

Data Sheet



Description

The Avago Technologies QFBR-S01IN001Z is a versatile optical phase interrogation (OPI) unit based on Avago proprietary technology. The working principle is based on comparing a fixed frequency pulsed sinusoidal signal, transmitted into two optical fibers. One of these fibers is subjected to strain, the other one is the unstrained reference. This allows for the detection of the resulting optical phase shift, which correlates to strain. QFBR-S01IN001Z is modulating visible light at 650 nm.

QFBR-S01IN001Z is a stand-alone system intended for application integrators to start developing their application around the OPI technology. The system is optimized for, but not limited to, the use with polymer optical fiber (POF). The robustness of the POF makes the implementation on and in a variety of materials possible. To adjust the sensitivity and dynamics of the system to a specific application, different sensor designs can be created with a fiber.

An Ethernet interface allows communication over LAN and a full duplex communication protocol can be used to control the unit. A 4-20 mA industrial interface offers an alternative analog signal output.

Two additional I²C channels allow you to connect additional sensors in parallel to the OPI. This functionality further enhances the sensor's capability of calibrating to an existing measurement setup or expanding the experimental setup. This is an important feature in system design and evaluation. Two onboard temperature sensors with different resolutions allow for temperature compensation and an accelerometer for positional information.

Features

- RoHS-compliant
- Compliant with UL 61010-1:2012-05
- High sensitivity
- Visible (650 nm) LED technology
- Rugged design
- Integrated BIT (Built-In Test)
- Isolated digital input/outputs
- Isolated 4-20 mA industrial interface
- Ethernet (10/100 MB/s) interface
- Onboard data storage capability
- Remote software updates and maintenance

Applications

- Industrial monitoring solutions
- Structural health monitoring

Regulatory Compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) ^a	EN 61326-1:2013 (industrial requirements)	Min ±2000 V
Electromagnetic Radiation Disturbance ^b	EN 61326-1:2013 (industrial requirements)	30 MHz to 1 GHz
Mains Terminal Disturbance Voltage ^b	EN 61326-1:2013 (industrial requirements)	150 kHz to 30 MHz

a. Tested with basic standards IEC 61000-4-2:2008 and EN 61000-4-2:2009; according to Chapter 4.

b. Tested with basic standards IEC/CISPR 11:2009 + A1:2010(mod.) and EN 55011:2009 + A1:2010; according to Chapter 4.

QFBR-S01IN001Z complies with the requirements set forth in the Code of Federal Regulations CFR 47, Part 15, Sections 15.107 and 15.109 (Class A) of the Federal Communication Commission (FCC) and the Interference-Causing Equipment Standard ICES-003 Issue 5 (Information Technology Equipment (ITE) - Limits and methods of measurement), Sections 5(a)(i) and 5(b)(i), Class A of Industry Canada (IC). Tested with communication and electrical signal cable lengths below 30 m.

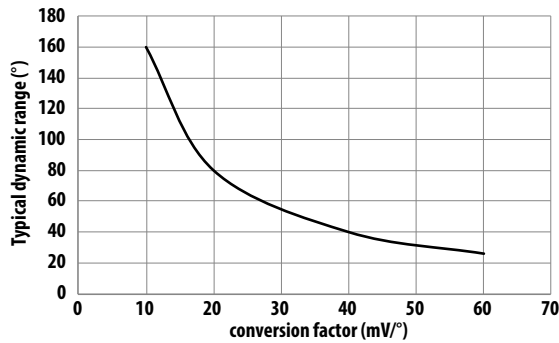
Specifications

All parameters tested under laboratory environment. Values valid for 25 °C, unless otherwise described.

Measurement	Typical Values	Notes
Sampling Rate	1 kHz	Software sampling rate up to 5 kHz. Data storage rate up to 120 data packet/second, limited by communication over Ethernet.
Optical Measurement Channels	1	—
Conversion Factor	10, 20, 40, 60 mV/°	4 sensitivity levels can be selected via software, default value is 20 mV/°.
Dynamic Range	160° to 26°	Depends on customizable conversion factor. See Figure 1 .
Resolution	0.1°	—
Repeatability	0.2°	Measured over 1 min. test interval.
Connectors		
Number of Optical Output Ports	2	One reference loop and one sensing loop.
Number of Optical Input Ports	2	One reference loop and one sensing loop.
Port Type	ST metal	—
Optical Cable		
Cable Type	Optical cable with core diameter >200 µm	OPI is optimized for Single Core SI-POF (QFBR-SUSX00Z).
Optical Power Budget per Optical Output Port	12 dB	With Single Core SI-POF (QFBR-SUSX00Z) about 63 m fiber length can be realized (typical fiber attenuation 0.19 dB/m).
Connector Type	ST	—
Data Communication		
Interface	Ethernet	10/100Base-T.
Mechanical		
Dimensions	166 mm × 80.8 mm × 50.8 mm	length × width × height.
Weight	470 g	—
Power		
Supply Voltage Range	37 VDC to 57 VDC	Power over Ethernet (PoE) is supported as well.
Power Consumption	6 W	Measured at supply voltage of 48 V.

