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P1TX/RX4A-SX4 Interface Information & Reference Designs

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Omron	SX4 Reference Design	DOCUMENT NO. DOC00617	REV 2.4
		SHEET 1 OF 11	

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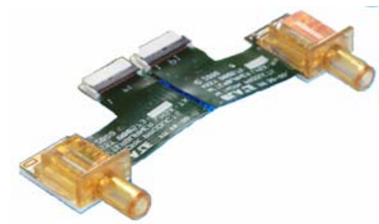
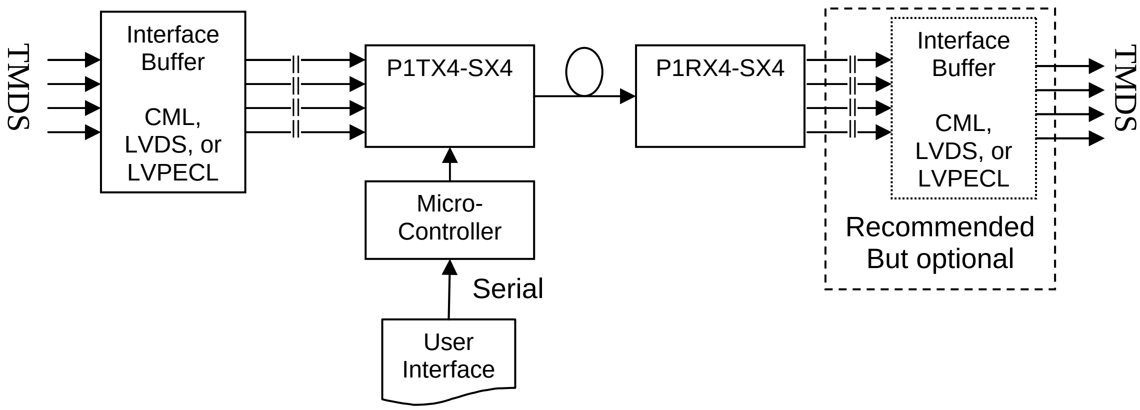


1.0 End of Life

The P1TX4A-SX4 and P1RX4A-SX4 will be replaced by the P1TX4C-SX4 and P1RX4C-SX4 in 2007. The new version will be compatible, via only change to the microcontroller code, with designs that adhere to Omron's reference design guidelines. This document only addresses the P1TX4A-SX4 and P1RX4A-SX4.

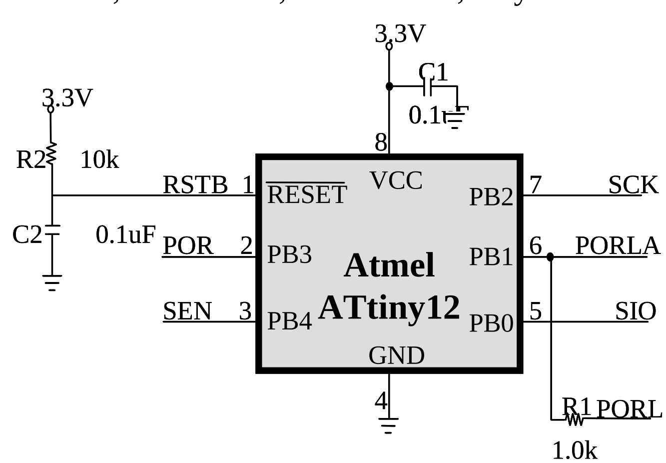
2.0 Block Diagram



The input to the P1TX4A-SX4-01 must be AC-coupled.
The output from the P1RX4A-SX4-01 is CML.

3.0 Microcontroller Circuit Design

Within the P1TX4A-SX4, the modulation current, bias current, rise/fall time, duty cycle and temperature compensation, etc. are all programmed through a microcontroller serial interface. Omron recommends the Atmel 8 bit ATtiny12V or ATtiny 13 microcontroller for use in interfacing with the SX4x-01 through the ZIF connector. Any equivalent microcontroller meeting the electrical and timing parameters of this microcontroller may be used.



