



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.



USB1T1103

Universal Serial Bus Peripheral Transceiver with Voltage Regulator

Features

- Complies with Universal Serial Bus Specification 2.0
- Integrated 5V to 3.3V voltage regulator for powering VBus
- Utilizes digital inputs and outputs to transmit and receive USB cable data
- Supports full speed (12Mbps/s) data rates
- Ideal for portable electronic devices
- MLP technology package (16 terminal) with HBCC footprint
- 15kV contact HBM ESD protection on bus terminals

Description

This chip provides a USB Transceiver functionality with a voltage regulator that is compliant to USB Specification Rev 2.0. this integrated 5V to 3.3V regulator allows interfacing of USB Application specific devices with supply voltages ranging from 1.65V to 3.6V with the physical layer of Universal Serial Bus. It is capable of operating at 12Mbps/s (full speed) data rates and hence is fully compliant to USB Specification Rev 2.0. The Vbusmon terminal allows for monitoring the Vbus line.

The USB1T1103 also provides exceptional ESD protection with 15kV contact HBM on D+,D- terminals

Applications

- PDA
- PC Peripherals
- Cellular Phones
- MP3 Players
- Digital Still Camera
- Information Appliance



Ordering Information

Part Number	Package Number	Product code Top Mark	Pb-Free	Package Description	Packing Method
USB1T1103MPX	MLP14D	\$Y&Z&2&T USB1103	Yes	14-Terminal Molded Leadless Package (MLP), 2.5mm Square	3K Units on Tape and Reel
USB1T1103MHX	MLP16HB	\$Y&Z&2&T USB1103	Yes	16-Terminal Molded Leadless Package (MHBCC), JEDEC MO-217,3mm Square	3K Units on Tape and Reel

Pb-Free package per JEDEC J-STD-020B.

Typical Application

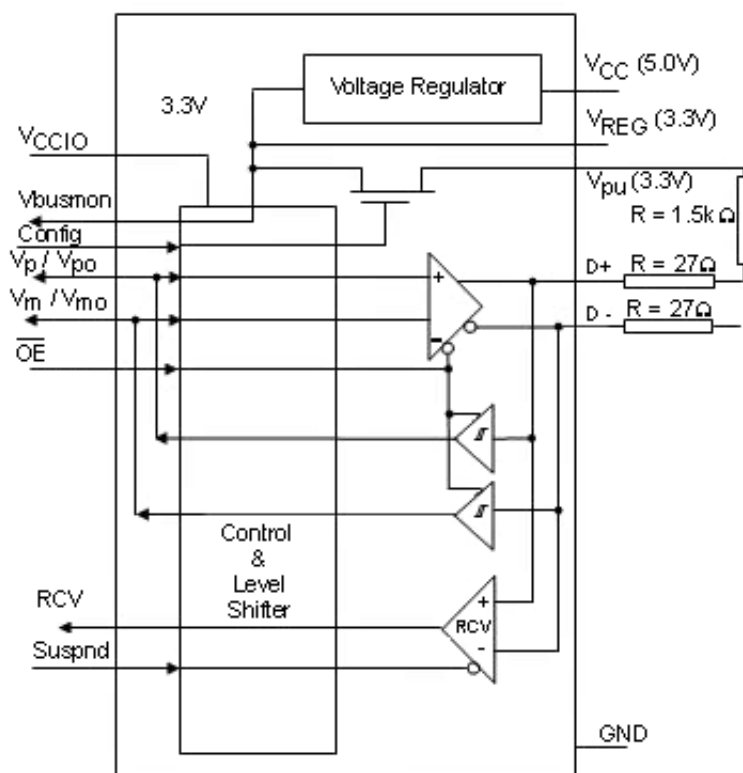


Figure 1. Logic Diagram

Connection Diagrams

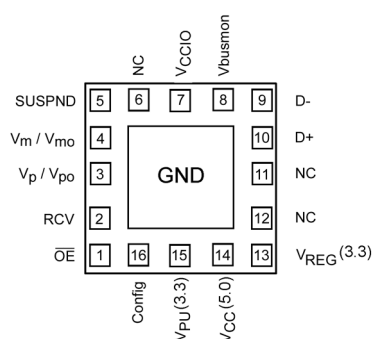


Figure 2. MLP16 GND Exposed Diepad
(Bottom View)

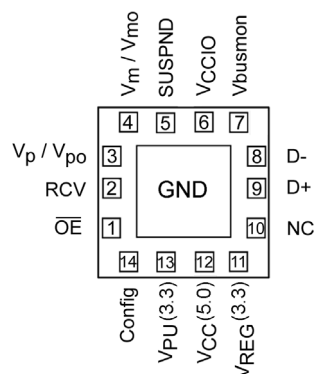


Figure 3. MLP14 GND Exposed Diepad
(Bottom View)