Measurement	Typical Values	Notes
Environmental		
Environmental Protection	IP 40	Not certified.
Operating Temperature	-40 °C to +60 °C	Valid for non-condensing environmental condition.
Storage Temperature	-45 °C to +85 °C	—
Pollution Degree	2	—
Operating Altitude	up to 2000 m	—

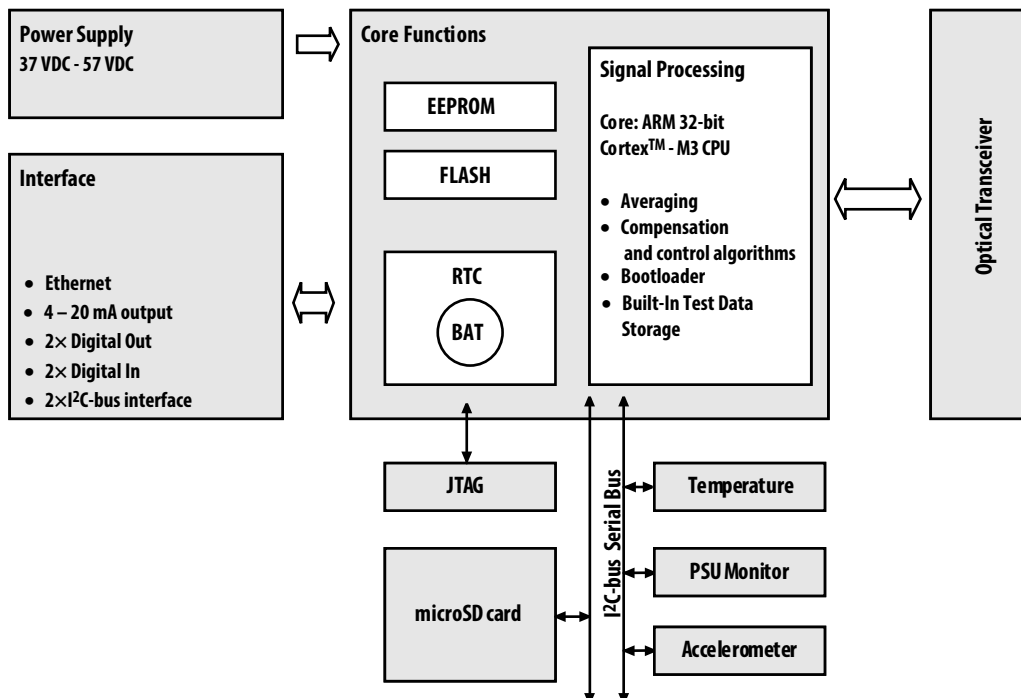
Figure 1 Typical Dynamic Range



Detailed Description

The OPI is the core element of the sensor system. The POF can be applied in different configurations, depending on the application environment.

Figure 2 Functional Blocks of Optical Phase Interrogator



Power Supply

The unit can be powered via the Ethernet interface (POE) or via the auxiliary connection on the Interface connector. The input voltage range is wide to be able to cater for various application scenarios.

POE (Power Over Ethernet)

The OPI complies with the 802.3at (Type 1) requirements for a PD (powered device). PoE provides both data and power connections in one cable, so equipment doesn't require a separate cable for each need. When multiple OPIs have to be implemented in a sensing solution, a POE enabled switch can be used. This configuration simplifies the installation requirements.

Interfaces

Various external interfaces are provided to the user to be able to control and monitor devices external to the OPI. Two input channels are provided to be able to directly monitor external switches or sensors. The two output channels provide the possibility to control external actuators. Two IIC channels are available for interfacing to various devices. These channels can be used to attach and monitor additional temperature sensors, strain gauge sensors.

The OPI provides a 4-20 mA current loop, which is a very robust sensor signaling standard. Current loops are ideal for signal transmission because of their inherent insensitivity to electrical noise. Typical rise and fall time of the 4-20 mA output is about 4 ms. Tested with an optical phase shift of 10° at 1 Hz, with 470 Ω placed between output pin A and B.

