
| 9     | RX <sub>OUT</sub>  | <b>Receive Output.</b> Connect to L <sub>IN</sub> (Pin 21) of MT8972.  |
| 10    | TX <sub>IN</sub>   | <b>Transmit Input.</b> Connect to L <sub>OUT</sub> (Pin 1) of MT8972.  |

### Functional Description

The MH89726/728 are 10 pin SIL thick film hybrid circuits that may be used to extend the loop range capability of the MT8972 (DNIC). For a detailed description of the DNIC, refer to the MT8972 data sheet.

Figure 1 shows a block diagram of the Loop Extender Circuit (LEC). The LEC takes the line signal which is transmitted by the DNIC on L<sub>OUT</sub>, pre-equalizes, and amplifies it before sending it to the termination network. The gain of the TX amplifier is adjustable by using an external resistor between pins 1 and 2. If no external resistor is added, TX<sub>GAIN</sub> and TX<sub>OUT</sub> must be shorted together, and the default gain condition exists. This gain results in a transmit signal power level of +10 dBm.

On the receive side, the LEC receives the differential line signal from the transformer, and performs first-order pre-cancellation as well as gain and phase adjustment of the receive signal. The signal is then output on RX<sub>OUT</sub> which is connected to L<sub>IN</sub> of the MT8972.

Tables 1 and 2 show typical results obtained by using the LEC with the MT8972. Actual distance achieved may vary depending on the characteristics of the transmission cable being used. Most important factors include cable attenuation (dB/km), bridged taps, and crosstalk interference.

The LEC is powered typically from ±15 Volts if dual power supplies are available. Alternately 0 to +30 Volts, or -30 to 0 Volts can be used if only a single power supply is available.

### Applications

Figure 3 shows a typical connection diagram of the MT8972 and MH89726/728. RX<sub>OUT</sub> and TX<sub>IN</sub> of the LEC are connected to L<sub>OUT</sub> and L<sub>IN</sub> of the DNIC respectively. Pins 5, 6 and 7 are the power supply pins, with the voltages being supplied as indicated in the table. An external resistor, R<sub>EXT</sub>, may be used to increase the gain of the transmitter. Without R<sub>EXT</sub>, TX<sub>GAIN</sub> and TX<sub>OUT</sub> are shorted together resulting in a transmit power level of +10 dBm.

R<sub>LL</sub>, R<sub>L</sub>, and C<sub>L</sub> comprise the termination network and are used to match the characteristic impedance of the transmission line. This provides the 4 wire to 2 wire hybrid conversion necessary for twisted pair transmission.

Figure 4 shows a typical application of the LEC. On short loops, jumpers (or switches) could be used to remove the LEC from the circuit. For longer loops, the jumpers could be changed to include the LEC in the signal path.

