



SY88808L

10.3Gbps Transceiver with Programmable Pre-Emphasis and Equalization

PRELIMINARY

General Description

The SY88808L high-speed transceiver is optimized for active copper cable assembly, backplane and transmission line data-path management applications. The SY88808L is capable of transmitting signals with up to 13dB of pre-emphasis as well as equalizing serial data up to 10.3Gbps across up to 36 inches of FR4 or 15 meters of cable.

The SY88808L differential inputs can directly interface to any differential signal as small as 90mV_{pk}. Both channels of the transceiver have programmable PE on the transmitting end and programmable EQ on the receiving end. The output of the transmitter can be programmed to provide an output swing from 90mV_{pk} to 350mV_{pk}. The output is optimized to drive into a 50Ω load.

The transmitter can be set to any level of pre-emphasis, from 0dB to 13dB. The AnyLength™ equalization circuit in the receiver can be programmed to optimize the eye of the data signal received from 0" to 36" of FR4 or 0m to 15m of 24AWG cable. Unlike discrete EQ settings, patent-pending AnyLength™ EQ provides optimal results as well as saves power.

The SY88808L operates at 3.3V ±5% supply and its operation is guaranteed over the full industrial temperature range of -40°C to +85°C. The SY88808L is part of Micrel's high-speed, Precision Edge® product line.

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



Precision Edge®

Features

- Transmit driver provides up to 13dB of Pre-Emphasis to extend transmission range and signal quality
- Programmable equalizing network optimize incoming data pattern
- Equalization is optimized for any transmission length
- Receives up to 36" FR4 PCB trace, or 15m of cable
- 1Gbps through 10.3Gbps data rate throughput
- Flexible I/O:
 - AC-coupled inputs and outputs
 - 50Ω source-terminated CML outputs minimize round-trip reflections
 - Wide input voltage range: 90mV_{pk} to 350mV_{pk}
 - Output disable
- Input Loss-of-Signal
 - Hysteresis included
- 3.3V ±5% supply voltage
- -40°C to +85°C temperature range
- Available in 28-pin (4mm x 4mm) MLF® package

Applications

- Active Copper Cable Assembly
- ATE, T&M backplane management
- Serial backplane management
- Combination FR4+cable+interconnect receiver
- Fibre Channel, GigE, SONET/SDH data transmission

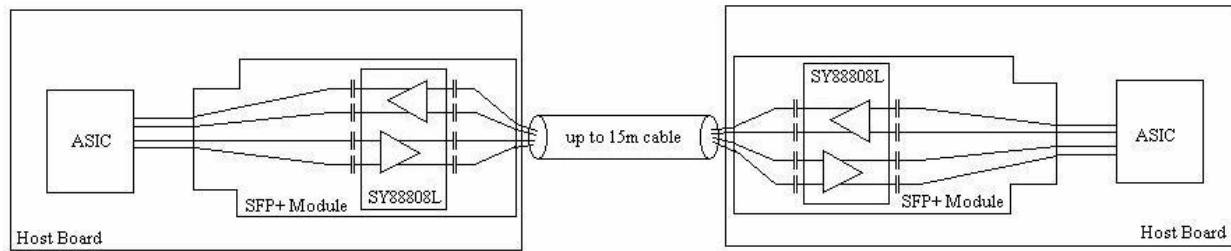
Precision Edge is a registered trademark of Micrel, Inc.
MLF and MicroLeadFrame are trademarks of Amkor Technology, Inc.

Micrel Inc. • 2180 Fortune Drive • San Jose, CA 95131 • USA • tel +1 (408) 944-0800 • fax + 1 (408) 474-1000 • <http://www.micrel.com>