Terminal Descriptions

Terminal Number		Terminal Name	I/O	Terminal Description
MLP14	MLP16			
1	1	OE	I	Output Enable: Active LOW enables the transceiver to transmit data on the bus. When not active the transceiver is in the receive mode (CMOS level is relative to V_{CCIO})
2	2	RCV	O	Receive Data Output: Non-inverted CMOS level output for USB differential Input (CMOS output level is relative to V_{CCIO}). Driven LOW when SUSPN is HIGH; RCV output is stable and preserved during SE0 condition.
3	3	V_p/V_{po}	I/O	Single-ended D+ receiver output V_p (CMOS level relative to V_{CCIO}): Used for external detection of SE0, error conditions, speed of connected device; Terminal also acts as drive data input V_{po} (see Table 1 and Table 2). Output drive is 4 mA buffer.
4	4	V_m/V_{mo}	I/O	Single-ended D- receiver output V_m (CMOS level relative to V_{CCIO}): Used for external detection of SE0, error conditions, speed of connected device; Terminal also acts as drive data input V_{mo} (see Table 1 and Table 2). Output drive is 4 mA buffer.
5	5	SUSPND	I	Suspend: Enables a low power state (CMOS level is relative to V_{CCIO}). While the SUSPND terminal is active (HIGH) it will drive the RCV terminal to logic "0" state.
—	6	NC		No Connect
6	7	V_{CCIO}		Supply Voltage for digital I/O terminals (1.65V to 3.6V): When not connected the D+ and D- terminals are in 3-STATE. This supply bus is totally independent of V_{CC} (5V) and V_{REG} (3.3V), and must never exceed the V_{REG} (3.3) voltage. For V_{CCIO} disconnected the O+/O- terminals are HIGH Impedance and the V_{PU} (3.3V) is turned off.
7	8	Vbusmon	O	Vbus monitor output (CMOS level relative to V_{CCIO}): When Vbus > 4.1V then Vbusmon = HIGH and when Vbus < 3.6V then Vbusmon = LOW. If SUSPND = HIGH then Vbusmon is pulled HIGH.
9, 8	10, 9	D+, D-	AI/O	Data +, Data -: Differential data bus conforming to the USB standard. Terminals are HIGH Impedance for bus powered mode when Vbus < 3.6V. For ByPass Mode then HIGH Impedance when $V_{REG}/V_{bus} < V_{REG}$ minimum.
10	11	NC		No Connect
—	12	NC		No Connect
11	13	V_{REG} (3.3V)		Internal Regulator Option: Regulated supply output voltage (3.0V to 3.6V) during 5V operation; decoupling capacitor of at least 0.1 μ F is required. Regulator ByPass Option: Used as supply voltage input for 3.3V operation.
12	14	V_{CC} (5.0V)		Internal Regulator Option: Used as supply voltage input (4.0V to 5.5V); can be connected directly to USB line Vbus. Regulator ByPass Option: Connected to V_{REG} (3.3V)
13	15	V_{PU} (3.3V)		Pull-up Supply Voltage ($3.3V \pm 10\%$): Connect an external 1.5k Ω resistor on D+ (FS data rate); Terminal function is controlled by Config input terminal: Config = LOW - V_{PU} (3.3V) is floating (HIGH Impedance) for zero pull-up current. Config = HIGH - V_{PU} (3.3V) = 3.3V; internally connected to V_{REG} (3.3V). V_{PU} is OFF in disable mode.
14	16	Config	I	USB connect or disconnect software control input. Configures 3.3V to external 1.5k Ω resistor on D+ when HIGH.
Exposed Diepad	Exposed Diepad	GND	GND	GND supply down bonded to exposed diepad to be connected to the PCB GND.

Functional Description

The USB1T1103 transceiver is designed to convert CMOS data into USB differential bus signal levels and to convert USB differential bus signal to CMOS data.

To minimize EMI and noise the outputs are edge rate controlled with the rise and fall times controlled and defined for full speed data rates only (12Mbits/s). The rise, fall times are balanced between the differential terminals to minimize skew.

The USB1T1103 differs from earlier USB Transceiver in that the V_p/V_m and V_{po}/V_{mo} terminals are now I/O termi-

nals rather than discrete input and output terminals. Table 1 describes the specific terminal functionality selection. Table 2 and Table 3 describe the specific Truth Tables for Driver and Receiver operating functions.

The USB1T1103 also has the capability of various power supply configurations, including a disable mode for V_{CCIO} disconnected, to support mixed voltage supply applications (see Table 4) and Section 2.1 for detailed descriptions.

Functional Tables

Table 1. Function Select

SUSPND	OE	D+, D-	RCV	V_p/V_{po}	V_m/V_{mo}	Function
L	L	Driving & Receiving	Active	V_{po} Input	V_{mo} Input	Normal Driving (Differential Receiver Active)
L	H	Receiving ⁽¹⁾	Active	V_p Output	V_m Output	Receiving
H	L	Driving	Inactive ⁽²⁾	V_{po} Input	V_{mo} Input	Driving during Suspend (Differential Receiver Inactive)
H	H	3 STATE ⁽¹⁾	Inactive ⁽²⁾	V_p Output	V_m Output	Low Power State

Notes:

- Signal levels is function of connection and/or pull-up/pull-down resistors.
- For SUSPND = HIGH mode the differential receiver is inactive and the output RCV is forced LOW. The out-of-suspend signaling (K) is detected via the single-ended receivers of the V_p/V_{po} and V_m/V_{mo} terminals.

