MICREL
The Infinite Bandwidth Company™

2.5V, 2.0GHz ANY DIFF. IN-TO-LVDS PROGRAMMABLE CLOCK DIVIDER AND 1:2 FANOUT BUFFER W/ INTERNAL TERMINATION

Precision Edge™
SY89875U
FINAL

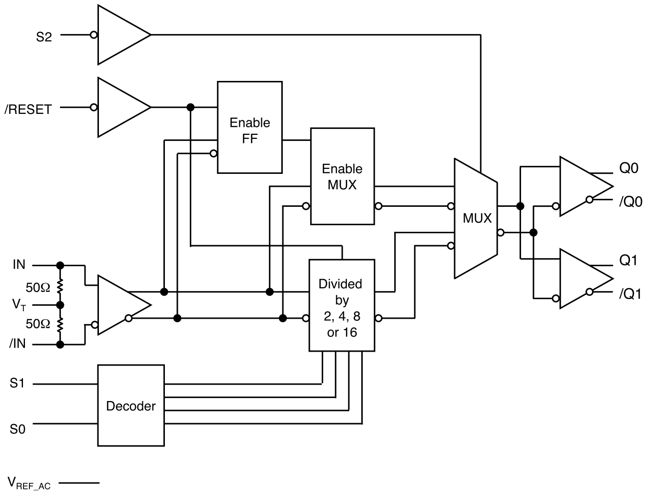
FEATURES

- **Integrated programmable clock divider and 1:2 fanout buffer**
- **Guaranteed AC performance over temperature and voltage:**
  - **> 2.0GHz f_{MAX}**
  - **< 200ps t_r/t_f**
  - **< 15ps within device skew**
- **Low jitter design:**
  - **< 10ps (pk-pk) total jitter**
  - **< 1ps (rms) cycle-to-cycle jitter**
- **Unique input termination and V_T Pin for DC-coupled and AC-coupled Inputs; CML, PECL, LVDS and HSTL**
- **LVDS compatible outputs**
- **TTL/CMOS inputs for select and reset**
- **Parallel programming capability**
- **Programmable divider ratios of 1, 2, 4, 8 and 16**
- **Low voltage operation 2.5V**
- **Output disable function**
- **–40°C to 85°C temperature range**
- **Available in 16-pin (3mm × 3mm) MLF™ package**

APPLICATIONS

- **SONET/SDH line cards**
- **Transponders**
- **High-end, multiprocessor servers**

FUNCTIONAL BLOCK DIAGRAM



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*Micro*LeadFrame and MLF are trademarks of Amkor Technology, Inc.

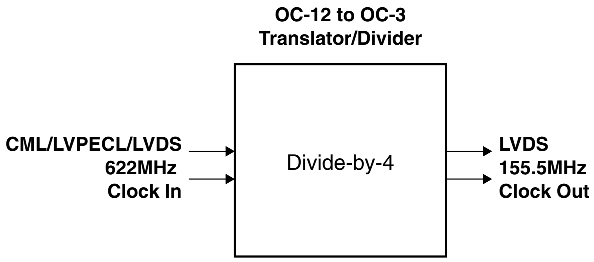
DESCRIPTION

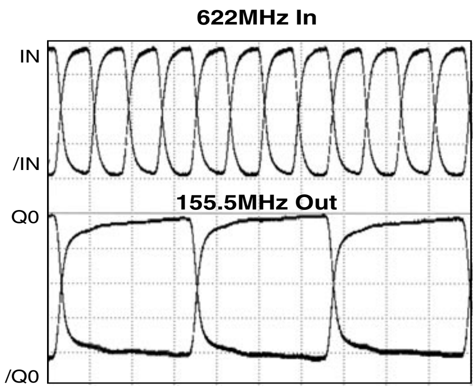
This low-skew, low-jitter device is capable of accepting a high-speed (e.g., 622MHz or higher) CML, LVPECL, LVDS or HSTL clock input signal and dividing down the frequency using a programmable divider to create a lower speed version of the input clock. Available divider ratios are 2, 4, 8 and 16, or straight pass-through.

The differential input buffer has a unique internal termination design that allows access to the termination network through a V_T pin. This feature allows the device to easily interface to different logic standards. A $V_{REF\text{-}AC}$ reference is included for AC-coupled applications.

