EXACTUS® IFD-5 DIGITAL and IFA-5 ANALOG OUTPUT

User's Guide
V1.8

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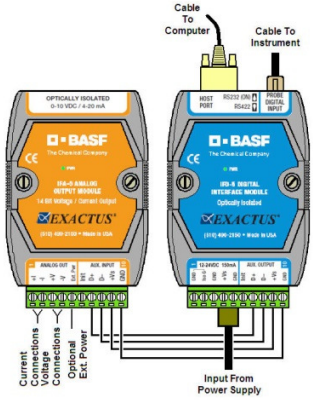

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1.0 System Description

A single channel ***EXACTUS***® system is composed of four parts:

- **Pyrometer Collection Optics:** either a lightpipe or lens assembly
- **Ex-100 Electronics:** SST tube dimension (1.0" diameter × 4.0" long / 25.4mm × 102mm)
- **IFD-5 Interface module:** for conditioning power and communicating with a PC.
  Dimension: (4.6" × 2.8" × 1" / 118mm × 72mm × 25mm).
  Optional IFA-5 analog output, 0 to 10 volts or 4 to 20mA output, (same size as IFD-5)
- **Power:** 24VDC, 3W, 125mA

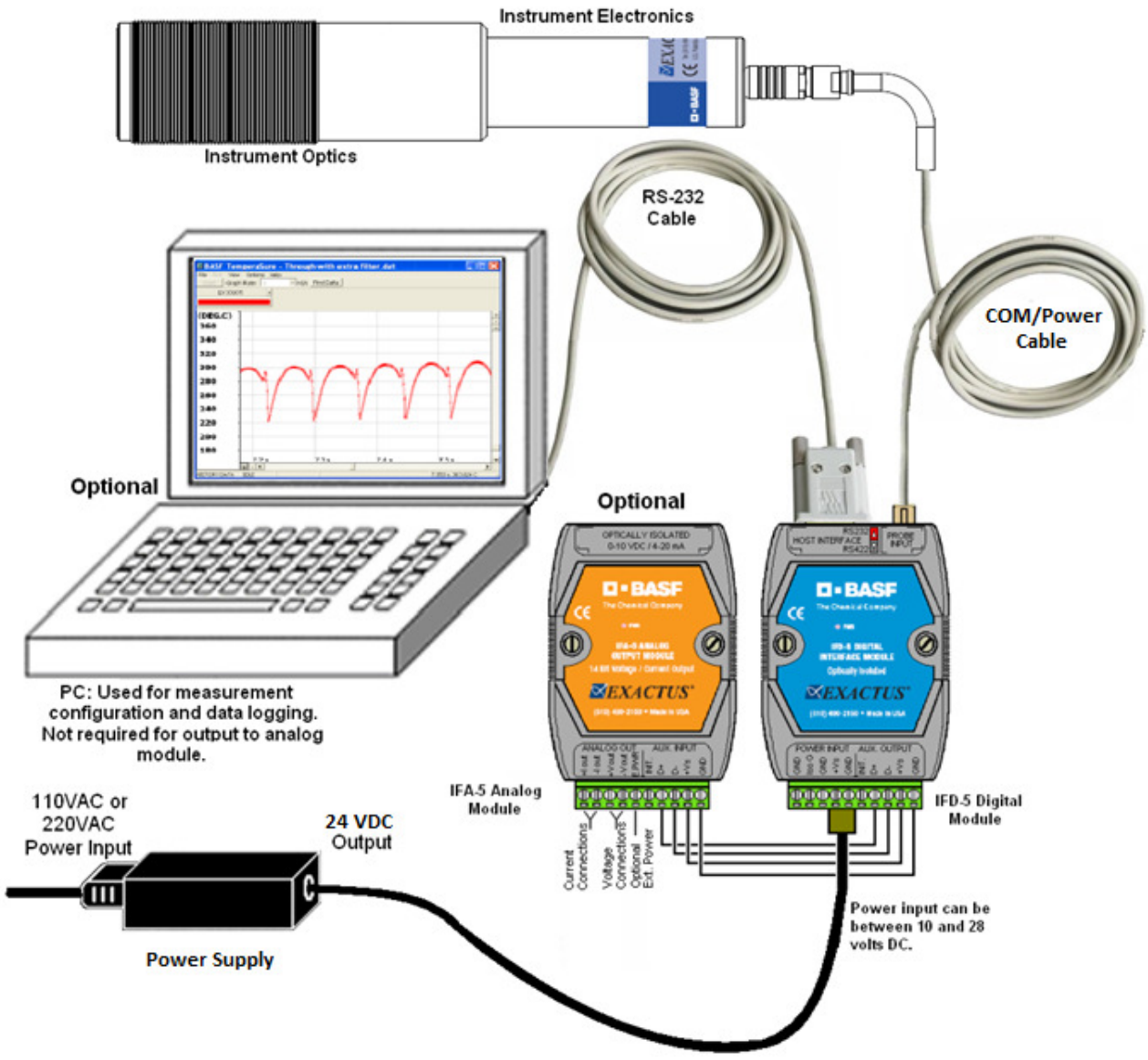

Figure 1

1.1 Digital and Analog Interface Modules

The IFD-5 Digital Interface Module allows the pyrometer to be connected to any PC. This module also isolates the electronics from any electrical noise and supplies a regulated power supply to the pyrometer. There are three connections on the IFD-5 Module: on one side of the module is a RJ45 connector for the pyrometer cable and a female DB9 connector for the host computer. On the opposite side of the module is the connection for the power supply. The interface module has a green LED that indicates when power is being applied.

The pyrometer can communicate with a host computer using either RS-232 or RS-422 serial communication. If it is configured for RS-232 than the interface module should be connected to the PC or digital data logger with a cable no longer than 15 meters.

BASF also offers an analog output option, the EXACTUS IFA-5, which can be configured to either a voltage or current output. The value of the analog output can be scaled as needed using the TemperaSure® software from 0 to 10 volts or 0 to 20 mA for the desired temperature range.

1.2 Power Supply

