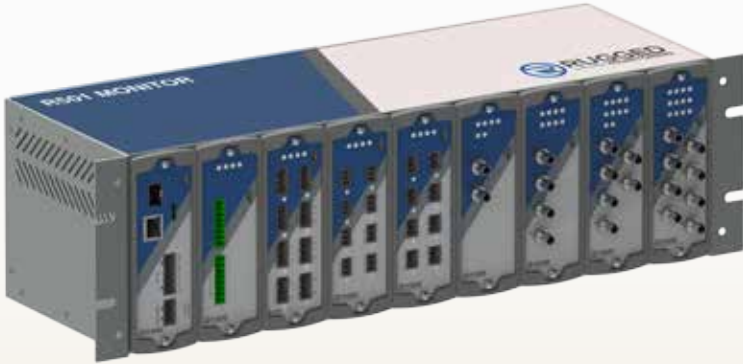


## R501 Most Versatile, Multi Channel and Rugged Fiber Optic Temperature Monitor



- Fully flexible rack mount and distributed architecture support
- Scalable and field upgradable from 02 channels to 256 channels with plug and play modules
- Expandable to add different analog and (or) digital inputs and outputs
- Best in class EMI, ESD Immunity; range of communication options and protocol support
- Range of communication options for third party system integration

Rugged design, and extensive multichannel fiber optic temperature monitor with flexibility to integrate other input and output parameters. Support for centralized and distributed installation make it most viable option for variety of applications.

### Product Summary

Increasing automation and centralization in all industries has created a need for having a flexible and expandable monitoring system that can collect data from large number of different sensors and provide a single visualization and control platform.

The Rugged Monitoring R501 is designed with built-in flexibility and upgradability to accommodate for the changing needs of customers.

The R501 solution provides real time monitoring of fiber optic temperature and many other parameters such as, Pressure, AC Current, AC Voltage, DC Current, DC Voltage, Binary Inputs etc.

It can be used in a wide range of applications including Aviation, Automotive, Cryogenic, Battery Bank/Racks, Medical, Semiconductors, Utilities, and R&D. It's wide measuring range (-271 °C to +300 °C), high precision and complete immunity to RFI, EMI, microwave radiation, and High Voltages make it an obvious choice for temperature measurement in extreme conditions.



**R501 Main Chassis**



**CPU Module    FO Module    Analog Input    Analog Output    Relay Output**

**R501 Modules**

# MULTICHANNEL FIBER OPTIC TEMPERATURE MONITORING SYSTEM FEATURING UP TO 64 CHANNELS, WITH FLEXIBLE MOUNTING OPTIONS

## 1. Rack Mounted Panel

The R501 comes up with a standard 3U / 19" rackmount chassis that can accommodate up to 8 Input/Output (I/O) modules with multichannel support totalling 64 channels in one chassis. Multiple chassis can be daisy chained to expand to 256 channels. Modules are hot swappable and easy plug and play to accommodate changing needs of users. The Rugged connect software is fully capable of detecting new modules as soon as they are plugged into the chassis.

