

## Features:

- CMOS Technology
- TTL/CMOS compatible inputs
- Low switching noise
- 5nS typical true / complement output skew
- 5nS typical output rise and fall times
- Up to 20V output voltage
- Output high voltage programmable via  $V_{OPT}$
- Output low voltage programmable via  $V_{EE}$

## Applications

- Digital control of analog circuits
- Level shifting and amplification
- Circuit applications requiring complementary signal generation with low skew
- Bias control for PIN diode drivers in a microwave switch

## General Description

The MX856 and MX857 are high speed single channel level shifters with complimentary output drivers. The MX856 features a 5.0V  $V_{CC}$  positive supply, and the MX857 features a 3.3V  $V_{CC}$  positive supply.

The input buffers accept digital TTL or CMOS level signals, amplifies them to the  $V_{CC}$  and GND supply rails, and generates complementary outputs. The translator level shifts these output signals by amplifying them to the  $V_{CC}$  and  $V_{EE}$  supply rails.

The output drivers then buffer the signals to  $V_{OPT}$  and  $V_{EE}$ .  $V_{OPT}$  may be set within the range of  $V_{CC}$  and GND. The output drivers also adjust the complimentary signals for minimized skew error.

The MX856 and MX857 are designed to operate over a temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ , and are available as die in wafer form, die in waffle pack, 8 lead SOIC package, and SOIC on Tape and Reel.

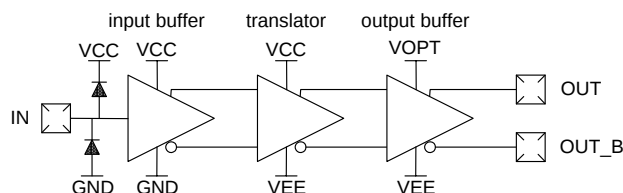
## Ordering Information – MX856

| Part No. | Description               |
|----------|---------------------------|
| 19202    | MX856 Die / Wafer Form    |
| 19201    | MX856 Die / Waffle Pack   |
| 19200-00 | MX856 8 Lead SOIC         |
| 19241-00 | MX856 SOIC on Tape & Reel |

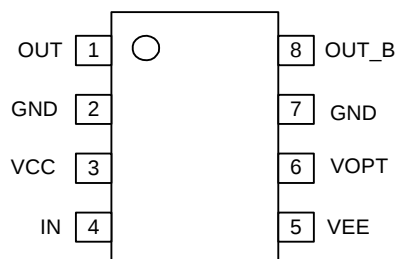
## Ordering Information – MX857

| Part No. | Description               |
|----------|---------------------------|
| 19302    | MX857 Die / Wafer Form    |
| 19301    | MX857 Die / Waffle Pack   |
| 19300-00 | MX857 8 Lead SOIC         |
| 19341-00 | MX857 SOIC on Tape & Reel |

## Functional Block Diagram



## 8 Lead SOIC Configuration



## Absolute Maximum Ratings

| SYMBOL                             | PARAMETER                                  | MIN   | MAX                  | UNITS |
|------------------------------------|--------------------------------------------|-------|----------------------|-------|
| V <sub>CC</sub>                    | Positive DC Supply Voltage                 | -0.4  | +6.0                 | V     |
| V <sub>EE</sub>                    | Negative DC Supply Voltage                 | -17.0 | +0.4                 | V     |
| V <sub>OPT</sub>                   | Output Positive DC Supply Voltage          |       | +6.0                 | V     |
| V <sub>OPT</sub> - V <sub>EE</sub> | Output Positive to Negative Supply Voltage | -0.4  | +20.0                | V     |
| V <sub>CC</sub> - V <sub>EE</sub>  | Positive to Negative Supply Voltage        | -0.4  | +14.0                | V     |
| V <sub>CC</sub> - V <sub>OPT</sub> | Positive to Output Supply Voltage          | -0.4  | V <sub>CC</sub> +0.4 | V     |
| V <sub>IN</sub>                    | DC Input Voltage                           | -0.4  | V <sub>CC</sub> +0.4 | V     |
| I <sub>IN</sub>                    | DC Input Current                           | -10   | +10                  | μA    |
| T <sub>A</sub>                     | Ambient Operating Temperature              | -40   | +85                  | °C    |
| T <sub>STG</sub>                   | Storage Temperature                        | -65   | +150                 | °C    |
| ESD                                | ESD sensitivity (human body model)         | 1.0   |                      | kV    |