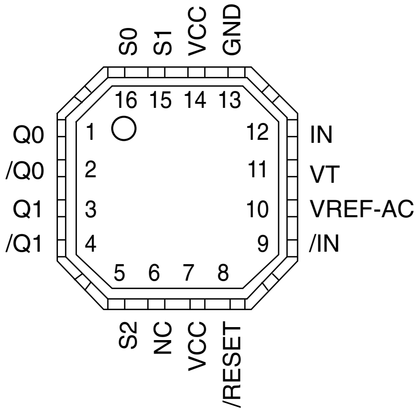
The /RESET input asynchronously resets the divider. In the pass-through function (divide by 1) the /RESET synchronously enables or disables the outputs on the next falling edge of IN (rising edge of /IN).

TYPICAL PERFORMANCE





PACKAGE/ORDERING INFORMATION



16-Pin MLF™ (MLF-16)

Ordering Information

Part Number	Package Type	Operating Range	Package Marking
SY89875UMI	MLF-16	Industrial	875U
SY89875UMITR*	MLF-16	Industrial	875U

*Tape and Reel

PIN DESCRIPTION

Pin Number	Pin Name	Pin Function
12, 9	IN, /IN	Differential Input: Internal 50Ω termination resistors to V_T input. Flexible input accepts any differential input. See *"Input Interface Applications"* section.
1, 2, 3, 4	Q0, /Q0 Q1, /Q1	Differential Buffered LVDS Outputs: Divided by 1, 2, 4, 8 or 16. See *"Truth Table."* Unused output pairs must be terminated with 100Ω across the different pair.
16, 15, 5	S0, S1, S2	Select Pins: See *"Truth Table."* LVTTL/CMOS logic levels. Internal 25kΩ pull-up resistor. Logic HIGH if left unconnected (divided by 16 mode.) Input threshold is $V_{CC}/2$.
6	NC	No Connect.
8	/RESET, /DISABLE	LVTTL/CMOS Logic Levels: Internal 25kΩ pull-up resistor. Logic HIGH if left unconnected. Apply LOW to reset the divider (divided by 2, 4, 8 or 16 mode). Also acts as a disable/enable function. The reset and disable function occurs on the next high-to-low clock input transition. Input threshold is $V_{CC}/2$.
10	VREF-AC	Reference Voltage: Equal to V_{CC}–1.4V (approx.). Used for AC-coupled applications only. Decouple the V_{REF-AC} pin with a 0.01µF capacitor. See *"Input Interface Applications"* section.
11	VT	Termination Center-Tap: For CML or LVDS inputs, leave this pin floating. Otherwise, See Figures 4a to 4f, *"Input Interface Applications"* section.
7, 14	VCC	Positive Power Supply: Bypass with 0.1µF//0.01µF low ESR capacitor.
13	GND Exposed	Ground. Exposed pad must be connected to the same potential as the GND pin.

TRUTH TABLE

/RESET(1)	S2	S1	S0	Outputs
1	0	X	X	Reference Clock (pass through)
1	1	0	0	Reference Clock ÷2
1	1	0	1	Reference Clock ÷4
1	1	1	0	Reference Clock ÷8
1	1	1	1	Reference Clock ÷16
0(1)	X	X	X	Q = LOW, /Q = HIGH Clock Disable

Note 1. Reset/Disable function is asserted on the next clock input (IN, /IN) high-to-low transition.

Absolute Maximum Ratings(Note 1)

Supply Voltage (V_{CC})	–0.5V to +4.0V
Input Voltage (V_{IN})	–0.5V to V_{CC}+0.3
ECL Output Current (I_{OUT})	
Continuous	50mA
Surge	100mA
Input Current IN, /IN (I_{IN})	±50mA
V_T Current (I_{VT})	±100mA
V_{REF-AC} Sink/Source Current ($I_{VREF-AC}$), **Note 3**	±2mA
Lead Temperature (soldering 10 sec.)	220°C
Storage Temperature (T_S)	–65°C to +150°C

Operating Ratings(Note 2)

Supply Voltage (V_{CC})	+2.5V ±5%
Ambient Temperature (T_A)	–40°C to +85°C
Package Thermal Resistance	
MLF™ (θ_{JA})	
Still-Air	60°C/W
500lfpm	54°C/W
MLF™ (ψ_{JB}), **Note 4**	
Junction-to-Board	32°C/W

Note 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 RATING conditions for extended periods may affect device reliability.

