



**5V/3.3V 1:9 DIFFERENTIAL
CLOCK DRIVER (w/ENABLE)**

**ClockWorks™
SY10E111AE/LE
SY100E111AE/LE**

FEATURES

- 5V and 3.3V power supply options
- 200ps part-to-part skew
- 50ps output-to-output skew
- Differential design
- VBB output
- Enable Input
- Voltage and temperature compensated outputs
- 75KΩ input pulldown resistors
- Fully compatible with Motorola MC10/100E111
- Available in 28-pin PLCC package

DESCRIPTION

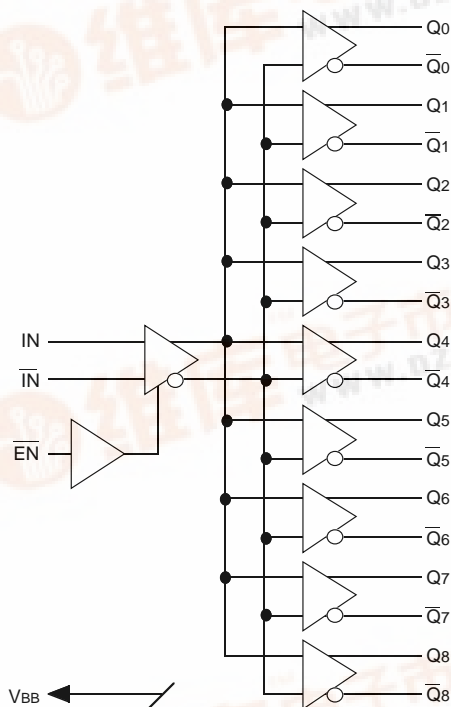
The SY10/100E111AE/LE are low skew 1-to-9 differential drivers designed for clock distribution in mind. The SY10/100E111AE/LE's function and performance are similar to the popular SY10/100E111, with the improvement of lower jitter and the added feature of low voltage operation. It accepts one signal input, which can be either differential or single-ended if the VBB output is used. The signal is fanned out to 9 identical differential outputs. An enable input is also provided such that a logic HIGH disables the device by forcing all Q outputs LOW and all \bar{Q} outputs HIGH.

The E111AE/LE is specifically designed, modeled and produced with low skew as the key goal. Optimal design and layout serve to minimize gate to gate skew within a device, and empirical modeling is used to determine process control limits that ensure consistent t_{pd} distributions from lot to lot. The net result is a dependable, guaranteed low skew device.

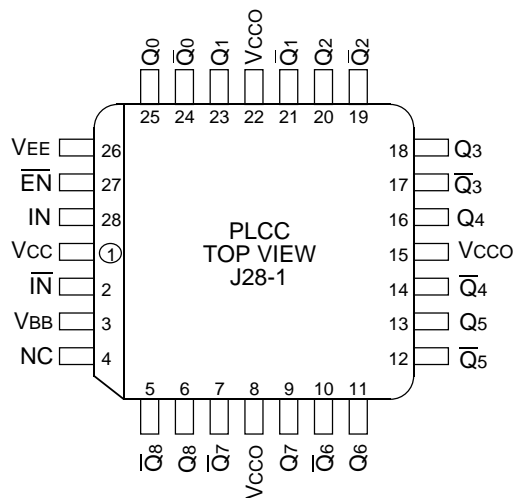
To ensure that the tight skew specification is met it is necessary that both sides of the differential output are terminated into 50Ω, even if only one side is being used. In most applications, all nine differential pairs will be used and therefore terminated. In the case where fewer than nine pairs are used, it is necessary to terminate at least the output pairs on the same package side as the pair(s) being used on that side, in order to maintain minimum skew. Failure to do this will result in small degradations of propagation delay (on the order of 10-20ps) of the output(s) being used which, while not being catastrophic to most designs, will mean a loss of skew margin.