*Absolute Maximum Ratings are stress ratings. Stresses in excess of these ratings can cause permanent damage to the device. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this data sheet is not implied. Exposure of the device to the absolute maximum ratings for an extended period may degrade the device and affect its reliability.*

## Guaranteed Operating Range

MX856 5.0V version

| SYMBOL                             | PARAMETER                                  | MIN   | MAX             | UNITS |
|------------------------------------|--------------------------------------------|-------|-----------------|-------|
| V <sub>CC</sub>                    | Positive DC Supply Voltage                 | 3.0   | 5.5             | V     |
| V <sub>EE</sub>                    | Negative DC Supply Voltage                 | -15.0 | -4.5            | V     |
| V <sub>OPT</sub>                   | Output Positive DC Supply Voltage          | 0.0   | 5.5             | V     |
| V <sub>OPT</sub> - V <sub>EE</sub> | Output Positive to Negative Supply Voltage | 7.5   | 20.0            | V     |
| V <sub>CC</sub> - V <sub>EE</sub>  | Positive to Negative Supply Voltage        | 7.5   | 20.0            | V     |
| V <sub>CC</sub> - V <sub>OPT</sub> | Positive to Output Supply Voltage          | 0.0   | V <sub>CC</sub> | V     |
| T <sub>A</sub>                     | Ambient Operating Temperature              | -40   | +85             | °C    |
| T <sub>R</sub> , T <sub>F</sub>    | Input Rise and Fall Time                   | 0.0   | 500             | nS    |

MX857B 3.3V version

| SYMBOL                             | PARAMETER                                  | MIN   | MAX             | UNITS |
|------------------------------------|--------------------------------------------|-------|-----------------|-------|
| V <sub>CC</sub>                    | Positive DC Supply Voltage                 | 3.0   | 3.6             | V     |
| V <sub>EE</sub>                    | Negative DC Supply Voltage                 | -17.0 | -4.5            | V     |
| V <sub>OPT</sub>                   | Output Positive DC Supply Voltage          | 0.0   | 3.6             | V     |
| V <sub>OPT</sub> - V <sub>EE</sub> | Output Positive to Negative Supply Voltage | 7.5   | 20.0            | V     |
| V <sub>CC</sub> - V <sub>EE</sub>  | Positive to Negative Supply Voltage        | 7.5   | 20.0            | V     |
| V <sub>CC</sub> - V <sub>OPT</sub> | Positive to Output Supply Voltage          | 0.0   | V <sub>CC</sub> | V     |
| T <sub>A</sub>                     | Ambient Operating Temperature              | -40   | +85             | °C    |
| T <sub>R</sub> , T <sub>F</sub>    | Input Rise and Fall Time                   | 0.0   | 500             | nS    |

### DC Characteristics - Over Guaranteed Operating Range

| SYMBOL    | PARAMETER                                   | MIN             | TYP  | MAX            | Units |
|-----------|---------------------------------------------|-----------------|------|----------------|-------|
| $V_{IH}$  | Input HIGH Voltage                          | 2.0             |      |                | V     |
| $V_{IL}$  | Input LOW Voltage                           |                 |      | 0.8            | V     |
| $V_{OH}$  | Output HIGH Voltage ( $I_{OH}=-1mA$ )       | $V_{OPT} - 0.1$ |      |                | V     |
| $V_{OL}$  | Output LOW Voltage ( $I_{OL}=1mA$ )         |                 |      | $V_{EE} + 0.1$ | V     |
| $I_{IN}$  | Input Current ( $V_{IN}=0.0$ to $V_{CC}$ )  | -10             |      | +10            | uA    |
| $I_{CC}$  | Supply Current ( $V_{IN}=0.0$ or $V_{CC}$ ) | $V_{CC} = 3.3V$ | <1.0 |                | uA    |
|           |                                             | $V_{CC} = 5.0V$ | <1.0 |                | uA    |
| $I_{EE}$  | Supply Current ( $V_{IN}=0.0$ or $V_{CC}$ ) | $V_{CC} = 3.3V$ | <1.0 |                | uA    |
|           |                                             | $V_{CC} = 5.0V$ | <1.0 |                | uA    |
| $I_{OPT}$ | Supply Current ( $V_{IN}=0.0$ or $V_{CC}$ ) | $V_{CC} = 3.3V$ | <1.0 |                | uA    |
|           |                                             | $V_{CC} = 5.0V$ | <1.0 |                | uA    |

