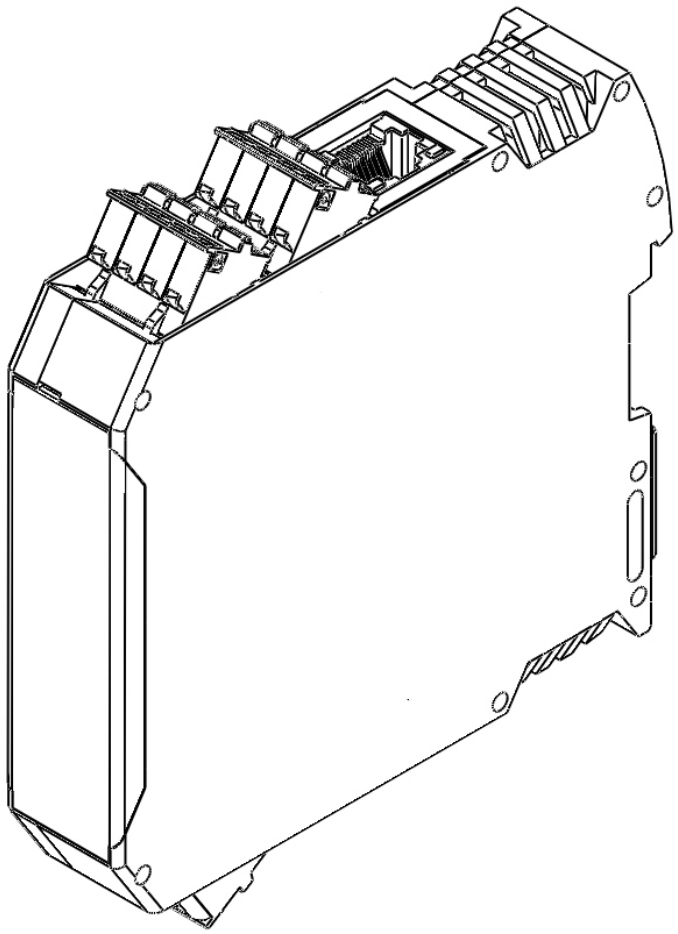
IFX-21 User Guide

Industrial Communications Module

EXACTUS®



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2. CONTENTS

1. Contact Information **2**
2. Contents **3**
3. Product Overview **4**
3.1. Description and Intended Use 4
3.2. Certifications and Approvals 4
3.3. Identification 4
3.4. Device Overview 4
4. Installation and Commission **5**
4.1. Software Minimum Requirements 5
4.2. Transportation and Storage 5
4.3. Mounting 6
4.4. Device Wiring 7
5. Device Operation and Setup **10**
5.1. Overview of Connection Methods 10
5.2. Value Display and Indicating LEDs 11
5.3. Device Configuration 12
5.4. The Configuration Menu 13
5.5. Analog Output Operation 14
5.6. Analog Output Configuration 14
6. Maintenance **14**
7. Specifications **15**
7.1. General 15
7.2. Technical 15
8. Warnings **18**
9. Troubleshooting **18**
9.1. Troubleshooting Instructions 18
9.2. Repair, Service, and Returns 19
9.3. Disposal 19
10. Appendix **20**
10.1. 7-Segment Display 20
10.2. MODBUS/TCP 21
10.3. MODBUS/RTU (RS485) Implementation 21
10.4. MODBUS register map 22

3. Product Overview

3.1. Description and Intended Use

The IFX-21 is a smart device for re-transmission, monitoring, and break out of ***EXACTUS***® pyrometer communications in industrial environments. It continuously buffers pyrometer output and makes the readings available to various isolated ports and protocols, including a user defined passive 4-20mA analog signal.

3.2. Certifications and Approvals

3.3. Identification

The IFX-21 features a Nameplate as seen in Figure 1.