Note 2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.

Note 3. Due to the limited drive capability use for input of the same package only.

Note 4. Junction-to-board resistance assumes exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.

DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

T_A= –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}	Power Supply		2.375		2.625	V
I_{CC}	Power Supply Current	No load, max. V_{CC}		70	95	mA
R_{IN}	Differential Input Resistance (IN, /IN)		80	100	120	Ω
V_{IH}	Input High Voltage (IN, /IN)	**Note 3**	0.1	–	V_{CC}+0.3	V
V_{IL}	Input Low Voltage (IN, /IN)	**Note 3**	–0.3	–	V_{CC}+0.2	V
V_{IN}	Input Voltage Swing	**Note 4**		–	1.8	V
V_{DIFF_IN}	Differential Input Voltage Swing	**Note 5**	0.1	–	3.6	V
$\|I_{IN}\|$	Input Current (IN, /IN)	**Note 3**	–	–	45	mA
V_{REF-AC}	Reference Voltage	**Note 6**	V_{CC}–1.525	V_{CC}–1.425	V_{CC}–1.325	V

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

Note 2. Specification for packaged product only.

Note 3. Due to the internal termination (see Figure 2a) the input current depends on the applied voltages at IN, /IN and V_T inputs. Do not apply a combination of voltages that causes the input current to exceed the maximum limit!

Note 4. See *"Timing Diagram"* for V_{IN} definition. V_{IN} (Max) is specified when V_T is floating.

Note 5. See *"Typical Operating Characteristics"* section for V_{DIFF} definition.

Note 6. Operating using V_{IN} is limited to AC-coupled PECL or CML applications only. Connect directly to V_T pin.

LVDS DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

V_{CC} = 2.5V ±5%; T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{OUT}	Output Voltage Swing	**Note 3, 4**	250	350	400	mV
V_{OH}	Output High Voltage	**Note 3**			1.475	V
V_{OL}	Output Low Voltage	**Note 3**	0.925			V
V_{OCM}	Output Common Mode Voltage	**Note 4**	1.125		1.375	V
ΔV_{OCM}	Change in Common Mode Voltage		–50		50	mV

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

Note 2. Specification for packaged product only.

Note 3. Measured as per Figure 2a, 100Ω across Q and /Q outputs.

Note 4. Measured as per Figure 2b.

LVTTL/CMOS DC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

V_{CC} = 2.5V ±5%; T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{IH}	Input HIGH Voltage		2.0			V
V_{IL}	Input LOW Voltage				0.8	V
I_{IH}	Input HIGH Current		–125		20	µA
I_{IL}	Input LOW Current				–300	µA

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

Note 2. Specification for packaged product only.

AC ELECTRICAL CHARACTERISTICS(Notes 1, 2)

V_{CC} = 2.5V ±5%; T_A = –40°C to +85°C; Unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
f_{MAX}	Maximum Input Frequency	Output Swing ≥ 200mV	2.0	2.5		GHz
t_{PLH} t_{PHL}	Differential Propagation Delay IN to Q	Input Swing < 400mV	590	690	870	ps
		Input Swing ≥ 400mV	540	690	820	ps
t_{SKEW}	Within-Device Skew (diff.)	**Note 3**		5	15	ps
	Part-to-Part Skew (diff.)	**Note 3**			280	ps
t_{RR}	Reset Recovery Time	**Note 4**	600			ps
t_{JITTER}	Cycle-to-Cycle Jitter	**Note 5**			1	ps(rms)
	Total Jitter	**Note 6**			10	ps(pk-pk)
t_r,t_f	Rise/Fall Time (20% to 80%)		70	120	200	ps

Note 1. Measured with 400mV input signal, 50% duty cycle, all outputs loaded with 100Ω across each output pair, unless otherwise stated.

Note 2. Specification for packaged product only.

