

General Description

The SY56572XR is a fully differential, low voltage 1.2V/1.8V/2.5V CML 4:1 Mux, with input equalization, and integrated 1:2 Fanout Buffer. The SY56572XR can process clock signals as fast as 4.5GHz or data patterns up to 6.4Gbps.

The differential input includes Micrel's unique 3-pin input termination architecture that interfaces to DC-coupled 2.5V/3.3V LVPECL, 1.2V/1.8V/2.5V CML or LVDS differential signals. For AC-coupled input applications, an internal voltage reference is provided for input bias. Input voltages as small as 200mV (400mV_{pp}) are applied before the 9, 18 or 27-inch FR4 transmission line.

The SY56572XR operates from a 2.5V ±5% core supply and a 1.2V, 1.8V or 2.5V ±5% output supply and is guaranteed over the full industrial temperature range (−40°C to +85°C). The SY56572XR is part of Micrel's high-speed, Precision Edge[®] product line.

Data sheets and support documentation can be found on Micrel's web site at: www.micrel.com.

Applications

- Data Distribution
- SONET clock and data distribution
- Fiber Channel clock and data distribution
- Gigabit Ethernet clock and data distribution

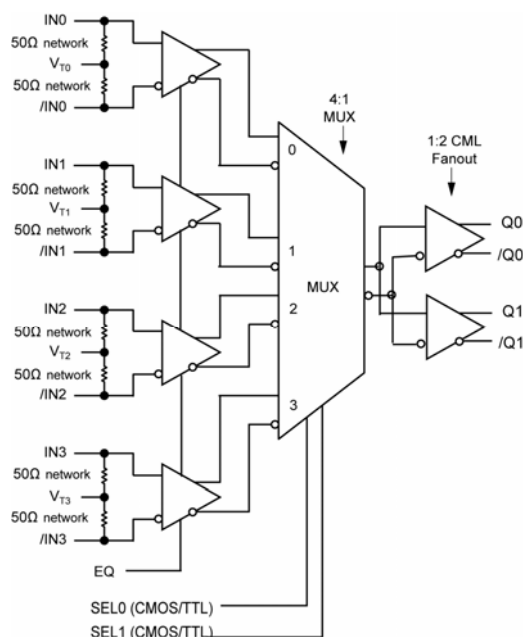


Precision Edge[®]

Features

- 1.2V/1.8V/2.5V CML 4:2 MUX with input equalization.
- Guaranteed AC performance over temperature and voltage:
 - DC-to > 6.4Gbps throughput
 - <360ps propagation delay (IN-to-Q)
 - <15ps within-device skew
- Ultra-low jitter design
 - <0.8ps_{RMS} random jitter
 - <10ps_{PP} deterministic jitter
- 2.5V ±5% , 1.8/1.2V ±5% power supply operation
- Industrial temperature range: −40°C to +85°C
- Available in 32-pin (5mm x 5mm) MLF[®] package

Functional Block Diagram



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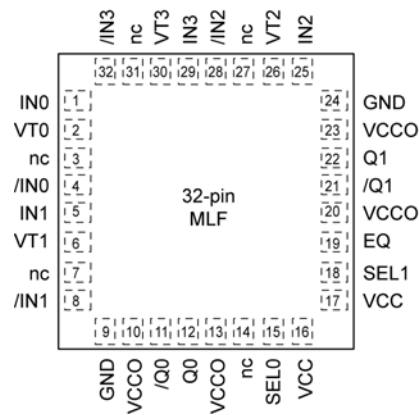
Ordering Information⁽¹⁾

| Part Number | Package Type | Operating Range | Package Marking | Lead Finish |
|------------------------------|--------------|-----------------|--|----------------|
| SY56572XRMG | MLF-32 | Industrial | SY56572X with Pb-Free bar-line indicator | NiPdAu Pb-Free |
| SY56572XRMGTR ⁽²⁾ | MLF-32 | Industrial | SY56572X with Pb-Free bar-line indicator | NiPdAu Pb-Free |

Notes:

1. Contact factory for die availability. Dice are guaranteed at T_A = 25°C, DC Electricals only.
2. Tape and Reel.

Pin Configuration



32-Pin MLF[®] (MLF-32)