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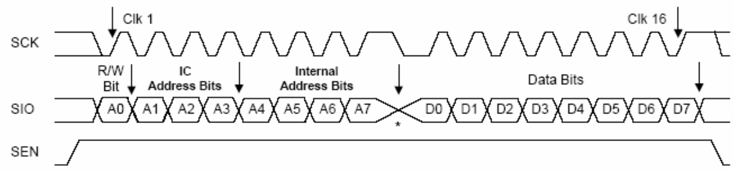
4.0 Microcontroller Interface

The P1TX4A-SX4 contains the AMCC S7022 laser driver that uses a three-line serial interface - serial clock (SCK), serial enable (SEN) and a bi-directional serial data input/output (SIO) - to enable the microcontroller to read/write to internal data registers. The serial clock signal is used as a reference for clocking data into and out of the serial input/output pin. The serial enable SEN enables the SCK and SIO signals. Data transfers can only occur when the serial enable line is asserted. Data present on the serial data input/output pin is latched into a serial shift register on the rising edge of SCK. A complete data transfer is comprised of a total of 16 bits. Each read or write operation requires a preamble of eight initial bits to be clocked into the serial interface, defined specifically for the SX4-Tx-01 as follows:



Function	Register Number	Address BIt				IC Address			R/W
		A7	A6	A5	A4	A3	A2	A1	A0
Laser Bias Output Current	1	0	0	0	0	1	1	1	
Laser Modulation Output Current	2	0	0	0	1	1	1	1	
Laser Modulation Current Temp coef.	3	0	0	1	0	1	1	1	
Wave Control Register 1	4	0	0	1	1	1	1	1	
Wave Control Register 2	5	0	1	0	0	1	1	1	
Wave Control Register 3	6	0	1	1	0	1	1	1	
Wave Control Register 4	7	0	1	1	1	1	1	1	
Status and Control Register	8	0	1	0	1	1	1	1	

Then, eight more bits are clocked into or out of the S7022 after the address bits. These bits contain the register data information, defined specifically for the SX4-Tx-01 as follows:

Function	Register Number	Bit							
		D7	D6	D5	D4	D3	D2	D1	D0
Laser Bias Output Current	1	0	0	I_{bias} (Section 4.0)					
Laser Modulation Output Current	2	0	0	I_{mod} (Section 4.0)					
Laser Modulation Current Tempco	3	0	0	0	1	1	0	0	0
Wave Control Register 1	4	0	0	0	0	1	1	1	1
Wave Control Register 2	5	0	0	0	1	0	0	0	0
Wave Control Register 3	6	1	1	1	1	1	1	1	1
Wave Control Register 4	7	1	1	1	1	1	1	1	1
Status and Control Register	8	1	0	0	1	1	1	1	1

4.1 Software

To assist you in programming your microcontroller to work with Omron's OSAs, Omron can provide (upon written request) two pre-written, ready-to-load software files. The first file (s7022_tiny12.hex) is the flash file and the second file (s7022_initial_eeprom.eep) is the initial eeprom file. The initial Bias and Modulation currents in these files are set to the following values:

Bias 3.02mA → 00001011 (In Eeprom Register 40 (decimal) or 00101000 (binary))
Mod 3.15mA → 00000111 (In Eeprom Register 41 (decimal) or 00101001 (binary))

4.2 Fuse Bits

You will also need to set the following Fuse bits:

For the ATtiny13				For the ATtiny12		
Fuse Bit	Value	State		Fuse Bit	Value	State
CKSEL0	0	default		CKSEL0	0	default
CKSEL1	1	default		CKSEL1	1	default
SUT0	0	default		CKSEL2	0	default
SUT1	1	default		CKSEL3	0	programmed
CKDIV8	0	default		RSTDISBL	1	default
WDTON	1	default		BODEN	0	programmed
EESAVE	1	default		BODLEVEL	0	default
RSTDISL	1	default		SPIEN	0	default
BODLEVEL0	1	default				
BODLEVEL1	0	programmed				
DWEN	1	default				
SELFPRGEN	1	default				

5.0 I_{bias} and I_{mod} Settings

The bias current (I_{bias}) and modulation current (I_{mod}) are parameters that must be set at that start of operation in order for the lasers to function. I_{bias} sets the drive current to ensure that it remains above the threshold current[1], yet is not so high as to reduce the transmission eye. I_{mod} sets the maximum AC signal that modulates

[1] Threshold Current: minimum current required for emission of light

the lasers during transmission. Because of normal variations in laser characteristics, the I_{bias} and I_{mod} setting will vary from one TOSA to the next (each P1TX4-SX4 is shipped with documentation showing its optical I_{bias} and I_{mod}). As such, Omron strongly recommends that any system using the P1TX4-SX4 should be designed to allow access to the microcontroller, and the ability to enter specific the codes for registers 1 and 2 to match the appropriate setting.