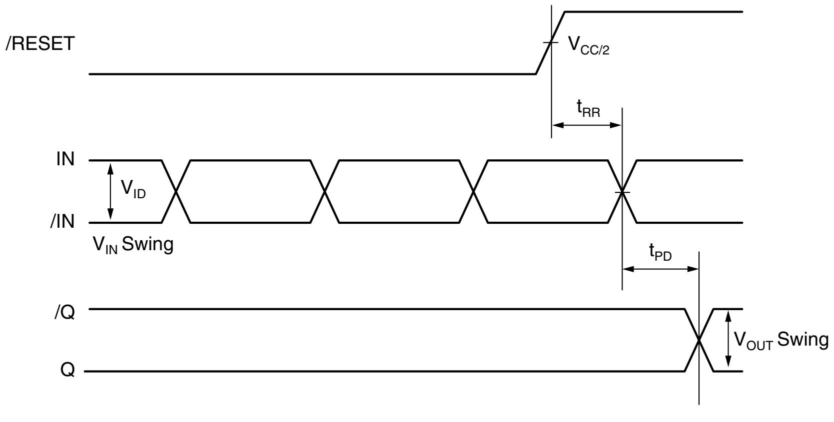
Note 3. Skew is measured between outputs under identical transitions.

Note 4. See "*Timing Diagram.*"

Note 5. Cycle-to-cycle jitter definition: the variation in period between adjacent cycles over a random sample of adjacent cycle pairs. $T_{jitter\_cc} = T_n - T_{n+1}$, where T is the time between rising edges of the output signal.

Note 6. Total jitter definition: with an ideal clock input of frequency ≤ f_{MAX}, no more than one output edge in 10^{12} output edges will deviate by more than the specified peak-to-peak jitter value.

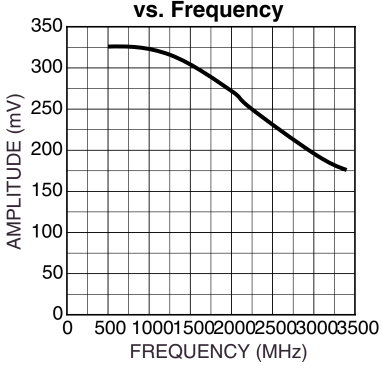
TIMING DIAGRAM



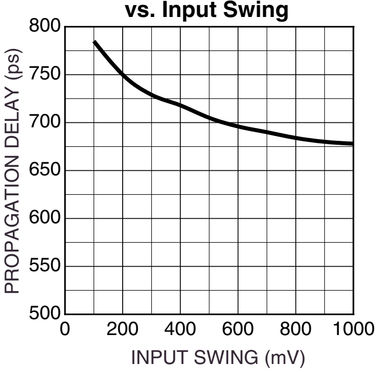
TYPICAL OPERATING CHARACTERISTICS

$V_{CC} = 2.5V$, $T_A = 25°C$, unless otherwise stated.

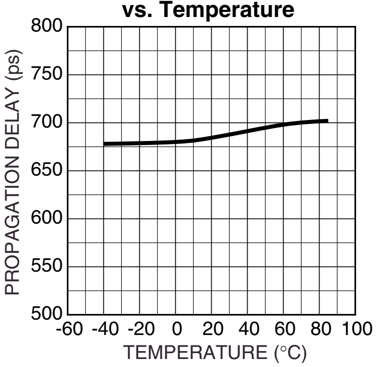
Output Amplitude vs. Frequency



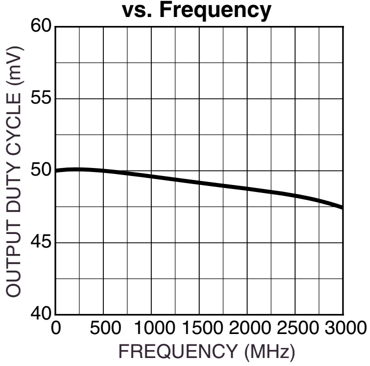
IN to Q Propagation Delay vs. Input Swing