Pin Description

| Pin Number | Pin Name | Pin Function |
|------------------------------|--|--|
| 1,4 5,8 25,28 29,32 | IN0, /IN0 IN1, /IN1 IN2, /IN2 IN3, /IN3 | Differential Inputs: Accepts differential signals as small as 200mV (400mV _{PP}) applied to the input of a 9, 18 or 27 inch 6mil FR4 stripline transmission line. See "Input and Output Stage" section for details of this input. |
| 2 6 26 30 | VT0 VT1 VT2 VT3 | Input Termination Center-Tap: Each side of the differential input pair terminates to the VT pin. This pin provides a center-tap to a termination network for maximum interface flexibility. An internal high impedance resistor divider biases VT to allow input AC coupling. For AC coupling, bypass VT with 0.1µF low ESR capacitor to VCC. See "Input Interface Applications" subsection and Figure 2a. |
| 19 | EQ | Three level input for equalization control. |
| 15 18 | SEL0 SEL1 | Single-ended TTL/CMOS compatible input selects the inputs to the multiplexer. This input is internally connected to a 25kΩ pull-up resistor and will default to a logic HIGH state if left open. Input logic threshold is VCC/2. See "Truth Table" for select control. |
| 16,17 | VCC | Positive Power Supply: Bypass with 0.1µF//0.01µF low ESR capacitors as close to the V _{CC} pin as possible. Supplies the input and core circuitry. |
| 10,13,20,23 | VCCO | Output Supply: Bypass with 0.1µF//0.01µF low ESR capacitors as close to the V _{CCO} pin as possible. Supplies the output buffers. |
| 9,24 | GND, Exposed pad | Ground: Exposed pad must be connected to a ground plane that is the same potential as the ground pins. |
| 12,11 22,21 | Q0, /Q0 Q1, /Q1 | CML Differential Output Pair: Differential buffered copy of the input signal. The output swing is typically 390mV. See "Functional Description" subsection for termination information. |

Truth Table

| EQ Input | Equalization FR4 6mil Stripline |
|----------|---------------------------------|
| LOW | 9" |
| FLOAT | 18" |
| HIGH | 27" |

| SEL1 | SEL0 | |
|------|------|--------------------|
| 0 | 0 | IN0 Input Selected |
| 0 | 1 | IN1 Input Selected |
| 1 | 0 | IN2 Input Selected |
| 1 | 1 | IN3 Input Selected |

Absolute Maximum Ratings⁽¹⁾

Supply Voltage (V_{CC}) -0.5V to +3.0V
 Supply Voltage (V_{CCO}) -0.5V to +3.0V
 $V_{CC} - V_{CCO}$ <1.8V
 $V_{CCO} - V_{CC}$ <0.5 V
 Input Voltage (V_{IN}) -0.5V to $V_{CC} + 0.4V$
 CML Output Voltage (V_{OUT}) 0.6V to 3V
 Current (I_T)
 Source or sink on VT pin $\pm 100mA$
 Input Current
 Source or sink Current on (IN, /IN) $\pm 50mA$
 Maximum operating Junction Temperature 125°C
 Lead Temperature (soldering, 20sec.) 260°C
 Storage Temperature (T_s) -65°C to +150°C

Operating Ratings⁽²⁾

Supply Voltage (V_{CC}) 2.375V to 2.625V
 (V_{CCO}) 1.14V to 2.625V
 Ambient Temperature (T_A) -40°C to +85°C
 Package Thermal Resistance⁽³⁾
 MLF[®]
 Still-air (θ_{JA}) 50°C/W
 Junction-to-board (ψ_{JB}) 20°C/W

DC Electrical Characteristics⁽⁴⁾

$T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------------|---|---|-------|-----|----------------|----------|
| V_{CC} | Power Supply Voltage Range | V_{CC} | 2.375 | 2.5 | 2.625 | V |
| | | V_{CCO} | 1.14 | 1.2 | 1.26 | V |
| | | V_{CCO} | 1.7 | 1.8 | 1.9 | V |
| | | V_{CCO} | 2.375 | 2.5 | 2.625 | V |
| I_{CC} | Power Supply Current | Max. V_{CC} | | 110 | 140 | mA |
| I_{CCO} | Power Supply Current | No Load. V_{CCO} | | 32 | 42 | mA |
| R_{DIFF_IN} | Differential Input Resistance (IN-to-/IN) | | 90 | 100 | 110 | Ω |
| V_{IH} | Input HIGH Voltage (IN, /IN) | IN, /IN | 1.2 | | $V_{CC} + 0.4$ | V |
| V_{IL} | Input LOW Voltage (IN, /IN) | IN, /IN | 0 | | $V_{IH} - 0.2$ | V |
| V_{IN} | Input Voltage Swing (IN, /IN) | See Figure 3a, Note 5, applied to input of transmission line. | 0.2 | | 1.0 | V |
| V_{DIFF_IN} | Differential Input Voltage Swing (IN - /IN) | See Figure 3b, Note 5, applied to input of transmission line. | 0.4 | | 2.0 | V |
| V_{T_IN} | Voltage from Input to V_T | | | | 1.28 | V |