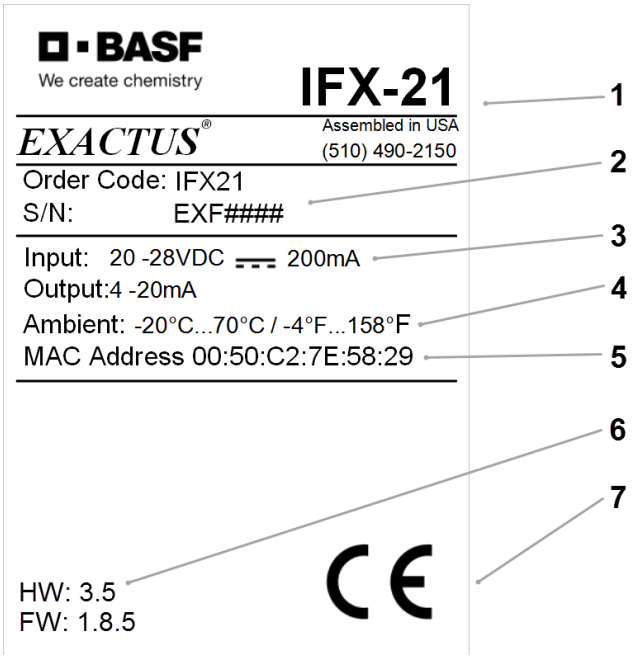


Figure 1: Example nameplate

1. Manufacturer and Product ID
2. Order Code and Serial Number
3. Power supply and current consumption
4. Ambient temperature range
5. Device MAC address
6. Device and Firmware version
7. Approval Logo

3.4. Device Overview

The IFX-21 is a DIN rail mountable plastic enclosure with a number of ports on its top, bottom, and front. The top has two sets of 4 spring terminals and one RJ45 port. The bottom has one set of 4 spring terminals and two RJ45 ports. The front has a clear polycarbonate door which covers a 5 character display, 2 indicating LED's, and a USB service port.

3.4.1. Port Callout

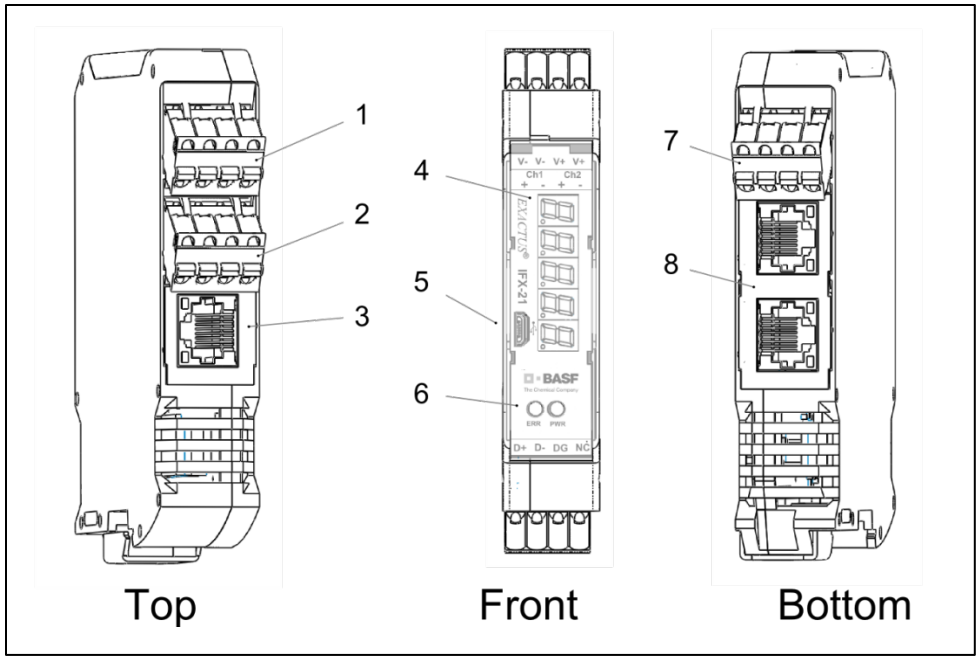


Figure 2: Device overview

1. Analog outputs
2. Device power input
3. Pyrometer port
4. 5 Character display
5. USB mini-B PC service port
6. Power and Error indication LEDs
7. TIA 485-A (RS485) port
8. Ethernet TCP/IP 2 port switch

Refer to section 7.2 for additional technical information about these ports.