Table 2. Driver Function ($\overline{OE} = L$) using Differential Input Interface

V_m/V_{mo}	V_p/V_{po}	Data (D+ / D-)
L	L	SE0 ⁽³⁾
L	H	Differential Logic 1
H	L	Differential Logic 0
H	H	Illegal State

Notes:

- SE0 = Single Ended Zero

Table 3. Receiver Function ($\overline{OE} = H$)

D+, D-	RCV	V_p/V_{po}	V_m/V_{mo}
Differential Logic 1	H	H	L
Differential Logic 0	L	L	H
SE0	X	L	L

Notes:

- X = Don't Care
- RCV(0) denotes the signal level on output RCV just prior to the SE0 or SE1 event. This level is stable during the SE0 or SE1 event period.

Power Supply Configurations and Options

The three modes of power supply operation are:

Normal Mode: Regulated Output and Regulator Bypass

1. Regulated Output: V_{CCIO} is connected and $V_{CC}(5.0)$ is connected to 5V (4.0V to 5.5V) and the internal voltage regulator then produces 3.3V for the USB connections.
2. Internal Regulator Bypass Mode: V_{CCIO} is connected and both $V_{CC}(5.0)$ and $V_{REG}(3.3)$ are connected to a 3.3V source (3.0V to 3.6V).

In both cases, for normal mode, the V_{CCIO} is an independent voltage source (1.65V to 3.6V) that is a function of the external circuit configuration.

Sharing Mode: V_{CCIO} is only supply connected. V_{CC} and V_{REG} are not connected. In this mode, the D+ and D- terminals are 3-STATE and the USB1T1103 allows

external signals up to 3.6V to share the D+ and D- bus lines. Internally the circuitry limits leakage from D+ and D- terminals (maximum 10 μ A) and V_{CCIO} such that device is in low power (suspended) state. Terminals Vbusmon and RCV are forced LOW as an indication of this mode with Vbusmon being ignored during this state.

Disable Mode: V_{CCIO} is not connected. V_{CC} is connected, or V_{CC} and V_{REG} are connected. 0V to 3.3V in this mode D+ and D- are 3-STATE and V_{PU} is HIGH Impedance (switch is turned off). The USB1T1103 allows external signals up to 3.6V to share the D+ and D- bus lines. Internally the circuitry limits leakage from D+ and D- pins (maximum 10 μ A).

A summary of the Supply Configurations is described in Table 4.

Table 4. Power Supply Configuration Options

Terminals	Disable	Sharing	Normal (Regulated Output)	Normal (Regulator Bypass)
$V_{CC}(5V)$	Connected to 5V source	Not Connected or <3.6V	Connected to 5V Source	Connected to $V_{REG}(3.3V)$ [Max Drop of 0.3V] (2.7V to 3.6V)
$V_{REG}(3.3V)$	3.3V, 300 μ A Regulated Output	Not Connected	3.3V, 300 μ A Regulated Output	Connected to 3.3V Source
V_{CCIO}	$\leq 0.5V$	1.65V to 3.6V Source	1.65V to 3.6V Source	1.65V to 3.6V Source
$V_{PU}(3.3V)$	3-STATE (off)	3-STATE (off)	3.3V Available if Config = HIGH	3.3V Available if Config = HIGH
D+, D-	3-STATE (off)	3-STATE	Function of Mode Set Up	Function of Mode Set Up
$V_p/V_{po}, V_m/V_{mo}$	Invalid [I]	L	Function of Mode Set Up	Function of Mode Set Up
RCV	Invalid [I]	L	Function of Mode Set Up	Function of Mode Set Up
Vbusmon	Invalid [I]	L	Function of Mode Set Up	Function of Mode Set Up
OE, SUSPND, Config	Hi-Z	Hi-Z	Function of Mode Set Up	Function of Mode Set Up

Notes:

6. Invalid [I] I/O are to be 3-STATE, outputs to be LOW.

ESD Protection

ESD Performance of the USB1T1103

- HBM D+/D-: 15.0kV
- HBM, all other terminals (Mil-Std 883E): 6.5kV

ESD Protection: D+/D- Terminals

Since the differential terminals of a USB transceiver may be subjected to extreme ESD voltages, additional immunity has been included in the D+ and D- terminals without compromising performance. The USB1T1103 differential terminals have ESD protection to the following limits:

- 15kV using the contact Human Body Model
- 8kV using the Contact Discharge method as specified in IEC 61000-4-2

Human Body Model

Figure 3 shows the schematic representation of the Human Body Model ESD event. Figure 4 is the ideal waveform representation of the Human Body Model.

IEC 61000-4-2, IEC 60749-26 and IEC 60749-27

The IEC 61000-4-2 standard covers ESD testing and performance of finished equipment and evaluates the equipment in its entirety for ESD immunity. Fairchild Semiconductor has evaluated this device using the IEC 6100-4-2 representative system model depicted in Figure 5. Under the additional standards set forth by the IEC, this device is also compliant with IEC 60749-26 (HBM) and IEC 60749-27 (MM).

Additional ESD Test Conditions

For additional information regarding our product test methodologies and performance levels, please contact Fairchild Semiconductor.