A single channel system is powered with a DC Power Supply through the IFD-5 Digital Interface Module as shown in Fig 1.0. The IFD-5 Module may be powered by any DC voltage between 12 and 24VDC. The IFD-5 supplies power for the electronics and optional IFA-5 analog module.

1.3 Software Interface

EXACTUS TemperaSure® graphical user software gives the user the ability to log and/or display temperature readings and configure the pyrometer and IFA-5 module user settings. Refer to the EXACTUS Optical Thermometer user manual on how to install and set up the software.

2.0 IFD-5 Digital Interface Module

Using the IFD-5 interface box, the EXACTUS pyrometer can communicate digitally, selectable for either RS232 or RS422 line levels. The IFD-5 provides power to the pyrometer and isolation of the communication lines. The Modbus and EXACTUS protocols are available using this interface.

To connect the pyrometer to a standard PC serial port using the IFD-5, make sure that the selector switch for RS232/RS422 is in the RS232 position. This is a small single DIP switch near the IFD-5's DB-9 connector.

IFD-5 Digital Pinouts		
Pin	RS232	RS422
1	Unused	TX+
2	RXD	Unused
3	TXD	Unused
4	Unused	RX-
5	Signal Gnd	Signal Gnd
6	Unused	TX-
7	RTS *	RTS *
8	Unused	RX+
9	Unused	Unused

Table 1:
RS232/RS422 Serial Connections for IFD-5

* NOTE: *For RS232 the RTS line must be held in an asserted (HIGH) state or be left unconnected.*

3.0 Analog Output

3.1 Hardware Setup

There are four wires that must be connected between the IFA-5 Analog Output Module and the IFD-5 Digital Interface Module. See Figure 2. The two modules are designed to stack one above the other. BASF provides a connector designed for use when the two modules are stacked. When the two modules are stacked vertically the power input and digital communications connections are, pin for pin, directly above one another. These connections are labeled D+, D-, Vs, and GND on both modules. To connect the two modules, wire D+ on the IFA-5 Module directly to D+ on the IFD-5 Module, and do the same for D-, Vs, and the GND connections.

