

## PROLABS – AJ715A-C

4GBd SFP (Small Form Pluggable) Short Wavelength (850nm) Transceiver

### AJ715A-C Overview

ProLabs's AJ715A-C SFP optical transceivers are compatible with Fiber Channel as defined in FC-PI-2 Rev7, and provide a quick and reliable interface for the 4FC/2FC/FC application. The Digital diagnostics functions are available via 2-wire serial bus specified in the SFP MSA. In addition, they comply with the Small Form Factor Pluggable Multi Sourcing Agreement (MSA) and SFF-8472.

### Product Features

- Up to 4.25 GBd bi-directional data links
- Compliant with Fiber Channel, 2X Fiber Channel and 4X Fiber Channel
- Compliant with SFP MSA
- Hot-pluggable SFP footprint
- 850nm VCSEL laser transmitter
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 500m on 50/125um MMF
- Up to 300m on 62.5/125um MMF
- Single power supply 3.3V
- RoHS Compliance
- Class 1 laser product complies with EN 60825-1
- Operating temperature range: 0°C to 70°C.

### Applications

- 1.25 GBd Gigabit Ethernet (Rate Selectable Version)
- 1.063 GBd Fiber Channel
- 2.125 GBd Fiber Channel
- 4.25 GBd Fiber Channel

### Ordering Information

Part Number	Description
AJ715A-C	4FC/2FC/FC SFP 850nm LC Connectors 500m on MMF, with DOM function.

### General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR		1.062		GBd	Fiber Channel
			2.125			2X Fiber Channel
			4.25			4X Fiber Channel
Bit Error Rate	BER		$10^{-12}$			
Operating Temperature	$T_{OP}$	0		70	°C	Case temperature
Storage Temperature	$T_{STO}$	- 40		85	°C	Ambient temperature
Supply Current	$I_S$		180	240	mA	For electrical power interface
Input Voltage	$V_{CC}$	3	3.3	3.6	V	
Maximum Voltage	$V_{MAX}$	- 0.5		4	V	For electrical power interface

## Optical Characteristics – Transmitter

$V_{CC}=3V$  to  $3.6V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power 50/125um fiber, NA=0.2 62.5/125um fiber, NA=0.275	$P_{TX}$	- 9		- 2.5	dBm	Class 1 Product
Optical Center Wavelength	$\lambda_C$	830		860	nm	
Optical Amplitude(<=2.125G) Modulation	OMA	190			uW	Equivalent extinction ratio specification for FC
Optical Amplitude(4.25GBd) Modulation	OMA	250			uW	Equivalent extinction ratio specification for FC
Spectral Width (RMS)	$\Delta\lambda$			0.85	nm	
Optical Rise/Fall Time (<=2.125G)	$T_{RF\_IN}$		100	150	ps	
Optical Rise/Fall Time (4.25G)	$T_{RF\_IN}$			90	ps	
Relative Intensity Noise	RIN			- 120	dB/Hz	
Deterministic Jitter Contribution(4.25G)	$TX\_ \Delta DJ$			30	ps	
Total Jitter Contribution(4.25G)	$TX\_ \Delta TJ$			60	ps	

## Optical Characteristics – Receiver

$V_{CC}=3V$  to  $3.6V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Receiver Power	$P_{RX}$			0	dBm	Average
Optical Center Wavelength	$\lambda_C$	770		860	nm	
Receiver Sensitivity @ 1.063GBd	$R_{X\_SEN1}$			- 20	dBm	BER < $10^{-12}$ w /
Receiver Sensitivity @ 2.125GBd	$R_{X\_SEN3}$			- 18	dBm	PRBS $2^7-1$ test
Receiver Sensitivity @ 4.25GBd	$R_{X\_SEN4}$			- 15	dBm	pattern
Optical Return Loss	ORL	12			dB	
Receiver Electrical 3dB Upper cutoff frequency				1500	MHz	
Loss of Signal-Asserted	$P_{LOS\_A}$	- 30			dBm	
Loss of Signal-Deasserted	$P_{LOS\_D}$			- 20	dBm	
Loss of Signal-Hysteresis		0.5			dB	

## Electrical Characteristics – Transmitter

$V_{CC}=3V$  to  $3.6V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	$R_{IN}$		100		$\Omega$	Non condensing
Single ended data input swing	$V_{IN\_PP}$	250		1200	mV	
Transmit disable voltage	$V_D$	2		$V_{CC}$	V	
Transmit enable voltage	$V_{EN}$	$V_{EE}$		$V_{EE}+0.8$	V	

## Electrical Characteristics – Receiver

$V_{CC}=3V$  to  $3.6V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Single ended data output swing	$V_{OUT\_PP}$	250	450	550	mV	
Data output rise time (20%-80%)	$T_R$		90	175	ps	
Data output fall time (20%-80%)	$T_F$		90	175	ps	
LOS Fault	$V_{LOS\_Fault}$	2		$V_{CC\_HO\_ST}$	V	
LOS Normal	$V_{LOS\_normal}$	$V_{EE}$		$V_{EE}+0.5$	V	

## Digital Diagnostic Functions

AJ715A-C support the 2-wire serial communication protocol as defined in the SFP MSA. Digital diagnostic information are accessible over the 2-wire interface at the address 0xA2. Digital Diagnostics for AJ715A-C are internally calibrated by default. A micro controller unit inside the transceiver gathers the monitoring information and reports the status of transceiver.