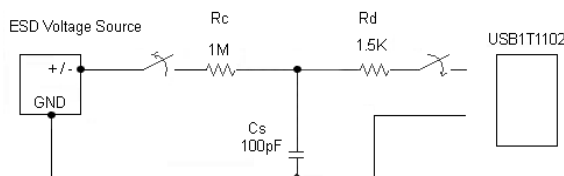


Figure 3. Human Body ESD Test Model

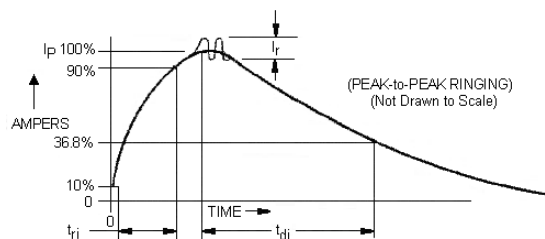


Figure 4. HBM Current Waveform

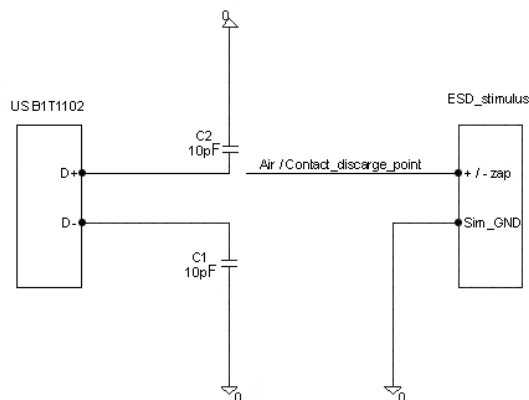


Figure 5. IEC 61000-4-2 ESD Test Model

Absolute Maximum Ratings

The “Absolute Maximum Ratings” are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the absolute maximum ratings. The “Recommended Operating Conditions” table defines the conditions for actual device operation.

Symbol	Parameter	Min.	Max.	Unit
V_{CC} (5V)	Supply Voltage	-0.5	+6.0	V
V_{CCIO}	I/O Supply Voltage	-0.5	+4.6	V
I_{LU}	Latch-up Current, $V_I = -1.8V$ to $+5.4V$		150	mA
I_{IK}	DC Input Current, $V_I < 0$		-18	mA
V_I	DC Input Voltage ⁽⁴⁾	-0.5	$V_{CCIO} + 0.5$	V
I_{OK}	DC Output Diode Current, $V_O > V_{CC}$ or $V_O < 0$		± 18	mA
V_O	DC Output Voltage ⁽⁵⁾	-0.5	$V_{CCIO} + 0.5$	V
I_O	Output Source or Sink Current, $V_O + 0$ to V_{CC}			
	Current for D+, D- Terminals		± 12	mA
	Current for RCV, V_M/V_P		± 12	mA
I_{CC}, I_{GND}	DC V_{CC} or GND Current		± 100	mA
V_{ESD}	ESD Immunity Voltage			
	Contact HBM			
	Terminals D+, D-, $I_{LI} < 1\mu A$		± 15	kV
	All other Terminals $I_{LI} < 1\mu A$		± 6.5	kV
T_{STG}	Storage Temperature	-40	+150	°C
P_{TOT}	Power Dissipation			
	I_{CC} (5V)		48	mW
	I_{CCIO}		9	mW

Notes:

- IO Absolute Maximum Rating must be observed.
- Per ESD Methodology described on page 6.

Recommended Operation Conditions

Symbol	Parameter	Min.	Max.	Unit
V_{CC}	Supply Voltage	4.0	5.5	V
V_{CC10}	I/O DC Voltage	1.65	3.6	V
V_I	DC Input Voltage Range	0	$V_{CCIO} + 5.5$	V
$V_{AI/O}$	DC Input Range for AI/O, Terminal D+ and D-	0	3.6	V
T_A	Operating Ambient Temperature	-40	+85	°C

DC Electrical Characteristics

Supply Terminals

Over recommended range of supply voltage and operating free air temperature (unless otherwise noted).

V_{CC} (5V) = 4.0V to 5.5V or V_{REG} (3.3V) = 3.0V to 3.6V, V_{CCIO} = 1.65V to 3.6V.