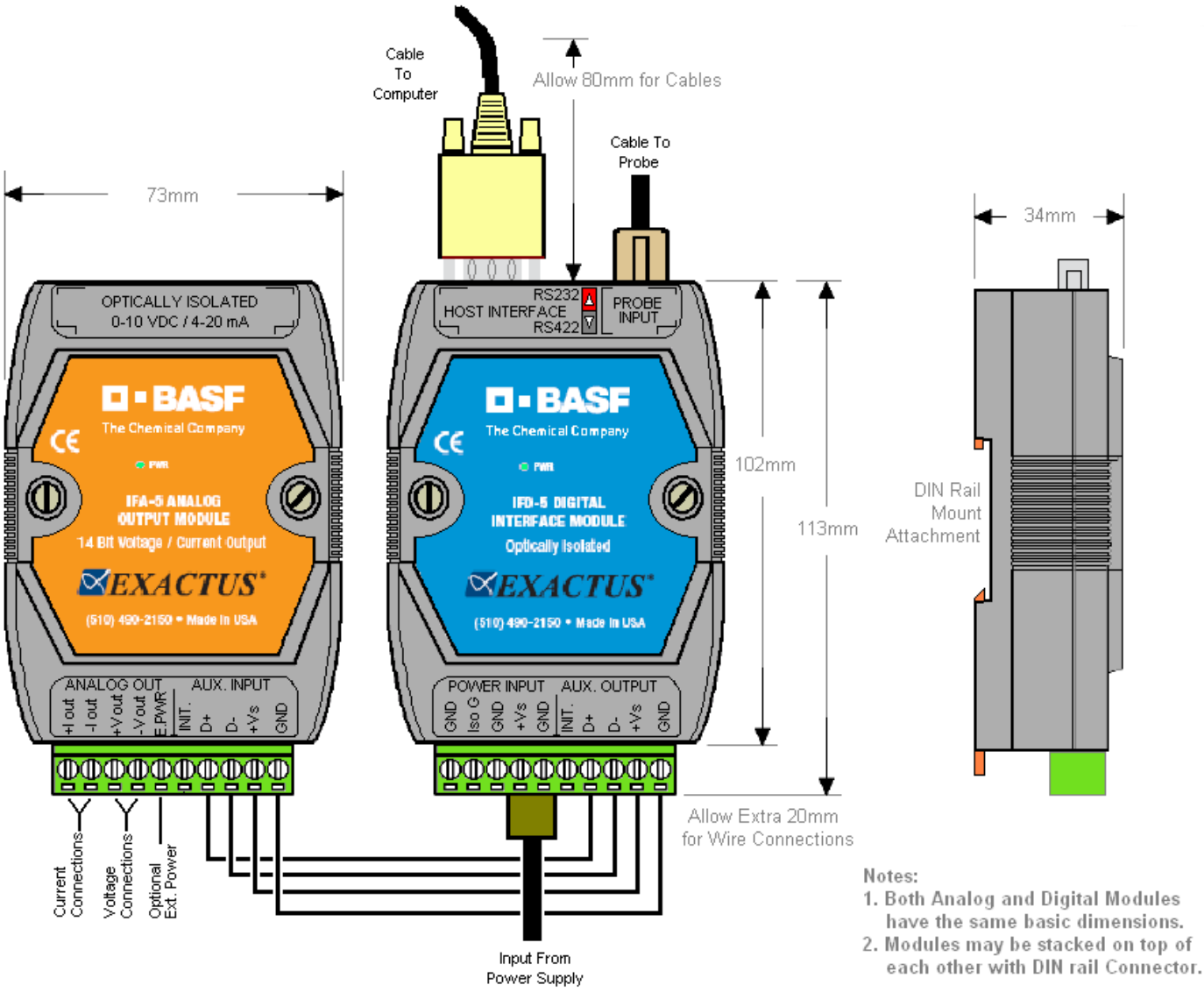

Figure 2 Analog Output Module (IFA-5) & Digital Interface Module (IFD-5)

If the modules are not to be stacked, the connections are wired the same as described above in figure 2.0. The IFA-5 Module and the IFD-5 Module can be wired up to 50 meters from each other. Shielded wiring is recommended for distances greater than a few meters or if the electronics are mounted in an area of high electromagnetic interference.

The voltage and current output connections are adjacent to the power and digital communication connections. For a voltage output, connect to "+V out" and "-V out", and for a current output connect to "+I out" and "-I out".

3.2 Optional External Power

The internal power source on the IFA-5 Module will drive the current output through a resistance of up to 500 ohms. The module can drive up to 1050 ohms if an external 24VDC power source is used.

The IFA-5 Module is supplied configured for internal power. To configure for external power a jumper inside the module must be moved. The IFA-5 Module and the IFD-5 Module are similar in appearance, so make sure you are working with the IFA-5 Module before you proceed. To move the jumper, completely remove the two screws that hold the IFA-5 Module case together. With one hand, grasp the sides of the module just below the case seam and squeeze firmly; the upper and lower covers will separate from each other. Remove the top cover of the module and set it aside.

Hold the IFA-5 Module so the writing on the circuit board is upright. There is only one jumper on the board, it is labeled JP1 and will be in the upper left-hand side of the board close to the module connections. Three pins allow the jumper to be in one of two positions. To configure for external power, locate the jumper connector onto the bottom two pins, to configure for internal power locate the jumper connector onto the top two pins. See Figure 3 below for details.

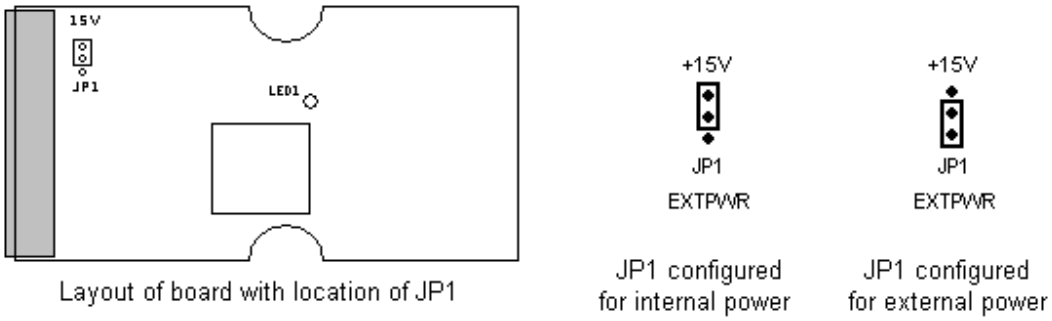

Figure 3

3.3 Wiring for External Power

The wiring for the current mode is also different when the output is powered externally. When an external 24VDC power supply is used, wire as shown in Figure 4.

