

FEATURES

- Precision 1:2, 400mV CML fanout buffer
- Low jitter performance:
 - 49fs_{RMS} phase jitter (typ)
- Guaranteed AC performance over temperature/voltage:
 - > 7GHz f_{MAX} clock
 - < 60ps t_r / t_f times
 - < 250ps t_{pd}
 - < 15ps max. skew
- Accepts an input signal as low as 100mV
- Unique input termination and V_T pin accepts DC-coupled and AC-coupled differential inputs: LVPECL, LVDS, and CML
- 50ohms source terminated CML outputs
- Power supply 2.5V ±5% and 3.3V ±10%
- Industrial temperature range: -40°C to +85°C
- Available in 16-pin (3mm * 3mm) QFN package



Precision Edge®

DESCRIPTION

The SY58011U is a 2.5V/3.3V precision, high-speed, fully differential 1:2 CML fanout buffer. Optimized to provide two identical output copies with less than 15ps of skew and only 49fs_{RMS} phase jitter, the SY58011U can process clock signals as fast as 7GHz or data patterns up to 10.7Gbps.

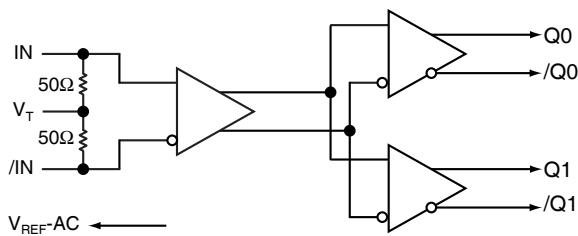
The differential input includes Micrel's unique, 3-pin input termination architecture that interfaces to LVPECL, LVDS, or CML differential signals, (AC-coupled or DC-coupled) as small as 100mV without any level-shifting or termination resistor networks in the signal path. For AC-coupled input interface applications, an on-board output reference voltage (V_{REF-AC}) is provided to bias the V_T pin. The outputs are compatible with 400mV typical swing into 50ohms loads, with extremely fast rise/fall times guaranteed to be less than 60ps.

The SY58011U operates from a 2.5V ±5% supply or 3.3V ±10% supply and is guaranteed over the full industrial temperature range (-40°C to +85°C). For applications that require LVPECL outputs, consider the SY58012U or SY58013U 1:2 fanout buffer with 800mV and 400mV output swing, respectively. The SY58011U is part of Micrel's high-speed, Precision Edge® product line. Datasheets and support documentation can be found on Micrel's web site at www.micrel.com.

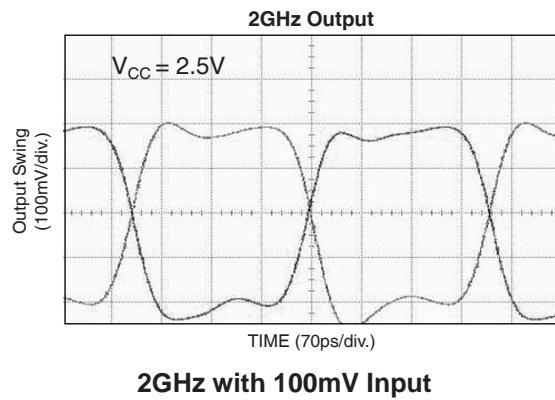
APPLICATIONS

- All SONET and GigE clock distribution
- Fibre Channel clock and data distribution
- Backplanes
- Data distribution: OC-48, OC-48+FEC, XAUI
- High-end, low skew, multiprocessor synchronous clock distribution

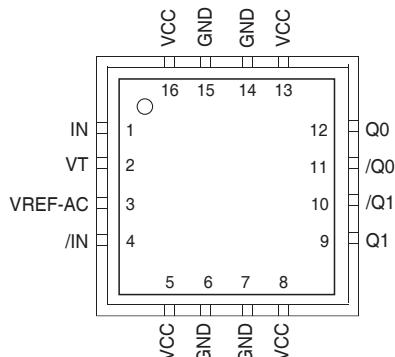
FUNCTIONAL BLOCK DIAGRAM



TYPICAL PERFORMANCE



PACKAGE/ORDERING INFORMATION



16-Pin QFN (QFN-16)