Symbol	Parameter	Conditions	Limits			Units
			-40°C to +85°C			
			Min.	Typ.	Max.	
V _{REG} (3.3V)	Regulated Supply Output	Internal Regulator Option; I _{LOAD} ≤300 μA	3.0 ⁽⁹⁾⁽¹⁰⁾	3.3	3.6	V
I _{CC}	Operating Supply Current (V _{CC} 5.0)	Transmitting and Receiving at 12 Mbits/s; C _{LOAD} = 50 pF (D+, D-)		4.0 ⁽¹¹⁾	8.0	mA
I _{CCIO}	I/O Operating Supply Current	Transmitting and Receiving at 12 Mbits/s		1.0 ⁽¹¹⁾	2.0	mA
I _{CC} (IDLE)	Supply Current during FS IDLE and SE0 (V _{CC} 5.0)	IDLE: V _{D+} + ≤2.7V, V _{D-} ≤ 0.3V; SE0: V _{D+} + ≤ 0.3V, V _{D-} ≤0.3V			300 ⁽¹²⁾	μA
I _{CCIO} (STATIC)	I/O Static Supply Current	IDLE, SUSPEND or SE0			20.0	μA
I _{CC} (DISABLE)	Disable Supply Current	V _{CCIO} = 0V V _{CC} Connected			25.0	μA
I _{CC} (SUSPEND)	Suspend Supply Current USB1T1103	SUSPEND = HIGH OE = HIGH V _m = V _p = OPEN			25.0 ⁽¹²⁾	μA
I _{CCIO} (SHARING)	I/O Sharing Mode Supply Current	V _{CC} (5V) Not Connected			20.0	μA
ID+ (SHARING) I _D +/-	Sharing Mode Load Current on D+/D- Terminals	V _{CC} (5V) Not Connected Config = LOW; V _{D±} = 3.6V			10.0	μA
I _{D+} (DISABLE) I _D +/-	Disable Mode Load Current on D+/D- Terminals	V _{CCIO} Not Connected or 0V Config = V _D ± = 3.6V LOW or HIGH			10.0	μA
V _{CCTH}	V _{CC} Threshold Detection Voltage	1.65V ≤ V _{CCIO} ≤3.6V				V
		Supply Lost			3.6	
		Supply Present	4.1			
V _{CCHYS}	V _{CC} Threshold Detection Hysteresis Voltage	V _{CCIO} = 1.8V		70.0		mV
V _{CCIO} TH	V _{CCIO} Threshold Detection Voltage	2.7V ≤ V _{REG} ≤ 3.6V				V
		Supply Lost			0.5	
		Supply Present	1.4			
V _{CCIO} HYS	V _{CCIO} Threshold Detection Hysteresis Voltage	V _{REG} = 3.3V		450		mV
V _{REG} TH	Regulated Supply Threshold Detection Voltage	1.65V ≤ V _{CCIO} ≤ V _{REG} 2.7V ≤ V _{REG} ≤ 3.6V				V
		Supply Lost			0.8	
		Supply Present	2.4 ⁽¹⁴⁾			
V _{REG} HYS ⁽¹⁵⁾	Regulated Supply Threshold Detection Hysteresis Voltage	V _{CCIO} = 1.8V		450		mV

Notes:

9. I_{LOAD} includes the pull-up resistor current via terminal V_{PU}

10. The minimum voltage in Suspend mode is 2.7V.

11. Not tested in production, value based on characterization.

12. Excludes any current from load and V_{PU} current to the 1.5k Ω resistor.

13. Includes current between V_{pu} and the 1.5k internal pull-up resistor.

14. When $V_{CCIO} < 2.7V$, minimum value for $V_{REG TH} = 2.0V$ for supply present condition.

15. DC electrical measurements should be taken with unused inputs and I/O pins connected to a valid logic level. This applies for all modes of device operation defined in the Functional Tables on Page 4.

DC Electrical Characteristics

Digital Terminals – excludes D+, D- Terminals

Over recommended range of supply voltage and operating free air temperature (unless otherwise noted).

$V_{CCIO} = 1.65V$ to $3.6V$.

Symbol	Parameter	Conditions	Limits		Units
			-40C° to +85°C		
			Min.	Max.	
Input Levels					
V _{IL}	LOW Level Input Voltage			0.3*V _{CCIO}	V
V _{IH}	HIGH Level Input Voltage		0.6*V _{CCIO}		V
Output Levels					
V _{OL}	LOW Level Output Voltage	I _{OL} = 2 mA		0.4	V
		I _{OL} = 100 =μA		0.15	
V _{OH}	HIGH Level Output Voltage	I _{OH} = 2 mA	V _{CCIO} - ^{0.4}		V
		I _{OH} = 100 =μA	V _{CCIO} - ^{0.15}		
Leakage Current					
I _{LI}	Input Leakage Current	V _{CCIO} = 1.65V to 3.6V		±1.0 ⁽¹⁶⁾	μA
Capacitance					
C _{IN} , C _{I/O}	Input Capacitance	Terminal to GND		10.0	pF

Notes:

16. If $V_{CCIO} \geq V_{REG}$, leakage current is higher than specified.

DC Electrical Characteristics

Analog I/O Terminals – D+, D- Terminals

Over recommended range of supply voltage and operating free air temperature (unless otherwise noted).

$V_{CC} = 4.0V$ to $5.5V$ or $V_{REG} = 3.0V$ to $3.6V$.