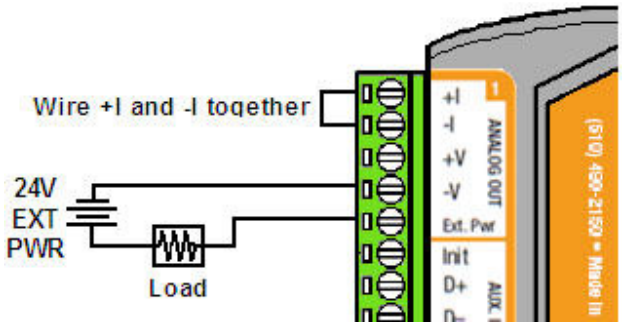

Figure 4

3.4 Software Setup

Analog output is configured with TemperaSure under each pyrometer's setup. The analog output from each unit (channel) can be configured as a voltage or a current, 0 to 10 volts or 4 to 20mA. The minimum and maximum electrical values are entered, along with the corresponding minimum and maximum temperature values. These four numbers will scale the analog output. See Figure 5: Analog Output Setup display.

3.5 Configuration

With all the connections made, open the TemperaSure software program. Wait a few seconds for the instrument to start displaying temperatures in the box or boxes above the graphical display. Open the Pyrometer Settings menu for the pyrometer that is to be configured and follow the steps below:

1. Select the Analog Output tab. See Figure 5 below.
2. Click the "Use Analog Output" checkbox.
3. Click on either Voltage or Current button.
4. Go to the corresponding section and type in the minimum temperature and the maximum temperature and the corresponding voltage or current values. Voltages between 0 and 10 volts and currents between 0 and 20mA may be entered. See Scaling section below for details.
5. Values may be stored in two ways. By pressing the "Save" button the values are stored in the electronics memory and are retained even if the pyrometer is reset or powered down. Values may also be stored by pressing the "Apply" button; however these values will not be retained if the pyrometer is reset or powered down. Pressing the "Apply" button will interrupt the output from the pyrometer for two to four seconds. Pressing the "Save" button will interrupt output from the pyrometer for several seconds.

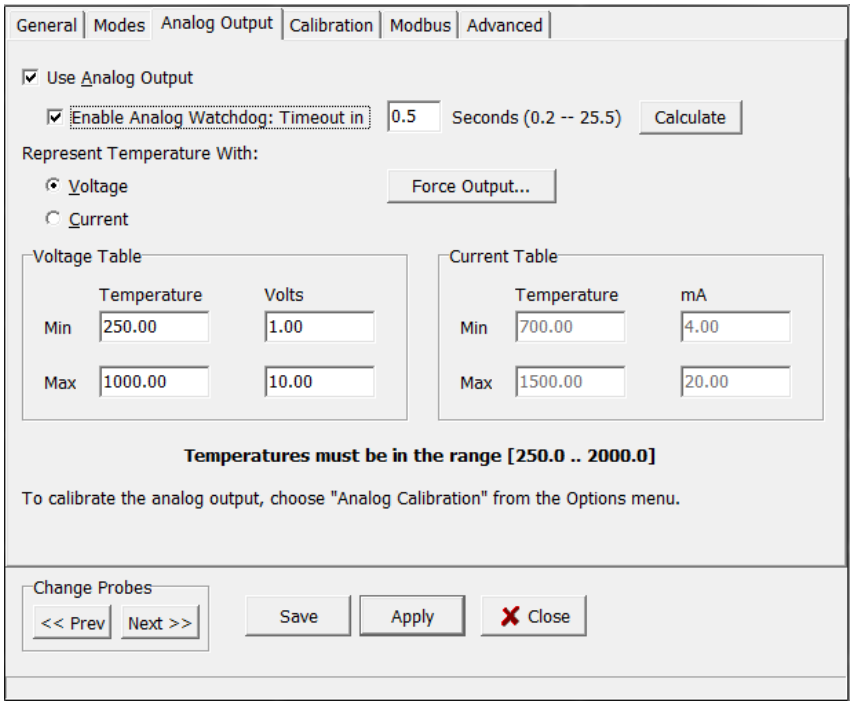

Figure 5

3.6 Scaling

The analog output will be scaled according to the four values entered in step four of Section 3.5. The minimum and maximum temperatures entered can be the minimum and maximum temperature the pyrometer will read, or they could be just a few degrees from each other. When the IFA-5 Module is configured the first time, the default value for minimum temperature will be 0.00°C. The maximum temperature will be the same as the maximum temperature of the pyrometer connected; values larger than the maximum temperature of the pyrometer will not be accepted.