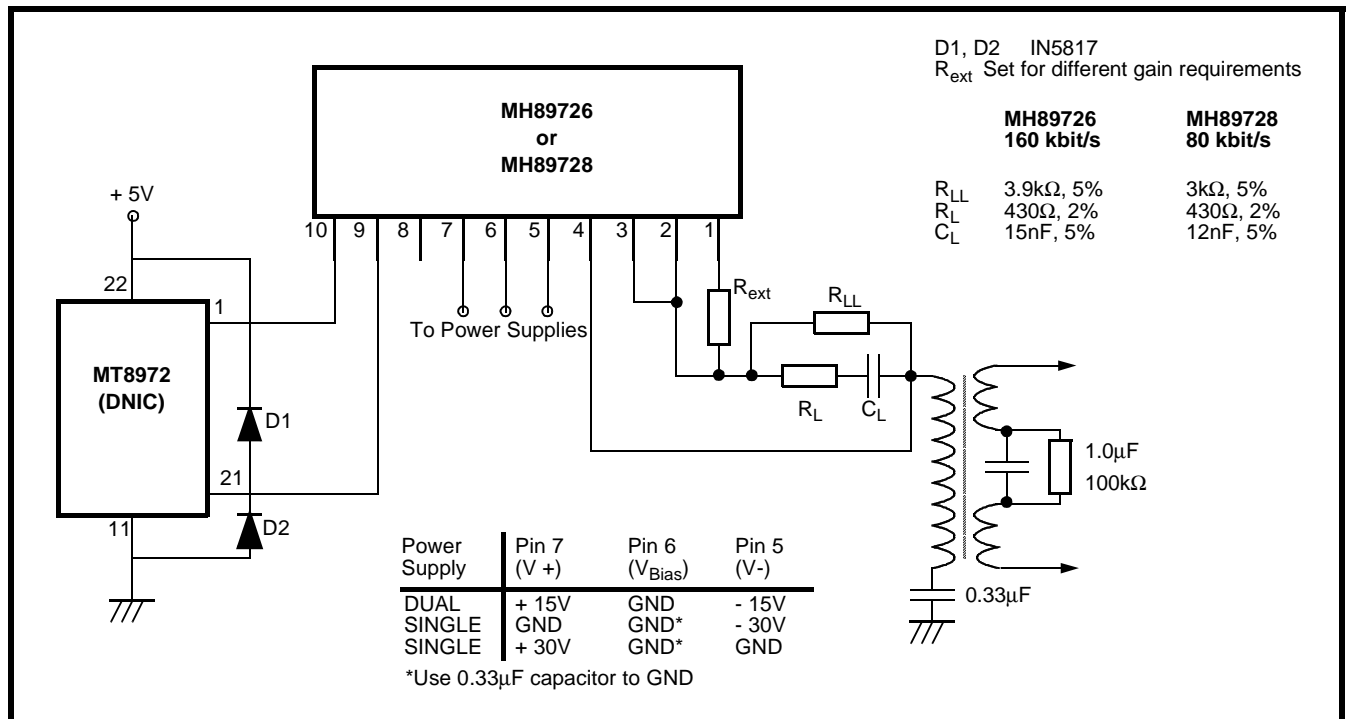


Figure 3 - Typical Connection Diagram for MT8972 and MH89726/728

| MH89726 (160 kbit/s)           |                                  |                                   |
|--------------------------------|----------------------------------|-----------------------------------|
| CONFIGURATION \ CABLE          | 24 AWG<br>(8.0 dB/km at 120 kHz) | 26 AWG<br>(11.5 dB/km at 120 kHz) |
| DNIC to DNIC                   | 0.0 to 4.1 km                    | 0.0 to 3.0 km                     |
| DNIC with LEC to DNIC with LEC | 0.65 to 5.1 km                   | 0.5 to 3.6 km                     |

Table 1 - Typical Transmission Performance at 160 kbit/s

| MH89728 (80 kbit/s)           |  |                                  |
|-------------------------------|--|----------------------------------|
| CONFIGURATION \ CABLE         | 24 AWG<br>(6.9 dB/km at 60 kHz (Note 1)) | 26 AWG<br>(10.0 dB/km at 60 kHz) |
| DNIC to DNIC                  | 0.0 to 5.2 km                            | 0.0 to 3.4 km                    |
| DNIC with LEC to DNIC and LEC | 0.9 to 6.5 km                            | 0.65 to 4.1 km                   |

Table 2 - Typical Transmission Performance at 80 kbit/s

Note 1: The attenuation of the cable as specified by Bell System Technical Reference PUB 62411.

