SY58018U

Ultra-Precision Differential LVPECL 2:1 MUX with Internal Termination

Features

- Guaranteed AC Performance over Temperature and Voltage:
  - DC to 5 Gbps Throughput
  - DC to >4 GHz f_{MAX} (Clock)
  - <240 ps Propagation Delay (IN-to-Q)
  - <110 ps Rise/Fall Times
- Ultra-Low Jitter Design
- Unique Input Termination and VT Pin Accepts DC- and AC-Coupled Inputs (CML, PECL, LVDS)
- 800 mV (100k) LVPECL Output Swing
- 2.5V ±5% or 3.3V ±10% Power Supply Operation
- Industrial Temperature Range: –40°C to +85°C
- Available in 16-lead (3 mm x 3 mm) QFN Package

Applications

- Redundant Clock Distribution
- SONET/SDH Clock/Data Distribution
- Loopback
- Fibre Channel Distribution

General Description

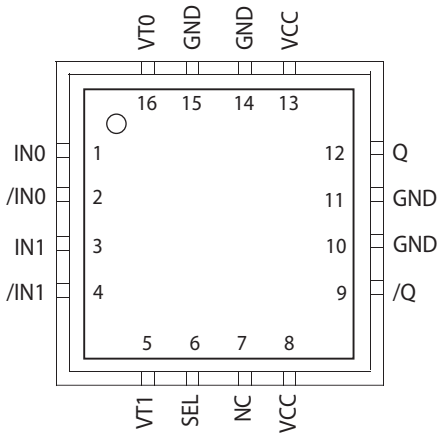
The SY58018U is a 2.5V/3.3V precision, high-speed, 2:1 differential MUX capable of handling clocks up to 4 GHz and data up to 5 Gbps.

The differential input includes Microchip's unique, 3-pin input termination architecture that allows customers to interface to any differential signal (AC- or DC-coupled) as small as 100 mV without any level shifting or termination resistor networks in the signal path. The outputs are 800 mV, 100k compatible, LVPECL, with extremely fast rise/fall times guaranteed to be less than 110 ps.

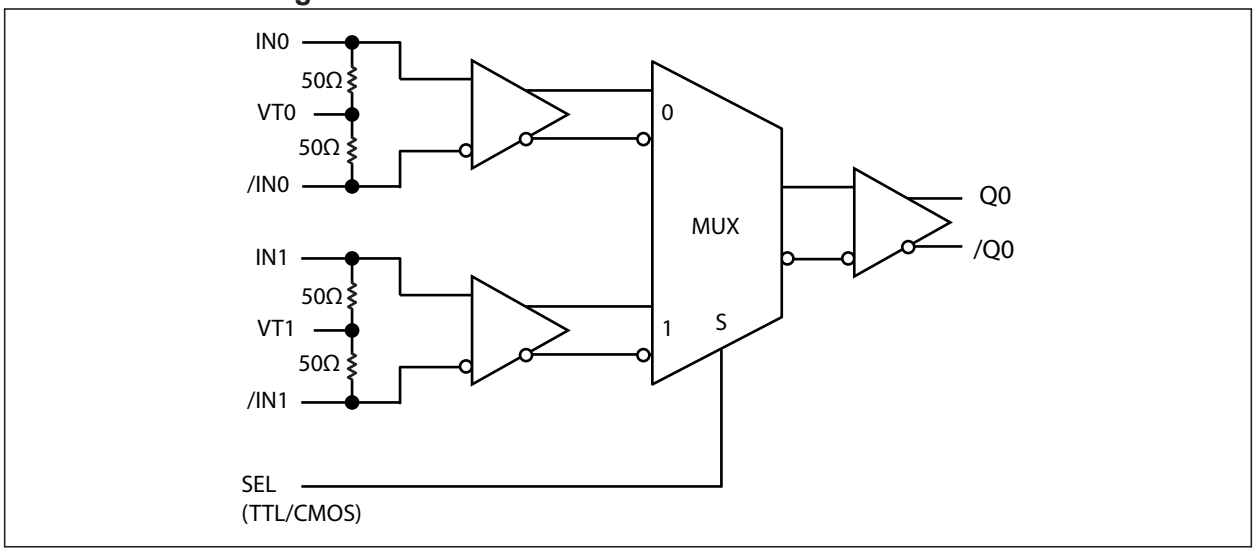
The SY58018U operates from a 2.5V ±5% supply or a 3.3V ±10% supply and is guaranteed over the full industrial temperature range of –40°C to +85°C. For applications that require CML outputs, consider the SY58017U or for 400 mV LVPECL outputs the SY58019U. The SY58018U is part of Microchip's high-speed, Precision Edge® product line.

Package Type

SY58018U
3 mm x 3 mm QFN-16 (M)
(Top View)



Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{CC}) ..... –0.5V to +4.0V
Input Voltage (V_{IN}) ..... –0.5V to V_{CC}
LVPECL Output Current (I_{OUT})
    Continuous ..... 50 mA
    Surge ..... 100 mA
Termination Current (I_{VT})
    Source or Sink on VT Pin ..... ±100 mA
Input Current
    Source or Sink Current on IN, /IN ..... ±50 mA

Operating Ratings ††

Supply Voltage (V_{CC}) ..... +2.375V to +2.625V
Supply Voltage (V_{CC}) ..... +2.97V to +3.63V

† Notice: 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.

†† Notice: The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.

DC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: T_A = –40°C to +85°C, unless otherwise stated. Note 1

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Power Supply Voltage Range	V_{CC}	2.375	2.5	2.625	V	—
		2.97	3.3	3.63		
Power Supply Current	I_{CC}	—	50	65	mA	No load, max. V_{CC}
Differential Input Resistance (IN0-to-/IN0, IN1-to-/IN1)	R_{DIFF_IN}	80	100	120	Ω	—
Input Resistance (IN0-to-VT0, /IN0-to-VT0, IN1-to-VT1, /IN1-to-VT1)	R_{IN}	40	50	60	Ω	—
Input HIGH Voltage (IN0, /IN0, IN1, /IN1)	V_{IH}	V_{CC} – 1.6	—	V_{CC}	V	Note 2
Input LOW Voltage (IN0, /IN0, IN1, /IN1)	V_{IL}	0	—	V_{IH} – 0.1	V	—
Input Voltage Swing (IN0, /IN0, IN1, /IN1)	V_{IN}	0.1	—	1.7	V	See Figure 4-1
Differential Input Voltage Swing |IN0, /IN0|, |IN1, /IN1|	V_{DIFF_IN}	0.2	—	—	V	See Figure 4-2
Voltage from Input to VT (IN0, /IN0, IN1, /IN1)	V_{T_IN}	—	—	1.28	V	—

Note 1: The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

2: $V_{IH(MIN)}$ not lower than 1.2V.