Ordering Information⁽¹⁾

| Part Number | Package Type | Operating Range | Package Marking |
|---------------------------|-------------------|-----------------|---|
| SY58011UMG ⁽³⁾ | QFN-16 Pb-Free | Industrial | 011U with Pb-Free bar-line indicator |
| SY58011UMGTR(2, 3) | QFN-16 Pb-Free | Industrial | 011U with Pb-Free bar-line indicator |

Notes:

1. Contact factory for die availability. Dice are guaranteed at $T_A = 25^\circ\text{C}$, DC electricals only.
All devices are Pb-Free.
2. Tape and Reel.
3. Pb-Free package recommended for new designs.

PIN DESCRIPTION

| Pin Number | Pin Name | Pin Function |
|-----------------|-----------------------|---|
| 1, 4 | IN, /IN | Differential Input: This input pair is the signal to be buffered. Each pin of this pair internally terminates with 50ohms to the V_T pin. Note that this input will default to an indeterminate state if left open. See "Input Interface Applications" section. |
| 2 | VT | Input Termination Center-Tap: Each input terminates to this pin. The V_T pin provides a center-tap for each input (IN, /IN) to a termination network for maximum interface flexibility. See "Input Interface Applications" section. |
| 3 | VREF-AC | Reference Output Voltage: This output biases to $V_{CC} - 1.2\text{V}$. It is used when AC-coupling the inputs (IN, /IN). Connect V_{REF-AC} directly to the V_T pin. Bypass with $0.01\mu\text{F}$ low ESR capacitor to V_{CC} . Maximum current source or sink is 0.5mA. See "Input Interface Applications" section. |
| 5, 8, 13, 16 | VCC | Positive Power Supply: Bypass with $0.1\mu\text{F}/0.01\mu\text{F}$ low ESR capacitors as close to the V_{CC} pins as possible. |
| 6, 7, 14, 15 | GND, (Exposed Pad) | Ground. Exposed pad must be connected to a ground plane that is the same potential as the ground pin. |
| 12, 11 9, 10 | Q0, /Q0, Q1, /Q1 | CML Differential Output Pairs: Differential buffered output copy of the input signal. The output swing is typically 400mV. Unused output pairs may be left floating with no impact on jitter. See "CML Output Termination" section. |

Absolute Maximum Ratings (Note 1)

| | | |
|---|---|----------------------------------|
| Power Supply Voltage (V_{CC}) | | -0.5V to +4.0V |
| Input Voltage (V_{IN}) | | -0.5V to V_{CC} |
| CML Output Voltage (V_{OUT}) | | V_{CC} -1.0V to V_{CC} +0.5V |
| Current (V_T) | Source or sink current on V_T pin | ± 100 mA |
| Input Current | Source or sink current on IN, /IN | ± 50 mA |
| Current (V_{REF}) | Source or sink current on V_{REF} -AC, Note 4 | ± 1.5 mA |
| Lead Temperature Soldering, (20 seconds) | | 260°C |
| Storage Temperature Range (T_{STORE}) | ... | -65°C to +150°C |

Operating Ratings (Note 2)

| | | |
|---------------------------------------|-----------|-------------------|
| Supply Voltage (V_{CC}) | | +2.375V to +3.60V |
| Operating Temperature Range (T_A) | | -40°C to +85°C |
| Package Thermal Resistance, Note 3 | | |
| QFN (θ_{JA}) | Still-Air | 60°C/W |
| | 500lfpmp | 54°C/W |
| QFN (ψ_{JB}) | | 33°C/W |

DC ELECTRICAL CHARACTERISTICS (Note 5) $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|----------------|----------------------------------|-------------------------|---------------|---------------|---------------|-------|
| V_{CC} | Power Supply Voltage | | 2.375 | | 3.60 | V |
| I_{CC} | Power Supply Current | Max. V_{CC} , no load | | 75 | 95 | mA |
| V_{IH} | Input HIGH Voltage | IN, /IN, Note 6 | V_{CC} -1.6 | | V_{CC} | V |
| V_{IL} | Input LOW Voltage | IN, /IN | 0 | | V_{IH} -0.1 | V |
| V_{IN} | Input Voltage Swing | see Figure 1a. | 0.1 | | 1.7 | V |
| V_{DIFF_IN} | Differential Input Voltage Swing | see Figure 1b. | 0.2 | | | V |
| R_{IN} | Into V_T Resistance | | 40 | 50 | 60 | ý |
| V_{REF} -AC | Output Reference Voltage | | V_{CC} -1.3 | V_{CC} -1.2 | V_{CC} -1.1 | V |
| IN to V_T | | | | | 1.28 | V |