Symbol	Parameter	Conditions	Limits			Units
			-40°C to +85°C			
			Min.	Typ.	Max.	
Input Levels – Differential Receiver						
V _{DI}	Differential Input Sensitivity	V _{I(D+)} - V _{I(D-)}	0.2			V
V _{CM}	Differential Common Mode Voltage		0.8		2.5	V
Input Levels – Single-ended Receiver						
V _{IL}	LOW Level Input Voltage				0.8	V
V _{IH}	HIGH Level Input Voltage		2.0			V
V _{HYS}	Hysteresis Voltage		0.30		0.7	V
Output Levels						
V _{OL}	LOW Level Output Voltage	R _L = 1.5kΩ to 3.6V			0.3	V
V _{OH}	HIGH Level Output Voltage ⁽¹⁷⁾	R _L = 15kΩ to GND	2.8		3.6	V
Leakage Current						
I _{OFF}	Input Leakage Current Off State				±1.0	μA
CAPACITANCE						
C _{I/O}	I/O Capacitance	Terminal to GND			20.0	pF
Resistance						

Symbol	Parameter	Conditions	Limits			Units
			-40°C to +85°C			
			Min.	Typ.	Max.	
Z _{DRV}	Driver Output Impedance ⁽¹⁸⁾		34.0	41.0	44.0	Ω
Z _{IN}	Driver Input Impedance		10.0			MΩ
R _{SW}	Switch Resistance				10.0	Ω
V _{TERM}	Termination Voltage ⁽¹⁹⁾⁽²⁰⁾	R _{PU} Upstream Port	3.0		3.6	V

Notes:

17. If V_{OH} minimum = V_{REG} - 0.2V.

18. Includes external resistors of 27Ω on both D+ and D- terminals.

19. This voltage is available at terminal V_{PU} and V_{REG}.

20. Minimum voltage is 2.7V in the suspend mode.

AC Electrical Characteristics

A I/O Terminals Full Speed

Over recommended range of supply voltage and operating free air temperature (unless otherwise noted).

V_{CC} = 4.0V to 5.5V or V_{REG} = 3.0V to 3.6V, V_{CCIO} = 1.65V to 3.6V, C_L = 50 pF; R_L = 1.5K on D+ to V_{PU}.

Symbol	Parameter	Conditions	Limits			Unit
			-40°C to +85°C			
			Min.	Typ.	Max.	
Driver Characteristics						
t _R	Output Rise Time	C _L = 50 - 125 pF 10% to 90%	4.0		20.0	ns
t _F	Output Fall Time	Figure 8, 12	4.0		20.0	
t _{RFM}	Rise/Fall Time Match	t _F / t _R Excludes First Transition from Idle State	90.0		111.1	%
V _{CRS}	Output Signal Crossover Voltage ⁽²¹⁾	Excludes First Transition from Idle State see Waveform	1.3		2.0	V
Driver Timing						
t _{PLH}	Propagation Delay	Figures 9,12			18.0	ns
t _{PHL}	(V _p /V _{po} , V _m /V _{mo} to D+/D-)					
t _{PHZ}	Driver Disable Delay	Figures 11,12			15.0	ns
t _{PLZ}	(OE to D+/D-)					
t _{PZH}	Driver Enable Delay	Figures 11,13			15.0	ns
t _{PZL}	(OE to D+/D-)					
Receiver Timing						
t _{PLH}	Propagation Delay (Diff)	Figures 10,14			15.0	ns
t _{PHL}	(D+/D- to Rev)					
t _{PLH}	Single-Ended Receiver Propagation Delay	Figures 10,14			18.0	ns
t _{PHL}	(D+/D- to V _p / V _{po} , V _m /V _{mo})					

NOTES:

21. Not production tested; limits guaranteed by design.

AC Waveforms

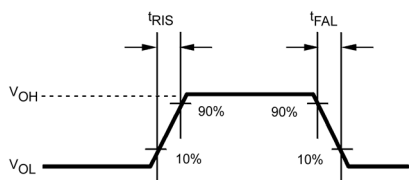


Figure 8. Rise and Fall Times

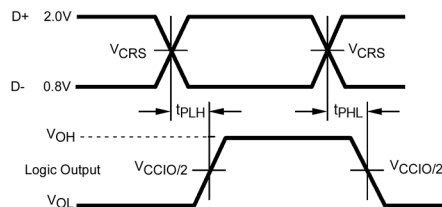


Figure 10. D+/D- to R_{CV} , V_{po}/V_p and V_{mo}/V_m

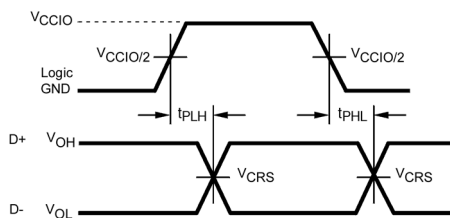


Figure 9. V_{po} , V_{mo} to D+/D-

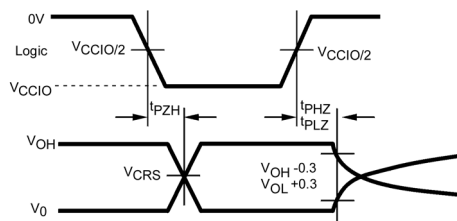
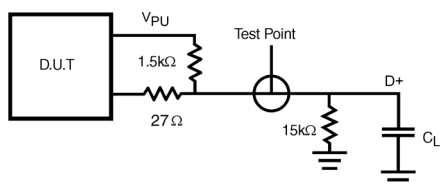