LVPECL OUTPUT DC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V_{CC} = +2.5V ±5% or +3.3V ±10%, R_L = 50Ω to V_{CC} – 2V; T_A = –40°C to +85°C, unless otherwise stated. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Output High Voltage Q, /Q	V_{OH}	V_{CC} – 1.145	—	V_{CC} – 0.895	V	—
Output Low Voltage Q, /Q	V_{OL}	V_{CC} – 1.945	—	V_{CC} – 1.695	V	—
Output Differential Swing Q, /Q	V_{OUT}	550	800	—	mV	See Figure 4-1
Differential Output Voltage Swing Q, /Q	V_{DIFF_OUT}	1100	1600	—	mV	See Figure 4-2

Note 1: The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

LVTTL/CMOS DC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V_{CC} = 2.5V ±5% or 3.3V ±10%; T_A = –40°C to +85°C. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Input HIGH Voltage	V_{IH}	2.0	—	—	V	—
Input LOW Voltage	V_{IL}	—	—	0.8	V	—
Input HIGH Current	I_{IH}	—	—	40	µA	—
Input LOW Current	I_{IL}	–300	—	—	µA	—

Note 1: The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

AC ELECTRICAL CHARACTERISTICS

Electrical Characteristics: V_{CC} = +2.5V ±5% or +3.3V ±10%, R_L = 50Ω to V_{CC} – 2V; T_A = –40°C to +85°C, unless otherwise stated. Note 1

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Maximum Frequency	f_{MAX}	5	—	—	Gbps	NRZ (Data)
		—	4	—	GHz	V_{OUT} > 400 mV (Clock)
Propagation Delay	t_{PD}	110	190	240	ps	(IN0 or IN1-to-Q)
		50	180	350	ps	(SEL-to-Q)
Differential Propagation Delay Temperature Coefficient	t_{PD} Tempco	—	75	—	fs/°C	—
Input-to-Input Skew	t_{SKEW}	—	4	15	ps	Note 2
Part-to-Part Skew		—	—	100	ps	Note 3
Additive Phase Jitter	t_{JITTER}	—	50	—	fs	622 MHz Integration Range: 12 kHz to 20 MHz
		—	104	—		156.25 MHz Integration Range: 12 kHz to 20 MHz
		—	173	—		100 MHz Integration Range: 12 kHz to 20 MHz
Output Rise/Fall Time	t_r/t_f	35	75	110	ps	20% to 80% at full swing

Note 1: High frequency AC parameters are guaranteed by design and characterization.

2: Input-to-input skew is the difference in time from and input-to-output in comparison to any other input-to-output.

3: 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.

TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Operating Ambient Temperature Range	T_A	–40	—	+85	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 20 sec.
Storage Temperature Range	T_S	–65	—	+150	°C	—
Package Thermal Resistances (Note 1)						
Thermal Resistance, 3x3 QFN-16Ld	θ_{JA}	—	60	—	°C/W	Still-air
	Ψ_{JB}	—	38	—	°C/W	Junction-to-board

Note 1: 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.

2.0 TYPICAL PERFORMANCE CURVES

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

V_{CC} = 3.3V, V_{IN} = 400 mV, T_A = +25°C, unless otherwise stated.

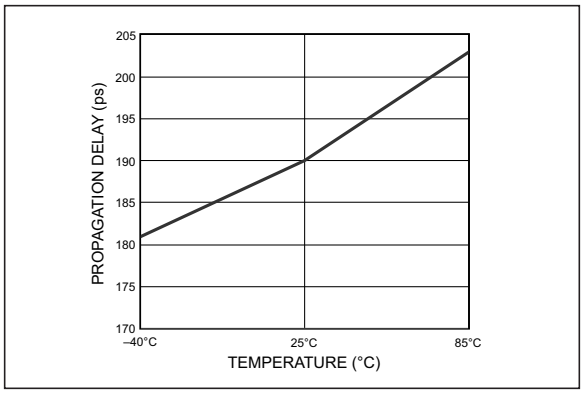


FIGURE 2-1: *Propagation Delay vs. Temperature.*

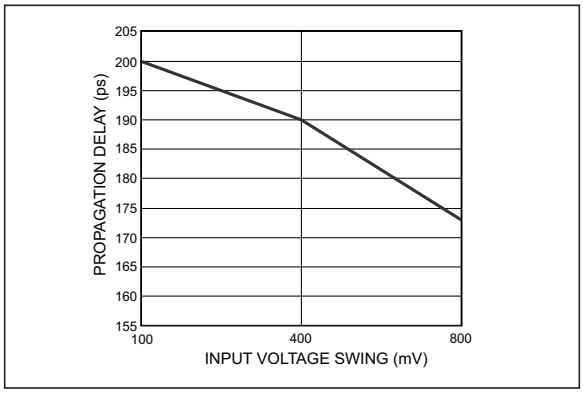


FIGURE 2-2: *Propagation Delay vs. Input Voltage Swing.*

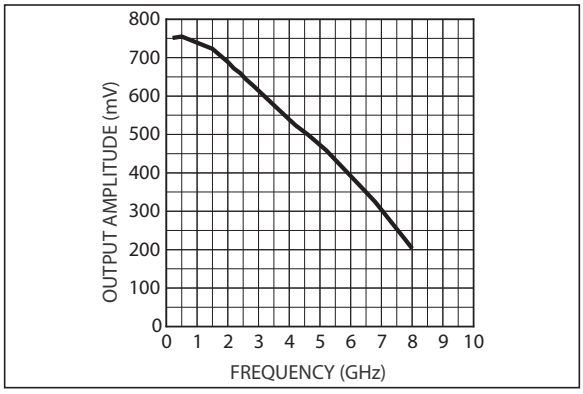


FIGURE 2-3: *Output Amplitude vs. Frequency.*

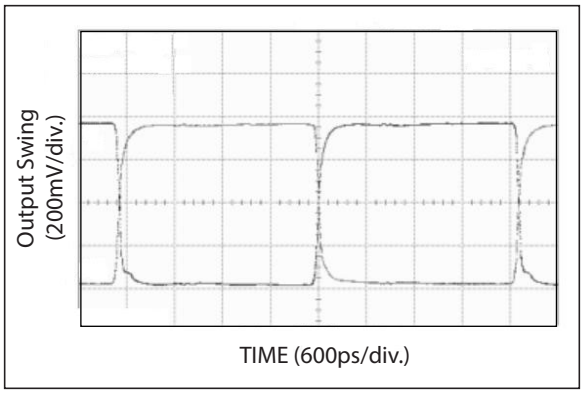


FIGURE 2-4: *200 MHz Output.*

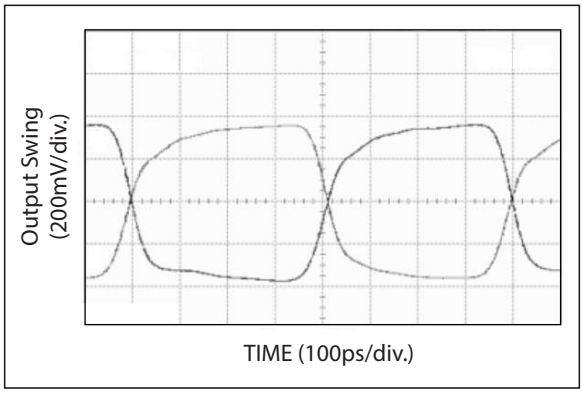


FIGURE 2-5: *1.25 GHz Output.*

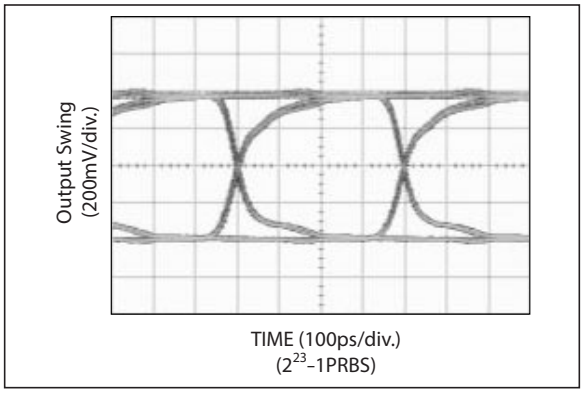


FIGURE 2-6: *2.5 Gbps Output.*

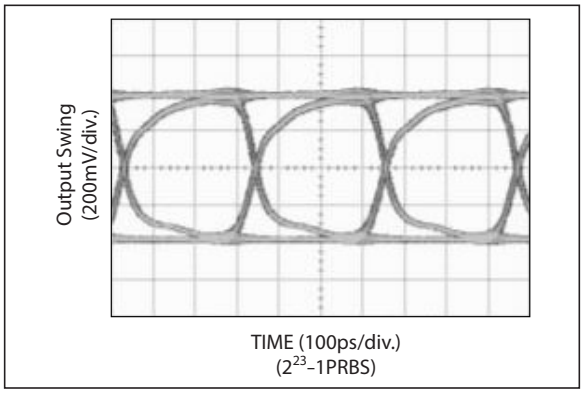


FIGURE 2-7: *3.2 Gbps Output.*

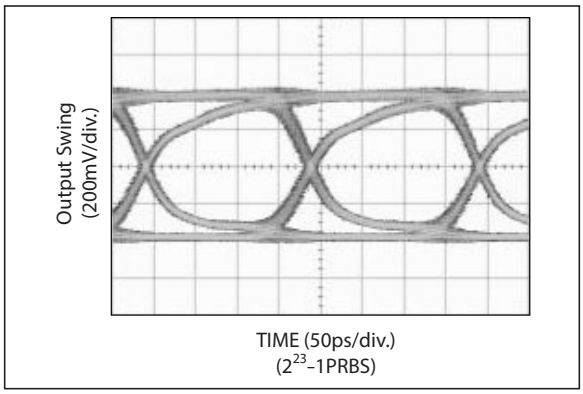


FIGURE 2-8: *5 Gbps Output.*

3.0 PHASE NOISE PLOTS

V_{CC} = +3.3V, T_A = +25°C.