### ESD Warning

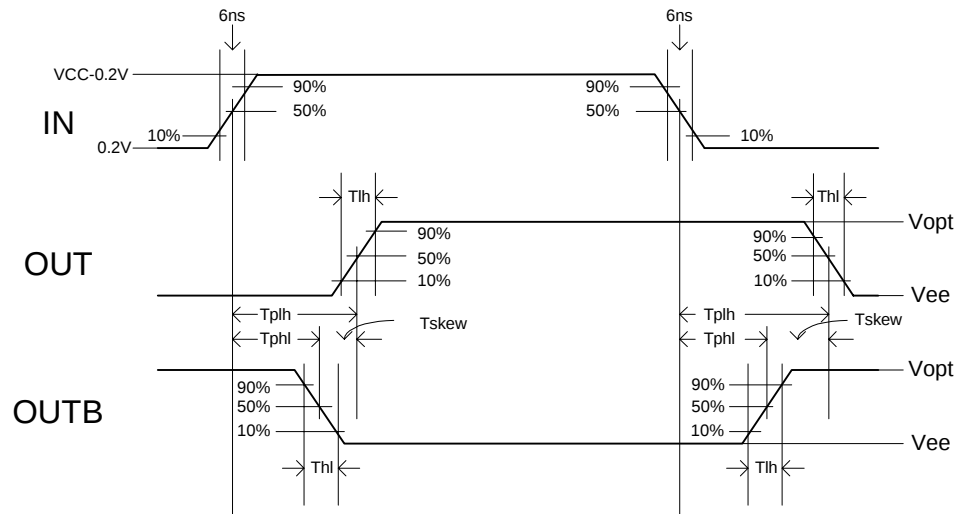
ESD (electrostatic discharge) sensitive device. Electrostatic charges can readily accumulate on test equipment and the human body in excess of 4000 Volts. This energy can discharge without detection. Although the MX856 / MX857 feature proprietary ESD protection circuitry, permanent damage may be sustained if subjected to high energy electrostatic discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

## AC Characteristics

$V_{CC}=V_{OPT}=3.3V$ ,  $V_{EE}=-16.7V$  or  $-4.5V$ , Input rise and fall time 6ns,  $V_{IH}=3.1$ ,  $V_{IL}=0.2V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$   
 $V_{CC}=V_{OPT}=5.0V$ ,  $V_{EE}=-15.0V$  or  $-4.5V$ , Input rise and fall time 6ns,  $V_{IH}=4.8$ ,  $V_{IL}=0.2V$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$

| SYMBOL     | PARAMETER                             |                 | Typ | Max | UNITS |
|------------|---------------------------------------|-----------------|-----|-----|-------|
| $T_{PLH}$  | Propagation Delay (low to high input) | $V_{CC} = 3.3V$ | 22  | 29  | nS    |
|            |                                       | $V_{CC} = 5.0V$ | 24  | 29  | nS    |
| $T_{PHL}$  | Propagation Delay (high to low input) | $V_{CC} = 3.3V$ | 20  | 29  | nS    |
|            |                                       | $V_{CC} = 5.0V$ | 20  | 29  | nS    |
| $T_{TLH}$  | Output Rise Time ( $C_{LD}=10pf$ )    | $V_{CC} = 3.3V$ | 5   | 9   | nS    |
|            |                                       | $V_{CC} = 5.0V$ | 4   | 9   | nS    |
| $T_{THL}$  | Output Fall Time ( $C_{LD}=10pf$ )    | $V_{CC} = 3.3V$ | 5   | 8   | nS    |
|            |                                       | $V_{CC} = 5.0V$ | 4   | 8   | nS    |
| $T_{SKEW}$ | Delay Skew (Output A to Output B)     | $V_{CC} = 3.3V$ | 5   | 10  | nS    |
|            |                                       | $V_{CC} = 5.0V$ | 5   | 10  | nS    |
| $C_{IN}$   | Input Capacitance                     |                 |     | 15  | pF    |