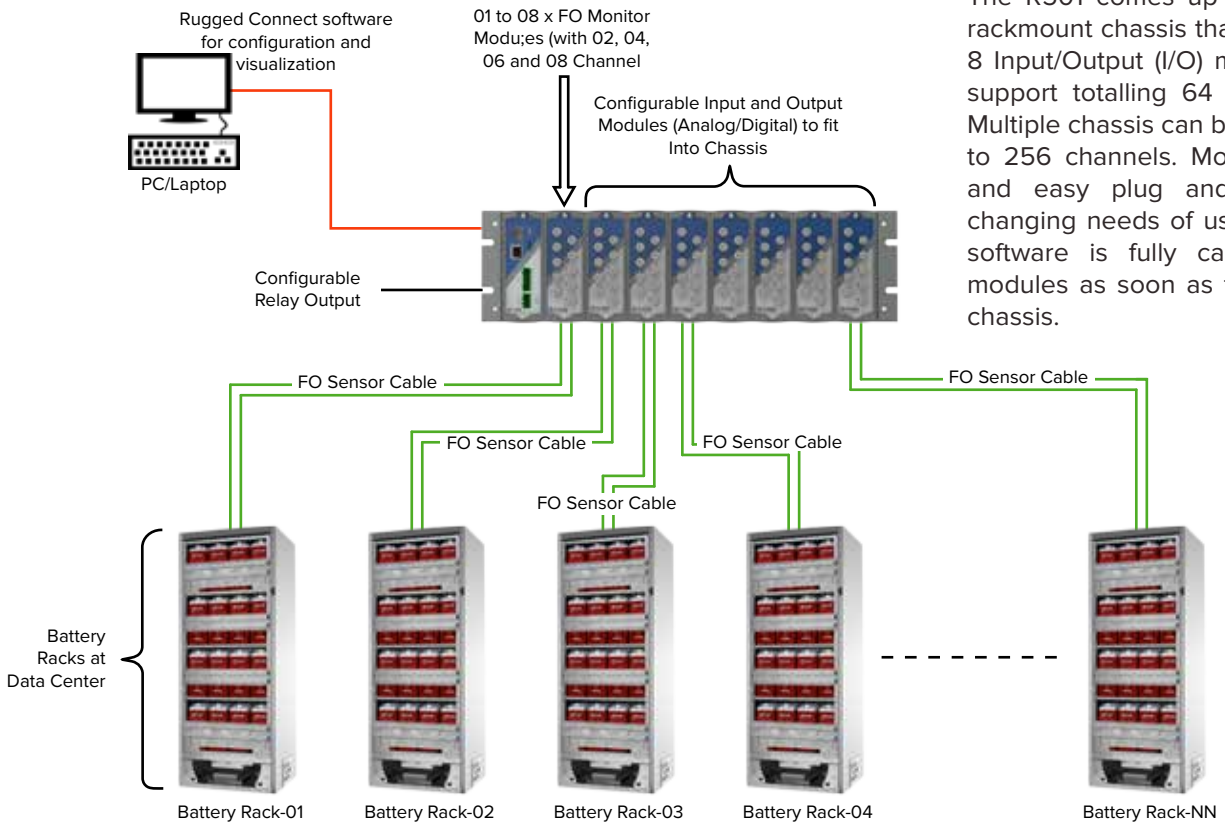


FIGURE: R501 RACK MOUNT INSTALLATION (CENTRALIZED ARCHITECTURE)

## 2. Distributed I/O modules with Centralized Processing

The R501 also supports distributed architecture where Input/Output (I/O) modules can be installed separately (din-rail mount) away from main chassis and then connected to one central CPU on CANBUS or Serial Modbus. The Rugged Connect software at the CPU is used for central data collection, alarm configuration, visualization, control and reporting. Distributed modules can also be directly connected to customer datalogger for high resolution data logging e.g. CAN-Logger.