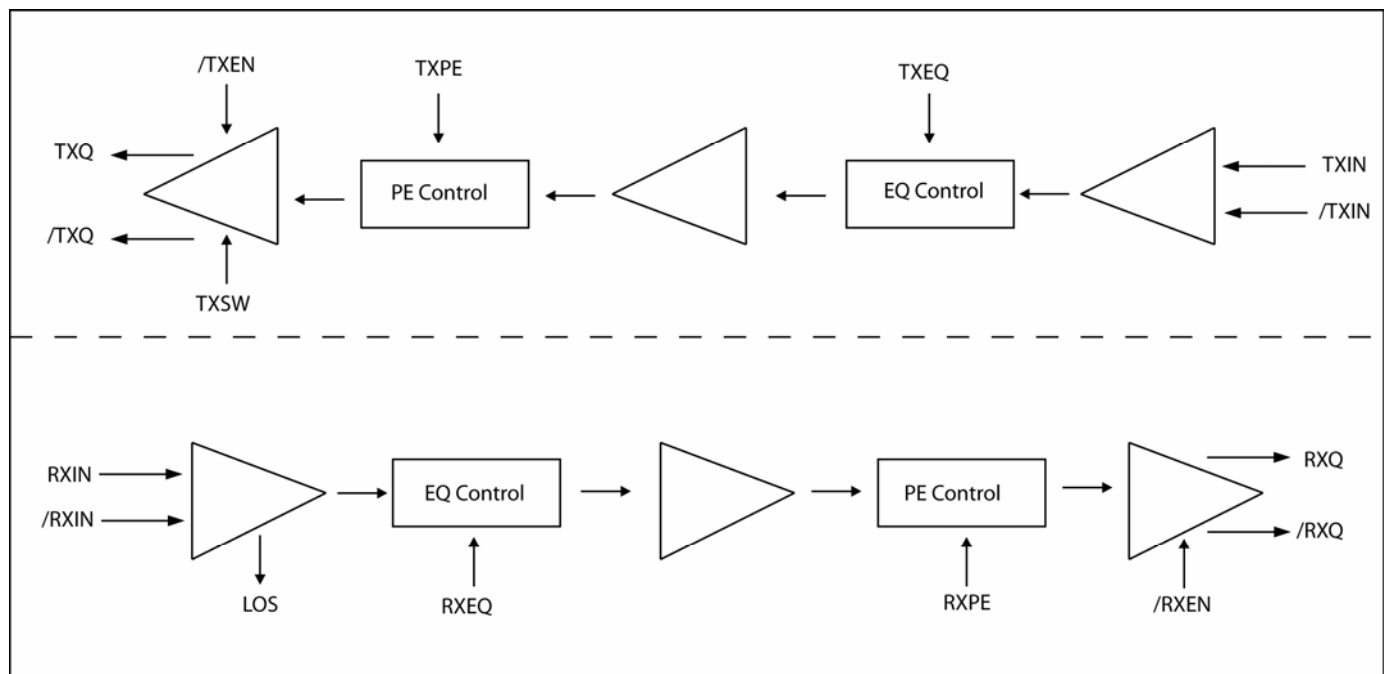
September 2009

M9999-091009-A
hbwhelp@micrel.com or (408) 955-1690

Typical Application Circuit



Functional Block Diagram



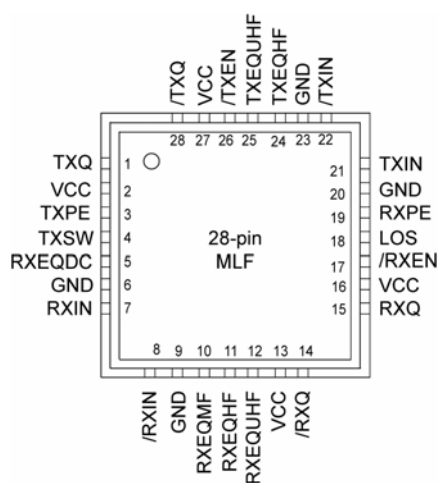
Ordering Information⁽¹⁾

Part Number	Package Type	Operating Range	Package Marking	Lead Finish
SY88808LMG	MLF-28	Industrial	SY88808L with Pb-Free bar-line indicator	NiPdAu Pb-Free
SY88808LMGTR ⁽²⁾	MLF-28	Industrial	SY88808L with Pb-Free bar-line indicator	NiPdAu Pb-Free

Notes:

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

Pin Configuration

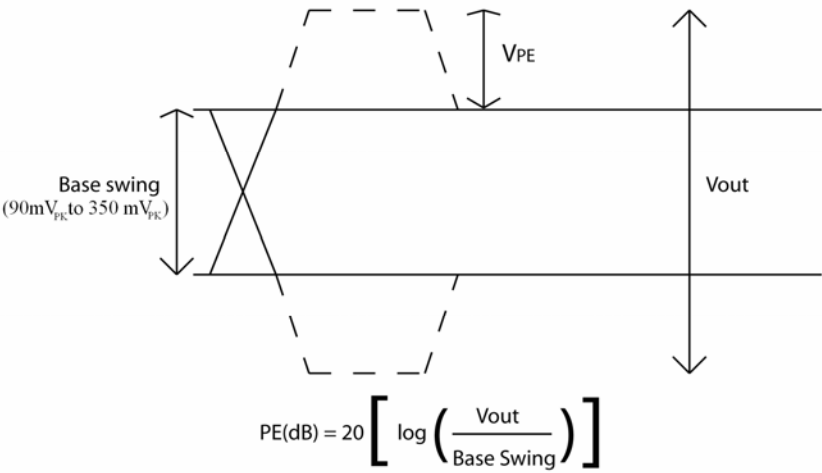


28-Pin MLF[®] (MLF-28)

Pin Description

Pin Number	Pin Name	Pin Function
1, 28	TXQ, /TXQ	Differential Transmitter Output: This CML output pair is designed to drive 50Ω signals with variable output swing and variable pre-emphasis. Output pre-emphasis can be set to up to 13dB of pre-emphasis.
2, 13, 16, 27	VCC	Positive power supply: Connect to 3.3V power supply. Bypass with 0.1μF||0.01μF low ESR capacitors as close to VCC pins as possible.
19, 3	RXPE, TXPE	Pre-Emphasis Input: These input pins can program the output pre-emphasis from 0dB to 13dB. Pre-emphasis can be programmed via an external potentiometer (or resistor) to drive signals up to 36" FR4 or 15m cable. See "Programmable Pre-Emphasis" table for details.
4	TXSW	Programmable Swing Input pin: This input pin allows the user to set variable output swing. This pin can be programmed via external potentiometer (or a resistor) to output a swing from 90mV _{PK} to 350mV _{PK} . See "Programmable TX Output Swing" table for details.
5, 10, 11, 12 24, 25	RXEQDC, RXEQMF, RXEQHF, RXEQUHF, TXEQHF, TXEQUHF	Programmable EQ: Equalization circuit can recover degraded signals after long traces of FR4 board. Equalization can be programmed via an external potentiometer (or resistor). This equalization scheme is optimized to recover degraded signal from any length of transmission line. The receiver of the RX channel can equalize up to 36" FR4 or 15m cable. The receiver of the TX channel can equalize up to 9" FR4 or 6m cable. RXEQDC, RXEQMF, RXEQHF, and RXEQUHF control DC, medium, high, and ultra high components of input data signals of RX channel respectively. TXEQHF and TXEQUHF control DC and medium components of input data signals of TX channel respectively. See "Programmable Equalization" table for details.
6, 9, 20, 23	GND, Exposed pad	Ground: Ground pins and exposed pad must be connected to the same ground plane.
7, 8	RXIN, /RXIN	Differential Receiver Input: This input pair is the differential input to the receive channel. It accepts differential AC-coupled signals as small as 90mV _{PK} . This signal is fed in to equalization circuit. The loss-of-signal (LOS level) includes a small amount of hysteresis to prevent the loss-of-signal output from oscillating when no signal is present. Consider disabling the outputs to save power when the differential input is not present.
15, 14	RXQ, /RXQ	Differential Receiver Output: This CML output pair is designed to drive 250mV _{PK} swing in to 50Ω with variable pre-emphasis. Output pre-emphasis can be set to drive up to 9" of FR4.
17, 26	/RXEN, /TXEN	Single-Ended Input: TTL/CMOS compatible control input for the output pairs. The disable pins are internally connected to a 25kΩ pull-up resistor and will default to a logic HIGH state (Disable) if left open. When disabled, the Q goes LOW, and /Q goes HIGH. Default threshold is V _{CC} /2.
18	LOS	Single-Ended Output: This TTL/CMOS output signal switches LOW when the input signal of the receiver channel is valid and switches HIGH when the input signal is not valid. LOS is an open-collector output.
21, 22	TXIN, /TXIN	Differential Transmitter Input: This input pair is the differential input to the transmit channel. It accepts differential AC-coupled signals as small as 90mV _{PK} . This signal is fed in to equalization circuit. Input swing is recommended be ≥90mV _{PK} at the input of the transmission line to ensure valid outputs. Consider disabling the outputs to save power when the differential input is not present.