4. Installation and Commission

4.1. Software Minimum Requirements

- Windows 7, 8.1, and 10 compatible.
- Windows 10 only for USB service port connection
- TemperaSure Version: 5.7.0.0 or later
- Pyrometer Models EX#-100 Firmware: 3.0.1.3 or later
- Pyrometer Models EX#-#10 Firmware: 9.3.0.0 or later

4.2. Transportation and Storage

The device should be transported and stored such that it is protected from impact, condensing atmospheres, and influx of liquids or contaminants.

Permitted storage temperature range: -40 to 85°C (-40 to +185°F)

4.3. Mounting

The IFX-21 is intended to mount on a 35mm top hat style DIN rail (IEC 60715 TH35). To ensure optimal performance the IFX-21 should be mounted on a grounded rail inside an enclosure with the appropriate NEMA rating for the environment. Where appropriate cooling air and/or radiation shielding should be installed to ensure ambient temperatures remain within device operational limits (see Section 7.1).

In choosing a mounting location note should be taken that the device power, analog output, and pyrometer ports are located on the top of the device while communications, both Ethernet and Modbus, are on the bottom.

4.3.1. Dimensions

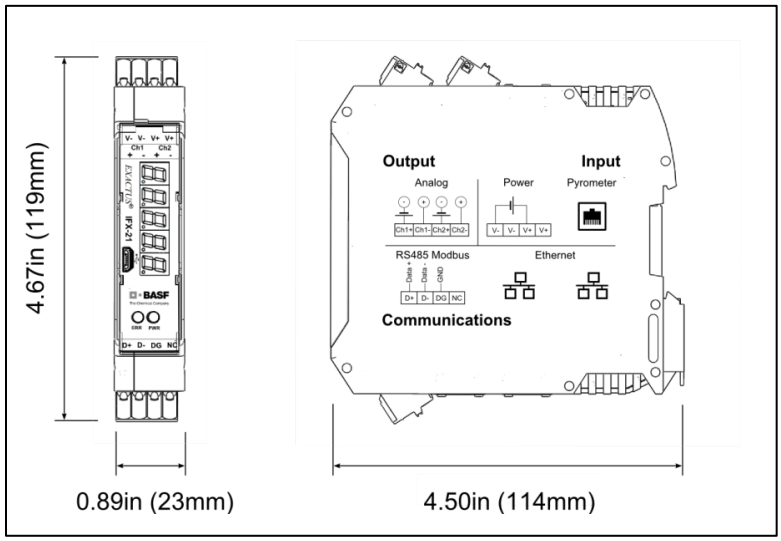


Figure 3: Device Dimensions

4.3.2. Installation procedure

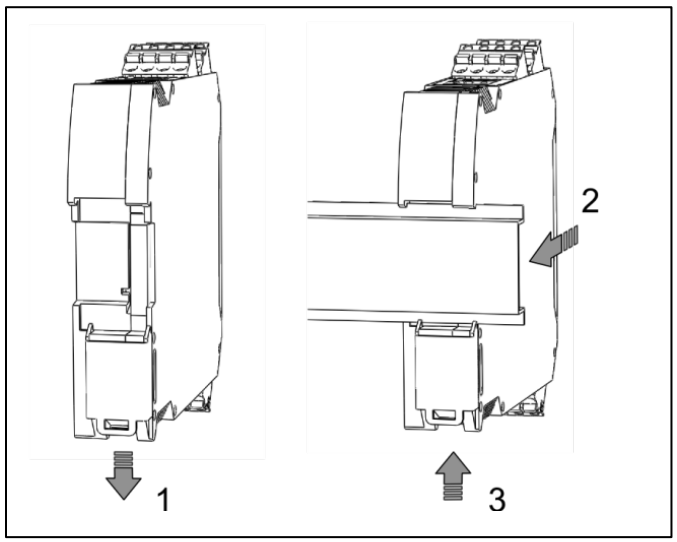


Figure 4: Installation steps

1. Pull down on spring clip
2. Hook top DIN rail forks over 35mm DIN rail
3. Release spring clip

4.4. Device Wiring

4.4.1. Wire Gauge

BASF recommends wire gauges of not less than 18AWG and no more than 12AWG. For best results stranded wire should be tinned or crimped into an appropriately sized ferrule. Ethernet connections may utilize either CAT5 or CAT5e cables, CAT5e is preferred where available.

