

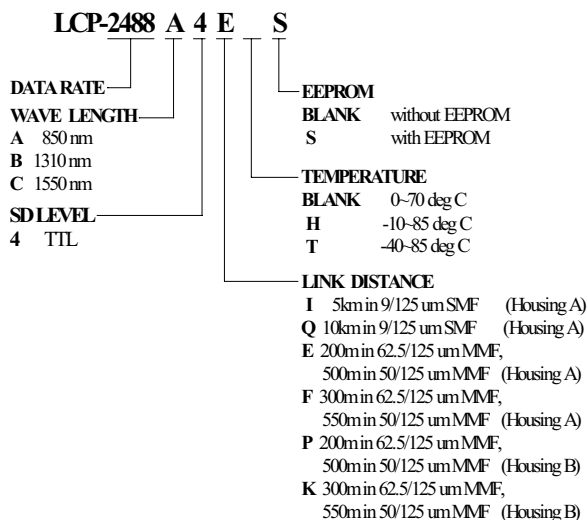


LCP-2488A4ES Small Form Factor Pluggable Transceiver for SONET OC-48/SDH STM-16

FEATURES

- Compliant with SFP Transceiver MSA Specification
- Compliant with Specifications for SONET OC-48/SDHSTM-16
- Compliant with Industry Standard RFT Electrical Connector and Cage
- 850nm Vertical Cavity Surface Emitter Laser (VCSEL) Source Technology
- Data Link up to 200m in 62.2/125 MMF, 500 m 50/125 MMF
- Single + 3.3V Power Supply and TTL Logic Interface
- EEPROM with Serial ID Functionality
- Laser Class 1 Product which comply with the requirements of IEC 60825-1 and IEC 60825-2

ORDERING INFORMATION



Product Description

The LCP-2488A4ES from DELTA ELECTRONIC is a hot pluggable 3.3V Small Form-Factor transceiver module designed expressly for high-speed bi-directional communication applications that require rates of up to 2.488 Gbit/sec. It is compliant with the SONET OC-48/SDH STM-16 standards, as well as the SFP Multisource Agreement.

The LCP-2488A4ES transceivers provide with the LC receptacle that is compatible with the industry standard LC connector. The transceiver is also compatible with industry standard RFT connector and cage.

The transmitter section of LCP-2488A4ES consists of an 850 nm Vertical Cavity Surface Emitting Laser (VCSEL) in an optical subassembly(OSA) while the receiver consists of a GaAs PIN photodiode mounted together with a transimpedance preamplifier. The post-amplifier of the LCP-2488A4ES also includes a Signal Detect circuit which provides a TTL logic-high output when an unusable optical signal level is detected.

The LCP-2488A4ES transceiver is a Class 1 eye safety product. The optical power levels, under normal operation, are at eye safe level.



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Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Supply voltage	V _{CC}	-0.5		5	V	
Storage temperature	T _S	-40		85	°C	
Lead soldering temperature	T _{SOLD}			240	°C	
Lead soldering time	t _{SOLD}			10	sec.	

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Ambient Operating Temperature	T _A	0		70	°C	
Supply voltage	V _{CC}	3.15		3.45	V	
Transmitter Differential Input Voltage	V _D	0.4		1.6	V	
Data Output Load	R _{DL}		50		Ω	

Electrical Characteristics(T_A=0 degC to 70 degC , V_{CC}=3.15V to 3.45V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
TRANSMITTER						
Supply current	I _{CC}			80	mA	
RECEIVER						
Supply current	I _{CC}			100	mA	
Data output differential voltage	V _D	0.5	0.7	1.2	V	
Output Data risetime	t _r			0.18	ns	Ref 1
Output Data faltime	t _f			0.18	ns	Ref 1
Signal Detect Output -High	V _{LH}	2		3.45		
Signal Detect Output -Low	V _{LL}	0		0.8		

Notes:

Ref 1. These are 20%~80% values



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Optical Characteristics($T_A=0$ degC to 70 degC , $V_{CC}=3.15V$ to 3.45V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
TRANSMITTER						
Launched power(avg.)	P_O	-10		-4	dBm	Ref 1
Optical extinction ratio		9			dB	
Center wavelength	λ_c	830	850	860	nm	
Spectral width(RMS)	σ			0.85	nm (rms)	
Optical risetime	t_r			0.175	ns	Ref 2
Optical falltime	t_f			0.175	ns	Ref 2
Relative Intensity Noise	RIN			-117	DB/Hz	
RECEIVER						
Optical input sensitivity(avg.)	P_{IN}			-17	dBm	Ref 3
Optical input saturation(avg.)	P_{SAT}	-3			dBm	
Optical wavelength	λ	820		860	nm	
Signal detect- Assert	P_A			-17	dBm	
Signal detect- Deassert	P_D	-30			dBm	
Signal detect- Hysteresis	$P_A - P_D$	0.5			dB	

Notes:

- Ref 1. The maximum optical output power complies with the IEEE 802.3z/D2 specification, and is class 1 laser eye safety.
- Ref 2. These are unfiltered 20-80% values.
- Ref 3. The receive sensitivity is measured using a worst case extinction ratio penalty BER better than or equal to 1×10^{-12} in the center of the eye opening with $2^{23}-1$ NRZ PRBS



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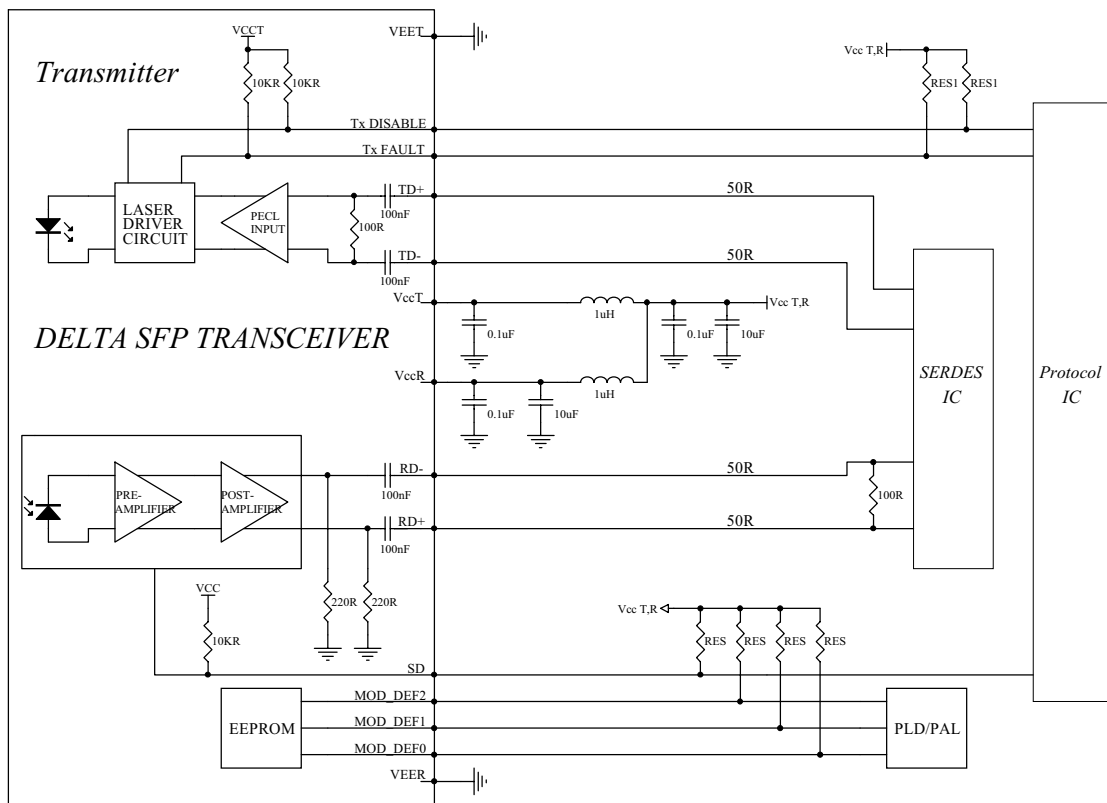
SFP to host connector pin assignment