Pre-Emphasis Output Description



Programmable Pre-Emphasis Table⁽¹⁾

PE (dB)	4	7	10	13
Resistor (Ω)	14	25	50	Open
V _{Base Swing} (mV _{PK})	350	250	150	90
V _{PE} (mV _{PK})	100	150	160	150

RX Channel Programmable Equalization Table⁽¹⁾

FR4 Length	36"	24"	18"	9"
RXEQDC (Ω)	1.4k	1.4k	650	190
RXEQMF (Ω)	1.7k	1.6k	800	1.1k
RXEQHF (Ω)	1.6k	1.4k	1.6k	2k
RXEQUHF (Ω)	1k	1.4k	1.6k	2k

TX Channel Programmable Equalization Table⁽¹⁾

FR4 Length	9"	0"
RXEQHF (Ω)	0	5k
RXEQUHF (Ω)	1.5k	5k

Note:
1. Values stated are preliminary.

Absolute Maximum Ratings⁽¹⁾

Supply Voltage (V_{CC})	.....-0.5V to +4.0V
Input Voltage (V_{IN})	..... -0.5V to V_{CC}
Input Current (I_{IN} , I_{IN} , ≤ 120 mins)	..... TBD
CML Output Current (I_{OUT})	
Continuous (≤ 120 mins)	..... TBD
Surge	..... TBD
Lead Temperature (soldering, 20 sec.)	..... +260°C
Storage Temperature (T_S)	..... -65°C to 150°C

Operating Ratings⁽²⁾

Supply Voltage (V_{CC})	..... +3.14V to +3.46V
Ambient Temperature (T_A)	..... -40°C to +85°C
Package Thermal Resistance ⁽³⁾	
MLF [®] (θ_{JA})	
Still-Air	..... 61°C/W
MLF [®] (Ψ_{JB})	
Junction-to-Board	..... 30°C/W

DC Electrical Characteristics⁽⁴⁾

$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$; unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{CC}	Power Supply		3.14	3.3	3.46	V
I_{EE}	Power Supply Current	Max V_{CC} , includes 50 Ω internal source resistors, no external load current, maximum PE & EQ settings		160	200	mA
	Power	Includes 50 Ω internal source resistors, no external load current, maximum PE & EQ settings		528	692	mW
R_{DIFF_IN}	Input Resistance (IN-to-/IN)		90	100	110	Ω
V_{IN}	Input Voltage Swing	RXIN, TXIN. Note 5	90		350	mV _{PK}
V_{DIFF_IN}	Differential Input Voltage Swing $|I_{IN}-/I_{IN}|$		180		700	mV _{PP}
LOS	Loss-of-Signal Levels	LOS De-assert. Note 6		75	90	mV _{PK}
		LOS Assert. Note 6	45	55		
	Hysteresis			3		dB

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 devices most negative potential on the PCB. θ_{JA} and Ψ_{JB} values are determined for a 4-layer board in still air unless otherwise stated.
4. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established. $T_J \leq 125^\circ\text{C}$.
5. Measured at input of the transmission line.
6. Measured with 101010 pattern at 10.3Gbps.

Outputs DC Electrical Characteristics⁽⁷⁾

$V_{CC} = 3.3V \pm 5\%$; $V_{EE} = 0V$; $T_A = -40^\circ C$ to $+85^\circ C$; $R_L = 100\Omega$ across output pair; unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
$V_{Base\ Swing}$	Output Base Swing	RXOUT	150	250	425	mV _{PK}
		TXOUT, Programmable swing	90		350	mV _{PK}
R_{OUT}	Output Resistance		45	50	55	Ω
I_{QSHDN}	Q Shutdown Leakage Current		-500		500	μA

LVTTL/CMOS DC Electrical Characteristics⁽⁷⁾

$V_{CC} = +3.3V \pm 5\%$, $T_A = -40^\circ C$ to $+85^\circ C$, unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
V_{IH}	Input HIGH Voltage		2			V
V_{IL}	Input LOW Voltage				0.8	V
I_{IH}	Input HIGH Current		-125		30	μA
I_{IL}	Input LOW Current		-300			μA

Notes:

7. The circuit is designed to meet the DC specifications, shown in the above table, after thermal equilibrium has been established. 500lpm Airflow.
 $T_J \leq 125^\circ C$.