4.4.2. Terminal blocks

The power, analog output, and Modbus terminals use detachable spring-cage connector blocks. To insert or release a wire, push in the tab as shown in Figure 5. Pin out numbering listed below for all terminal blocks, see section 7.2 for related input/outputs.

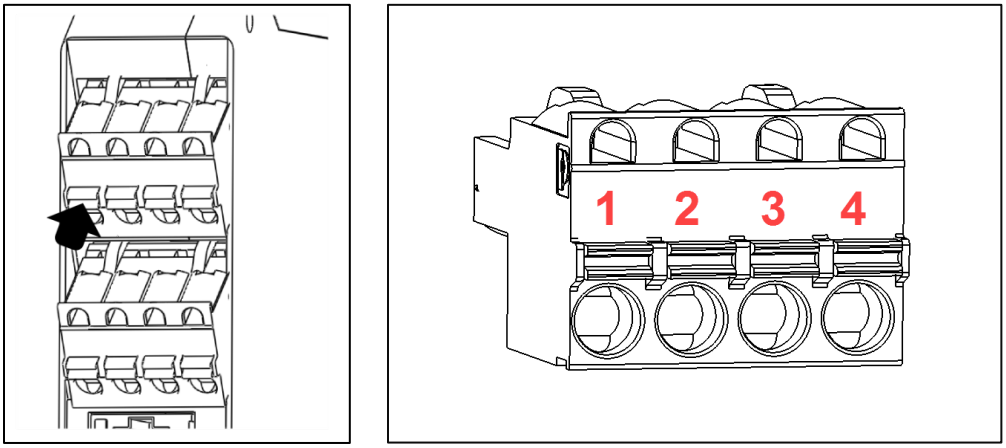


Figure 5: Wire release tab

In some situations, it may be necessary to remove the entire plug assembly. This can be done by pulling the connector down and away from the device. If a tool is used care must be taken not to crush or pierce the plastic.

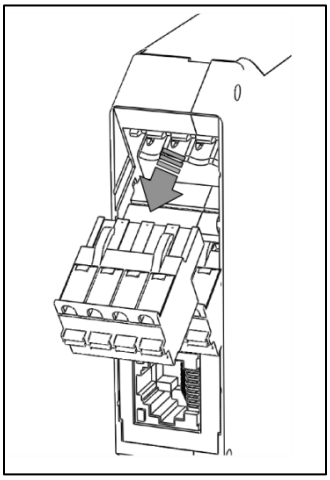


Figure 6: Terminal block removal

4.4.3. WIRING DIAGRAMS

The IFX-21 enclosure features a simplified wiring diagram for all permanent device connections.