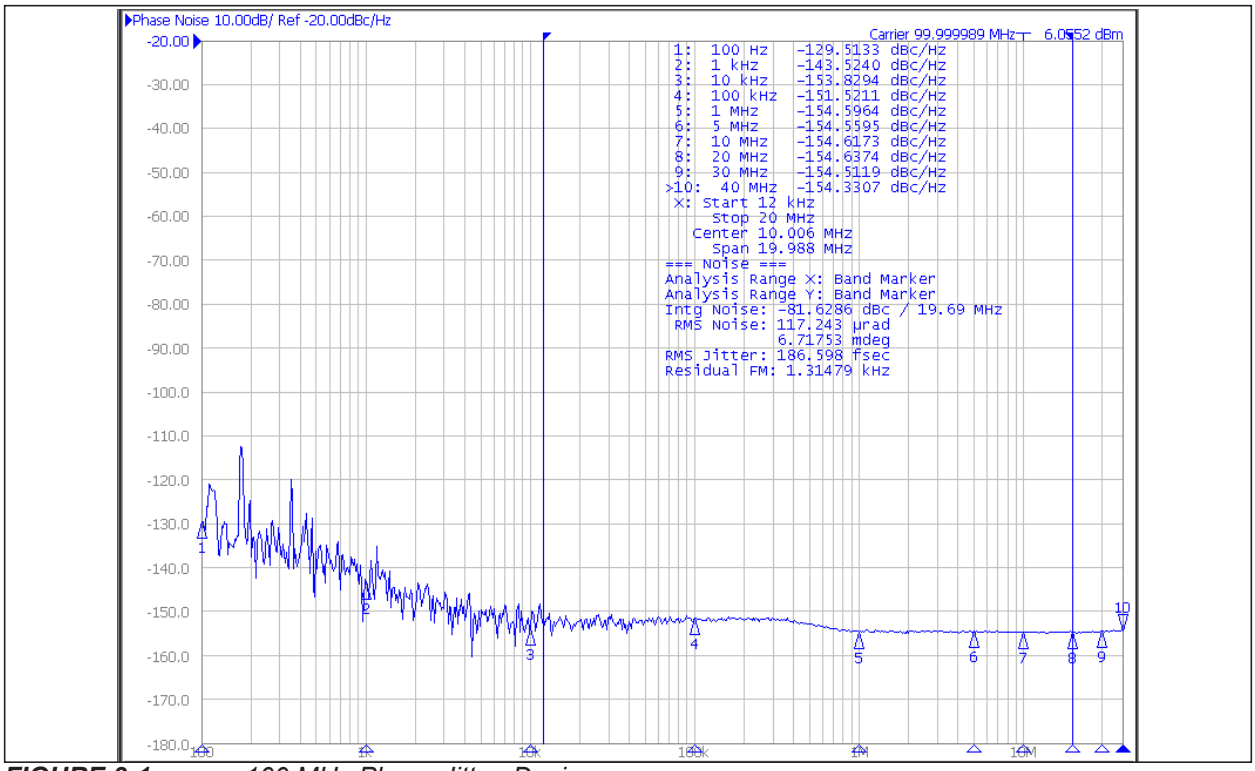


FIGURE 3-1: *100 MHz Phase Jitter, Device.*

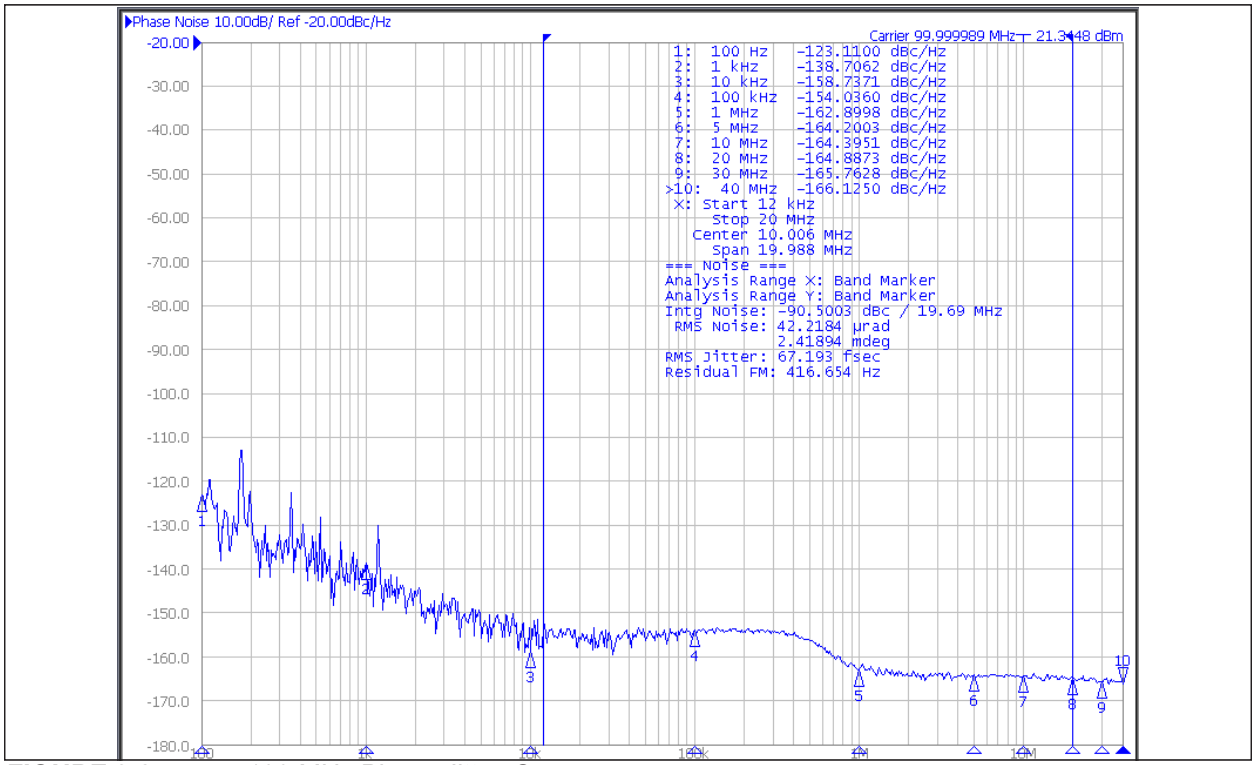


FIGURE 3-2: *100 MHz Phase Jitter, Source.*

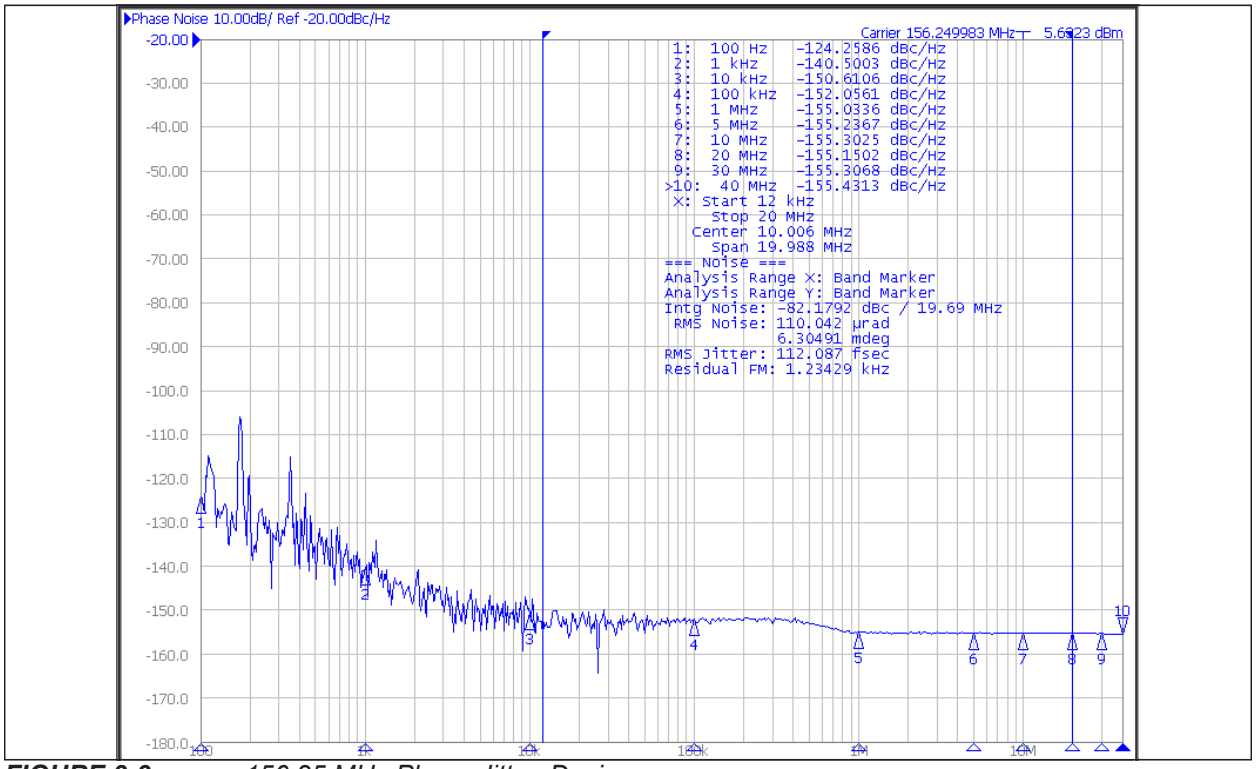


FIGURE 3-3: *156.25 MHz Phase Jitter, Device.*

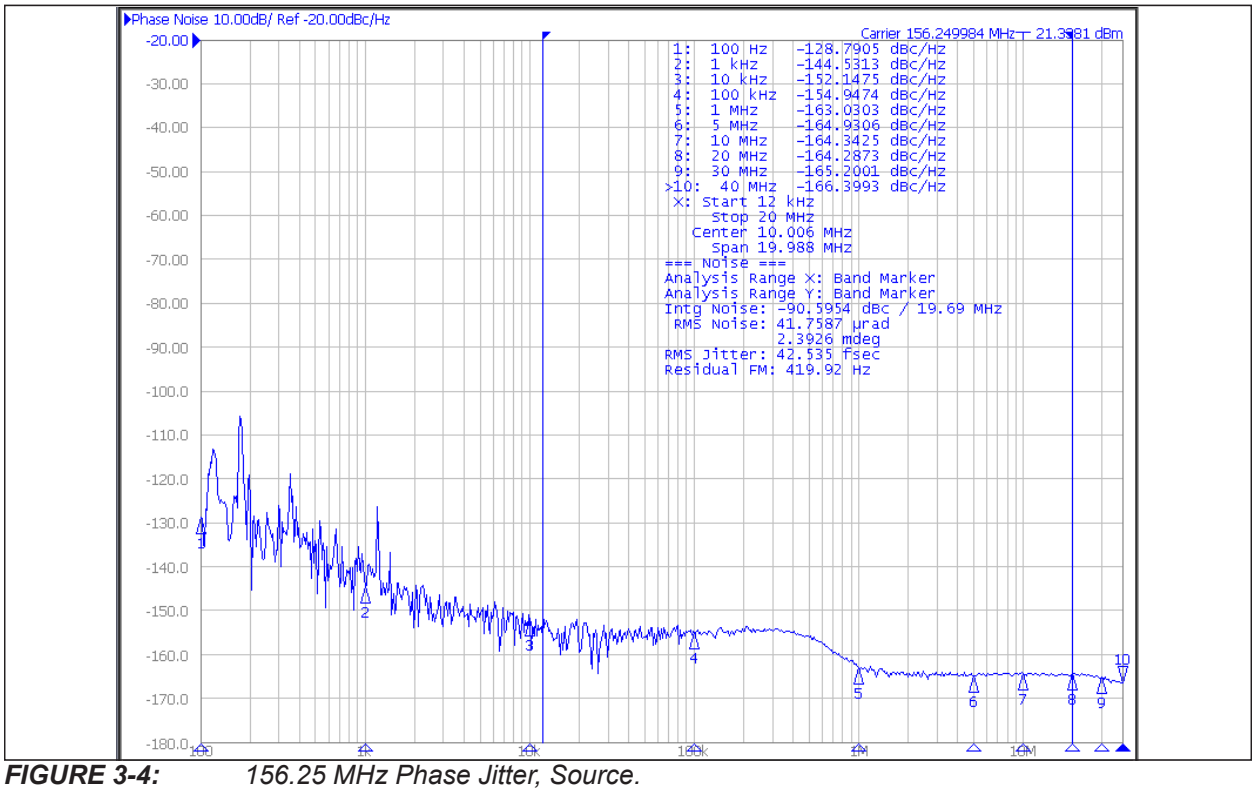


FIGURE 3-4: *156.25 MHz Phase Jitter, Source.*

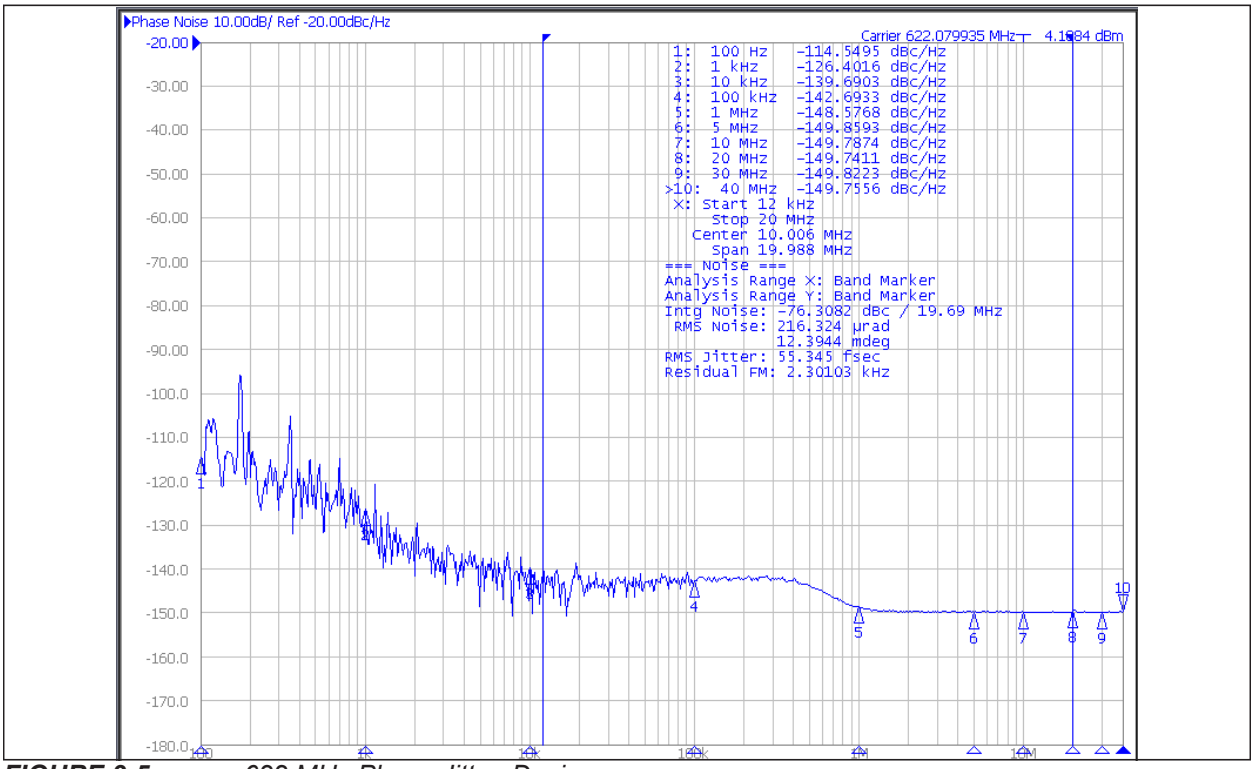


FIGURE 3-5: *622 MHz Phase Jitter, Device.*

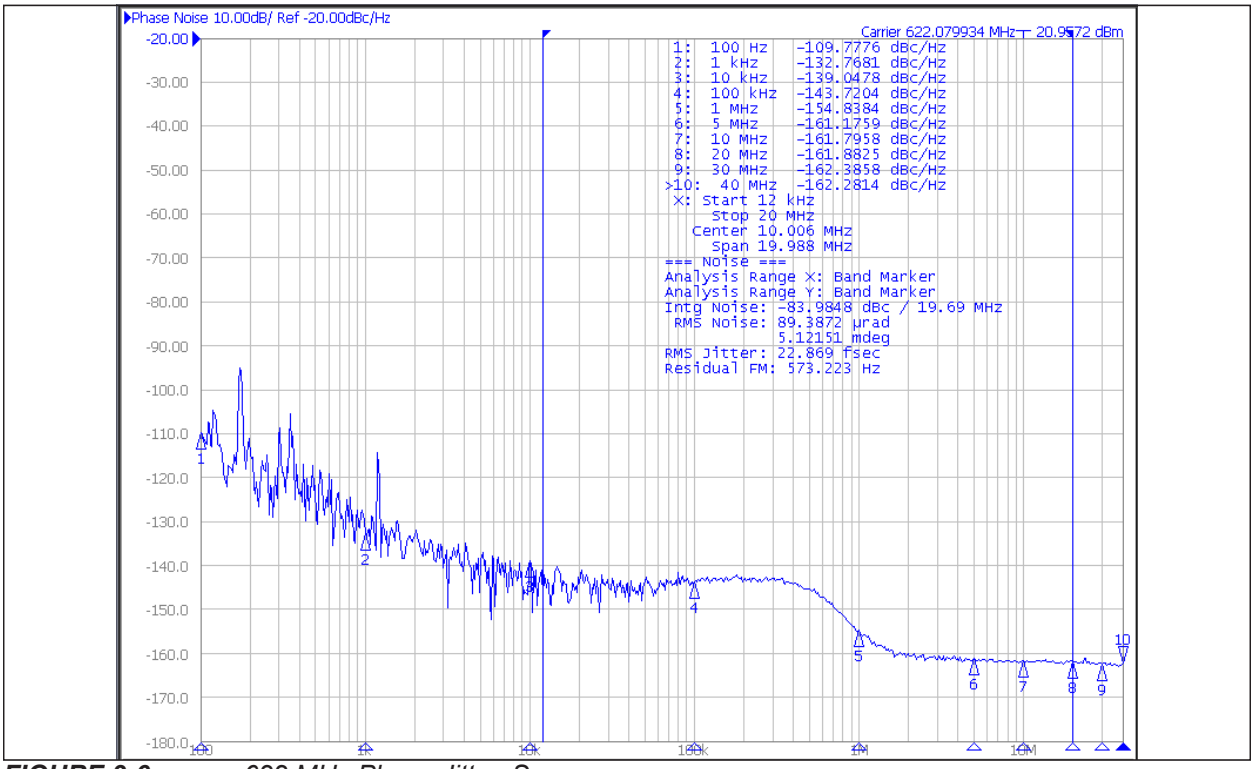


FIGURE 3-6: *622 MHz Phase Jitter, Source.*

4.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 4-1.

TABLE 4-1: PIN FUNCTION TABLE

Pin Number	Symbol	Description
1, 2 3, 4	IN0, /IN0 IN1, /IN1	Differential Input: These input pairs are the differential signal inputs to the device. They accept differential AC- or DC-coupled signals as small as 100 mV. Each pin of a pair internally terminates to a VT pin through 50Ω. Note that these inputs will default to an indeterminate state if left open. Please refer to the “Input Interface Applications” section for more details.
16, 5	VT0, VT1	Input Termination Center-Tap: Each side of the differential input pair terminates to a VT pin. The VT0 and VT1 pins provide a center-tap to a termination network for maximum interface flexibility. See “Input Interface Applications” section for more details.
6	SEL	This single-ended TTL/CMOS compatible input selects the inputs to the multiplexer. Note that this input is internally connected to a 25 kΩ pull-up resistor and will default to a logic HIGH state if left open.
7	NC	No connect.
8, 13	VCC	Positive Power Supply: Bypass with 0.1 µF//0.01 µF low ESR capacitors. 0.01 µF capacitor should be as close to VCC pin as possible.
12, 9	Q, /Q	Differential Outputs: This 100k compatible LVPECL output pair is the output of the device. Normally terminate with 50Ω to V_{CC} – 2V. See “Output Interface Applications” section. It is a logic function of the IN0, IN1, and SEL inputs. Please refer to the “Truth Table” for details.
10, 11, 14, 15	GND, Exposed Pad	Ground. Ground pins and exposed pad must be connected to the same ground plane.