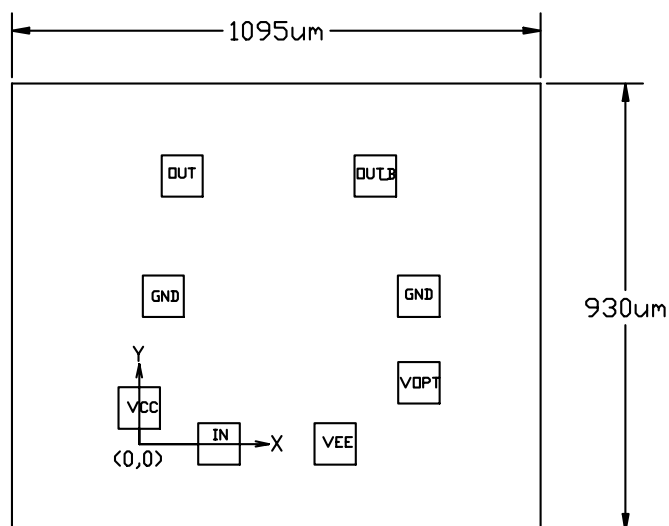
Note: Production Tested at  $25^{\circ}C$



## Pad Locations (in $\mu\text{m}$ )

| PAD NAME         | X     | Y     |
|------------------|-------|-------|
| OUT              | 89.1  | 556.4 |
| OUT_B            | 489.1 | 556.4 |
| GND              | 579.1 | 306.3 |
| V <sub>OPT</sub> | 579.3 | 126.8 |
| V <sub>EE</sub>  | 406   | 0     |
| IN               | 165.4 | 0     |
| V <sub>CC</sub>  | 0     | 74.3  |
| GND              | 49.9  | 306.3 |

Pad location is the pad center point in microns. The origin of the coordinates is located as shown.

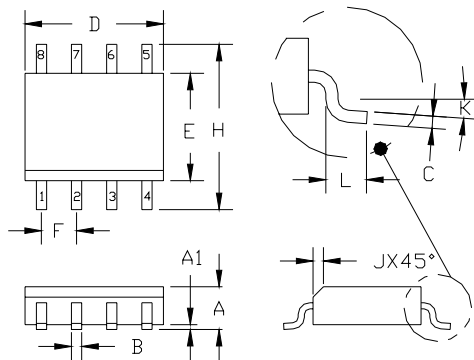


Die Size: 1095  $\mu\text{m}$  X 930  $\mu\text{m}$   
(Not Drawn To Scale)

## 8 Lead SOIC – I/O Assignment

| Pin No. | Pin Name         | Description                       |
|---------|------------------|-----------------------------------|
| 1       | OUT              | Output Driver                     |
| 2       | GND              | Ground                            |
| 3       | V <sub>CC</sub>  | Positive Supply for Input Buffer  |
| 4       | IN               | Input Buffer                      |
| 5       | V <sub>EE</sub>  | Negative Supply for Output Driver |
| 6       | V <sub>OPT</sub> | Positive Supply for Output Driver |
| 7       | GND              | Ground                            |
| 8       | OUT_B            | Complimentary Output Driver       |

### 8-LEAD SOIC



3. MOLDED PACKAGE SHALL CONFORM TO JEDEC STANDARD CONFIGURATION MS-012 VARIATION AA.

② DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.

① CONTROLLING DIMENSIONS: MILLIMETERS.

NOTES: (UNLESS OTHERWISE SPECIFIED)

| DIMENSIONS ① |       |       |      |      |       |
|--------------|-------|-------|------|------|-------|
| DIM.         | INCH  |       | MM.  |      | NOTES |
|              | MIN.  | MAX.  | MIN. | MAX. |       |
| A            | .0532 | .0688 | 1.35 | 1.75 | ----  |
| A1           | .0040 | .0098 | .10  | .25  | ----  |
| B            | .013  | .020  | .33  | .51  | ----  |
| C            | .0075 | .0098 | .19  | .25  | ----  |
| D            | .1890 | .1968 | 4.80 | 5.00 | ②     |
| E            | .1497 | .1574 | 3.80 | 4.00 | ②     |
| F            | .050  | BSC   | 1.27 | BSC  | ----  |
| H            | .2284 | .2440 | 5.80 | 6.20 | ----  |
| J            | .0099 | .0196 | .25  | .50  | ----  |
| K            | 0°    | 8°    | 0°   | 8°   | ----  |
| L            | .016  | .050  | .40  | 1.27 | ----  |

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