Figure 11. $\overline{OE}$ to D+/D-

Test Circuits and Waveforms



$C_L = 50 \text{ pF}$ Full Speed Propagation Delays

$C_L = -125 \text{ pF}$ Edge Rates only

Figure 12. Load for D+/D-

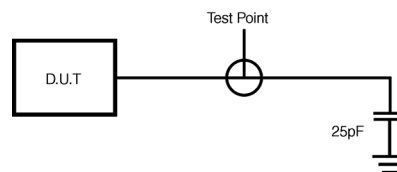
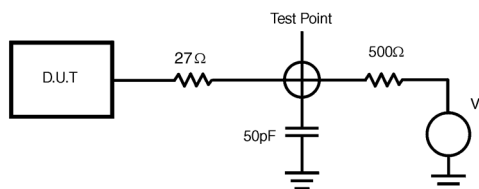


Figure 14. Load for V_m/V_{mo} , V_p/V_{po} and R_{CV}



$V = 0$ for t_{PZH} , t_{PHZ}

$V = V_{REG}$ for t_{PZL}

Figure 13. Load for Enable and Disable Times

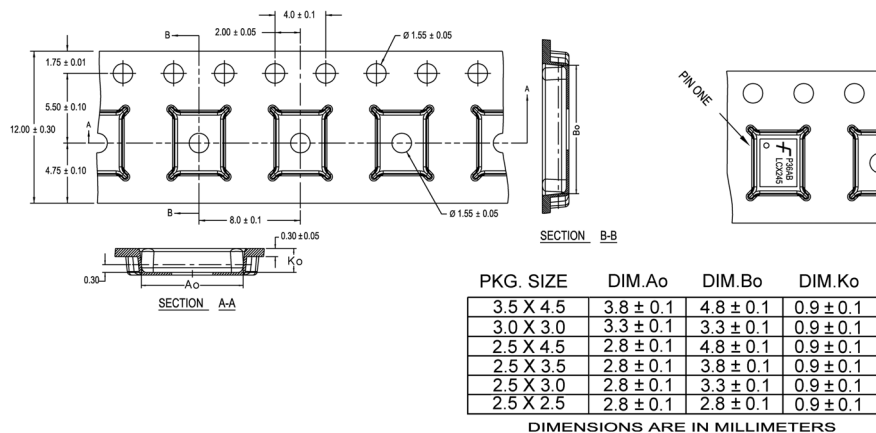
Tape and Reel Specification

Tape Format for MHBCC and MLP

Package Designator	Tape Section	Number Cavities	Cavity Status	Cover Tape Status
MHX/MPX	Leader (Start End)	125 (typ)	Empty	Sealed
	Carrier	2500/3000	Filled	Sealed
	Trailer (Hub End)	75 (typ)	Empty	Sealed

TAPE DIMENSIONS

Dimensions are in inches (millimeters) unless otherwise specified.

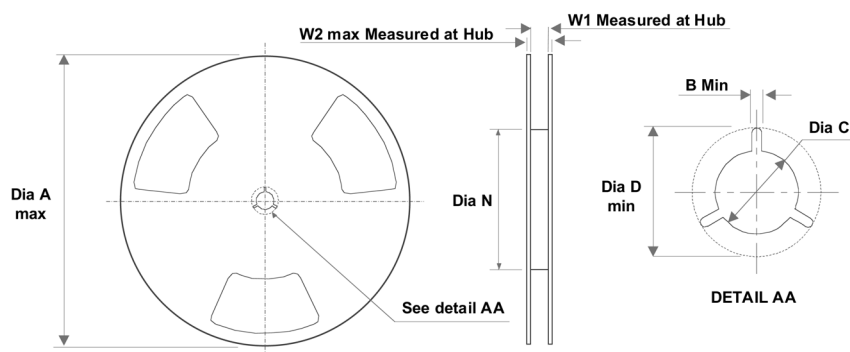


NOTES: unless otherwise specified

1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is $\pm 0.002[0.05]$ for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

REEL DIMENSIONS

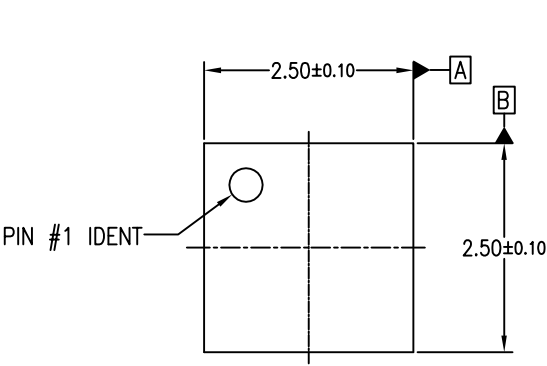
Dimensions are in inches (millimeters) unless otherwise specified.