TABLE 4-2: TRUTH TABLE

SEL	Output
0	CH0 Input Selected
1	CH1 Input Selected

Single-Ended and Differential Swings

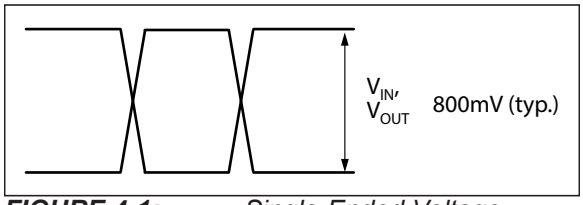


FIGURE 4-1: *Single-Ended Voltage Swing.*

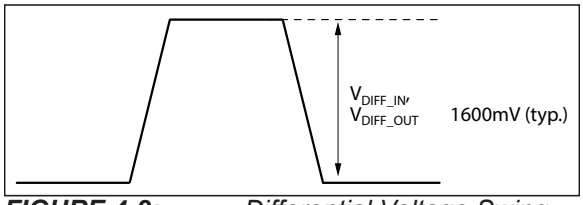
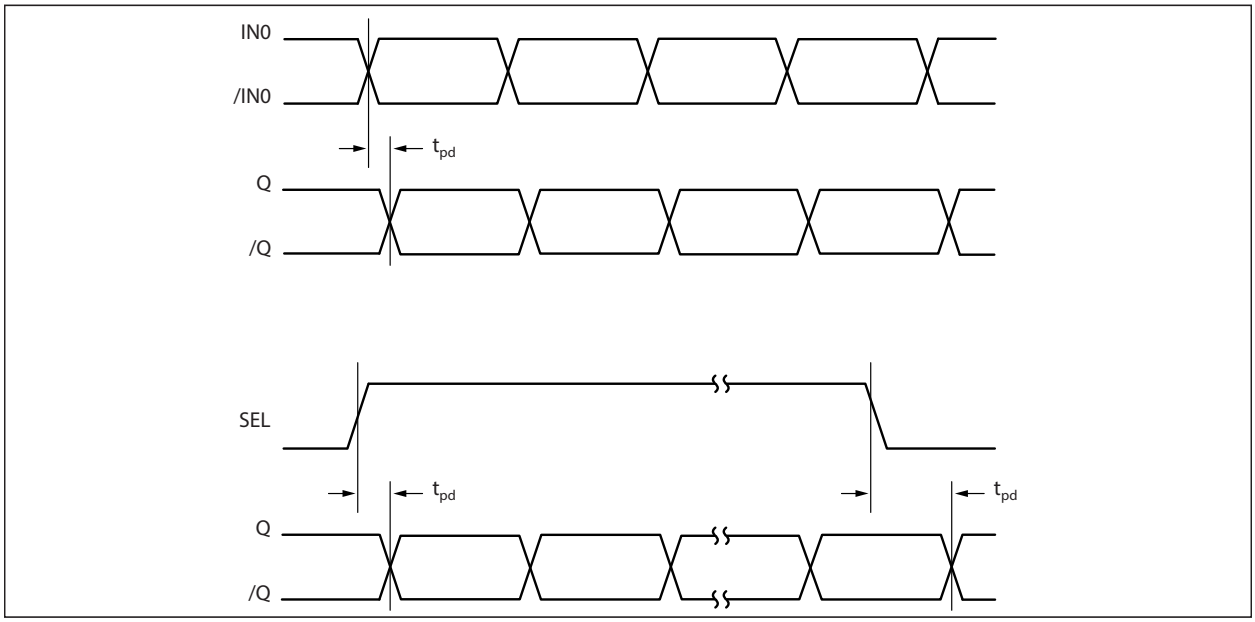