**Transceiver Temperature**, internally measured, represented as a 16 bit signed twos complement value in increments of 1/256 degrees Celsius, Temperature accuracy is better than  $\pm 3$  degrees Celsius over specified operating temperature and voltage.

**Transceiver Supply Power**, internally measured, represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100  $\mu$ Volt, yielding a total range of 0 to +6.55 Volts.

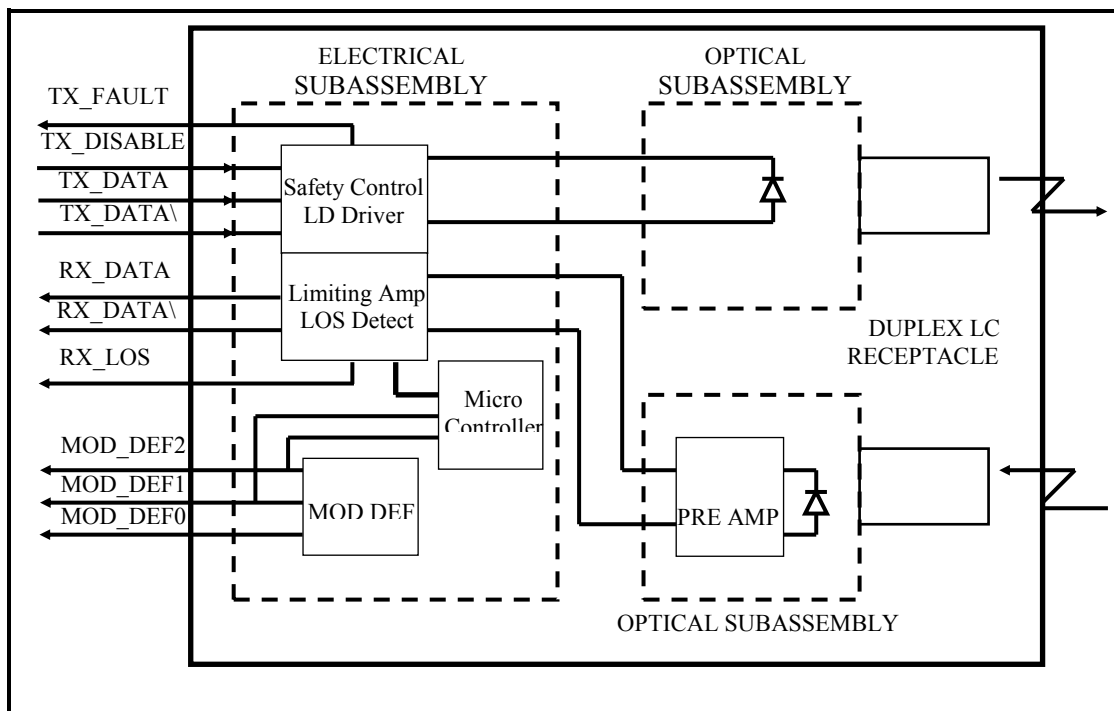
**Transceiver TX bias current**, internally measured, represented as a 16 bit unsigned integer with the current defined as the full 16 bit value (0 – 65535) with LSB equal to 2  $\mu$ A, yielding a total range of 0 to 131mA. Accuracy is better than  $\pm 10\%$  over specified operating temperature and voltage.

**Transceiver TX output power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit value (0 – 65535) with LSB equal to 0.1  $\mu$ W. Data is assumed to be based on measurement of laser monitor photodiode current. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage. Data is not valid when the transmitter is disabled.

**Transceiver RX received optical power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit 35 value (0 – 65535) with LSB equal to 0.1  $\mu$ W. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage.

<i>Parameter</i>	<i>Symbol</i>	<i>Accuracy</i>	<i>Units</i>	<i>Report Range</i>	<i>Unit</i>	<i>Remarks</i>
<i>Internal Calibration</i>						
Temperature	T <sub>MON</sub>	±3	°C	– 40	95	°C
Voltage	V <sub>MON</sub>	±0.1	V	2.7	3.9	V
Bias Current	I <sub>MON</sub>	±10	%	1	15	mA
Tx Power	P <sub>MON</sub>	±3	dB	– 12	1	dBm
Rx Power	P <sub>MON</sub>	±3	dB	– 20	1	dBm

## Block Diagram of Transceiver



### Transmitter Section

The VCSEL driver accept differential input data and provide bias and modulation currents for driving a laser. An automatic power-control (APC) feedback loop is incorporated to maintain a constant average optical power. 850 nm VCSEL in an eye safe optical subassembly (OSA) mates to the fiber cable.