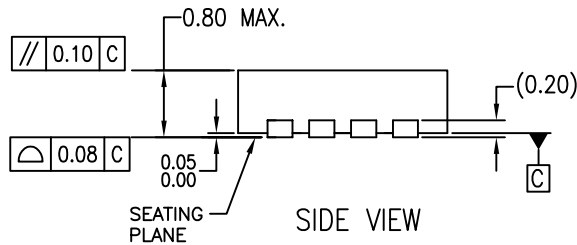
Tape Size	A	B	C	D	N	W1	W2
12 mm	13.0	0.059	0.512	0.795	7.008	0.488	0.724
	330	(1.50)	(13.00)	(20.20)	(178)	(12.4)	(18.4)

THIS DRAWING IS THE PROPERTY OF FAIRCHILD SEMICONDUCTOR CORPORATION. NO USE THEREOF SHALL BE MADE OTHER THAN AS A REFERENCE FOR PROPOSALS AS SUBMITTED TO FAIRCHILD SEMICONDUCTOR CORPORATION FOR JOBS TO BE EXECUTED IN CONFORMITY WITH SUCH PROPOSALS UNLESS THE CONSENT OF SAID FAIRCHILD SEMICONDUCTOR CORPORATION HAS PREVIOUSLY BEEN OBTAINED. NO PART OF THIS DRAWING SHALL BE COPIED OR DUPLICATED OR ITS CONTENTS DISCLOSED. THE INFORMATION CONTAINED ON THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY.

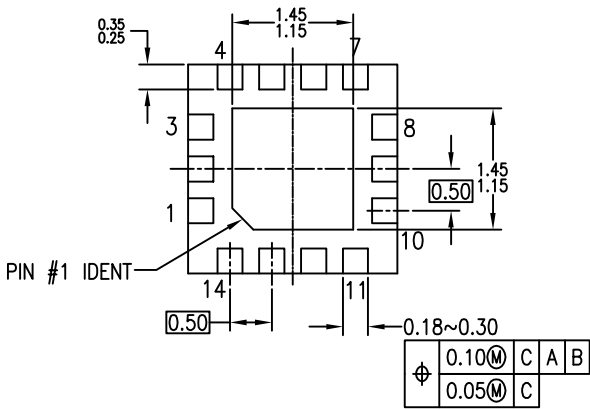
REVISIONS				
LTR	DESCRIPTION	EDCN	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL		25-2-2004	FEITAN



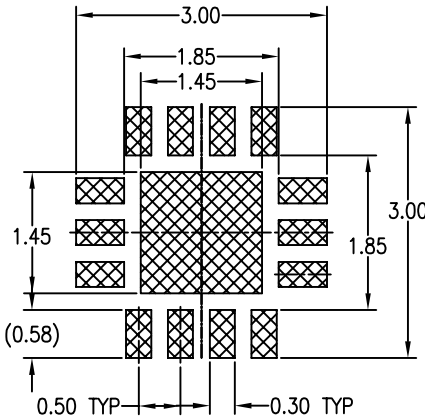
TOP VIEW



SIDE VIEW



BOTTOM VIEW



RECOMMENDED LAND PATTERN

NOTES:

- A. NO JEDEC REGISTRATION
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP14DrevA

APPROVALS		DATE		FAIRCHILD Bayan Lepas, FIZ, SEMICONDUCTOR 11900, Penang, Malaysia.	
DRAWN		FEITAN			
DFTG. CHK.					
ENGR. CHK.					
				14LD, MLP, 2.5MM SQUARE	
PROJECTION  INCH [MM]		SCALE	SIZE	DRAWING NUMBER	REV
		N/A	N/A	MKT-MLP14D	A
		DO NOT SCALE DRAWING			SHEET 1 of 1



TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

AccuPower™	FRFET®	PowerTrench®	The Power Franchise®
Auto-SPM™	Global Power Resource™	PowerXS™	the power franchise
Build it Now™	Green FPS™	Programmable Active Droop™	TinyBoost™
CorePLUS™	Green FPS™ e-Series™	QFET®	TinyBuck™
CorePOWER™	Gmax™	QS™	TinyCalc™
CROSSVOLT™	GTO™	Quiet Series™	TinyLogic®
CTL™	IntelliMAX™	RapidConfigure™	TINYOPTO™
Current Transfer Logic™	ISOPLANAR™	 ™	TinyPower™
DEUXPEED®	MegaBuck™	Saving our world, 1mW/W/kW at a time™	TinyPWM™
Dual Cool™	MICROCOUPLER™	SignalWise™	TinyWire™
EcoSPARK®	MicroFET™	SmartMax™	TriFault Detect™
EfficientMax™	MicroPak™	SMART START™	TRUECURRENT™*
 Fairchild®	MicroPak2™	SPM®	µSerDes™
Fairchild Semiconductor®	MillerDrive™	STEALTH™	 SerDes™
FACT Quiet Series™	MotionMax™	SuperFET™	UHC®
FACT®	Motion-SPM™	SuperSOT™-3	Ultra FRFET™
FAST®	OptoHiT™	SuperSOT™-6	UniFET™
FastvCore™	OPTOLOGIC®	SuperSOT™-8	VCX™
FETBench™	OPTOPLANAR®	SupreMOS™	VisualMax™
FlashWriter®*	 ™	SyncFET™	XS™
FPS™	PDP SPM™	Sync-Lock™	
F-PFS™	Power-SPM™	 SYSTEM GENERAL®*	

* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support, device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, www.fairchildsemi.com, under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative / In Design	Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
No Identification Needed	Full Production	Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.
Obsolete	Not In Production	Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.

Rev. I47

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada

Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local
Sales Representative