The analog output may be configured to a number of different electrical ranges. For example, if a voltage that varies from +1 to +5 volts is desired, simply enter these voltages and their corresponding temperatures into the table. If the temperature goes below the temperature assigned to +1 volt the output will stay at +1 volt. If the temperature exceeds the temperature assigned to +5 volts, the output will stay at +5 volts. The resolution of the IFA-5 Module in voltage mode is 10,000 different voltage levels over the 0 – 10 V range; when the voltage output range is reduced (e.g. 0 – 5V) the number of different voltage levels will be reduced proportionally. The resolution of the IFA-5 Module in current mode is 20,000 different current levels over the 0 – 20mA current range; when the current output range is reduced (e.g. 4 – 20mA) the number of different current levels will be reduced proportionally.

3.7 Reverse Scaling

The output can be set up with reverse scaling if desired. With reverse scaling, the voltage or current output will decrease as the temperature increases. To set up the analog output in reverse scaling mode, assign the minimum voltage or current to the maximum temperature and assign the maximum voltage or current to the minimum temperature.

3.8 Watchdog Failure Alarm Configuration

If enabled, the Analog Watchdog Timer feature will change the analog output level to a user prescribed 'safe value' to indicate an instrument or communication failure. If the Watchdog Failure Alarm is not enabled, loss of pyrometer connection will cause the last good value sent to the analog output to be held until the pyrometer connection is re-established. If Watchdog is enabled, analog output will drop to 3.6 mA or 0V (depending on mode) by default, or to a user specified level, after the passage of a user specified time.

If adjustments are to be made to the Watchdog Failure Signal Level settings, please select Advanced Mode in TemperaSure first (Menu-Options-Advanced Mode or Ctrl-Alt-A). This will allow the user to access and adjust the Watchdog Failure settings. To fully configure the Watchdog Failure Alarm, two separate menus must be accessed. The Analog Output menu (Figure 5) is used to enable and set the delay time between the last good update value and the activation of the Watchdog Failure Alarm ('Timeout In:____' box). The Configure IFA-5 Module menu (accessed through Menu-Options-Configure IFA-5 Module) is used to set the Watchdog Failure Signal Level current or voltage level that will be used to indicate an alarm condition.

1. Enabling Watchdog Timer Alarm and Setting Delay Time: Activate *Advanced Mode* (Menu-Options-Advanced Mode or Ctrl-Alt-A) to access the Watchdog Failure settings. Select the 'Enable Analog Watchdog:' radio button. Use the "Calculate" Button to determine the minimum passage time for the current graph rate and fill in the Timeout In box. The value can be set to a longer, but not shorter, time.
2. Specifying the 'Watchdog Failure Signal Level': The user can specify the Watchdog Failure Signal Level for the analog output to drop to in case of loss of connection. Activate *Advanced Mode* (Menu-Options-Advanced Mode or Ctrl-Alt-A) then go to the Configure IFA-5 Module option under the Options tab. Select the port and the output type. The safe level can be set in the Watchdog Failure Signal Level box. Click the "Save" Button to save the value (see Figure 6). The Calibration section in the middle will be covered is covered in more detail in section 3.9: Calibration.

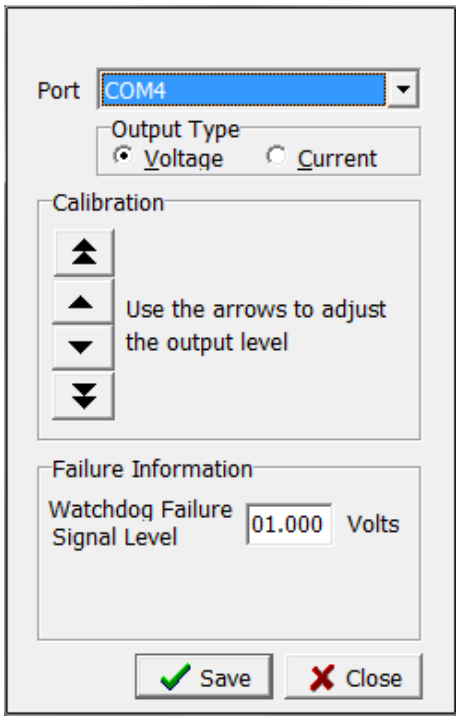

Figure 6

NOTE: LED on IFA-5 will blink when watchdog failure occurs.

3.9 Calibration

3.9.1 Checking Calibration of the IFA-5 Analog Output Module

Calibration of the analog output is very easy and straightforward. A menu within TemperaSure provides an easy-to-use interface for the calibration of the analog output. Checking the calibration does not modify the calibration of the IFA-5 Module. To check the calibration, follow the steps below. Instructions for changing the calibration follow this section. Calibration of the analog output is not required before the first year of operation and only annually after the first year.