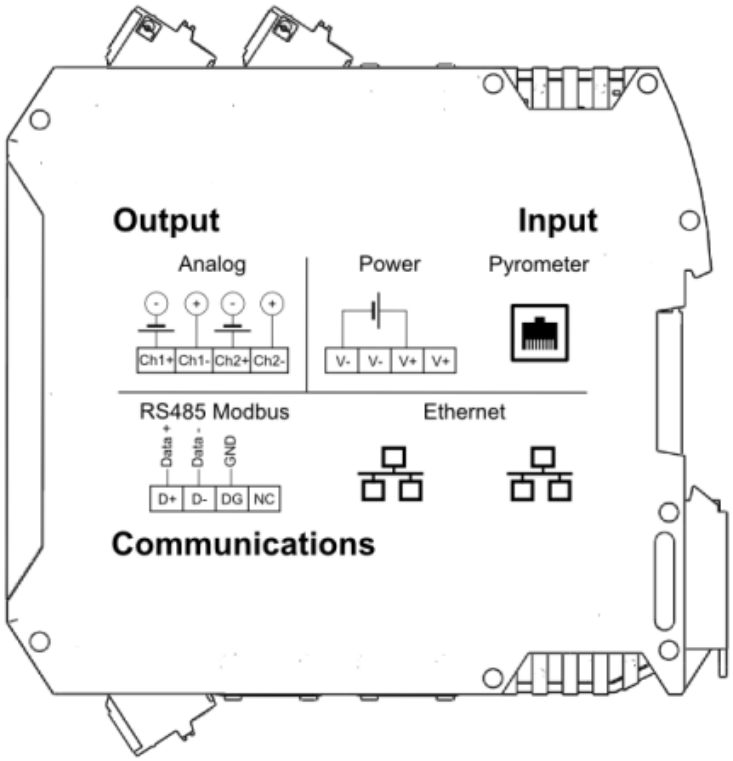
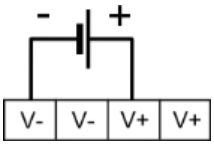
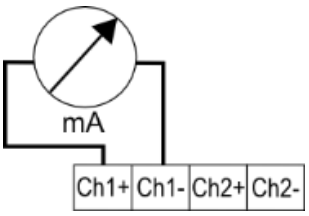


FIGURE 7: DEVICE WIRING

Additional terminal wiring information is provided in Table 1.

Power Supply	
20 to 28 VDC	
Analog Output	
Passive (Loop powered)	

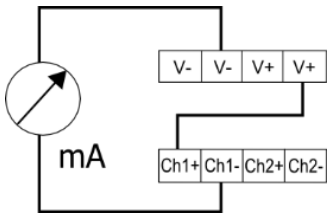
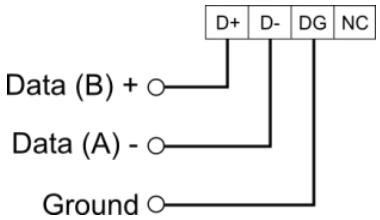
Active* (Supplying power to loop)	
Modbus	
TIA-485-A (RS485)	

TABLE 1: EXPANDED DEVICE WIRING

*The IFX-21 is natively a passive analog device, it will modulate incoming current but it provides no voltage. If required the incoming power may be routed to also provide power to the analog loop, though doing so will compromise the isolation of the analog loop.

5. Device Operation and Setup

5.1. Overview of Connection Methods

An important feature of the IFX-21 is its support for daisy chaining multiple units together. In Figure 8 examples are shown of the minimum connections necessary to receive temperature readings over various protocols. In these examples 4 units are shown, however the methodology would be the same for any number of units.

BASF recommends that only communication connections necessary to the application be implemented. Redundant connections, such as utilizing both Modbus and Ethernet, should be avoided unless they are for periodic service purposes only.