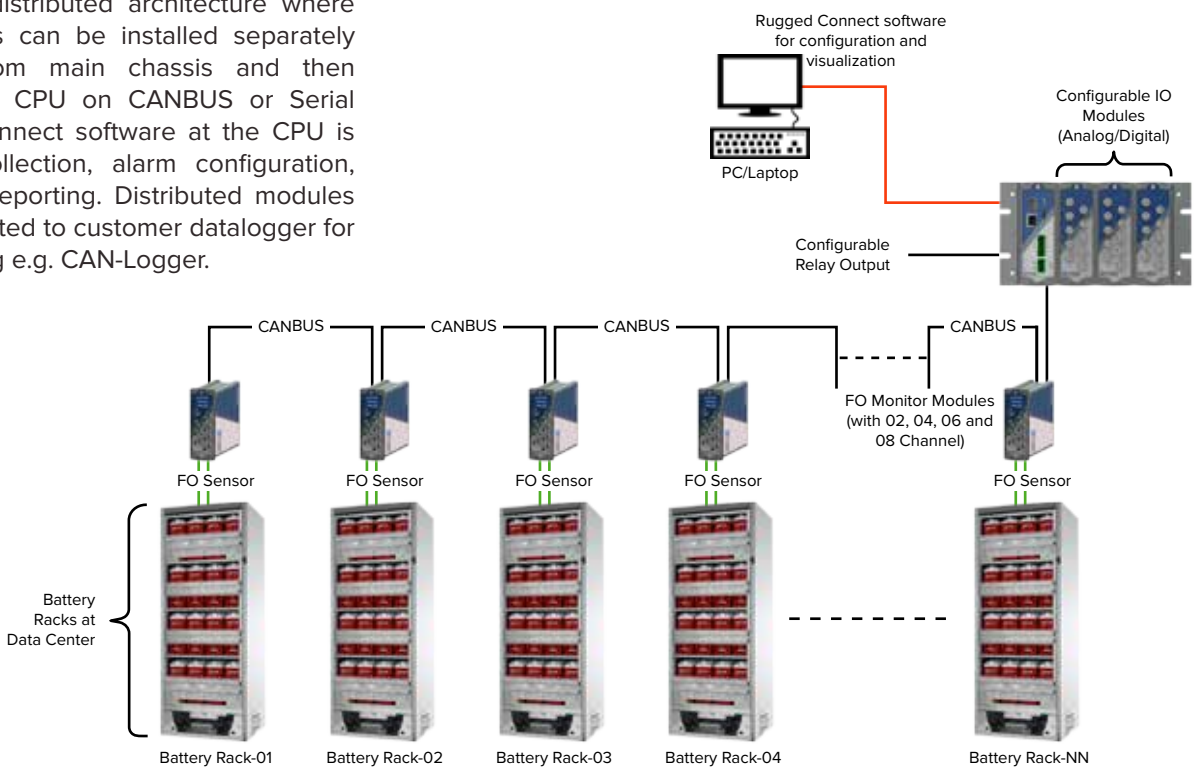


FIGURE: R501 DISTRIBUTED INSTALLATION / ARCHITECTURE

# WIDE RANGE OF INPUT / OUTPUT MODULES DESIGNED TO CATER FOR VARIETY OF APPLICATION ACROSS ALL INDUSTRIES

## Range of Fiber Optic Temperature Module

The R501 system accepts different kinds of FO modules into the same chassis making it suitable for varying application / testing needs. Range of FO modules are available to fit into the R501 chassis:

- Varying number of channels: 08, 06, 04 and 02 channels
- GaAs FO Temperature Sensor Modules with standard resolution
- GaAs FO Temperature Sensor Modules with high precision
- Built-In LED indicators for Power, Communication, and all FO Channel status
- Dinrail mount option for distributed architecture
- CANBUS and MODBUS support for distributed data logging



8-Channels



6-Channels



4-Channels



2-Channels

## Analog Input Module

The R501 system allows using different types of Analog Input modules for monitoring/measuring other parameters of test objects such as, Pressure, Vibrations, Currents, Voltages etc.

- 08 x Analog input channels per module
- Support for all major analog inputs sensor type
- Built-In LED indicators for Power, Communication, and all Channel status
- Easy to set up on the field including calibration and configuration
- Dinrail mount option for distributed architecture
- CANBUS and MODBUS support for distributed data logging



Analog Input Modules

## Digital Input Module

The R501 system allows Digital Input modules for monitoring/measuring Status signals and relay alarms (Dry Contact) from third party sensors/devices.

- 08 x Digital input channels per module
- Signal input voltage up to 250Vdc (Threshold >60Vdc)
- Built-In LED indicators for Power, Communication, and Status
- Easy to set up on the field including calibration and configuration
- Dinrail mount option for distributed architecture
- CANBUS and MODBUS support for distributed data logging



Digital Input Modules

## Analog Output Module

The R501 system allows Analog Output module for applications that require monitoring / analyzed data to send to third party systems e.g. IED, RTU, Control System etc.

- 08 x Analog outputs per Module
- DC Current Loop: 4-20mA
- Built-In LED indicators for Power, Communication, and Status
- User customizable and configurable
- Available in Rack mount and Distributed installation (Dinrail mount) options



Analog Output Modules

## Relay Output Module

The R501 system allows Relay Output module for applications that require relay alarm or control signal to send to third party systems e.g. IED, RTU, Control System etc.

- 08 x Form C relays per module
- Dry contact relays (NO-C-NC)
- Built-In LED indicators for Power, Communication, and all Channel status
- User customizable and configurable for different alarm conditions
- Available in Rack mount and Distributed installation (Dinrail mount) options



Relay Output Modules

# WEBSERVER BASED, EASY TO USE SOFTWARE FOR DEVICE CONFIGURATION, DATA COLLECTION, ANALYSIS, VISUALIZATION AND REPORTING

## Rugged Connect Software

The intuitive user interface of the software is designed to give quick access to the most relevant information with highest level of data security. The key features of rugged connect software are:

- Flexibility to compare and plot multiple parameters from modules for correlative analysis (or comparison) such as Temperature, Pressure, Vibration, Current etc.
- Real time data visualization and user configurable alarming
- Monitoring of Signal strength for Fiber Optic signals for easy troubleshooting
- Easily customizable dashboards to meet different application requirements
- Flexibility to adjust data storage frequency and with user selectable summary feature (Minimum, Maximum and Average)
- Historic trending for user selectable duration
- Export of data into CSV, Excel, and JPEG format
- Flexibility to Enable / Disable Channels remotely using rugged connect software
- Support for multiple languages



## Integration with third party systems

Rugged connect provides easy to configure protocols for integration with third party data logger and systems. It supports the following protocols for data input and output:

- Serial Protocols: CANBUS, Profinet, Modbus, DNP3.0, IEC 60870-5-101
- Ethernet (TCP/IP) Protocols: Modbus, DNP3.0, IEC 60870-5-104, IEC61850

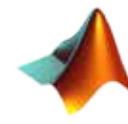
## Distributed Modules have CANBUS / MODBUS data output for high resolution data logging such as CAN Dataloggers.