The E111AE/LE, as with most other ECL devices, can be operated from a positive VCC supply in PECL mode. This allows the E111AE/LE to be used for high performance clock distribution in +5V/+3.3V systems. Designers can take advantage of the E111AE/LE's performance to distribute low skew clocks across the backplane or the board. In a PECL environment, series or Thevenin line terminations are typically used as they require no additional power supplies. For systems incorporating GTL, parallel termination offers the lowest power by taking advantage of the 1.2V supply as terminating voltage.

BLOCK DIAGRAM



PIN CONFIGURATION



PIN NAMES

| Pin | Function |
|---|-------------------------|
| IN, \overline{IN} | Differential Input Pair |
| \overline{EN} | Enable Input |
| $Q_0, \overline{Q}_0 - Q_8, \overline{Q}_8$ | Differential Outputs |
| VBB | VBB Output |
| VCCO | Vcc to Output |

ECL DC ELECTRICAL CHARACTERISTICS

VEE = VEE (Min.) to VEE (Max.); VCC = GND

| Symbol | Parameter | TA = -40°C | | | TA = 0°C | | | TA = +25°C | | | TA = +85°C | | | Unit |
|-----------------|--------------------------|------------|------|-------|----------|------|-------|------------|------|-------|------------|------|-------|------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| VOH | Output HIGH Voltage | | | | | | | | | | | | | mV |
| | 10EL | -1080 | — | -890 | -1020 | — | -840 | -980 | — | -810 | -910 | — | -720 | |
| | 100EL | -1085 | — | -880 | -1025 | — | -880 | -1025 | — | -880 | -1025 | — | -880 | |
| VOL | Output LOW Voltage | | | | | | | | | | | | | mV |
| | 10EL | -1950 | — | -1650 | -1950 | — | -1630 | -1950 | — | -1630 | -1950 | — | -1595 | |
| | 100EL | -1830 | — | -1550 | -1810 | — | -1620 | -1810 | — | -1620 | -1810 | — | -1620 | |
| VIH | Input HIGH Voltage | | | | | | | | | | | | | mV |
| | 10EL | -1230 | — | -890 | -1170 | — | -840 | -1130 | — | -810 | -1060 | — | -720 | |
| | 100EL | -1165 | — | -880 | -1165 | — | -880 | -1165 | — | -880 | -1165 | — | -880 | |
| VIL | Input LOW Voltage | | | | | | | | | | | | | mV |
| | 10EL | -1950 | — | -1500 | -1950 | — | -1480 | -1950 | — | -1480 | -1950 | — | -1445 | |
| | 100EL | -1810 | — | -1475 | -1810 | — | -1475 | -1810 | — | -1475 | -1810 | — | -1475 | |
| VBB | Output Reference Voltage | | | | | | | | | | | | | V |
| | 10EL | -1.43 | — | -1.30 | -1.38 | — | -1.27 | -1.35 | — | -1.25 | -1.31 | — | -1.19 | |
| | 100EL | -1.38 | — | -1.26 | -1.38 | — | -1.26 | -1.38 | — | -1.26 | -1.38 | — | -1.26 | |
| I _{IH} | Input HIGH Current | — | — | 150 | — | — | 150 | — | — | 150 | — | — | 150 | μA |
| I _{IL} | Input LOW Current | | | | | | | | | | | | | μA |
| | 10EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.3 | — | — | |
| | 100EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | |
| I _{EE} | Power Supply Current | | | | | | | | | | | | | mA |
| | 10EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 66 | |
| | 100EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 78 | |

NOTE:

- Parametric values specified at:

| | |
|---------------------------|--------------------------------------|
| 5 volt Power Supply Range | 100E111AE Series: -4.2V to -5.5V. |
| | 10E111AE Series -4.75V to -5.5V. |
| 3 volt Power Supply Range | 10/100E111LE Series: -3.0V to -3.8V. |