Core Functions

The unit is powered by an ARM 32-bit Cortex™-M3 CPU. The CPU handles all the control, communication, and data storage features. A microSD card provides data storage inside the unit. Setup and calibration values are saved in the internal EEPROM. Internal operational voltages, currents, and temperature can be inspected.

BIT (Built-in Test - Includes PSU Monitor)

The OPI unit has been designed with built-in test capability. The ability to request the health of a sensor remotely is a key feature to be able to ensure the correct operational state of the unit.

Additional Features

- Internal voltages

- Main currents
- Onboard temperature (converts temperature information from its onboard solid-state sensor)
- SD card
- Hardware version
- Software version

Accelerometer

The OPI implements an ultra low-power high performance three axes linear accelerometer. The device features ultra low-power operational modes that allow advanced power saving and smart sleep to wake-up functions.

The accelerometer has dynamically user selectable full scales of ±2g/±4g/±8g and it is capable of measuring accelerations with output data rates from 0.5 Hz to 400 Hz.

The self-test capability allows the user to check the functioning of the sensor in the final application. The device may be configured to generate interrupt signal by inertial wake-up/free-fall events as well as by the position of the device itself.

Optical Transceiver

The optical transceiver is a pluggable module inside the unit. The transceiver provides the necessary optical drive and detection function to be able to accurately determine the phase relationship between the measurement and reference channels.

Ethernet

The OPI internally implements a device server to manage the Ethernet communications.

Network Interface - Wired

Physical Layer	10/100Base-T
Data Rate	10/100Mbps (auto-sensing)
Mode	Full or half duplex (auto-sensing)
Connector	RJ-45
POE Power	802.3af (802.3at Type 1) compliant

RTC (Real Time Clock)

The real-time clock provides a set of continuously running counters that can be used with suitable software to provide a clock/calendar function. This feature is important for the time stamping of sampled data. This is a key feature in relating a recorded event back to a specific date and time.

Interfaces

Communications Interface

Figure 3 Communications Interface

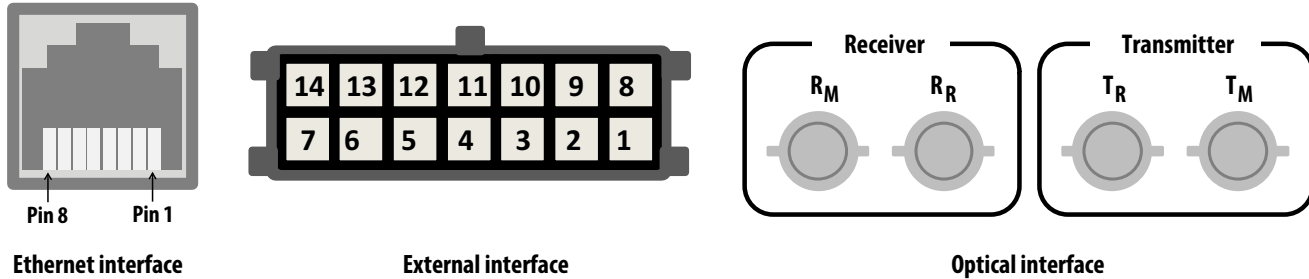


Table 1 Ethernet Interface Pin Assignments

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
TXD+	TXD-	RXD+	EPWR+	EPWR+	RXD-	EPWR-	EPWR-
Transmit Data+	Transmit Data-	Receive Data+	Power from Switch+	Power from Switch+	Receive Data-	Power from Switch-	Power from Switch-

External Interface

14-pin dual-row connector.

Table 2 Pin Definitions

Pin	Name	Description
1	Power In+	Power supply voltage range: 37 VDC to 57 VDC
2	GND_Ext	Ground connection (Isolated)
3	+5V_Ext	+5 V output for external use (100 mA maximum) (Isolated)
4	IO_IN_1	Isolated digital input_1
5	IO_IN_2	Isolated digital input_2
6	IIC-SDA-EXT-2	IIC Data - 2 (Isolated)
7	IIC-SCL-EXT-2	IIC Clock - 2 (Isolated)
8	IIC-SCL-EXT-1	IIC Clock - 1 (Isolated)
9	IIC-SDA-EXT-1	IIC Data - 1 (Isolated)
10	Power In-	Power supply GND
11	IO_Out-2	Output
12	IO_Out-1	Output
13	4-20 mA output A	Current drive output A
14	4-20 mA output B	Current drive output B