CML DC ELECTRICAL CHARACTERISTICS (Note 5) $V_{CC} = 3.3\text{V} \pm 10\%$ or $2.5\text{V} \pm 5\%$; $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $R_L = 100\text{ý}$ across each output pair, or equivalent, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|-----------------|-----------------------------------|----------------------------------|-----------------|-----------------|----------|-------|
| V_{OH} | Output HIGH Voltage | Q0, /Q0, Q1, /Q1 | V_{CC} -0.020 | V_{CC} -0.010 | V_{CC} | V |
| V_{OUT} | Output Voltage Swing | Q0, /Q0, Q1, /Q1; see Figure 1a. | 325 | 400 | | mV |
| V_{DIFF_OUT} | Differential Output Voltage Swing | Q0, /Q0, Q1, /Q1; see Figure 1b. | 650 | 800 | | mV |
| R_{OUT} | Output Source Impedance | Q0, /Q0, Q1, /Q1 | 40 | 50 | 60 | ohms |

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. Thermal performance assumes exposed pad is soldered (or equivalent) to the device's most negative potential (gnd) on the pcb.
4. Due to the limited drive capability, use for input of the same package only.
5. The circuit is designed to meet the dc specifications shown in the above table after thermal equilibrium has been established.
6. V_{IH} (min) not lower than 1.2V.

AC ELECTRICAL CHARACTERISTICS (Note 7)

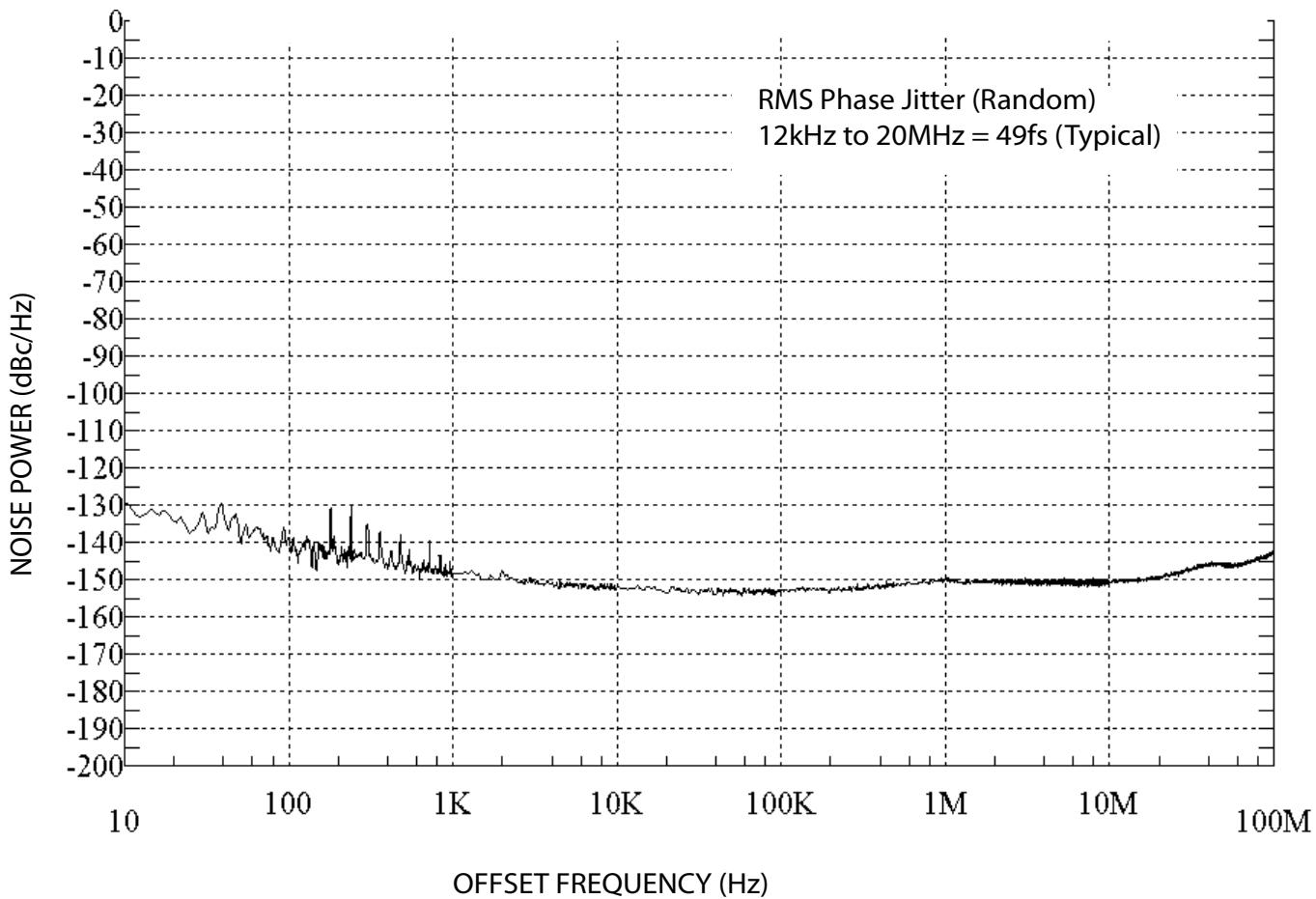
$V_{CC} = 2.5V \pm 5\%$ or $3.3V \pm 10\%$; $T_A = -40^\circ C$ to $+85^\circ C$; $R_L = 100\text{ohms}$ across each output pair, or equivalent, unless otherwise stated.