3.3V PECL DC ELECTRICAL CHARACTERISTICS⁽¹⁾

VCC = +3.0V to +3.8V, VEE = GND

| Symbol | Parameter | TA = -40°C | | | TA = 0°C | | | TA = +25°C | | | TA = +85°C | | | Unit |
|-----------------|---|------------|------|------|----------|------|------|------------|------|------|------------|------|------|------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| VOH | Output HIGH Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 2220 | — | 2110 | 2280 | — | 2460 | 2320 | — | 2490 | 2390 | — | 2580 | |
| | 100EL | 2215 | — | 2120 | 2275 | — | 2420 | 2275 | — | 2420 | 2275 | — | 2420 | |
| VOL | Output LOW Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 1350 | — | 1650 | 1350 | — | 1670 | 1350 | — | 1670 | 1350 | — | 1705 | |
| | 100EL | 1470 | — | 1750 | 1490 | — | 1680 | 1490 | — | 1680 | 1490 | — | 1680 | |
| VIH | Input HIGH Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 2070 | — | 2410 | 2130 | — | 2460 | 2170 | — | 2490 | 2240 | — | 2580 | |
| | 100EL | 2135 | — | 2420 | 2135 | — | 2420 | 2135 | — | 2420 | 2135 | — | 2420 | |
| VIL | Input LOW Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 1350 | — | 1800 | 1350 | — | 1820 | 1350 | — | 1820 | 1350 | — | 1855 | |
| | 100EL | 1490 | — | 1825 | 1490 | — | 1825 | 1490 | — | 1825 | 1490 | — | 1825 | |
| VBB | Output Reference Voltage ⁽²⁾ | | | | | | | | | | | | | V |
| | 10EL | 1.87 | — | 2.00 | 1.92 | — | 2.03 | 1.95 | — | 2.05 | 1.99 | — | 2.11 | |
| | 100EL | 1.92 | — | 2.04 | 1.92 | — | 2.04 | 1.92 | — | 2.04 | 1.92 | — | 2.04 | |
| I _{IH} | Input HIGH Current | — | — | 150 | — | — | 150 | — | — | 150 | — | — | 150 | μA |
| I _{IL} | Input LOW Current | | | | | | | | | | | | | μA |
| | 10EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.3 | — | — | |
| | 100EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | |
| I _{EE} | Power Supply Current | | | | | | | | | | | | | mA |
| | 10EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 66 | |
| | 100EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 78 | |

NOTES:

- Parametric values specified at: 3 volt Power Supply Range 10/100E111LE Series: +3.0V to +3.8V.
- These values are for VCC = 3.3V. Level specifications will vary 1:1 with VCC.

5V PECL DC ELECTRICAL CHARACTERISTICS⁽¹⁾

VCC = VCC (Min.) to VCC (Max.); VEE = GND

| Symbol | Parameter | TA = -40°C | | | TA = 0°C | | | TA = +25°C | | | TA = +85°C | | | Unit |
|-----------------|---|------------|------|------|----------|------|------|------------|------|------|------------|------|------|------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| VOH | Output HIGH Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 3920 | — | 4110 | 3980 | — | 4160 | 4020 | — | 4190 | 4090 | — | 4280 | |
| | 100EL | 3915 | — | 4120 | 3975 | — | 4120 | 3975 | — | 4120 | 3975 | — | 4120 | |
| VOL | Output LOW Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 3050 | — | 3350 | 3050 | — | 3370 | 3050 | — | 3370 | 3050 | — | 3405 | |
| | 100EL | 3170 | — | 3450 | 3190 | — | 3380 | 3190 | — | 3380 | 3190 | — | 3380 | |
| VIH | Input HIGH Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 3770 | — | 4110 | 3830 | — | 4160 | 3870 | — | 4190 | 3940 | — | 4280 | |
| | 100EL | 3835 | — | 4120 | 3835 | — | 4120 | 3835 | — | 4120 | 3835 | — | 4120 | |
| VIL | Input LOW Voltage ⁽²⁾ | | | | | | | | | | | | | mV |
| | 10EL | 3050 | — | 3500 | 3050 | — | 3520 | 3050 | — | 3520 | 3050 | — | 3555 | |
| | 100EL | 3190 | — | 3525 | 3190 | — | 3525 | 3190 | — | 3525 | 3190 | — | 3525 | |
| VBB | Output Reference Voltage ⁽²⁾ | | | | | | | | | | | | | V |
| | 10EL | 3.57 | — | 3.70 | 3.62 | — | 3.73 | 3.65 | — | 3.75 | 3.69 | — | 3.81 | |
| | 100EL | 3.62 | — | 3.74 | 3.62 | — | 3.74 | 3.62 | — | 3.74 | 3.62 | — | 3.74 | |
| I _{IH} | Input HIGH Current | — | — | 150 | — | — | 150 | — | — | 150 | — | — | 150 | μA |
| I _{IL} | Input LOW Current | | | | | | | | | | | | | μA |
| | 10EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.3 | — | — | |
| | 100EL | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | 0.5 | — | — | |
| I _{EE} | Power Supply Current | | | | | | | | | | | | | mA |
| | 10EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 66 | |
| | 100EL | — | — | 66 | — | — | 66 | — | — | 66 | — | — | 78 | |