FIGURE 4-2: *Differential Voltage Swing.*

Timing Diagrams



Input and Output Stages

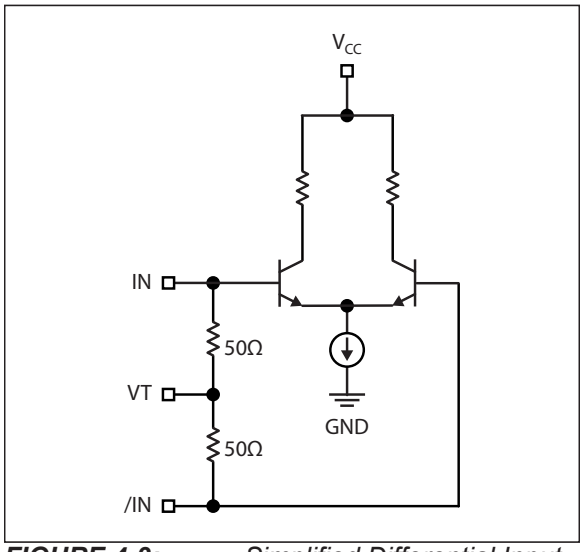


FIGURE 4-3: *Simplified Differential Input Stage.*

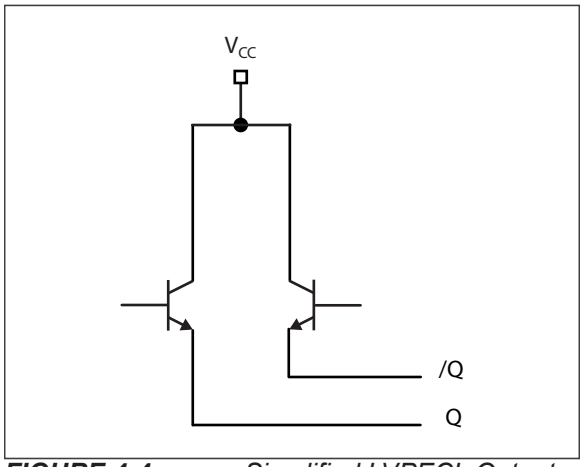


FIGURE 4-4: *Simplified LVPECL Output Stage.*

5.0 INPUT INTERFACE APPLICATIONS

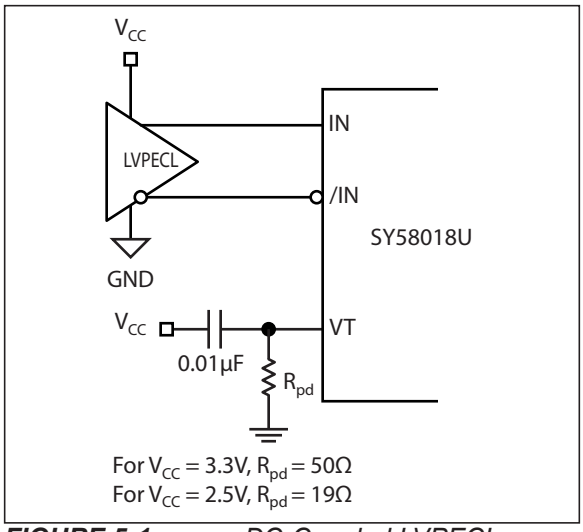


FIGURE 5-1: *DC-Coupled LVPECL Interface.*

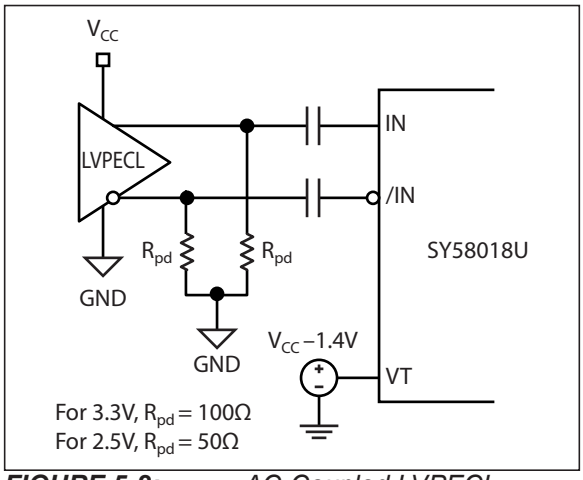


FIGURE 5-2: *AC-Coupled LVPECL Interface.*

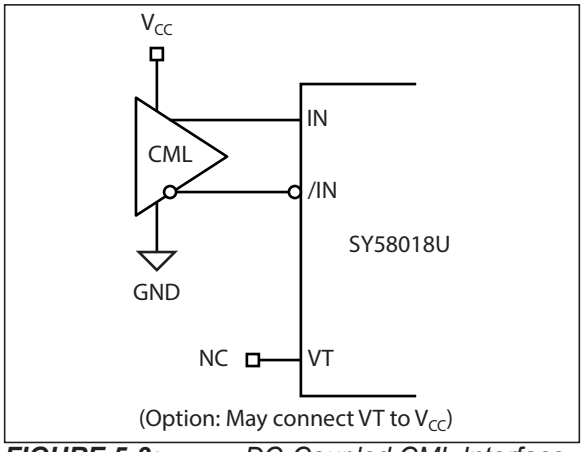


FIGURE 5-3: *DC-Coupled CML Interface.*

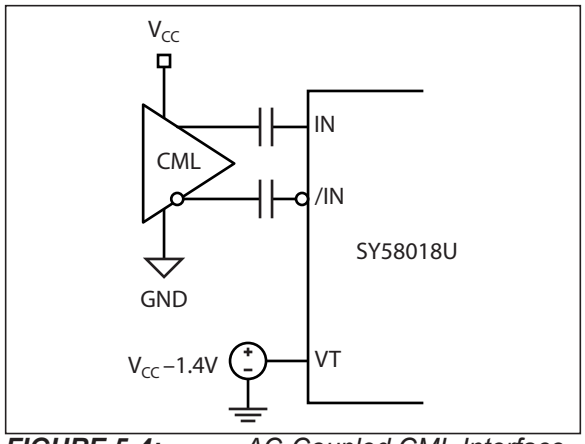


FIGURE 5-4: *AC-Coupled CML Interface.*

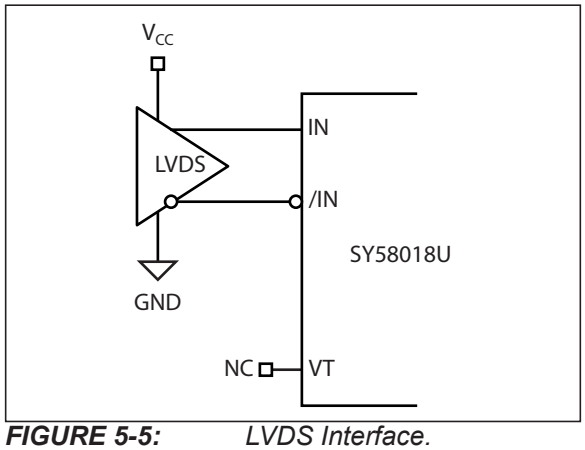


FIGURE 5-5: *LVDS Interface.*

6.0 OUTPUT INTERFACE APPLICATIONS