Pin Name	Pin#	Sequence	Sequence	Pin#	Pin Name
VeeT	1	1	1	11	VeeR
Tx Fault	2	3	3	12	RD-
Tx Disable	3	3	3	13	RD+
MOD_DEF(2)	4	3	1	14	VeeR
MOD_DEF(1)	5	3	2	15	VccR
MOD_DEF(0)	6	3	2	16	VccT
Rate Select	7	3	1	17	VeeT
LOS	8	3	3	18	TD+
VeeR	9	1	3	19	TD-
VeeR	10	1	1	20	VeeT

Overview of internal interface signal Definition

Pin Name	Pin #	Name/Function	Signal Specification
Receiver Signals			
VeeR	9,10,11,14	Receiver Ground	Ground, to SFP
VccR	15	Receiver Power (3.3 ±5%)	Power, to SFP
RD+	13	Receive Data Out	High speed serial, from SFP
RD-	12	Inv. Receive Data Out	High speed serial, from SFP
LOS	8	Receiver Loss of Signal, logic high, open collector compatible,4.7 K to 10 K Ohm pull up to VccR on host	Low speed, from SFP
Transmitter Signals			
VeeT	1,17,20	Transmitter Ground	Ground, to SFP
VccT	16	Transmitter Power	Power, to SFP
TD+	18	Transmit Data In	High speed serial, to SFP
TD-	19	Inv. Transmit Data In	High speed serial,to SFP
TX DISABLE	3	Transmitter Disable, logic high, open collector compatible,4.7 K to 10 K Ohm pull up to VccT on SFP	Low speed, to SFP
TX FAULT	2	Transmitter Fault, logic high, open collector compatible,4.7 K to 10 K Ohm pull up to VccT on host	Low speed, from SFP
Control Signals			
MOD_DEF(0)	6	Module definition 0,They should be pulled up with a 4.7 K to 10 K resistor on host board.	Low speed, from SFP
MOD_DEF(1)	5	Module definition 1, They should be pulled up with a 4.7 K to 10 K resistor on host board.	Low speed, from SFP
MOD_DEF(2)	4	Module definition 2, They should be pulled up with a 4.7 K to 10 K resistor on host board.	Low speed, from SFP
Rate Select	7	Select between full or reduced receiver bandwidth	NIC

Recommended Circuit Schematic :



Note: $4.7KR < RES < 10KR$



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SFP module definition parameters :

Module Definition	MOD_DEF(0) pin 6	MOD_DEF(1) pin 5	MOD_DEF(2) pin 4	Interpretation by host Reference
0	NC	NC	NC	GBIC not present clause
1	NC	NC	TTL LOW	Copper Style 1 or Style 2 connector, 1.0625 Gbd, 100-TW-EL-S or 100-TP-EL-S, active inter-enclosure connection and IEEE802.3 1000BASE-CX
2	NC	TTL LOW	NC	Copper Style 1 or Style 2 connector, 1.0625 Gbd, 100-TW-EL-S, or 100-TP-EL-S, active or passive intraenclosure connection
3	NC	TTL LOW	TTL LOW	Optical LW, 1.0625 Gbd 100-SM-LC-L
4	TTL LOW	SCL	SDA	Serial module definition protocol
5	TTL LOW	NC	TTL LOW	Optical SW, 1.0625 Gbd 100-M5-SN-I or 100-M6-SN-I
6	TTL LOW	TTL LOW	NC	Optical LW, 1.0625 Gbd 100-SM-LC-L and similar to 1.25 Gbd IEEE802.3z 1000BASE-LX, single mode
7	TTL LOW	TTL LOW	TTL LOW	Optical SW, 1.0625 Gbd 100-M5-SN-I or 100-M6-SN-I and 1.25 Gbd, IEEE 802.3z, 1000BASE-SX