Notes:

1. Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB. ψ_{JB} and θ_{JA} values are determined for a 4-layer board in still-air number, unless otherwise stated.
4. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.
5. V_{IN} (max) is specified when V_T is floating.

CML Outputs DC Electrical Characteristics⁽⁶⁾

$V_{CCO} = 1.14V$ to $1.26V$ $R_L = 50\Omega$ to V_{CCO} .

$V_{CCO} = 1.7V$ to $1.9V$, $2.375V$ to $2.625V$, $R_L = 50\Omega$ to V_{CCO} or 100Ω across the outputs.

$V_{CC} = 2.375V$ to $2.625V$; $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|-----------------|-----------------------------------|-------------------------------|----------------|----------------|----------|----------|
| V_{OH} | Output HIGH Voltage | $R_L = 50\Omega$ to V_{CCO} | $V_{CC}-0.020$ | $V_{CC}-0.010$ | V_{CC} | V |
| V_{OUT} | Output Voltage Swing | See Figure 3a | 300 | 390 | 475 | mV |
| V_{DIFF_OUT} | Differential Output Voltage Swing | See Figure 3b | 600 | 780 | 950 | mV |
| R_{OUT} | Output Source Impedance | | 45 | 50 | 55 | Ω |

LVTTTL/CMOS DC Electrical Characteristics⁽⁶⁾

$V_{CC} = 2.375V$ to $2.625V$; $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------|--------------------|-----------|------|-----|----------|---------|
| V_{IH} | Input HIGH Voltage | | 2.0 | | V_{CC} | V |
| V_{IL} | Input LOW Voltage | | | | 0.8 | V |
| I_{IH} | Input HIGH Current | | -125 | | 30 | μA |
| I_{IL} | Input LOW Current | | -300 | | | μA |

Three Level EQ Input DC Electrical Characteristics⁽⁶⁾

$V_{CC} = 2.375V$ to $2.625V$; $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------|--------------------|-------------------|--------------|-----|--------------|---------|
| V_{IH} | Input HIGH Voltage | | $V_{CC}-0.3$ | | V_{CC} | V |
| V_{IL} | Input LOW Voltage | | 0 | | $V_{EE}+0.3$ | V |
| I_{IH} | Input HIGH Current | $V_{IH} = V_{CC}$ | | | 400 | μA |
| I_{IL} | Input LOW Current | $V_{IL} = GND$ | -480 | | | μA |

Note:

6. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

AC Electrical Characteristics

$V_{CCO} = 1.14V$ to $1.26V$ $R_L = 50\Omega$ to V_{CCO} .

$V_{CCO} = 1.7V$ to $1.9V$, $2.375V$ to $2.625V$, $R_L = 50\Omega$ to V_{CCO} or 100Ω across the outputs.

$V_{CC} = 2.375V$ to $2.625V$; $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|---|---------------------------|-----|-----|-----|-------------------|
| f_{MAX} | Maximum Frequency | NRZ Data | 6.4 | | | Gbps |
| | | $V_{OUT} > 200mV$ (Clock) | 4.5 | | | GHz |
| t_{PD} | Propagation Delay (IN-to-Q) (SEL-to-Q) | Note 7, Figure 1a | 210 | 280 | 360 | ps |
| | | Figure 1b | | | 1 | ns |
| t_{Skew} | Output-to-Output Skew | Note 8 | | 3 | 15 | ps |
| | Part-to-Part Skew | Note 9 | | | 100 | ps |
| t_{Jitter} | Data Random Jitter | Note 10 | | | 0.8 | ps _{RMS} |
| | Data Deterministic Jitter | Note 11 | | | 10 | ps _{PP} |
| t_R t_F | Output Rise/Fall Time (20% to 80%) | At full output swing. | 30 | 55 | 85 | ps |
| | Duty Cycle | Differential I/O | 45 | | 55 | % |

Notes:

7. Propagation delay is measured with no attenuating transmission line connected to the input.
8. Output-to-Output skew is the difference in time between both outputs under identical input transition, temperature and power supply
9. Part-to-part skew is defined for two parts with identical power supply voltages at the same temperature and no skew at the edges at the respective inputs.
10. Random jitter is additive jitter.
11. Deterministic jitter is measured with $2^{23}-1$ PRBS pattern.