| Symbol | Parameter | Condition | Min | Typ | Max | Units |
|--------------|-----------------------------|---|-----|------|-----|-------------------|
| f_{MAX} | Maximum Operating Frequency | NRZ Data | | 10.7 | | Gbps |
| | | $V_{OUT} > 200\text{mV}$ Clock | 7 | 8 | | GHz |
| t_{pd} | Propagation Delay | $V_{IN} > 100\text{mV}$ | 100 | 170 | 250 | ps |
| t_{CHAN} | Channel-to-Channel Skew | Note 8 | | 3 | 15 | ps |
| t_{SKEW} | Part-to-Part Skew | Note 9 | | | 100 | ps |
| t_{JITTER} | RMS Phase Jitter | Output = 622MHz Integration Range: 12kHz - 20MHz | | 49 | | fs_{RMS} |
| t_r, t_f | Output Rise/Fall Time | 20% to 80% at full output swing | 20 | 40 | 60 | ps |

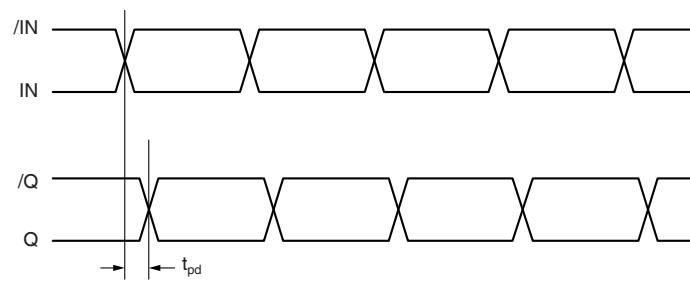
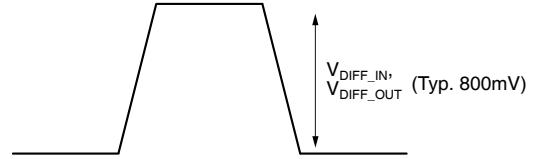
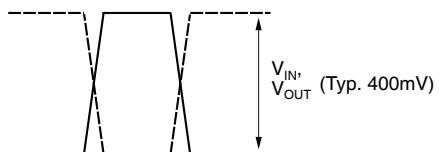
Notes:

7. High frequency AC electricals are guaranteed by design and characterization.
8. Skew is measured between outputs of the same bank under identical transitions.
9. Skew is defined for two parts with identical power supply voltages at the same temperature and with no skew of the edges at the respective inputs.