SFP timing parameters for SFP management

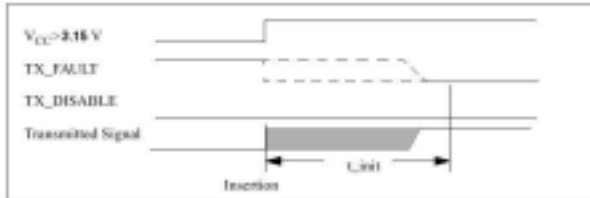
Parameter	Symbol	Min.	Max.	Unit	Unit Conditions
TX_DISABLE Assert time	t_off		10	μsec	Time from rising edge of TX_DISABLE to when the optical output falls below 10% of nominal
TX_DISABLE Negate time	t_on		1	msec	Time from falling edge of TX_DISABLE to when the modulated optical output rises above 90% of nominal
Time to initialize, including reset of TX_FAULT	t_init		300	msec	From power on or negation of TX_Fault using TX Disable.
TX_FAULT Assert time	t_fault		100	μsec	Time from fault to TX Fault on
TX_DISABLE to reset	t_rest	10		μsec	Time TX Disable must be held high to reset TX Fault
LOS Assert Time	t_loss_on		100	μsec	Time from LOS state to Rx LOS assert
LOS Deassert Time	t_loss_off		100	μsec	Time from non-LOS state to Rx LOS deassert
Rate-Select Change Time	t_ratesel		10	μsec	Time from rising or falling edge of Rate Select input until receiver bandwidth is in conformance with appropriate specification.
Serial ID Clock Rate	f_serial_clock		100	kHz	



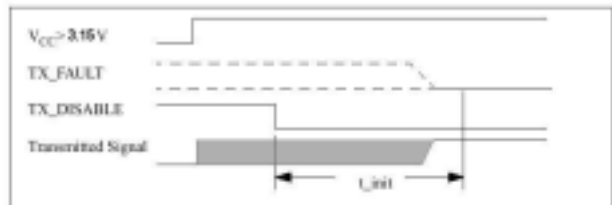
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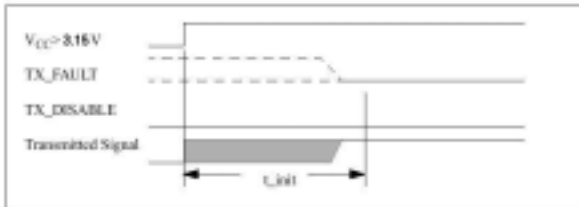
SFP timing parameters :



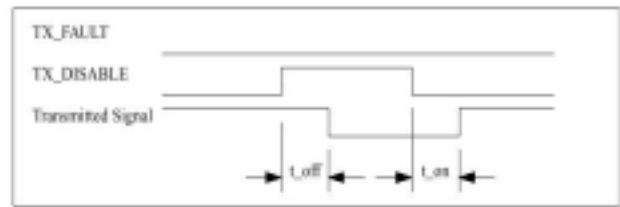
Power on initialization of SFP, TX_DISABLE negated



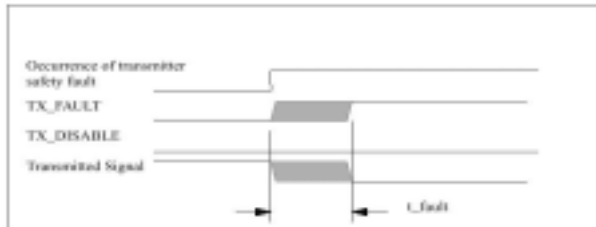
Power on initialization of SFP, TX_DISABLE asserted



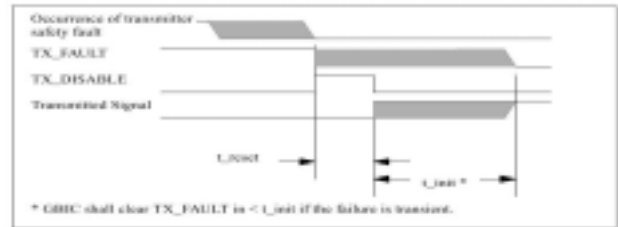
Example of initialization during hot plugging, TX_DISABLE negated



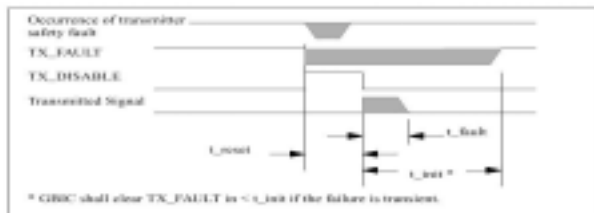
Management of SFP during normal operation, TX_DISABLE implemented