### TX\_DISABLE

The TX\_DISABLE signal is high (TTL logic "1") to turn off the laser output. The laser will turn on within 1ms when TX\_DISABLE is low (TTL logic "0").

### TX\_FAULT

When the TX\_FAULT signal is high, output indicates a laser fault of some kind. Low indicates normal operation.

### Receiver Section

The receiver utilizes a PIN detector integrated with a trans-impedance preamplifier in an OSA. This OSA is connected to a Limiting Amplifier which providing post-amplification quantization, and optical signal detection. The limiting Amplifier is AC-coupled to the transimpedance amplifier, with internal 100Ω differential termination.

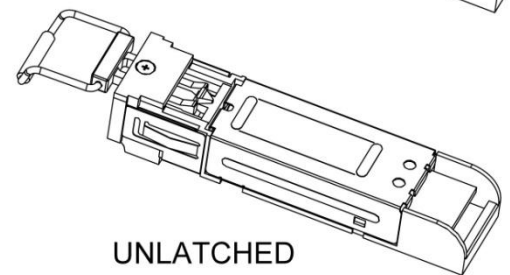
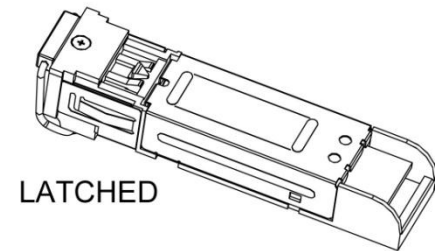
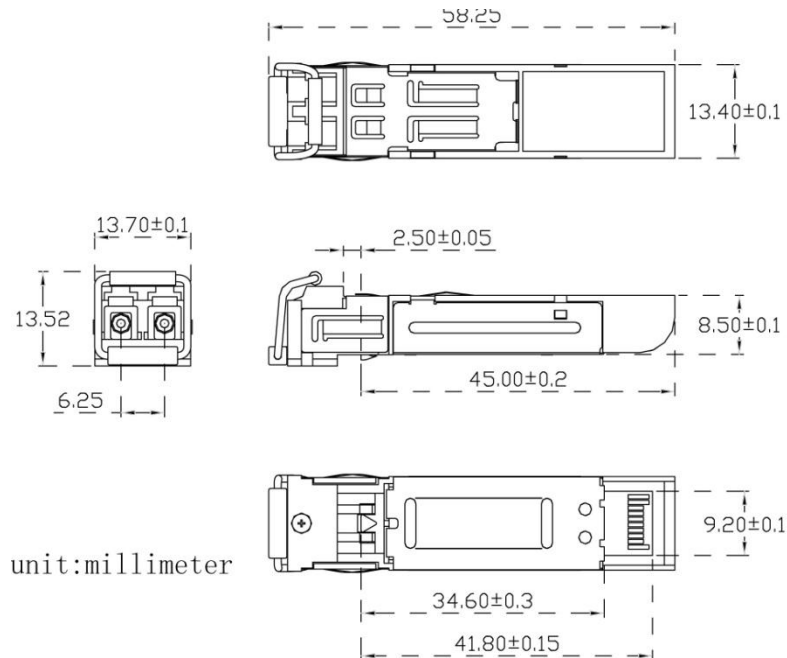
### Receive Loss (RX\_LOS)

The RX\_LOS is high (logic "1") when there is no incoming light from the companion transceiver. This signal is normally used by the system for the diagnostic purpose. The signal is operated in TTL level.