PHASE NOISE

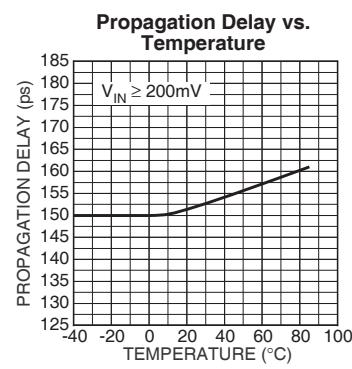
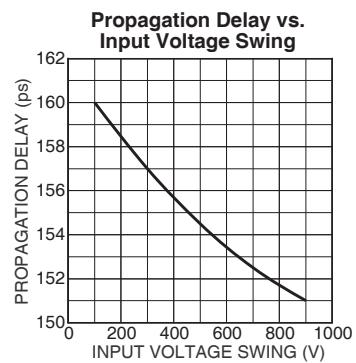
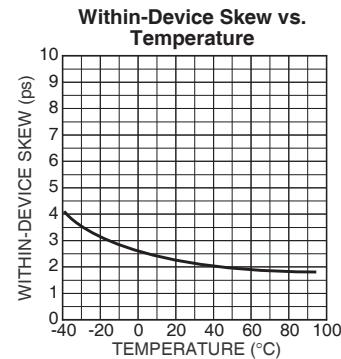
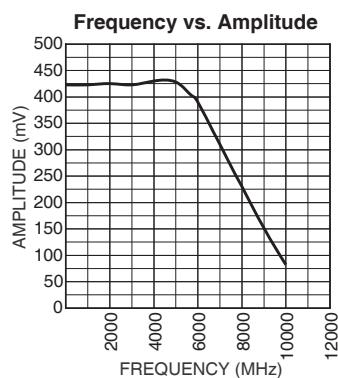


Phase Noise Plot: 622MHz @ 3.3V

TIMING DIAGRAM**SINGLE-ENDED AND DIFFERENTIAL SWINGS**

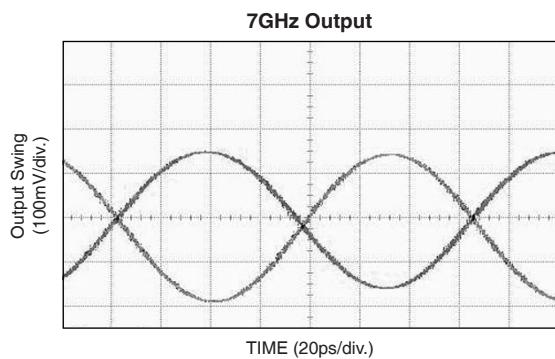
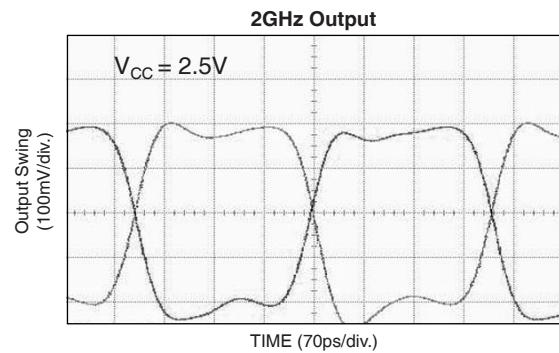
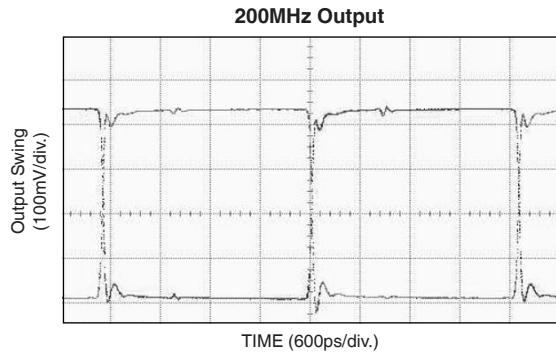
TYPICAL OPERATING CHARACTERISTICS

$V_{CC} = 3.3V$, $GND = 0$, $V_{IN} = 100mV$, $T_A = 25^\circ C$, unless otherwise stated.