The I_{bias} and I_{mod} settings are 6-bit variables determined by converting the value (with each unit shipped) into a bit code per the table:

Ibias	Imod	D5	D4	D3	D2	D1	D0
1.95	2.05	0	0	0	0	0	0
2.05	2.21	0	0	0	0	0	1
2.14	2.36	0	0	0	0	1	0
2.24	2.52	0	0	0	0	1	1
2.34	2.68	0	0	0	1	0	0
2.44	2.84	0	0	0	1	0	1
2.53	2.99	0	0	0	1	1	0
2.63	3.15	0	0	0	1	1	1
2.73	3.31	0	0	1	0	0	0
2.83	3.47	0	0	1	0	0	1
2.92	3.62	0	0	1	0	1	0
3.02	3.78	0	0	1	0	1	1
3.12	3.94	0	0	1	1	0	0
3.22	4.10	0	0	1	1	0	1
3.31	4.25	0	0	1	1	1	0
3.41	4.41	0	0	1	1	1	1
3.51	4.57	0	1	0	0	0	0
3.61	4.73	0	1	0	0	0	1
3.70	4.88	0	1	0	0	1	0
3.80	5.04	0	1	0	0	1	1
3.90	5.20	0	1	0	1	0	0
4.00	5.36	0	1	0	1	0	1
4.09	5.51	0	1	0	1	1	0
4.19	5.67	0	1	0	1	1	1
4.29	5.83	0	1	1	0	0	0
4.39	5.99	0	1	1	0	0	1
4.48	6.14	0	1	1	0	1	0
4.58	6.30	0	1	1	0	1	1
4.68	6.46	0	1	1	1	0	0
4.78	6.62	0	1	1	1	0	1
4.87	6.77	0	1	1	1	1	0
4.97	6.93	0	1	1	1	1	1

Ibias	Imod	D5	D4	D3	D2	D1	D0
5.07	7.09	1	0	0	0	0	0
5.17	7.25	1	0	0	0	0	1
5.26	7.40	1	0	0	0	1	0
5.36	7.56	1	0	0	0	1	1
5.46	7.72	1	0	0	1	0	0
5.56	7.88	1	0	0	1	0	1
5.65	8.03	1	0	0	1	1	0
5.75	8.19	1	0	0	1	1	1
5.85	8.35	1	0	1	0	0	0
5.95	8.51	1	0	1	0	0	1
6.04	8.66	1	0	1	0	1	0
6.14	8.82	1	0	1	0	1	1
6.24	8.98	1	0	1	1	0	0
6.34	9.14	1	0	1	1	0	1
6.43	9.29	1	0	1	1	1	0
6.53	9.45	1	0	1	1	1	1
6.63	9.61	1	1	0	0	0	0
6.73	9.77	1	1	0	0	0	1
6.82	9.92	1	1	0	0	1	0
6.92	10.08	1	1	0	0	1	1
7.02	10.24	1	1	0	1	0	0
7.12	10.40	1	1	0	1	0	1
7.21	10.55	1	1	0	1	1	0
7.31	10.71	1	1	0	1	1	1
7.41	10.87	1	1	1	0	0	0
7.51	11.03	1	1	1	0	0	1
7.60	11.18	1	1	1	0	1	0
7.70	11.34	1	1	1	0	1	1
7.80	11.50	1	1	1	1	0	0
7.90	11.66	1	1	1	1	0	1
7.99	11.81	1	1	1	1	1	0
8.09	11.97	1	1	1	1	1	1