## Third Party Drivers Available

Drivers for the following computing environment and programming languages are provided by the software. These drivers enable customers to use the measured / monitored temperature data directly into their existing computing environment.



LABVIEW



MATLAB



PYTHON



## TYPICAL APPLICATIONS

Approximately 70-80 fiber optic (FO) temperature sensors are being used to measure temperature during the testing of new EV design. The measurement points include batteries, cable terminations, motor drive train, electric motors, Charger Plugs and Power electronic modules. FO temperature sensors provide highest level of accuracy and repeatability and help vehicle manufacturer in making the high performance, robust, and durable electric vehicles.

The R501 system is used by EV manufacturer to measure temperature from the FO temperature sensors. Mostly R501 modules are installed in distributed architecture and connected directly to CAN dataloggers for high precision data storage and analysis.



Medical industry is continuously researching on newer products for imaging such as new version on MRI/NMR machines, MRI coils etc. Identifying hot spots and then performing long term testing in MRI/NMR machines is critical for the success of any new product. Normal temperature sensors cannot be used during these testing cycle because of magnetic resonance field of the machines. Fiber Optic temperature sensors (ranging from 10 to 128) are ideal for such applications.

The R501 system is the most cost effective and usable system in these applications. R501 system is directly connected to the fiber optic sensors installed at machines and support long term testing to ensure that machine design meet regulatory compliance.

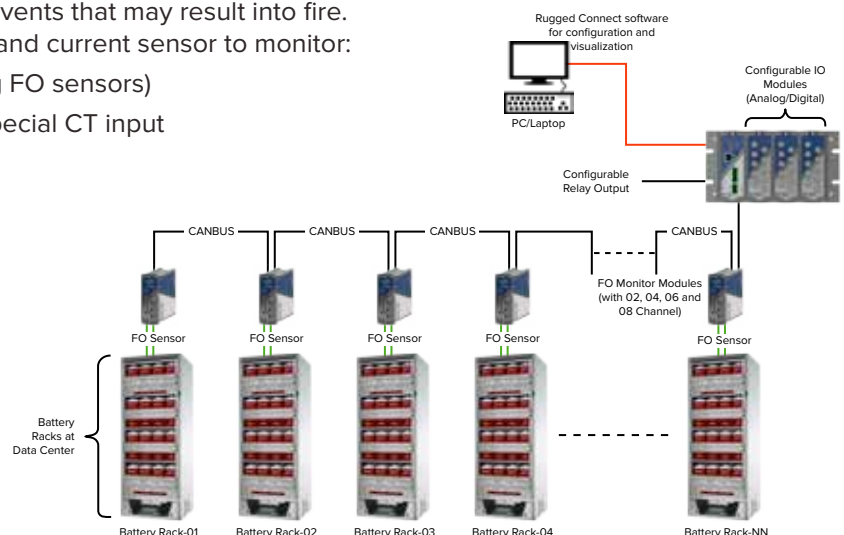


Any large data centres specially from companies that provide cloud data storage services such as Apple, Amazon, Google, Microsoft etc. use multiple racks of batteries for power back up. As per the Fire Code these batteries must be monitored and provision shall be made for detection and alerting of all events that may result into fire.

Therefore, these companies install temperature sensors and current sensor to monitor:

- Top and Bottom temperature in the Rack/Panel (using FO sensors)
- Charging / Discharging current using a wide range special CT input

Normal temperature sensor are not always correct and suitable for these application due to the interference created by the battery circuit. Therefore, Fiber Optic sensors are being used on the top and bottom of the battery rack. The R501 unit is ideal for such applications with its FO temperature module, Analog Input Module and Relay Output Module. One R501 unit can be used to monitor up to 80 battery racks.