FUNCTIONAL CHARACTERISTICS

$V_{CC} = 2.5V$, GND = 0, $V_{IN} = 100mV$, $T_A = 25^\circ C$, unless otherwise stated.



INPUT STAGE

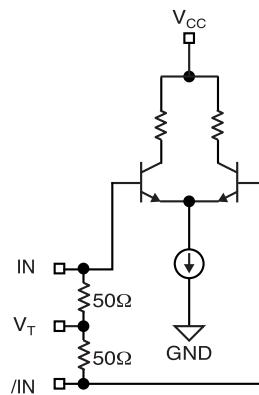


Figure 2. Simplified Differential Input Buffer

INPUT INTERFACE APPLICATIONS

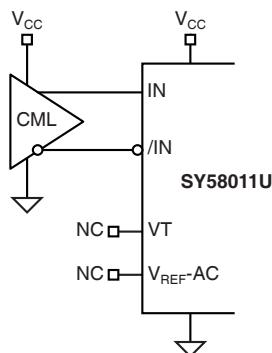


Figure 3a. DC-Coupled CML Input Interface
(option: may connect V_T to V_{CC})

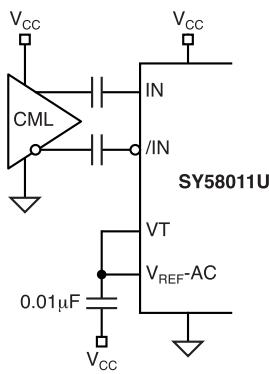
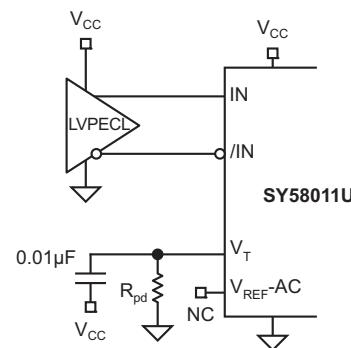
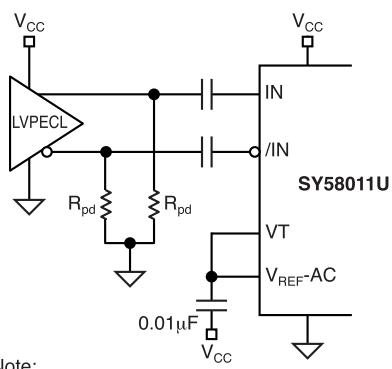


Figure 3b. AC-Coupled CML Input Interface



Note:
For $V_{CC} = 2.5V$ systems, $R_{pd} = 19\Omega$.
For $V_{CC} = 3.3V$ systems, $R_{pd} = 50\Omega$.

Figure 3c. LVPECL Input Interface



Note:
 $R_{pd} = 100\Omega$ for a 3.3V system
 $R_{pd} = 50\Omega$ for a 2.5V system

Figure 3d. AC-Coupled LVPECL Input Interface

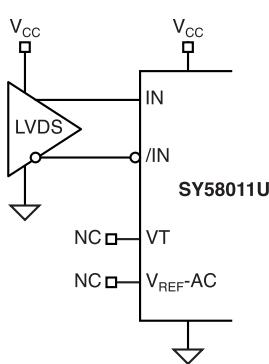


Figure 3e. LVDS Input Interface

CML OUTPUT TERMINATION

Figure 4 and Figure 5 illustrates how to terminate a CML output using both the AC-coupled and DC-coupled

configuration. All outputs of the SY58011 are 50ohms with a 16mA current source.