NOTES:

- Parametric values specified at: 5 volt Power Supply Range 100E111AE Series: +4.2V to +5.5V.
10E111AE Series: +4.75V to +5.5V.

- These values are for VCC = 5V. Level specifications will vary 1:1 with VCC.

AC ELECTRICAL CHARACTERISTICS⁽¹⁾

VEE = VEE (Min.) to VEE (Max.); VCC = GND

| Symbol | Parameter | TA = -40°C | | | TA = 0°C | | | TA = +25°C | | | TA = +85°C | | | Unit |
|--------------|--|--------------------------|------------------|--------------------------|--------------------------|------------------|--------------------------|--------------------------|------------------|--------------------------|--------------------------|------------------|--------------------------|------|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| tPLH tPHL | Propagation Delay to Output IN (differential) ⁽²⁾ IN (single-ended) ⁽³⁾ Enable ⁽⁴⁾ Disable ⁽⁴⁾ | 380 280 400 400 | — — — — | 680 780 900 900 | 430 330 450 450 | — — — — | 630 730 850 850 | 430 330 450 450 | — — — — | 630 730 850 850 | 430 330 450 450 | — — — — | 630 730 850 850 | ps |
| tskew | Within-Device Skew ⁽⁵⁾ Part-to-Part Skew (Diff.) | — — | — — | 75 250 | — — | — — | 50 200 | — — | — — | 50 200 | — — | — — | 50 200 | ps |
| ts | Set-up Time, \overline{EN} to IN ⁽⁶⁾ | 250 | — | 0 | 200 | 0 | — | 200 | 0 | — | 200 | 0 | — | ps |
| tH | Hold Time, IN to \overline{EN} ⁽⁷⁾ | 0 | — | -200 | 0 | -200 | — | 0 | -200 | — | 0 | -200 | — | ps |
| tR | Release Time, \overline{EN} to IN ⁽⁸⁾ | 350 | — | 100 | 300 | 100 | — | 300 | 100 | — | 300 | 100 | — | ps |
| VPP | Minimum Input Swing ⁽⁹⁾ | 250 | — | — | 250 | — | — | 250 | — | — | 250 | — | — | mV |
| VCMR | Common Mode Range ⁽¹⁰⁾ | -1.5 | — | -0.4 | -1.5 | — | -0.4 | -1.5 | — | -0.4 | -1.5 | — | -0.4 | V |
| tr tf | Rise/Fall Times 20% to 80% | 200 | — | 650 | 200 | — | 600 | 200 | — | 600 | 200 | — | 600 | ps |

NOTES:

- Parametric values specified at:

| | | |
|---------------------------|----------------------|------------------|
| 5 volt Power Supply Range | 100E111AE Series: | -4.2V to -5.5V. |
| | 10E111AE Series | -4.75V to -5.5V. |
| 3 volt Power Supply Range | 10/100E111LE Series: | -3.0V to -3.8V. |
- The differential propagation delay is defined as the delay from the crossing points of the differential input signals to the crossing point of the differential output signals.
- The single-ended propagation delay is defined as the delay from the 50% point of the input signal to the 50% point of the output signal.
- Enable is defined as the propagation delay from the 50% point of a negative transition on \overline{EN} to the 50% point of a positive transition on Q (or a negative transition on \overline{Q}). Disable is defined as the propagation delay from the 50% point of a positive transition on \overline{EN} to the 50% point of a negative transition on Q (or a positive transition on \overline{Q}).
- The within-device skew is defined as the worst case difference between any two similar delay paths within a single device.
- The set-up time is the minimum time that \overline{EN} must be asserted prior to the next transition of IN/ \overline{IN} to prevent an output response greater than $\pm 75\text{mV}$ to that IN/ \overline{IN} transition (see Figure 1).
- The hold time is the minimum time that \overline{EN} must remain asserted after a negative going IN or a positive going \overline{IN} to prevent an output response greater than $\pm 75\text{mV}$ to that IN/ \overline{IN} transition (see Figure 2).
- The release time is the minimum time that \overline{EN} must be de-asserted prior to the next IN/ \overline{IN} transition to ensure an output response that meets the specified IN to Q propagation delay and output transition times (see Figure 3).
- VPP (min) is defined as the minimum input differential voltage which will cause no increase in the propagation delay. The VPP (min) is AC limited for the E111AE/LE, as a differential input as low as 50mV will still produce full ECL levels at the output.
- VCMR is defined as the range within the VIH level may vary, with the device still meeting the propagation delay specification. the VIL level must be such that the peak-to-peak voltage is less than 1.0V and greater than or equal to VPP (min).
For PECL operation: $V_{CMR}(\text{max}) = V_{CC} - |V_{CMR}(\text{max})|$ and
 $V_{CMR}(\text{min}) = V_{CC} - |V_{CMR}(\text{min})|$

TIMING DIAGRAMS

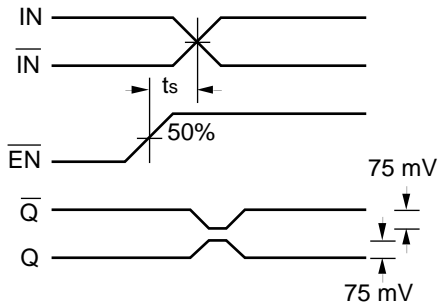


Figure 1. Set-up Time

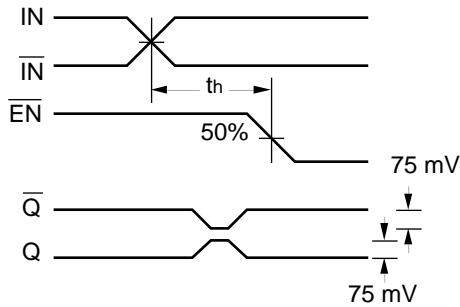


Figure 2. Hold Time

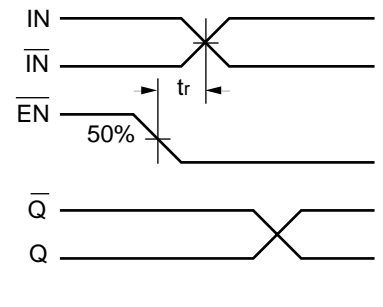


Figure 3. Release Time

PRODUCT ORDERING CODE

5V

| Ordering Code | Package Type | Operating Range | VEE Range (V) |
|-----------------|--------------|-----------------|---------------|
| SY10E111AEJC | J28-1 | Commercial | -4.75 to -5.5 |
| SY10E111AEJCTR | J28-1 | Commercial | -4.75 to -5.5 |
| SY100E111AEJC | J28-1 | Commercial | -4.2 to -5.5 |
| SY100E111AEJCTR | J28-1 | Commercial | -4.2 to -5.5 |