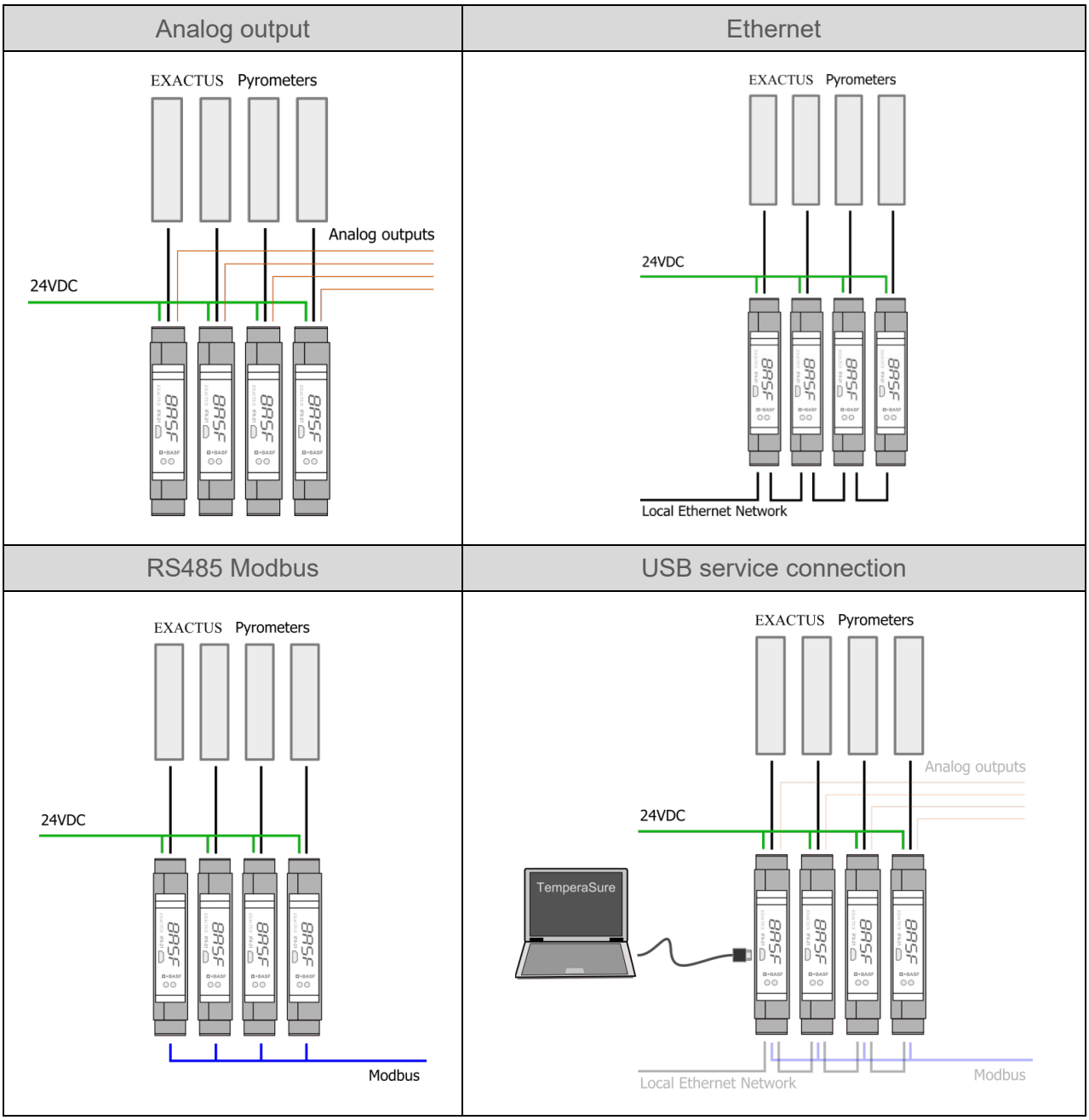


Figure 8: Connection methods for the IFX-21

5.1.1. USB Service Connection

The USB port is intended for setup and maintenance of the IFX-21. It may be utilized for the short term collection of readings from a connected pyrometer. Long term data collection is not recommended. Windows 10 is recommended for all USB service port connections.