IN to Q Propagation Delay vs. Temperature



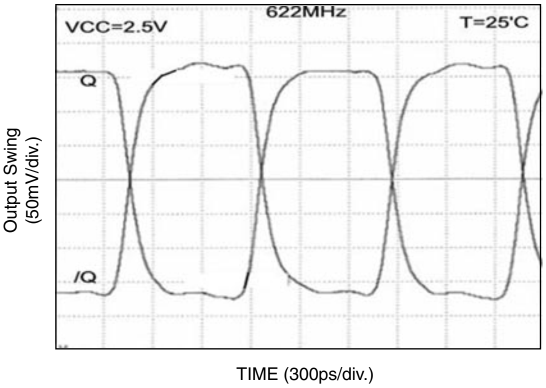
Output Duty Cycle vs. Frequency



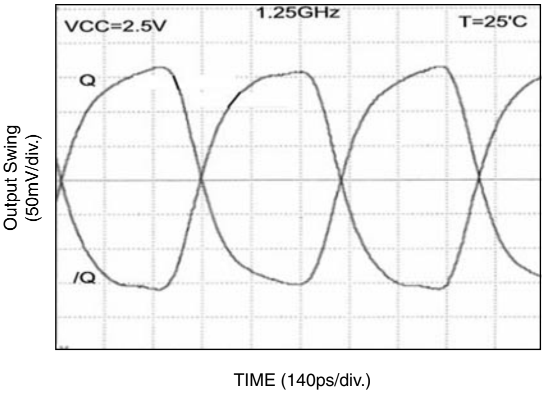
TYPICAL OPERATING CHARACTERISTICS (Continued)

$V_{CC} = 2.5V$, $T_A = 25°C$, unless otherwise stated.

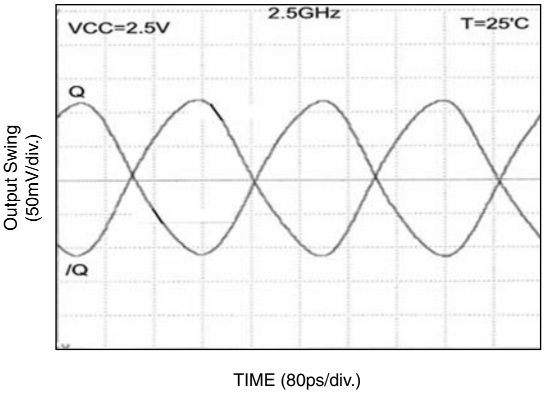
622MHz Output



1.25GHz Output



2.5GHz Output



DEFINITION OF SINGLE-ENDED AND DIFFERENTIAL SWINGS

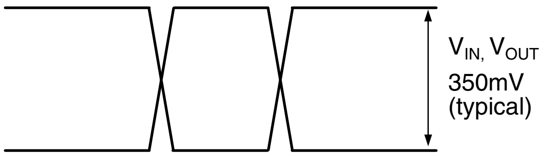


Figure 1a. Single-Ended Swing

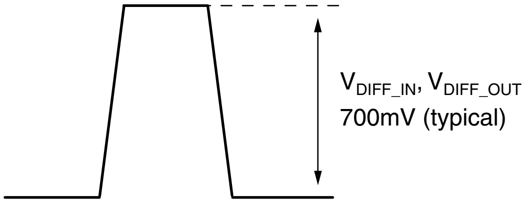


Figure 1b. Differential Swing

INPUT INTERFACE APPLICATIONS

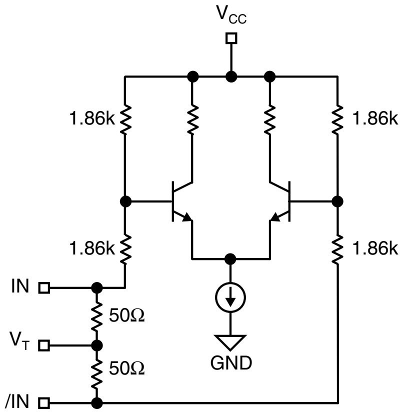


Figure 2a. Simplified Differential Input Buffer

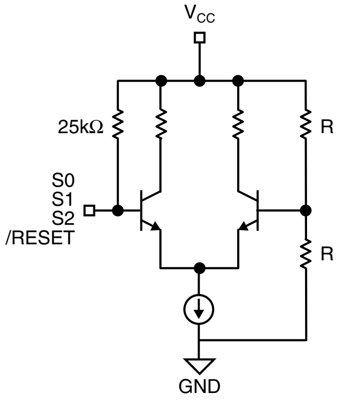


Figure 2b. Simplified TTL/CMOS Input Buffer

LVDS OUTPUTS

LVDS (Low Voltage Differential Swing) specifies a small swing of 350mV typical, on a nominal 1.25V common mode above ground. The common mode voltage has tight limits to permit large variations in ground between an LVDS driver and receiver. Also, change in common mode voltage, as a function of data input, is also kept tight, to keep EMI low.