Optical Interface

Table 3 Pin Definitions

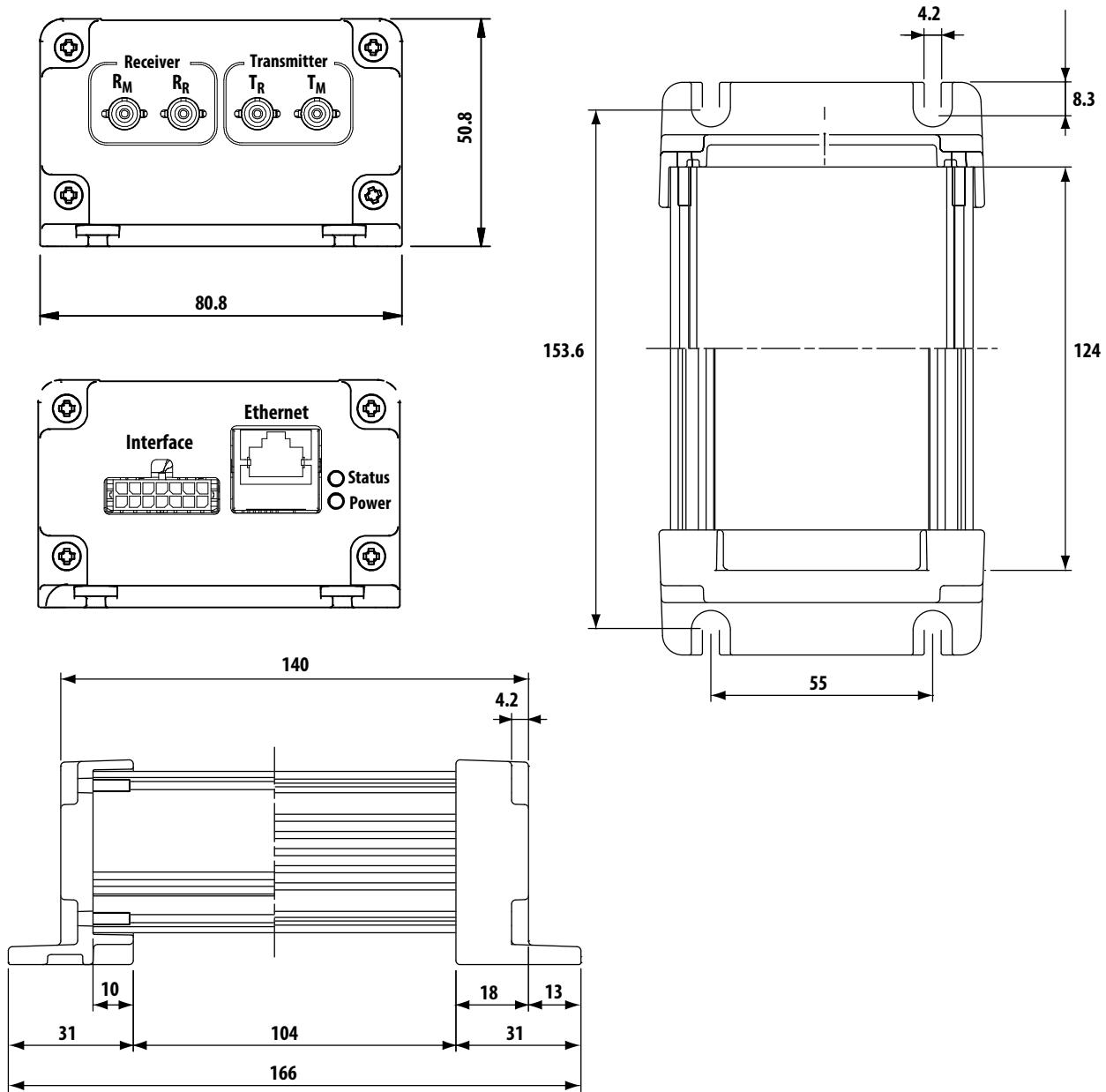
Item	Name	Description
1	T _M	Transmitter output for measurement channel. (ST Port)
2	T _R	Transmitter output for reference channel. (ST Port)
3	R _M	Receiver input for measurement channel. (ST Port)
4	R _R	Receiver input for reference channel. (ST Port)

Power and Status LEDs

Power Indication: Red LED

Status Indication: Green LED

Mechanical Drawings



Typical Dimensions (mm)

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