To check the calibration of the IFA-5 Analog Output Module:

1. Make sure that the IFA-5 Module and the pyrometer are disconnected from any process, system, or tool that could be affected by readings from the IFA-5 Module or the pyrometer itself.
2. Verify that the voltage or current meter being used to calibrate the IFA-5 Module is properly calibrated and its calibration is up to date.
3. Connect the pyrometer to a computer capable of running the TemperaSure software under the Windows® operating system. Open the TemperaSure software and verify readings are coming from the pyrometer to the computer.
4. Connect the meter to the IFA-5 Module. If the IFA-5 Module is to be used in voltage mode, the meter should be connected in parallel with the output. If the IFA-5 Module is to be used in current mode, the meter should be connected in series.
5. Configure the IFA-5 Module for Internal Power (see instructions for Optional External Power).
6. Make sure the IFA-5 Module has been running for at least 30 minutes so it is fully warmed up.
7. Determine the COM port to which the pyrometer is connected. To determine the COM port, click on the numbered box above the temperature readout for the pyrometer. The COM port will be displayed in the Pyrometer section on the General tab.
8. Under the Options menu in TemperaSure, select Configure IFA-5 Module. A calibration menu box will pop up (see Figure 5).
9. Using the menu, select the COM port of the pyrometer that is attached to the IFA-5 Module and whether the IFA-5 Module is being used in voltage or current mode.
10. Measure the voltage or current from the IFA-5 Module. For a voltage output there should be a potential of 10 volts across the +V out and –V out terminals. For a current output there should be a 20mA current flowing between the +I out and –I out terminals (ExtPWR and –V out if External Power is utilized – see section on Optional External Power).

3.9.2 Adjusting Calibration of the IFA-5 Analog Output Module

To adjust the calibration of the IFA-5 Module, follow the steps outlined in the previous section. Adjustments are made by the up and down arrows on the calibration menu box. Adjust the calibration so the output from the module is either 10.000 volts or 20.000mA, depending on the mode selected. Once the output is correct, press the “Save” button on the calibration menu box. None of the adjustments will be stored until the “Save” button is pressed.

4.0 Product Specifications

IFD-5 and IFA-5 General Specifications	
Operating Temperature	0 to 70°C
Storage Temperature	-20 to 85°C
Humidity	5 to 95% (non-condensing)
Environmental Air	No corrosive gasses permitted
Agency Approvals	CE, CB, EMC, Pending UL and CSA

IFD-5 and IFA-5 Mechanical	
Size: H x W x D	4.6" × 2.8" × 1", 118mm × 72mm × 25mm
DIN Rail Mount	35mm rail

IFD-5 Input/Output	
Input Voltage Range	Standard: 24VDC (+10VDC to +30VDC)
Power Consumption (with IFD-5, IFA-5, and Pyrometer sensor)	3 watts, 125mA, 24VDC
Pin 1 – 10 Assignments	Pin 1 GND (Pins 1, 3, 5, and 10 are internally connected)
	Pin 2 Isolates pyrometer if open (COM/power)
	Pin 3 GND (earth ground option)
	Pin 4 +Vs (internally connected to pin 9)
	Pin 5 GND (circuit ground)
	Pin 6 Init (N/C - for manufacture use only)
	Pin 7 D+ RS485 communications to IFA-5
	Pin 8 D- RS485 communications to IFA-5
	Pin 9 +Vs power to IFA-5 (internally connected to pin 4)
	Pin 10 GND (circuit ground)
10 pin Terminal – pin spacing	5.08mm
DB9 connector	RS232 or RS422 communication to PC
RJ45 connector – Isolated COM/Power	Pyrometer communications and 6VDC

IFA-5 Input/Output	
Input Voltage Range (supplied by IFD-5)	Standard: 24VDC (+10VDC to +30VDC)
Power Consumption (with IFD-5, IFA-5, and Pyrometer sensor)	3 watts, 125mA, 24VDC
Pin 1 – 10 Assignments ***(Isolated Analog Output - 3000VDC)***	Pin 1 +I (0 to 20mA output)
	Pin 2 -I (0 to 20mA output
	Pin 3 +V (0 to 10VDC output)
	Pin 4 -V (0 to 10VDC output)
	Pin 5 Ext. Pwr (0 to 20mA loop power 24VDC)
	Pin 6 Init (N/C - for manufacture use only)
	Pin 7 D+ RS485 communications to IFD-5
	Pin 8 D- RS485 communications to IFD-5
	Pin 9 +Vs (power from IFD-5)
	Pin 10 GND (circuit ground)
10 pin Terminal – pin spacing	5.08mm
Analog Outputs	0 to 20mA
	0 to 10 Volts
0 – 10 Voltage Output	10mA maximum
Accuracy	± 0.02% of FSR
Resolution	± 0.002% of FSR
Readback Accuracy	± 1% of FSR
Zero Drift	Voltage output: ± 10µV/°C
	Current output: ± 0.2µA/°C
Span Temperature Coefficient	± 5ppm/°C
Accuracy	± 0.02% of FSR
Resolution	± 0.002% of FSR
Current Load Resistance	Internal power : 500 ohms
	External 24VDC power: 1050 ohms
Update Rate	Adjustable up to 100 readings per second.