### Controller Section

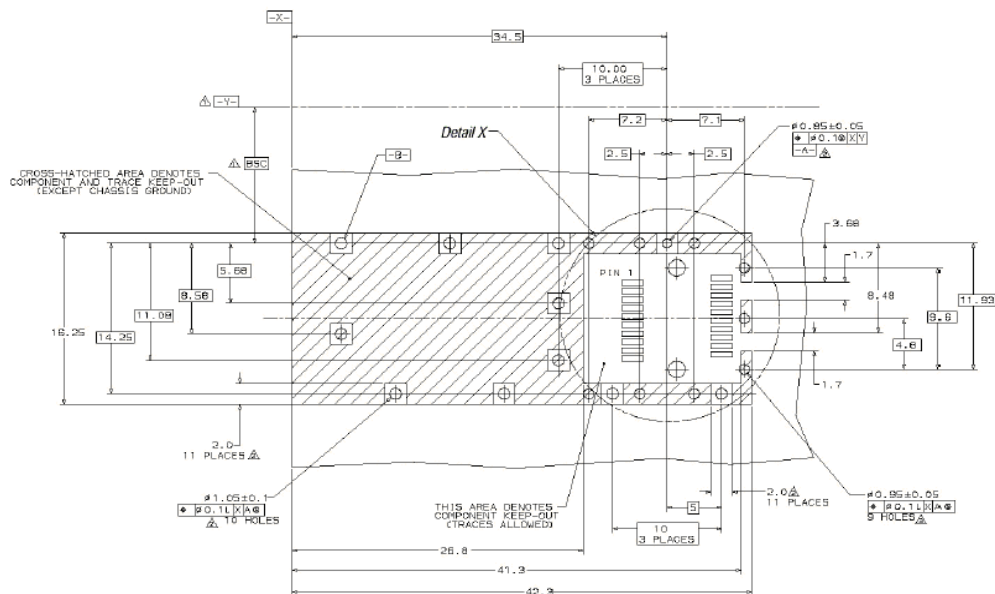
The micro controller unit monitors the operation information of LD driver and Limiting Amplifier. And report these status to the customer.

## Dimensions



**ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED**  
**UNIT: mm**

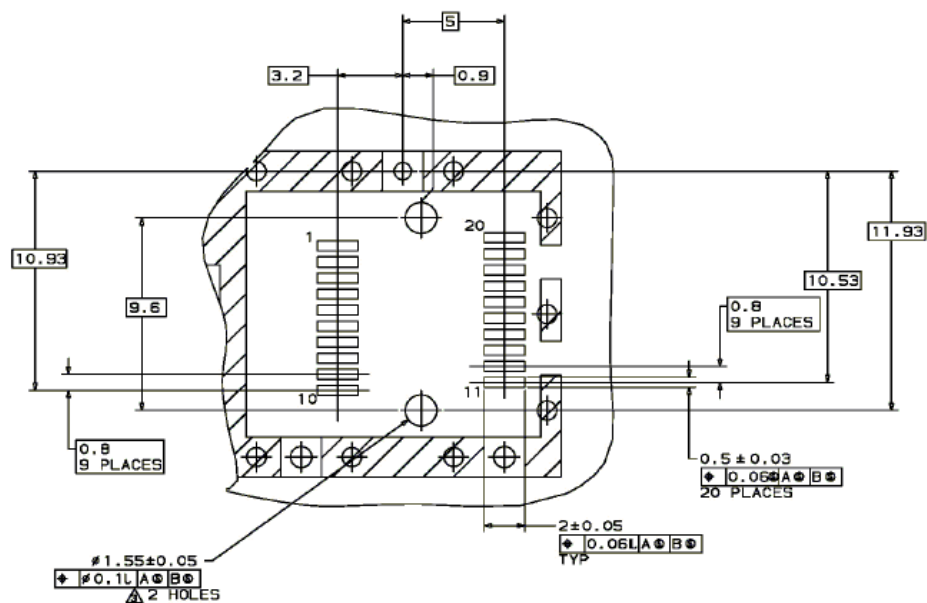
## PCB Layout Recommendation



Datum and Basic Dimension Established by Customer

 Rads and Vias are Chassis Ground, 11 Places

 Through Holes are Unplated







## Pin Assignment

PIN #	Symbol	Description	Remarks
1	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	Circuit ground is isolated from chassis ground
2	T <sub>FAULT</sub>	Transmitter Fault. Not supported	
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disable on high or open	Disabled: T <sub>DIS</sub> >2V or open Enabled: T <sub>DIS</sub> <0.8V
4	MOD_DEF (2)	Module Definition 2. Data line for serial ID	Should Be pulled up with 4.7k – 10k ohm on host board to a voltage between 2V and 3.6V
5	MOD_DEF (1)	Module Definition 1. Clock line for serial ID	
6	MOD_DEF (0)	Module Definition 0. Grounded within the module	
7	Rate Select	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	LOS is open collector output
9	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	Circuit ground is isolated from chassis ground
10	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	
11	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	
12	RD–	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	V <sub>EER</sub>	Receiver ground (common with transmitter ground)	Circuit ground is isolated from chassis ground
15	V <sub>CCR</sub>	Receiver power supply	
16	V <sub>CCT</sub>	Transmitter power supply	
17	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	Circuit ground is connected to chassis ground
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD–	Transmitter Inverted DATA in. AC coupled	
20	V <sub>EET</sub>	Transmitter ground (common with receiver ground)	Circuit ground is connected to chassis ground

## References

1. IEEE standard 802.3. IEEE Standard Department, 2005.
2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
3. Fiber Channel Draft Physical Interface Specification (FC-PI-2 Rev7.0).
4. Digital Diagnostics Monitoring Interface for Optical Transceivers – SFF-8472.