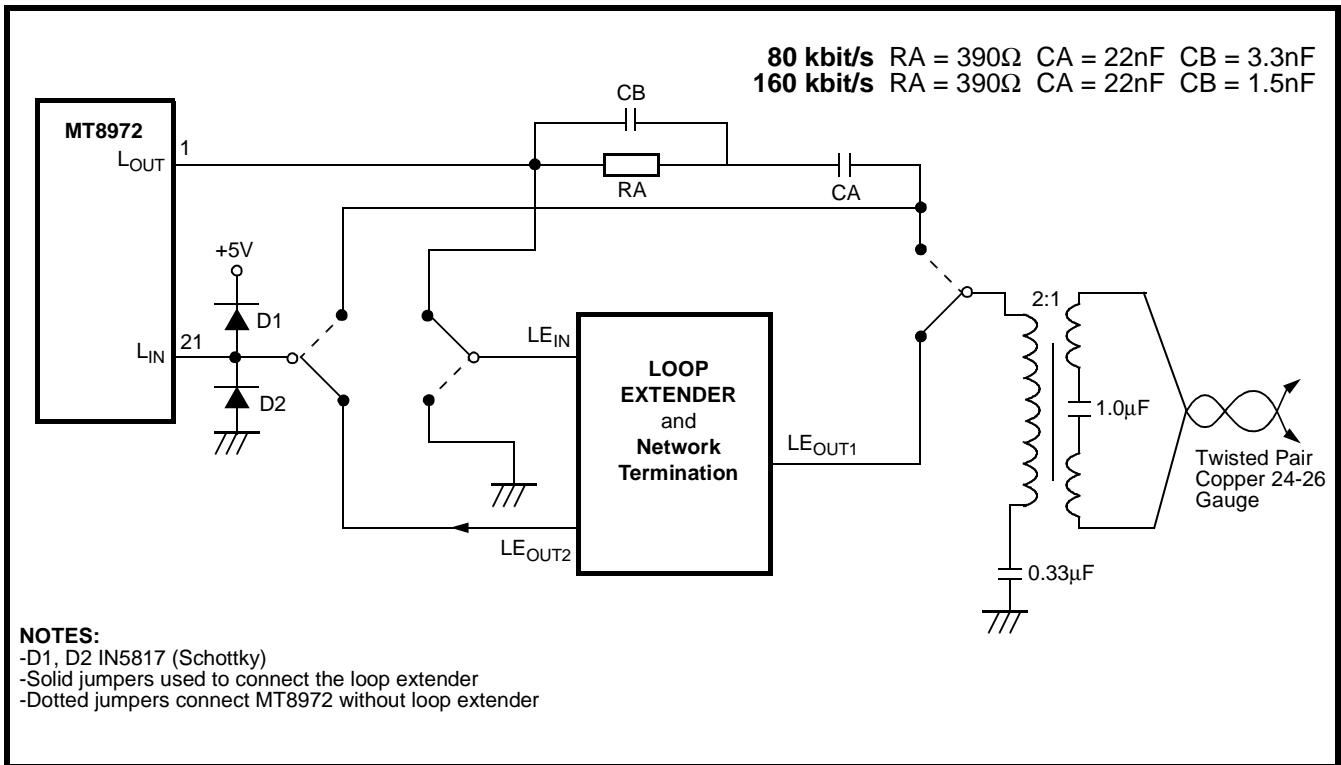


Figure 4 - Typical Application of the Loop Extender

**Recommended Operating Conditions**

|   | Characteristics | Sym      | Min   | Typ   | Max   | Units | Test Conditions |
|---|-----------------|----------|-------|-------|-------|-------|-----------------|
| 1 | + 15 V Supply   | $V_{DD}$ | 13.5  | 15.0  | 16.5  | V     | Note 1          |
| 2 | - 15 V Supply   | $V_{SS}$ | -16.5 | -15.0 | -13.5 | V     | Note 2          |
| 3 | Standby Current | $I_S$    |       | 3.0   |       | mA    |                 |

Note 1: A single voltage supply of  $+30V \pm 10\%$  can be used on  $V_{DD}$  with  $V_{Bias}$  grounded through a  $0.33 \mu F$  capacitor and  $V_{SS}$  grounded.

Note 2: A single voltage supply of  $-30V \pm 10\%$  can be used on  $V_{SS}$  with  $V_{Bias}$  grounded through a  $0.33 \mu F$  capacitor and  $V_{DD}$  grounded.