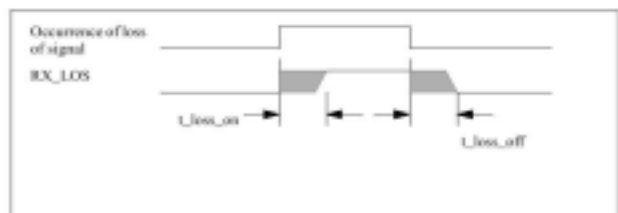
Detection of transmitter safety fault condition



Successful recovery from transient safety fault condition



Unsuccessful recovery from safety fault condition



Timing of RX_LOS detection



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Serial ID Identification

A SFP having module definition 4 provides access to sophisticated identification information that describe the SFP's capabilities, standard interfaces, manufacturer, and other information. The serial interface uses the 2-wire serial CMOS E 2 PROM protocol defined for the SEIKO S-24C 01A/02/04 family of components (see 5.2.1). The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

Data Address	Field Size (Bytes)	Name of field	Description of field
BASE OF FIELDS			
0	1	Identifier	Type of serial transceiver (see table D.2)
1	1	Ext. Identifier	Extended identifier of type of serial transceiver
2	1	Connector	Code for connector type (see table D.3)
3-10	8	Transceiver	Code for electronic compatibility or optical compatibility (see table D.4)
11	1	Encoding	Code for serial encoding algorithm (see table D.5)
12	1	BR, Nominal	Nominal bit rate, units of 100 MBits/sec.
13-14	2	Reserved	
15	1	Length (9μ)	Link length supported for 9/125 mm fiber, units of 100 m
16	1	Length (50μ)	Link length supported for 50/125 mm fiber, units of 10 m
17	1	Length (62.5μ)	Link length supported for 62.5/125 mm fiber, units of 10 m
18	1	Length (Copper)	Link length supported for copper, units of meters
19	1	Reserved	
20-35	16	Vendor name	SFP vendor name (ASCII)
36	1	Reserved	
37-39	3	Vendor OUI	SFP vendor IEEE company ID
40-55	16	Vendor PN	Part number provided by GBIC vendor (ASCII)
56-59	4	Vendor rev	Revision level for part number provided by vendor (ASCII)
60-62	3	Reserved	
63	1	CC BASE	Check code for Base ID Fields (addresses 0 to 62)
EXTENDED ID FIELDS			
64-65	2	Options	Indicates which optional SFP signals are implemented (see table D.7)
66	1	BR, max	Upper bit rate margin, units of %
67	1	BR, min	Lower bit rate margin, units of %
68-83	16	Vendor SN	Serial number provided by vendor (ASCII)
84-91	8	Date code	Vendor's manufacturing date code (see table D.8)
92-94	3	Reserved	
95	1	CC EXT	Check code for the Extended ID Fields (addresses 64 to 94)
VENDOR SPECIFIC ID FIELDS			
96-127	32	Read-only	Vendor specific data, read only
128-511	384	Reserved	
512-n			Vendor specific

Table D.1 : Serial ID Data Field

Identifier

The identifier value specifies the physical device described by the serial information. This value shall be included in the serial data. The defined identifier values are shown in **table D.2**.

Value	Description of physical device
00h	Unknow or unspecified
01h	GBIC
02h	Module/connector soldered to motherboard
03h	SFP transceiver
03-7Fh	Reserved
80-FFh	Vendor specific

Table D.2 : Identifier values

Extended Identifier

The field should be set to 04h for all SFP modules indicating serial ID module definition.

Connector

The connector value indicates the external connector provided on the interface. This value shall be included in the serial data. The defined connector values are Shown in **Table D.3** note that 01h-05h are not SFP compatible, and are included For compatibility with GBIC standards.