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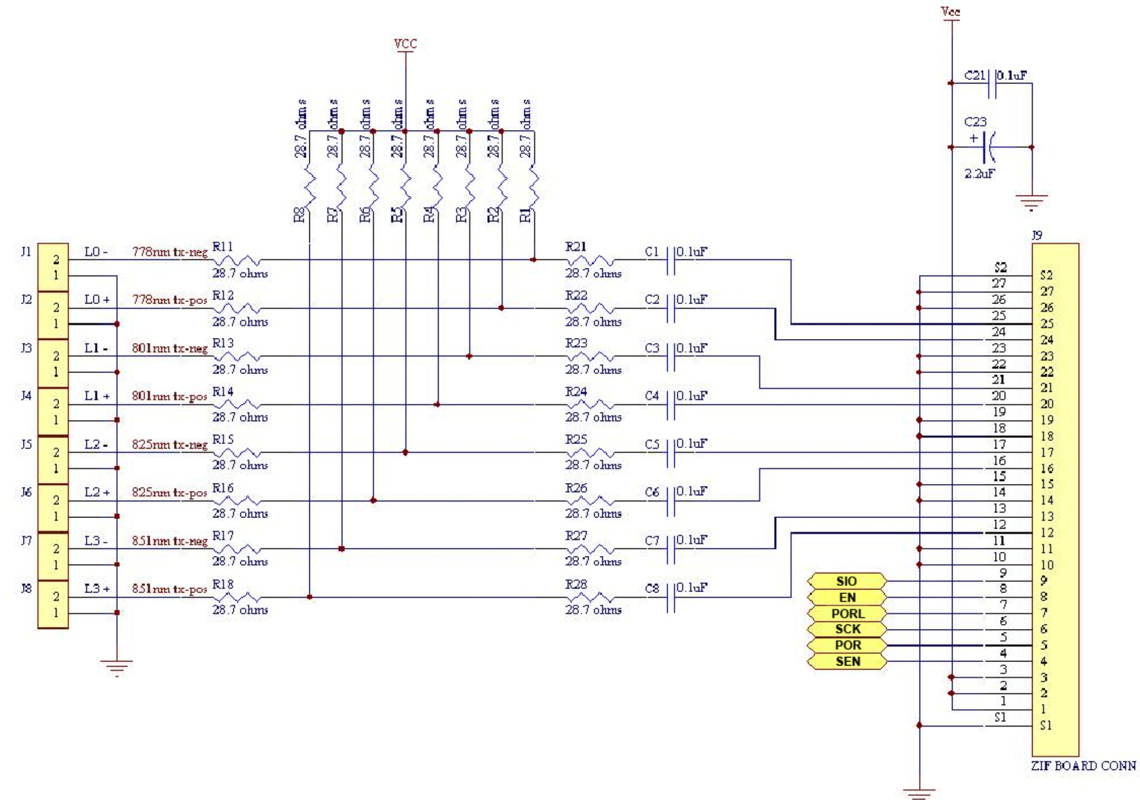
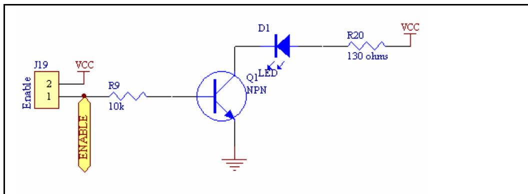
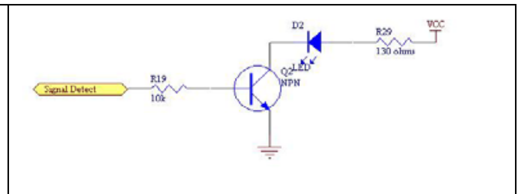
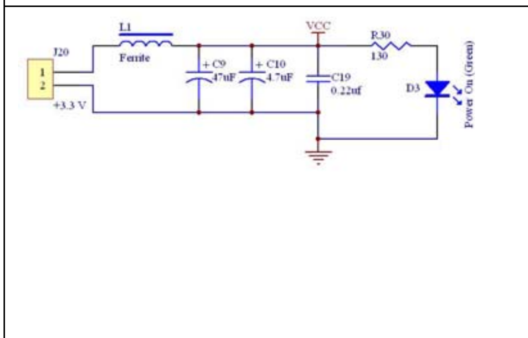
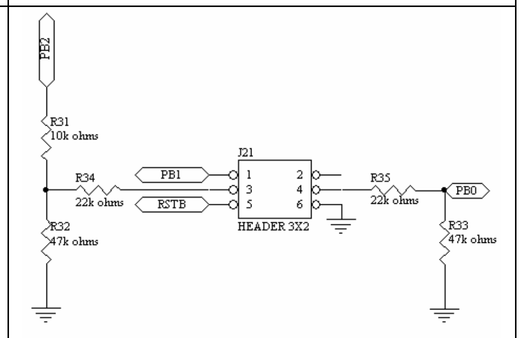
6.0 Reference Design for TOSA Input Circuit

The enclosed schematics are provided as a reference design for creating an input circuit to the P1TX4A-SX4-01. **Omron highly recommends including all coupling capacitors. Excluding the coupling capacitors will jeopardize interoperability with future revisions of this product.**



Input	R1 - R8	R11 - R18	R21 - R28	C1 - C8
LVDS	Open	Short	Short	0.1µF
LVPECL	Open	Short	Short	0.1µF
CML	Open	Short	Short	0.1µF
TMDS[2]	28.7Ω	28.7Ω	28.7Ω	0.1µF

[2] Implementing this resistive network for TMDS will cause a 50% reduction in voltage delivered to the P1TX4C-SX4-01. Designers must ensure that regardless of the input circuit chosen, the minimum specified Differential Input Voltage (section 5 of the P1TX4A-SX4x-01 Datasheet) is achieved. A TMDS buffer chip can be installed as an alternative, which will not reduce the voltage.