Functional Description

CML Output Termination with Vcco 1.2V

For VCCO of 1.2V, Figure 5a, terminate the output with 50Ω to 1.2V, not 100Ω differentially across the outputs. If AC coupling is used, Figure 5d, terminate into 50Ω to 1.2V before the coupling capacitor and then connect to a high value resistor to a reference voltage. Any unused output pair with VCCO at 1.2V needs to be terminated, do not leave floating.

CML Output Termination with VCCO 1.8V, 2.5V

For VCCO of 1.8V or 2.5V, Figure 5a/b, terminate with either 50Ω to 1.8V or 100Ω differentially across the outputs. AC-or DC-coupling is fine. For best signal integrity, terminate any unused output pairs.

Timing Diagrams

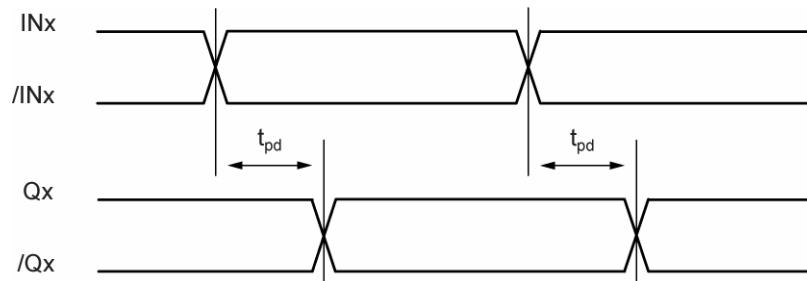


Figure 1a. IN-to-Q Timing Diagram

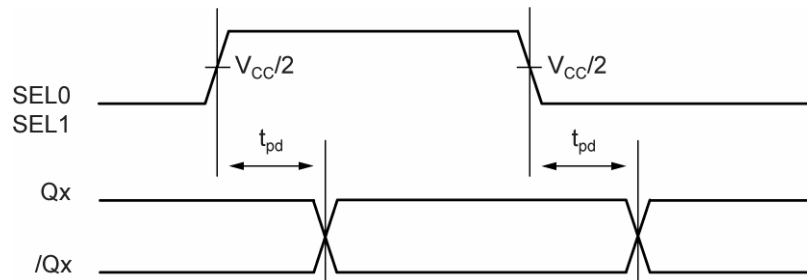


Figure 1b. SEL-to-Q Timing Diagram
(Qx state can be high or low depending on input data)