5V

| Ordering Code | Package Type | Operating Range | VEE Range (V) |
|-----------------|--------------|-----------------|---------------|
| SY10E111AEJI | J28-1 | Industrial | -4.75 to -5.5 |
| SY10E111AEJITR | J28-1 | Industrial | -4.75 to -5.5 |
| SY100E111AEJI | J28-1 | Industrial | -4.2 to -5.5 |
| SY100E111AEJITR | J28-1 | Industrial | -4.2 to -5.5 |

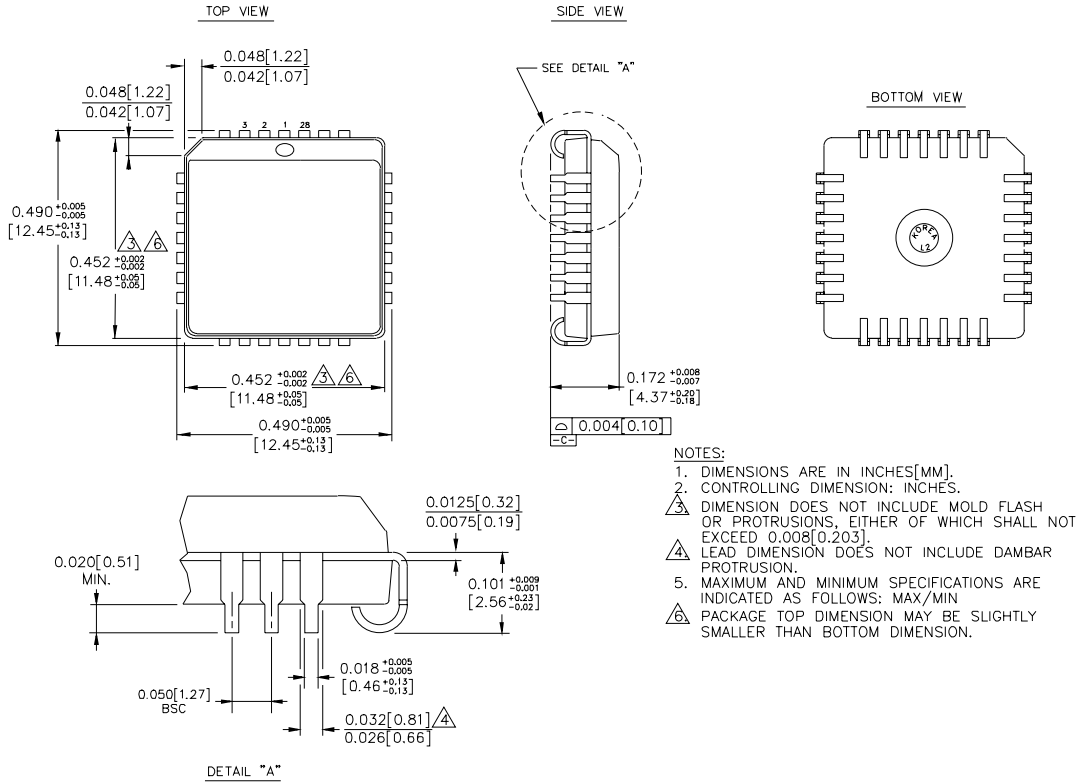
3.3V

| | | | |
|-----------------|-------|------------|--------------|
| SY10E111LEJC | J28-1 | Commercial | -3.0 to -3.8 |
| SY10E111LEJCTR | J28-1 | Commercial | -3.0 to -3.8 |
| SY100E111LEJC | J28-1 | Commercial | -3.0 to -3.8 |
| SY100E111LEJCTR | J28-1 | Commercial | -3.0 to -3.8 |

3.3V

| | | | |
|-----------------|-------|------------|--------------|
| SY10E111LEJI | J28-1 | Industrial | -3.0 to -3.8 |
| SY10E111LEJITR | J28-1 | Industrial | -3.0 to -3.8 |
| SY100E111LEJI | J28-1 | Industrial | -3.0 to -3.8 |
| SY100E111LEJITR | J28-1 | Industrial | -3.0 to -3.8 |

28 LEAD PLCC (J28-1)



Rev. 03