**A.C. Electrical Characteristics**

|   | Characteristics | Sym         | Min | Typ    | Max | Units | Test Conditions                                    |
|---|-----------------|-------------|-----|--------|-----|-------|--|
| 1 | Active Current  | $I_A$       |     | 7.0    |     | mA    | @ 60 kHz for 80 kbit/s<br>@ 120 kHz for 160 kbit/s |
| 2 | TX Gain         | $A_{TX}$    |     | 9.0    |     | dB    | @ 60 kHz for 80 kbit/s<br>@ 120 kHz for 160 kbit/s |
| 3 | TX Phase Angle  | $\Phi_{TX}$ |     | -170.0 |     | °     | @ 60 kHz for 80 kbit/s<br>@ 120 kHz for 160 kbit/s |
| 4 | RX Gain         | $A_{RX}$    |     | 0.0    |     | dB    | @ 60 kHz for 80 kbit/s<br>@ 120 kHz for 160 kbit/s |
| 5 | RX Phase Angle  | $\Phi_{RX}$ |     | 12.0   |     | °     | @ 60 kHz for 80 kbit/s<br>@ 120 kHz for 160 kbit/s |
| 6 | Line Power      |             |     | 10.0   |     | dBm   | With 2:1 transformer                               |

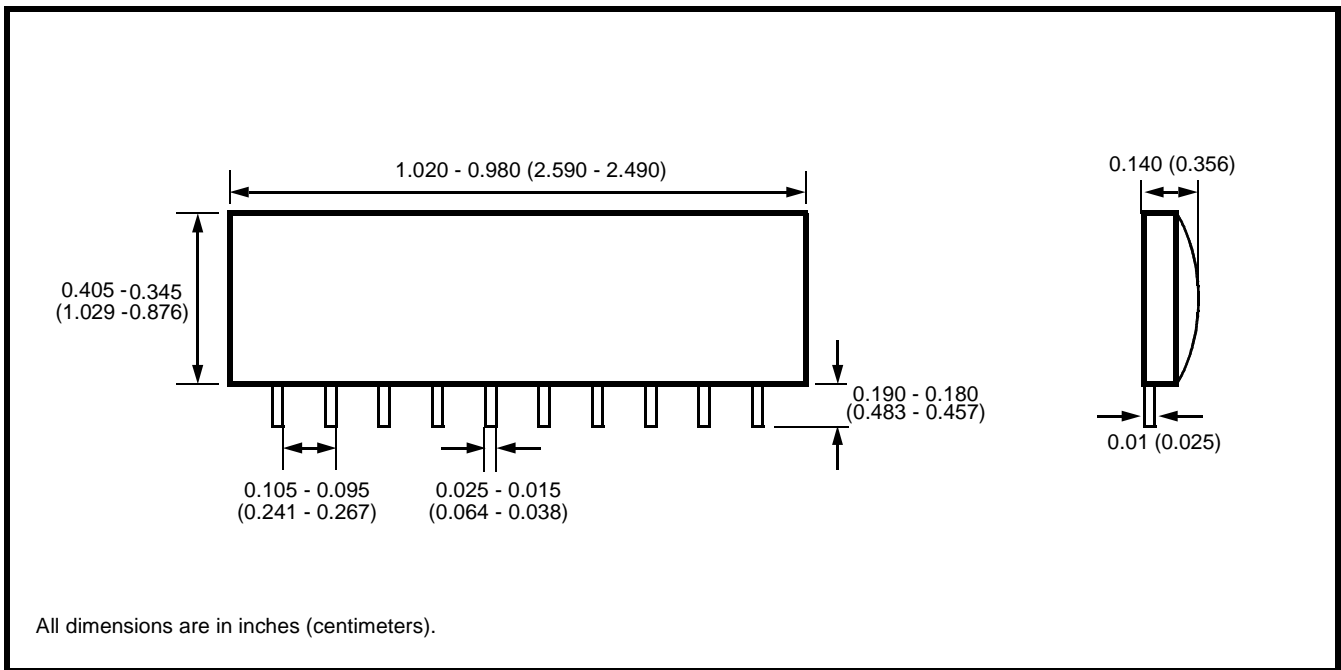


Figure 4 - Mechanical Data