Input and Output Stage

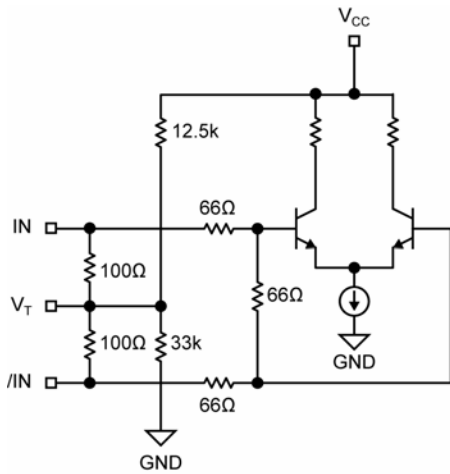


Figure 2a. Simplified Differential Input Buffer

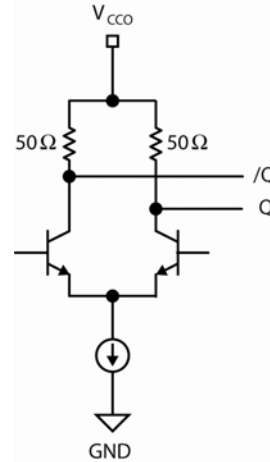


Figure 2b. Simplified CML Output Buffer

Single-Ended and Differential Swings

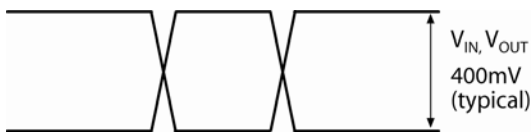


Figure 3a. Single-Ended Swing

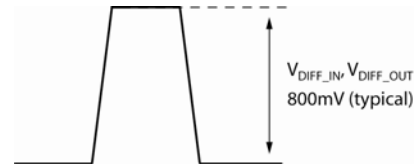
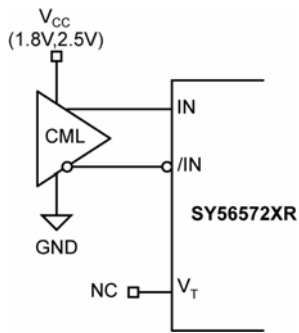
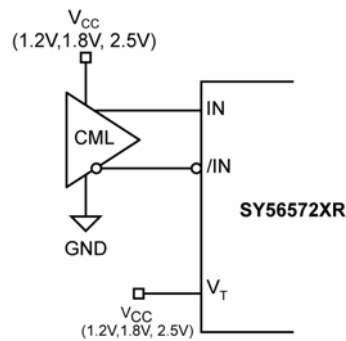


Figure 3b. Differential Swing

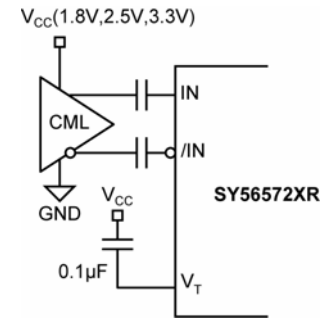
Input Interface Applications



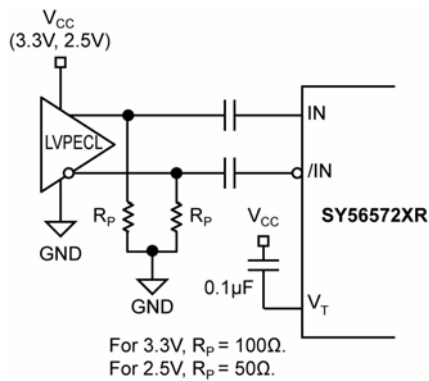
**Figure 4a. CML Interface
100 Ω Differential
(DC-Coupled, 1.8V, 2.5V)**



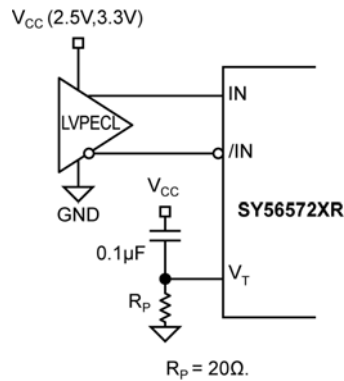
**Figure 4b. CML Interface
50 Ω -to-V_{CC}
(DC-Coupled, 1.2V, 1.8V, 2.5V)**