## TECHNICAL SPECIFICATIONS

POWER SUPPLY	Input Power Requirement	24V DC ( Default), Optional USB powered
CPU MODULE	Inputs and Outputs	01 x RS-485 (RS-232 optional converter) with Modbus , Canbus
	Data Storage Capacity	MicroSD external memory slot (up to 2 TB)
	Logging Rate	1 sec interval on USB
	Config port	USB (to use with Rugged connect windows software)
SYSTEM CAPACITY	Maximum number of Channels	Expandable to 256 Channels, Daisy chain up to 32 units (with Modbus, Canbus)
FIBER OPTIC MODULES	Measurement Range	-80 °C to +300 °C (cryogenic 4 °K range optional)
	Resolution	0.1 °C
	Accuracy	±1.0 °C (±0.2 °C in relative temperature)
	Scan Rate	200 ms / channel ( Optional: Faster scanning rates available)
	Number of Channels	2, 4, 6 and 8 channels
	Serail Port	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support for CAN Dataloggers
	Power Requirement	24V DC ( Default), Optional USB powered
ANALOG INPUT MODULE	# of Input Channels	Up to 08 Channels
	Accuracy of Channels	±0.5% full scale input range
	AC Current Input	Clamp-on CT with different ranges: 5Amp, 10Amp, 20Amp, 100Amp and others available
	AC Voltage Input	0 - 125 VAC and 0 - 340 VAC; 50/60 Hz
	DC Current Input	4 - 20 mA
	DC Voltage Input	0 - 125 mV and 0 - 25 VDC
	Temperature Input	100 ohm platinum (Pt100)
	Potentiometer	up to 20,000 ohms
	Serail Port	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support for CAN Dataloggers
	Power Requirement	24V DC ( Default), Optional USB powered
DIGITAL INPUT MODULE	# of Input Channels	08 Channels
	Maximum voltage	250 Vdc
	Threshold voltage	>75 Vdc
	Serail Port	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support for CAN Dataloggers
	Power Requirement	24V DC ( Default), Optional USB powered
ANALOG OUTPUT MODULE	# of Input Channels	08 Channels
	Output format	4-20 mA (Configurable for any measured / calculated value)
	Serail Portvoltage	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support
	Power Requirement	24V DC ( Default), Optional USB powered

OUTPUT RELAY MODULE	# of Output Channels	8 Form C relays
	Serial Port	RS485 with Modbus support
	CANBUS Port	CANBUS Master/Slave support for Can Dataloggers
	Power Requirement	24V DC ( Default), Optional USB powered
MECHANICAL AND ENVIRONMENTAL	Operating Temperature	-40 to 72 °C
	Operating Humidity	95% Non Condensing
	Storage Temperature	-40 to 85 °C

## TYPICAL APPLICATIONS

Passenger aircrafts have fuel tanks in their wings, that may pose a risk to the robustness and safety of the design if proper testing is not performed with all possible conditions / scenarios. During the testing of aircrafts and their fuel tanks, temperature is measured at multiple locations to identify the risk of overheating or freezing.

On an average 125 - 130 points are being measured for temperature. Fiber Optic Temperature sensors have been in use by major aircraft manufacturers. R501 provides the best available solution for data collection from these fiber optic sensors. The data collected from FO modules can directly be sent to the customer dataloggers or computing environment so that it can be used with other parameters.



The R501 system is also a cost effective and flexible system for supplier and users of Industrial Microwaves (MW) that are used at a very large scale in food processing industry, wood and fabric drying industries. The typical applications where R501 systems are being used in Industrial Microwaves are as below:

- MW oven design and testing to ensure uniform heat distribution in an oven
- New material research in food and pharmaceutical industry
- Microwave drying applications such as Wood Drying, Grain Drying, Fabric Drying
- Microwave (MW) food products development and testing
- Food sterilization, irradiation and pasteurization processes
- Food packaging and tempering
- Microwave assisted organic synthesis, medical chemistry and process control



Winding temperature measurement is very critical for the safe operation of transformers. Traditionally, simulated winding temperature indicators have in wide use that approximates winding temperature based on transformer load and oil temperature. However, the simulated winding temperature is not the true reflection of hottest spots on the windings. Therefore Fiber Optic sensors have been used by transformer manufacturer to measure direct hot spot temperature of windings. Typically, two fiber optic sensors are being installed for each winding. With the advancement of transformer monitoring, utilities are now looking for a monitoring other parameters of transformers and correlating them with Hot spot temperature. The R501 is used for such applications that require large quantity of fiber optic sensors and / or the following parameters monitored in addition to the hot spot:

- Oil temperature, Load Current, Load Voltages, Pressures, OLTC, Cooling System
- Status signals e.g. PRD status, Buchholz Relay status, Fan Status etc.
- Cooling control and automatic exercise of fans/pumps



### Rugged Monitoring Services

Rugged Monitoring provides customization of sensors, monitors & software. In addition we offer on-site commissioning services, maintenance contracts and technical support to all customers worldwide.



### About Rugged Monitoring

Industry leading team of fiber optic experts with 100+ years of combined experience committed to delivering customizable solutions for challenging applications. We offer a range of reliable, high performance, customizable sensors and monitoring solutions that are immune to external influence.