AC Electrical Characteristics⁽⁸⁾

$V_{CC} = 3.3V \pm 5\%$; $V_{EE} = 0V$; $T_A = -40^\circ C$ to $+85^\circ C$; $R_L = 100\Omega$ across output pair; unless otherwise stated.

Symbol	Parameter	Condition	Min	Typ	Max	Units
Freq	Data Rate Throughput	NRZ Data	1		10.3	Gbps
t_{pd}	Differential Propagation Delay	RXIN-to-RXQ,	150	250	450	ps
		TXIN-to-TXQ,	150	250	450	ps
t_{SKEW}	Part-to-Part Skew	Note 9			200	ps
t_{EN}	TXQ Enable/Disable Time	/TXEN		450	600	ps
	RXQ Enable/Disable Time	/RXEN		450	600	ps
t_{JITTER}	Deterministic Jitter (DJ)	Note 10			10	ps _{pp}
	Total Jitter (TJ)	Note 11			20	ps _{pp}
LOS _{Delay}	LOS Delay	t_{los_on} and t_{los_off} , See figure 1			100	μs
t_r, t_f	Output Rise/Fall Time (20% to 80%)	At full output swing	20	50	80	ps

Notes:

8. The circuit is designed to meet the DC specifications, shown in the above table, after thermal equilibrium has been established. 500lfpm Airflow. $T_J \leq 125^\circ C$.
9. High-frequency AC-parameters are guaranteed by design and characterization.
10. Part-to-part 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.
11. Deterministic jitter is measured with 2^9 -1 PRBS pattern at 10.3Gbps.
12. Total jitter is measured with 2^{23} -1 PRBS pattern at 10.3Gbps.

Timing Diagram

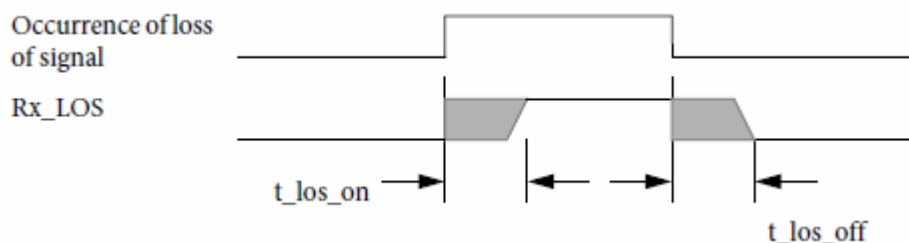
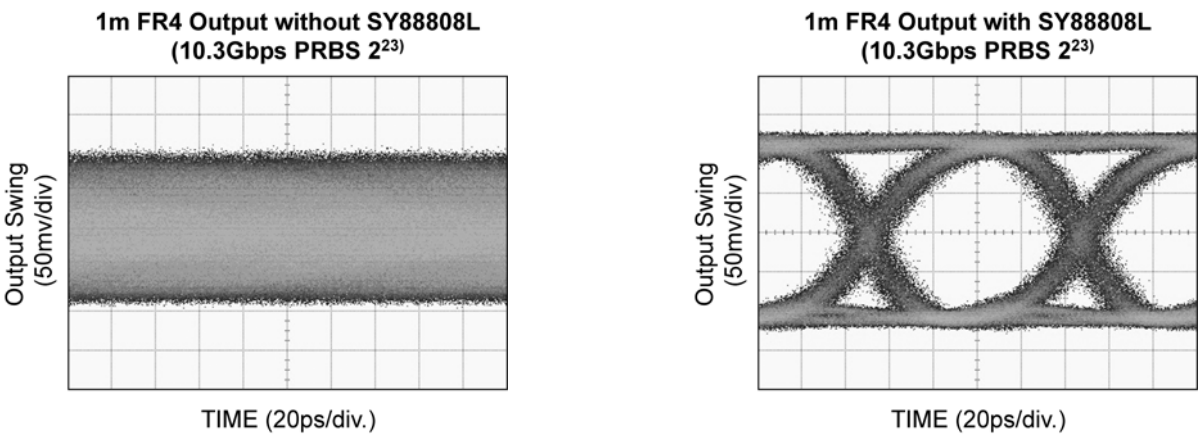