5.0 Mounting

- The backs of both the IFD-5 Digital Interface Module and IFA-5 Analog Output Module have attachments for easy DIN rail mounting. To attach the modules to a DIN rail pull the orange tab at the bottom of the module out, slip the module onto the DIN rail and push the tab back in to secure the module to the rail. A short piece of DIN rail is provided for mounting the Module to solid surfaces.
- It is recommended that the modules be mounted in a cabinet or NEMA enclosure rated for area of use. See mounting examples in section 5.1

5.1 IFD-5 and IFA-5 Support Cabinets

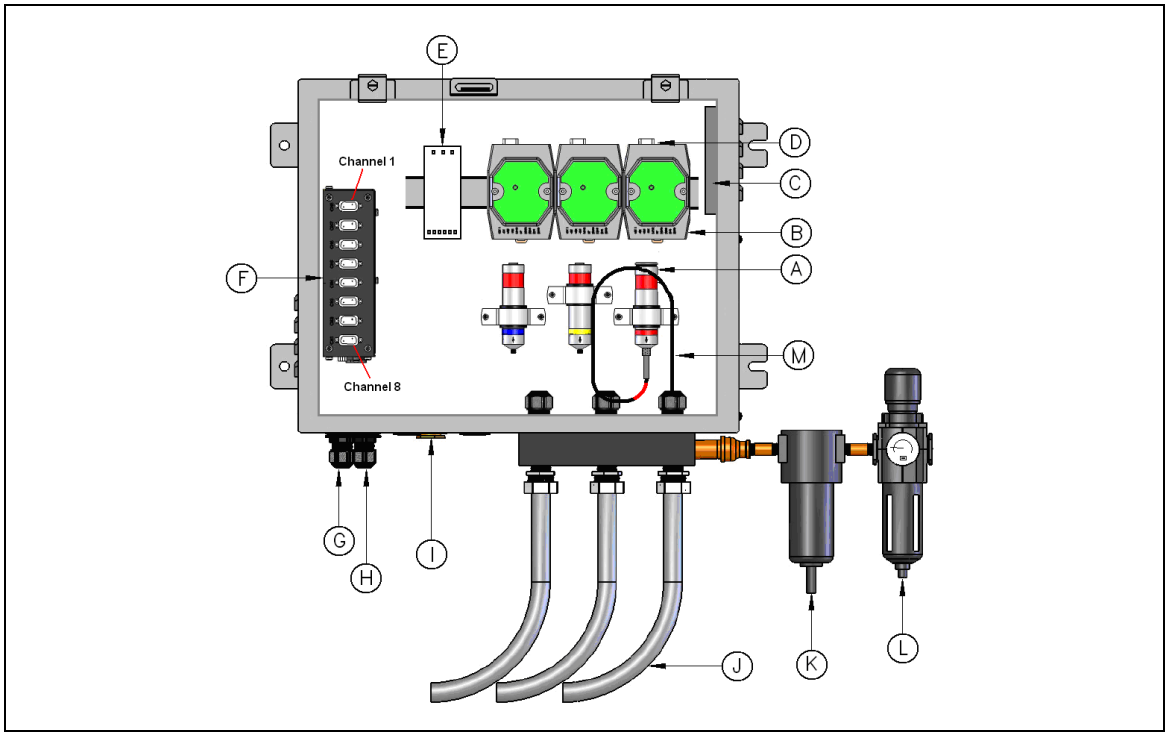

Figure 7 – Electronics support cabinet layout example – Fiber optic Version

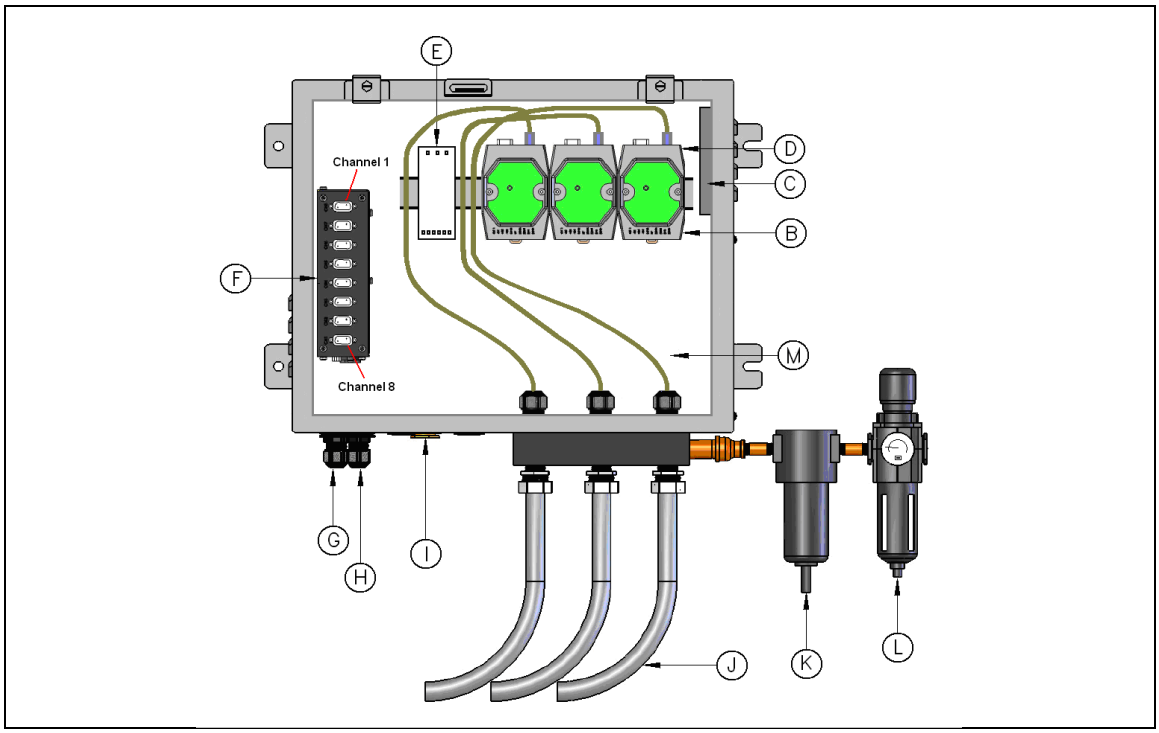

Figure 8 – Electronics support cabinet layout example – Integrated Instrument System

Cabinet may not include all of the following components

The electronics support cabinet provides an air distribution system, power management, and communication necessary to support EXACTUS temperature measurement. Typical cabinets may accommodate one to eight EXACTUS units.

A. Pyrometer – Measures intensity of light from the optics and calculates temperature. For Fiber-Optic Instruments, fiber-optic cables thread into the nosepiece of the electronics module providing the light for the measurement. Typical cabinets may be equipped with one to eight units (channels).

B. Analog Output Module – Provides DC signal output of the temperature measurement. There are separate pairs of labeled screw terminals for the 4-20mA and 0-10V output.

C. Cooling Fan – if used. Active air cooling from the air purge system is the preferred method of cooling the cabinet as it reduces the risk of introducing contaminants to the cabinet.

D. Digital Interface Module (located beneath analog output module) – Supplies power to the optic head and analog output module. Passes on data to the analog output modules, the multi-channel interface box, or a PC via serial connection.