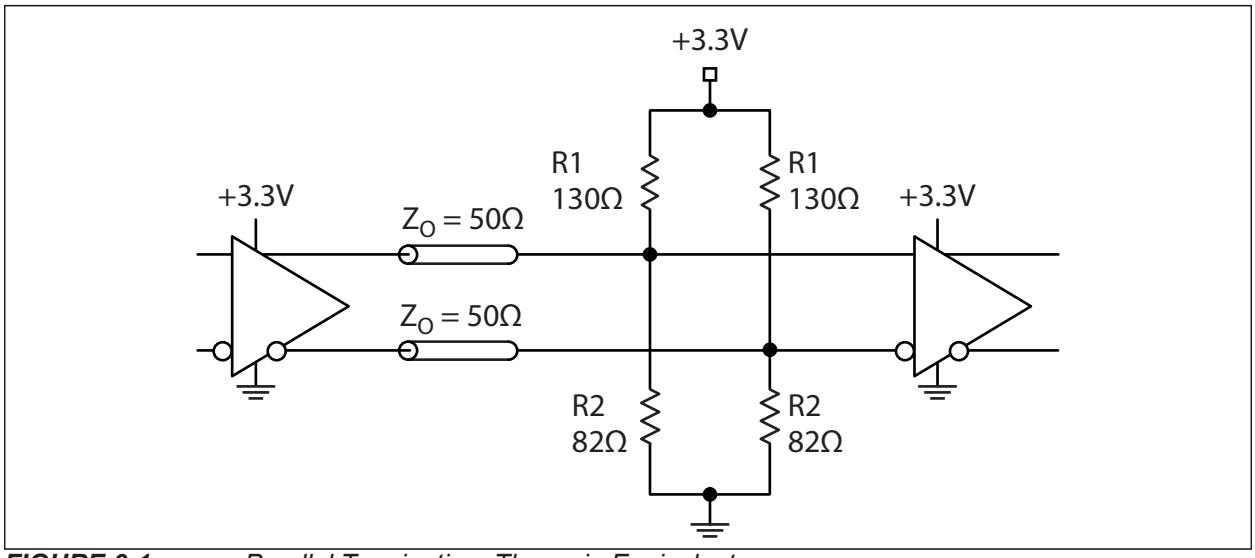


FIGURE 6-1: *Parallel Termination: Thevenin Equivalent.*

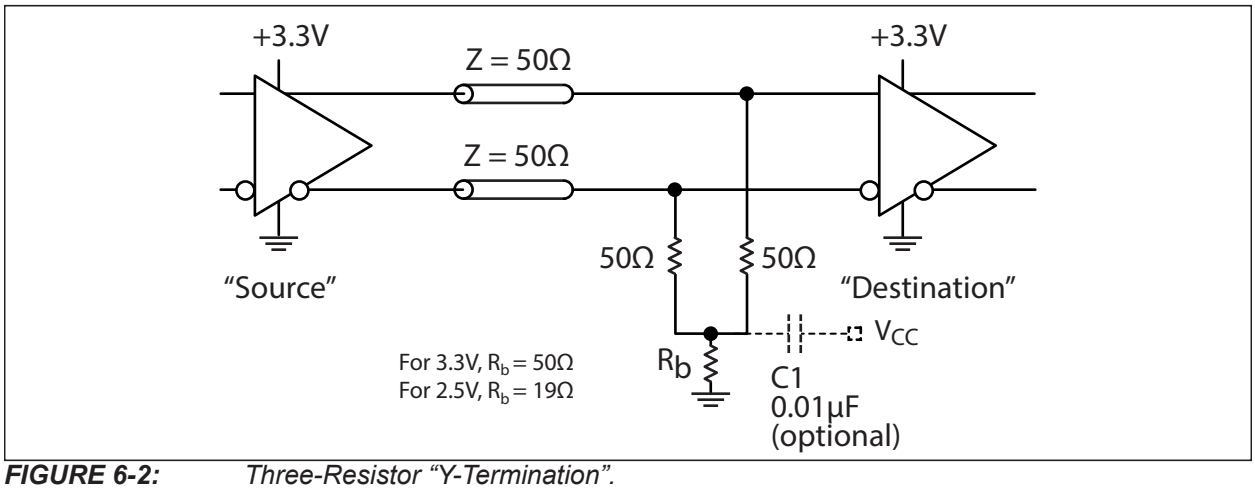


FIGURE 6-2: *Three-Resistor "Y-Termination".*

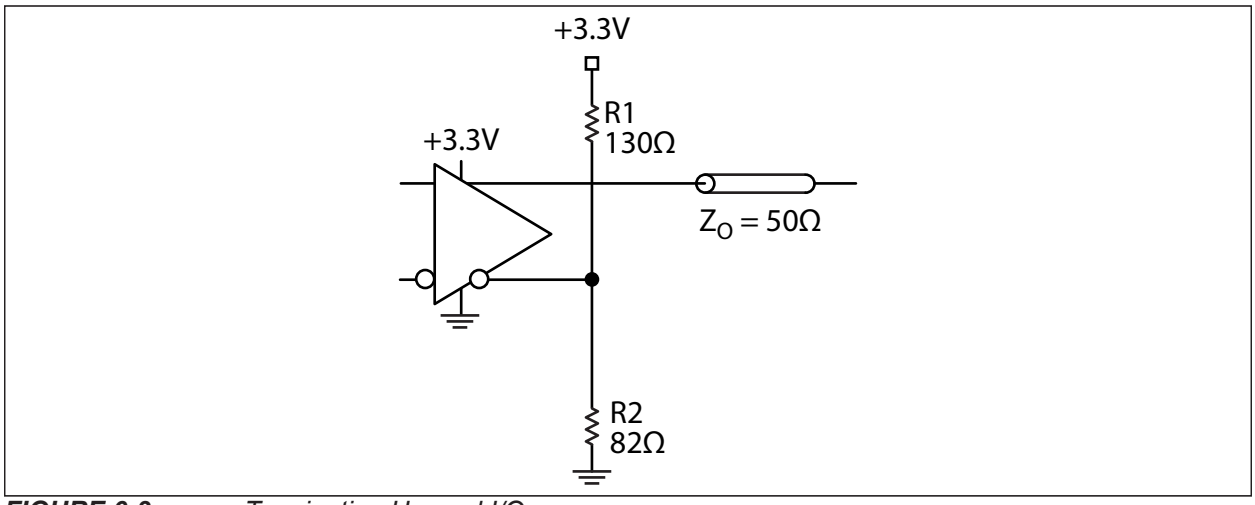


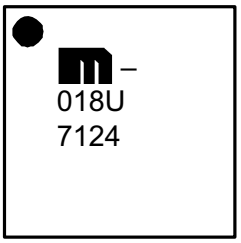
FIGURE 6-3: *Terminating Unused I/O.*

7.0 PACKAGING INFORMATION

7.1 Package Marking Information

16-Lead QFN*

Example

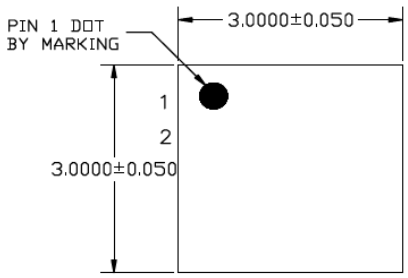


Legend:	XX...X	Product code or customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package.
	●, ▲, ▼	Pin one index is identified by a dot, delta up, or delta down (triangle mark).
Note:	In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.	
	Underbar (_) and/or Overbar (¯) symbol may not be to scale.	