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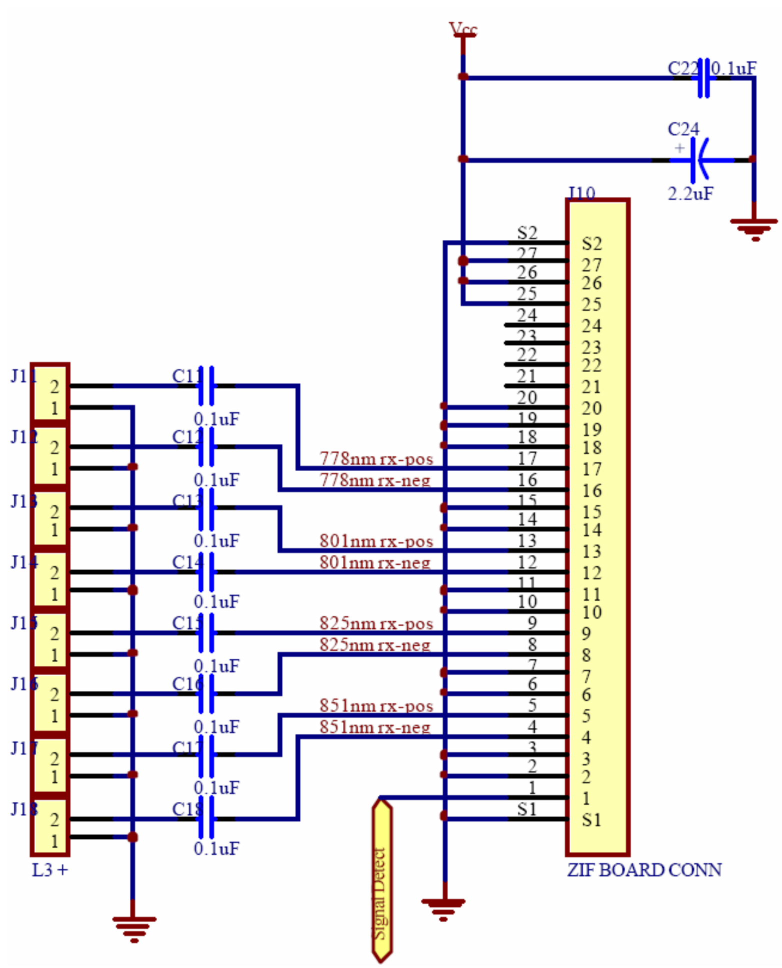
7.0 Reference Design for ROSA Output Circuit

Output	C11 - C18
LVDS	0.1µF
LVPECL	0.1µF
CML	Short
TMDS	Short



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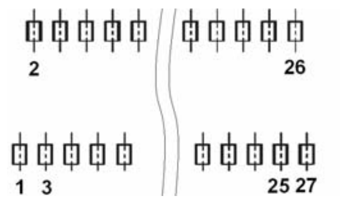
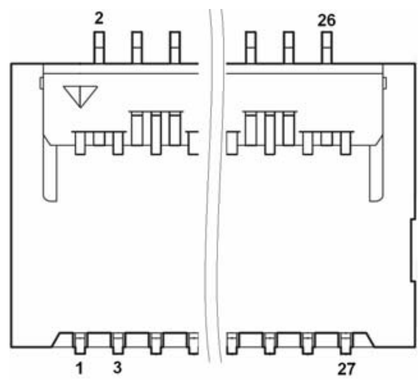
8.0 Using the Omron Connector

The following pin map can be used to assist when designing-in the Omron flex connector to be used with the Omron ROSA or TOSA. For description of pins, see the OSA data sheet.