E. Power Supply – Converts 120/240 VAC to 24 VDC

F. Multi-Channel Interface Module – Allows for PC communication with all instruments via Ethernet connection.

G. Gland Nut for Power Input

H. Gland Nut for Signal Cables

I. Optional Cabinet Cooling Air Inlet Valve

J. Conduit containing the combined power/data cable and the air purge flow.

K. Liquid Separator (may be integrated with air pressure regulator).

L. Air Pressure Regulator with Pressure Gauge.

M. Cables

    a. Fiber-Optic Version: Fiber-Optic Transmission Cable

    b. Integrated System: Combined Power/Data Cable

6.0 Maintenance

- The equipment does not require periodic maintenance. If the equipment becomes dusty or dirty, clean it by disconnecting the DC power and wiping it down with a soft, slightly damp cloth.
  - IFA-5 Module calibration should be checked once a year by a qualified electronic technician, see section 3.9.
- If equipment is mounted in a cabinet, door should remain closed as often as possible. A lock should be used if necessary.
- The ambient temperature of the electronic equipment should be checked in the operating environment at its highest temperature. The temperature should not exceed 70ºC. Exceeding this temperature will not damage the electronics but may affect the temperature measurement accuracy. If the temperature exceeds 80ºC, failure is possible. Use radiation shielding or the optional purge air to keep the electronics cool.
- Periodically check equipment for signs of contamination by water, oil, dirt, etc. If necessary, clean with clean soft damp cloth.

7.0 Warnings

- If the equipment is not used in a manner consistent with manufacturer instructions and specifications, the protections provided by the equipment may be impaired
- Use of pyrometer without the IFD-5 interface box may degrade measurement quality. The IFD-5 interface box isolates the pyrometer from electrical noise and provides power conditioning.