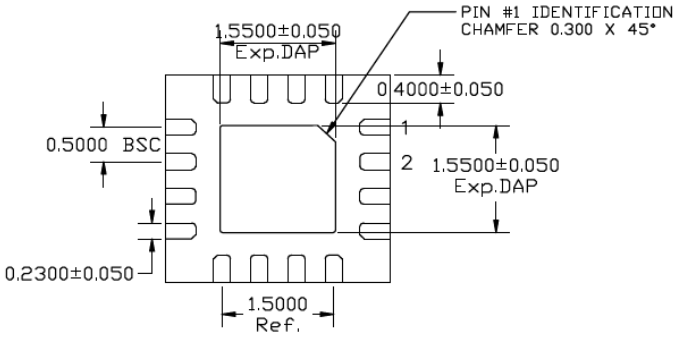
16-Lead QFN 3 mm x 3 mm Package Outline and Recommended Land Pattern

TITLE
16 LEAD QFN 3x3mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

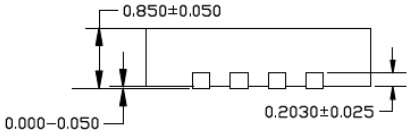
DRAWING #	QFN33-16LD-PL-1	UNIT	MM



TOP VIEW
NOTE: 1, 2, 3



BOTTOM VIEW
NOTE: 1, 2, 3

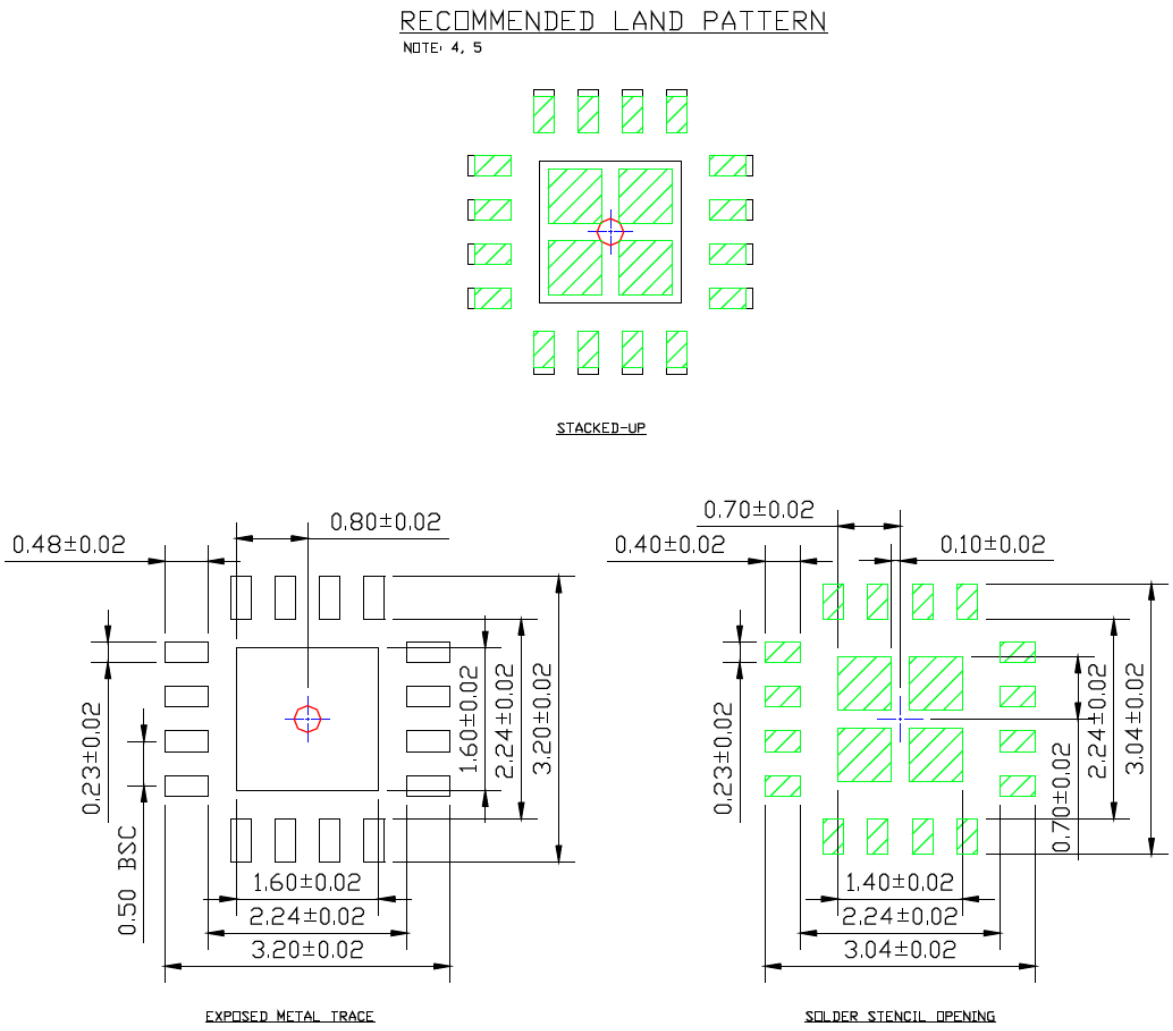


SIDE VIEW
NOTE: 1, 2, 3

NOTE:
1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076 MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. RED CIRCLE IN LAND PATTERN INDICATE THERMAL VIA. SIZE SHOULD BE 0.30-0.35 MM IN DIAMETER AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
5. GREEN RECTANGLES (SHADED AREA) indicate SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 0.60x0.60 MM IN SIZE, 0.20 MM SPACING.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

POD-Land Pattern drawing # QFN33-16LD-PL-1



Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging.

APPENDIX A: REVISION HISTORY

Revision A (December 2019)

- Converted Micrel document SY58018U to Microchip data sheet template DS20006286A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

PART NO.	X	X	X	XX
Device	Supply Voltage	Package	Temperature Range	Tape and Reel

Device:	SY58018:	Ultra-Precision Differential LVPECL 2:1 MUX with Internal Termination	
Supply Voltage:	U	=	2.5V/3.3V
Package:	M	=	3 mm x 3 mm QFN-16 (NiPdAu Lead-Free)
Temperature Range:	G	=	–40°C to 85°C
Special Processing:	<blank>	=	100/Tube
	TR	=	1,000/Reel

Examples:

a) SY58018UMG: SY58018, 2.5V/3.3V Supply Voltage, 3 mm x 3 mm 16-Lead QFN, –40°C to +85°C Temperature Range, 100/Tube

b) SY58018UMG-TR: SY58018, 2.5V/3.3V Supply Voltage, 3 mm x 3 mm 16-Lead QFN, –40°C to +85°C Temperature Range, 1,000/Reel

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

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