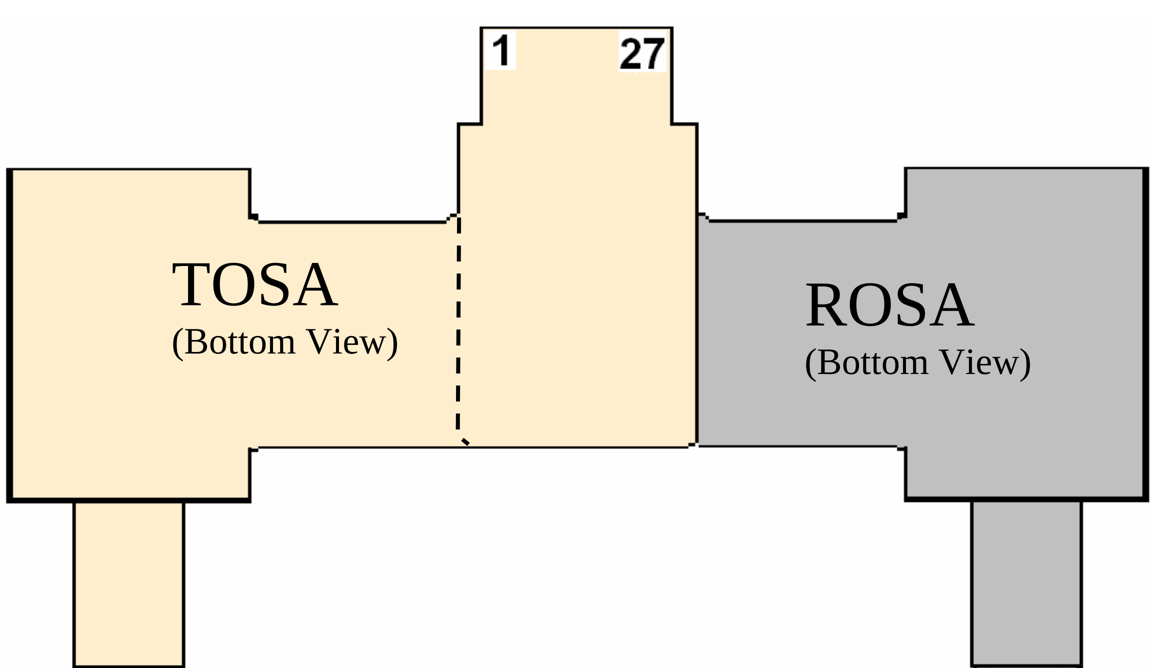
Mating Board Pads
(Top View)



ZIF
(Top View)



(Not to Scale)

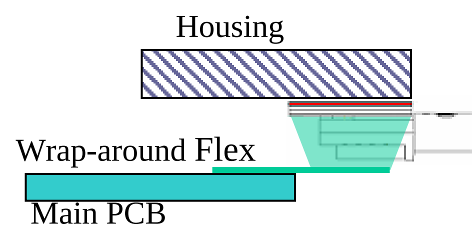


9.0 Mounting Configurations

Heat-sinking is critical to the life of the OSA, particularly the lasers. The OSA should be mounted upside down and in direct contact with a thermally conductive surface. The preferable surface is the main product's external metal housing, enabling heat transfer through the top of the product to the ambient environment. The two recommended configurations are:

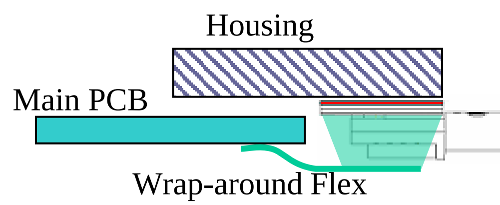
9.1 Top Connect

For those with space available on the CDR board, the flex can be connected to the top of the main CDR board via a ZIF connector (e.g. Omron P/N XF2B-2745-31A).



9.2 Bottom-connect

For those with space constraints, the flex circuit can be connected to the bottom of the main board via the ZIF connector.



One of the unique benefits of the SX4 is that the ferrule is integrated into the OSA, eliminating the cost and complexity of a fiber pigtail and a connector sleeve. To optimize use of this feature, the OSA can be held in place by its wings and the ferrule via a clip, (example shown). By applying upward pressure to the bottom of the clip, the OSA will remain adequately seated for heat-sinking but still *float* to relieve any mechanically induced stress when the fiber is connected. In such a configuration, stress from the fiber (e.g. wiggle) will be transferred to the wing and the product housing, not the optical elements. We also strongly recommended placing a thermal pad (shown in red above) between the OSA and the heat-sink.