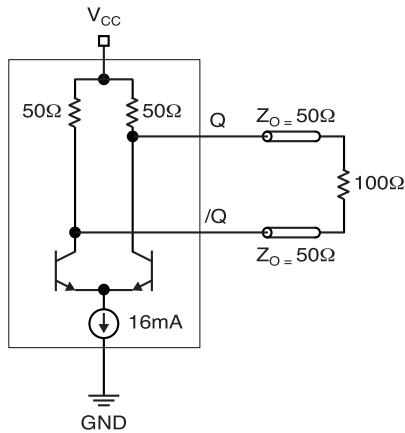


Figure 4. CML DC-Coupled Termination

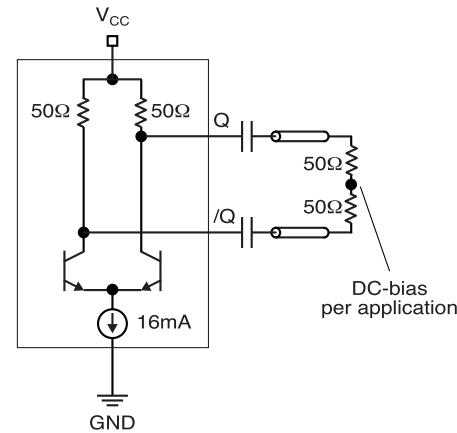
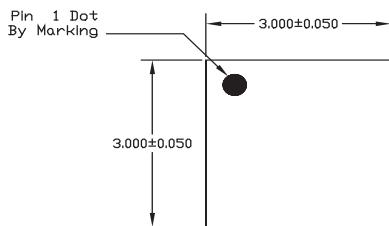


Figure 5. CML AC-Coupled Termination

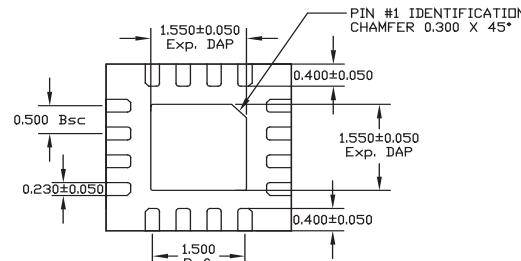
RELATED MICREL PRODUCTS AND SUPPORT DOCUMENTATION

| Part Number | Function | Data Sheet Link |
|-------------|---|--|
| SY58011U | 7GHz, 1:2 CML Fanout Buffer/Translator with Internal I/O Termination | http://www.micrel.com/product-info/products/sy58011u.shtml |
| SY58012U | 5GHz, 1:2 LVPECL Fanout Buffer/Translator with Internal Input Termination | http://www.micrel.com/product-info/products/sy58012u.shtml |
| SY58013U | 6GHz, 1:2 Fanout Buffer/Translator with 400mV LVPECL Outputs and Internal Input Termination | http://www.micrel.com/product-info/products/sy58013u.shtml |
| | 16-MLF® Manufacturing Guidelines Exposed Pad Application Note | www.amkor.com/products/notes_papers/MLF_AppNote_0902.pdf |
| | HBW Solutions | http://www.micrel.com/product-info/as/solutions.shtml |

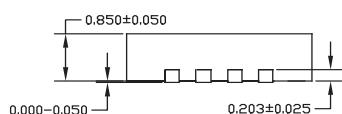
16-PIN QFN (QFN-16)



TOP VIEW

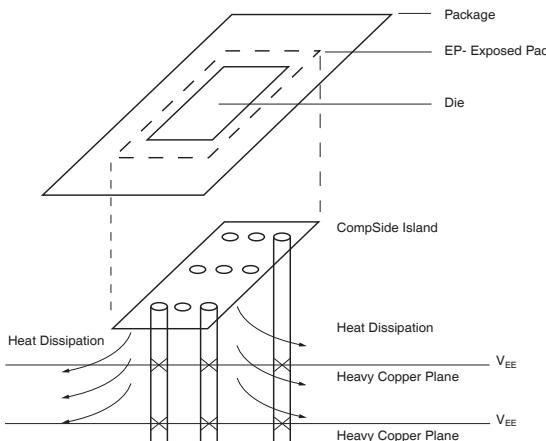


BOTTOM VIEW



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.



PCB Thermal Consideration for 16-Pin QFN Package
(Always solder, or equivalent, the exposed pad to the PCB)

Package Notes:

1. Package meets Level 2 qualification.
2. All parts are dry-packaged before shipment.
3. Exposed pads must be soldered to a ground for proper thermal management.

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