Figure 1. LOS Delay

Typical Operating Characteristics

$V_{CC} = 3.3V \pm 5\%$; $V_{IN} > 300mV$; $T_A = 25^{\circ}C$, $R_L = 100\Omega$ across output pair; unless otherwise stated.



Output Interface Applications

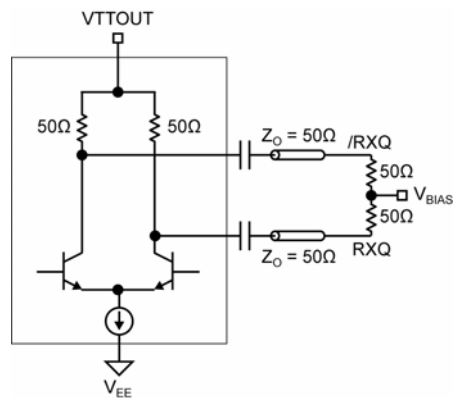
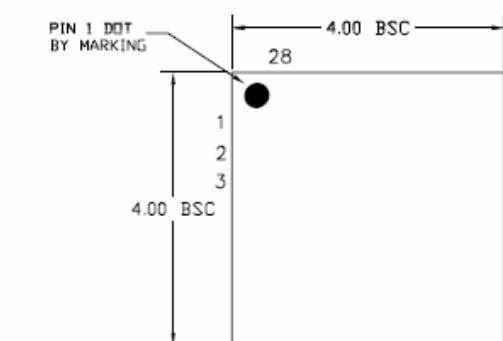


Figure 2. CML AC-Coupled Termination

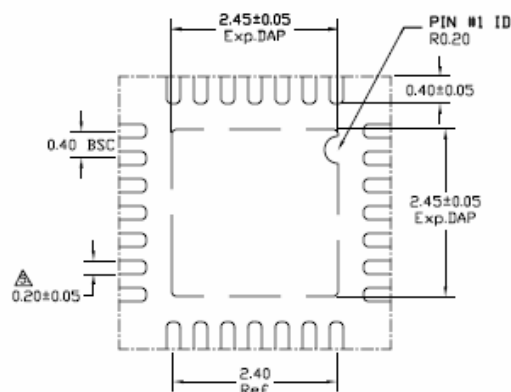
Related Product and Support Information

Part Number	Function	Datasheet Link
SY58626L	DC-to-6.4Gbps Backplane Transmit Buffer with Selectable Output Pre-emphasis, I/O DC-Offset Control, and 200mV-3V _{PP} Output Swing	www.micrel.com/product-info/products/sy58626l.shtml
	MLF [®] Application Note	www.amkor.com/products/notes_papers/MLFAppNote.pdf
HBW Solutions	New Products and Applications	www.micrel.com/product-info/products/solutions.shtml

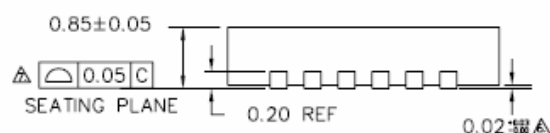
Package Information



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 0.08 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.
5. APPLIED ONLY FOR TERMINALS.
6. APPLIED FOR EXPOSED PAD AND TERMINALS.

28-Pin MLF® (MLF-28)

Package Notes:

1. Package meets Level 2 Moisture Sensitivity Classification.
2. All parts are dry-packed before shipment.
3. Exposed pad must be soldered to a ground for proper thermal management.

MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA

TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB <http://www.micrel.com>

The information furnished by Micrel in this data sheet is believed to be accurate and reliable. However, no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer.

Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is a Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 2009 Micrel, Incorporated.