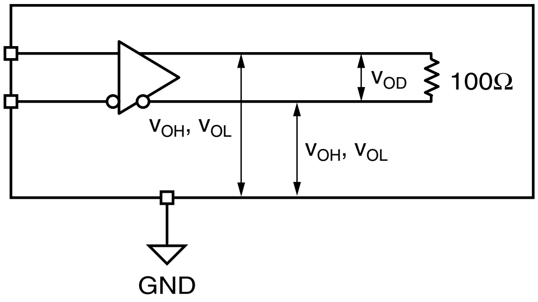


Figure 3a. LVDS Differential Measurement

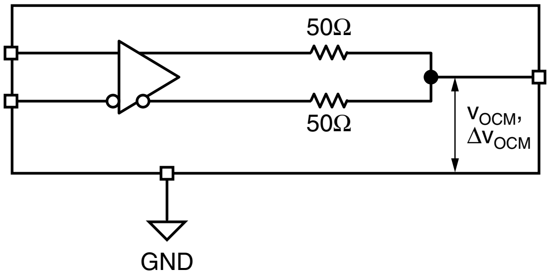


Figure 3b. LVDS Common Mode Measurement

INPUT INTERFACE APPLICATIONS

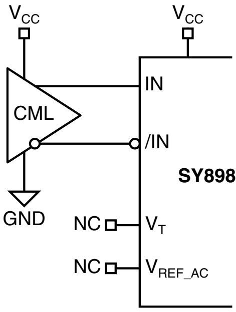


Figure 4a. DC-Coupled CML Input Interface

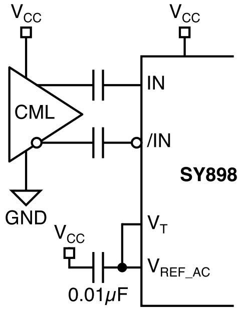


Figure 4b. AC-Coupled CML Input Interface

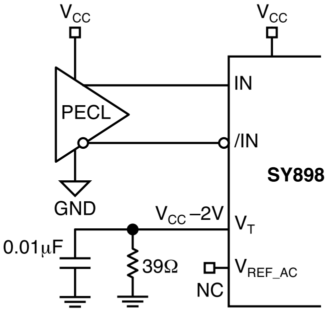


Figure 4c. DC-Coupled PECL Input Interface

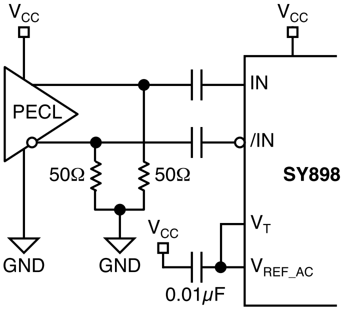


Figure 4d. AC-Coupled CML Input Interface

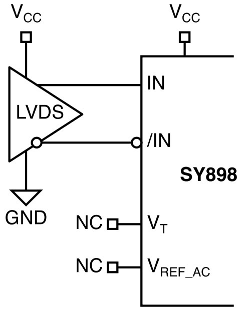


Figure 4e. LVDS Input Interface

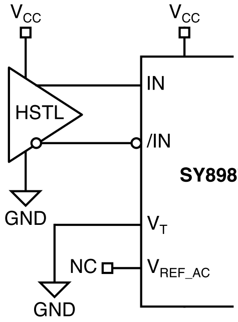
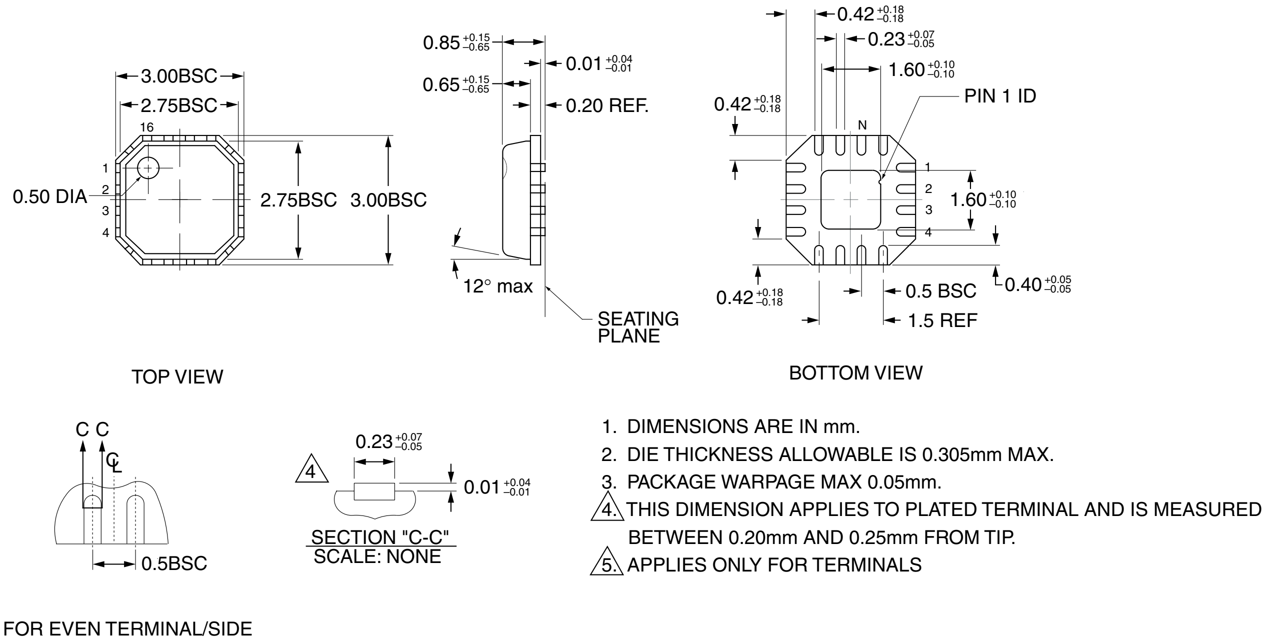


Figure 4f. HSTL Input Interface

RELATED PRODUCT AND SUPPORT DOCUMENTATION

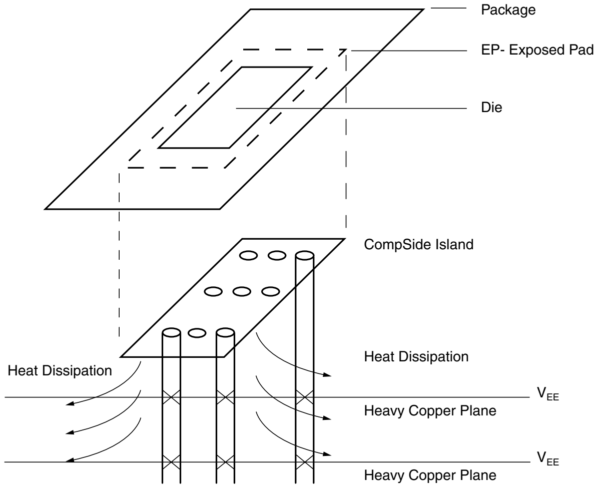
Part Number	Function	Data Sheet Link
SY89872U	2.5V, 2.5GHz Any Diff. In-to-LVDS Programmable Clock Divider/Fanout Buffer w/ Internal Termination	http://www.micrel.com/product-info/products/sy89872u.shtml
	MLF™ Application Note	http://www.amkor.com/products/notes_papers/mlf_appnote_0902.pdf
HBW Solutions	New Products and Applications	http://www.micrel.com/product-info/products/solutions.shtml

16 LEAD *Micro*LeadFrame™ (MLF-16)



1. DIMENSIONS ARE IN mm.
2. DIE THICKNESS ALLOWABLE IS 0.305mm MAX.
3. PACKAGE WARPAGE MAX 0.05mm.
4. THIS DIMENSION APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20mm AND 0.25mm FROM TIP.
5. APPLIES ONLY FOR TERMINALS

Rev. 02



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

Package Notes:

Note 1. Package meets Level 2 moisture sensitivity classification, and are shipped in dry-pack form.
Note 2. Exposed pads must be soldered to a ground for proper thermal management.