Value	Description of Connector
00h	Unknown or unspecified.
01h	sc
02h	Fibre channel Style 1 copper connector
03h	Fibre channel Style 2 copper connector
04h	BNC/TNC
05h	Fibre channel coaxial headers
06h	Fiber Jack
07h	LC
08h	MTRJ
09h	MU
0Ah	SG
0Bh	Optical Pigtail
0C-1Fh	Reserved
20h	HSSDCII
21h	Copper Pigtail
22h-7Fh	Reserved
80-FFh	Vendor specific

Table D.3 : Connector values



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Transceiver

The following bit significant indicators define the electronic or optical interfaces that are supported by the SFP Transceiver. At least one bit shall be set in this field. For Fibre Channel SFPs, the Fibre Channel speed, transmission media, transmitter technology, and distance capability shall all be indicated. The defined transceiver values are shown in **table D.4**.

Data Addr	Bit	Description of transceiver	Data Addr	Bit	Description of transceiver
Reserved Standard Compliance Codes			Fibre Channel link length		
3	7-0	Reserved	7	7	very long distance (L)
4	7-4	Reserved	7	6	short distance (S)
SONET Compliance Codes			7	5	intermediate distance (I)
4	3	Reserved	7	4	long distance (L)
4	2	OC 48, long reach	Fibre Channel transmitter technology		
4	1	OC 48, intermediate reach	7	3-2	Reserved
4	0	OC 48 short reach	7	1	Longwave laser (LC)
5	7	Reserved	7	0	Electrical inter-enclosure (EL)
5	6	OC 12, single mode long reach	8	7	Electrical intra-enclosure (EL)
5	5	OC 12, single mode intermediate reach	8	6	Shortwave laser w/o OFC (SN)
5	4	OC 12 multi-mode short reach	8	5	Shortwave laser w/ OFC (SL)
5	3	Reserved	8	4	Longwave laser(LL)
5	2	OC 3, single mode long reach	8	0-3	Reserved
5	1	OC 3, single mode intermediate reach			
5	0	OC 3, multi-mode short reach	Fibre Channel transmission media		
			9	7	Twin Axial Pair (TW)
			9	6	Shielded Twisted Pair (TP)
			9	5	Miniature Coax (MI)
Gigabit Ethernet Compliance Codes			9	4	Video Coax (TV)
6	7-4	Reserved	9	3	Multi-mode, 62.5 μ (M6)
6	3	1000BASE-T 8 0-3 Reserved	9	2	Multi-mode, 50 μ (M5)
6	2	1000BASE-CX	9	1	Reserved
6	1	1000BASE-LX	9	0	Single Mode (SM)
6	0	1000BASE-SX			
			Fibre Channel speed		
			10	7-5	Reserved
			10	4	400 MBytes/Sec
			10	3	Reserved
			10	2	200 MBytes./Sec
			10	1	Reserved
			10	0	100 MBytes./Sec

a. Bit 7 is the high order bit and is transmitted first in each byte.

Table D.4: Transceiver codes



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Encoding

The encoding value indicates the serial encoding mechanism that is the normal design target of the particular SFP transceiver. The value shall be contained in the serial data. The defined Encoding Values are shown in Table D.5.

Code	Description of encoding mechanism
00h	unspecified.
01h	8B10B
02h	4B5B
03h	NRZ
04h	Manchester
05h-FFh	Reserved

Table D.5: Encoding codes



DELTA ELECTRONICS, INC.

**LCP-2488A4ES Small Form Factor
Pluggable Transceiver for SONET
OC-48/SDH STM-16**

Regulatory Compliance

Test Item	Reference	Qty'	Evaluation
#1) Electromagnetic Interference EMI	FCC Class B	5	(1) Satisfied with electrical characteristics of product spec. (2) No physical damage
	EN 55022 Class B		
	CISPR 22		
#2) Immunity : Radio Frequency Electromagnetic Field	EN 61000-4-3	5	
	IEC 1000-4-3		
#3) Immunity : Electrostatic Discharge to the Duplex LC Receptacle	EN 61000-4-2	5	
	IEC 1000-4-2		
	IEC 801.2		
#4) Electrostatic Discharge to the Electrical Pins	MIL-STD-883C Method 3015.4	5	
	EIAJ#1988.3.2B Version 2, Machine model		

<p>DELTA ELECTRONICS, INC.</p>	TITLE			DATE:	
	LC-2488A4ES			18.10.2001	
	WRITTEN	CHECKED	APPROVED	DOCUMENT NO:	REV:
William.weng	Teddy.Kuo	YY.Tsai	S0		