**Figure 4c. CML Interface
(AC-Coupled)**
*See note in Functional Description
for 1.2V CML driver with AC-Coupling.



**Figure 4d. LVPECL Interface
(AC-Coupled)**



**Figure 4e. LVPECL Interface
(DC-Coupled 2.5V and 3.3V)**

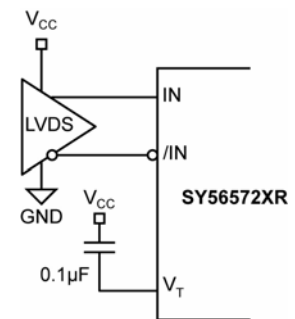


Figure 4f. LVDS Interface

CML Output Termination

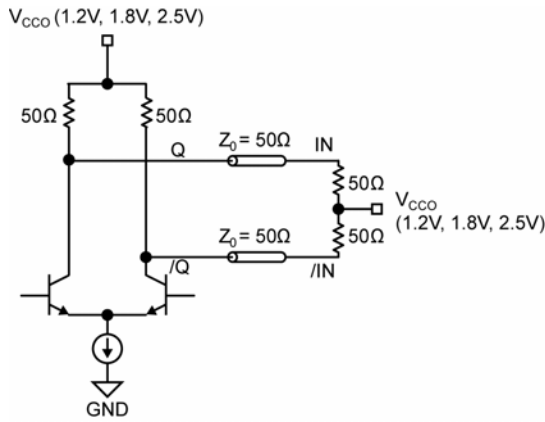


Figure 5a. 1.2V, 1.8V, 2.5V CML DC-Coupled Termination

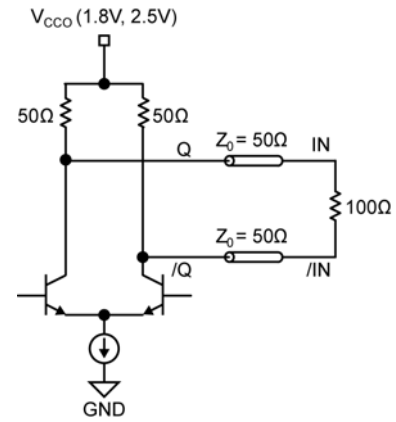


Figure 5b. 1.8V, 2.5V CML DC-Coupled Termination

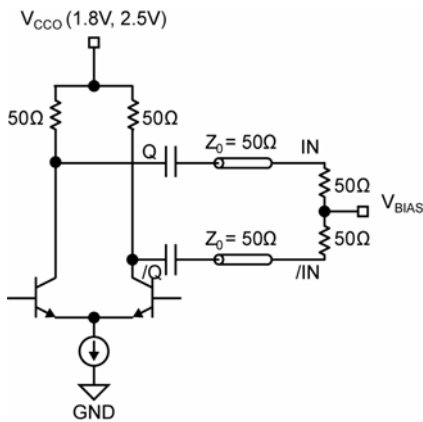


Figure 5c. CML AC-Coupled Termination.
VCCO 1.8V, 2.5V only.

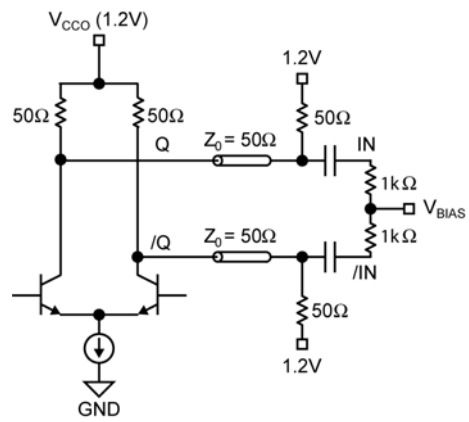
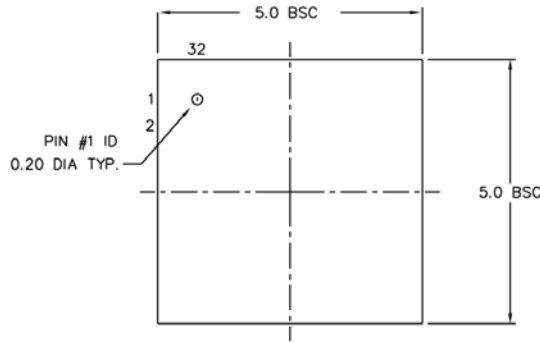
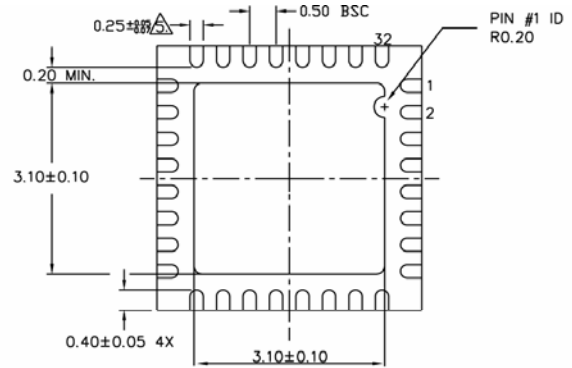


Figure 5d. CML AC-Coupled Termination.
VCCO 1.2V only.

Package Information



TOP VIEW



BOTTOM VIEW



SIDE VIEW

- NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
 2. MAX. PACKAGE WARPAGE IS 0.05 mm.
 3. MAXIMUM ALLOWABLE BURRS IS 0.076 mm IN ALL DIRECTIONS.
 4. PIN #1 ID ON TOP WILL BE LASER/INK MARKED.
- ⚠ DIMENSION APPLIES TO METALIZED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25 mm FROM TERMINAL TIP.
- ⚠ APPLIED ONLY FOR TERMINALS.
- ⚠ APPLIED FOR EXPOSED PAD AND TERMINALS.

32-Pin MLF[®] (5mm x5mm) (MLF-32)

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