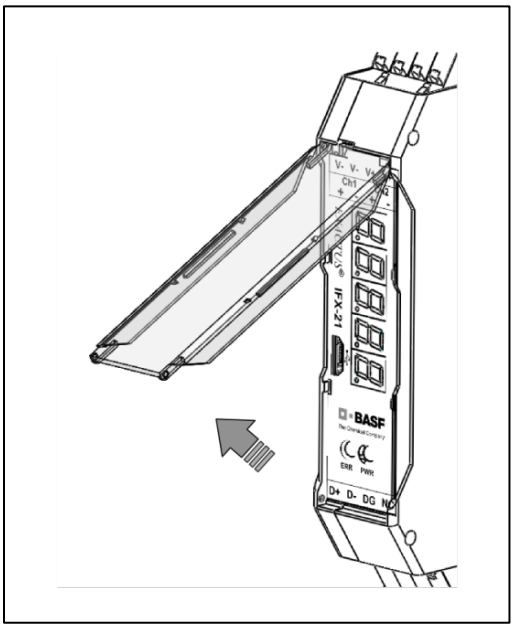


Figure 9: Accessing the USB port

5.2. Value Display and Indicating LEDs

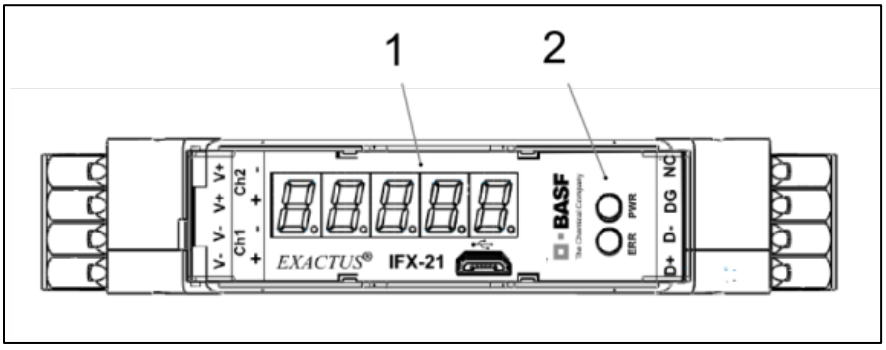


Figure 10: Device display

1. Process Temperature display
2. Error and power indicating LEDS

During normal operation the IFX-21 will display the temperatures measured by the ***EXACTUS®*** Pyrometer. While the TemperaSure pyrometer management software is running this display will switch to either the user entered channel identification text or the pyrometer serial number. For complete alphabet mapping and standard messages see Appendix 7 Segment Display Alphabet.

Note: Last Segment decimal point flashes when data is received from pyrometer.

Overall device status can be determined by observing the red and green status LEDs. Refer to Table 2 for more information.

Green “PWR” LED	Red “ERR” LED	Meaning
Off	Off	No power applied
Solid	Off	Device powered on, Pyrometer is functioning normally
Solid	Solid	IFX-21 has experienced a fault / failure
Solid	Flashing	Pyrometer not present or experiencing a fault condition

TABLE 2: STATUS LED BEHAVIOR

5.3. DEVICE CONFIGURATION

Configuration of the IFX-21 allows a user to change the device IP address, set custom ambient temperature alarms, and adjust the pyrometer supply voltage.

Analog output settings and advanced operation modes, such as peak picking mode, must be configured within the Pyrometer. Please see the ***EXACTUS*** Optical Thermometer User Manual for more information.

5.3.1. DEFAULT PARAMETERS

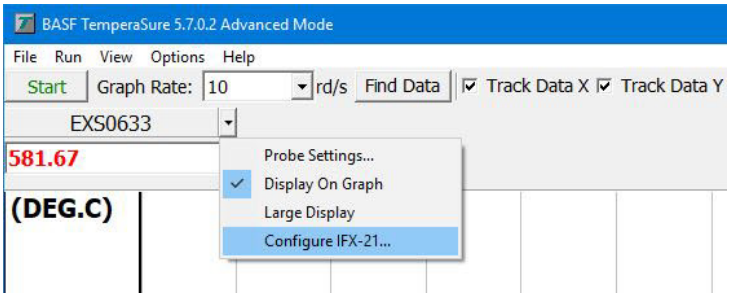
The IFX-21 ships with the following default parameters:

- Analog output is enabled.
- Instrument Ambient Alarm will trigger when internal IFX-21 electronics temperature goes above 70ºC (158ºF). [NOT ENABLED]
- Instrument Ambient Alarm will trigger when Pyrometer internal electronics goes above 60ºC (140ºF). [NOT ENABLED]
- The Pyrometer Supply Voltage is set to 6.2V – adequate for standard pyrometer power/communication cables up to 15 meters (50 ft).
- Initial Static IP Address is set to 192.168.1.80. [Restore Factory Default will not change IP address.]

5.4. The Configuration Menu

5.4.1. Connecting via TemperaSure®

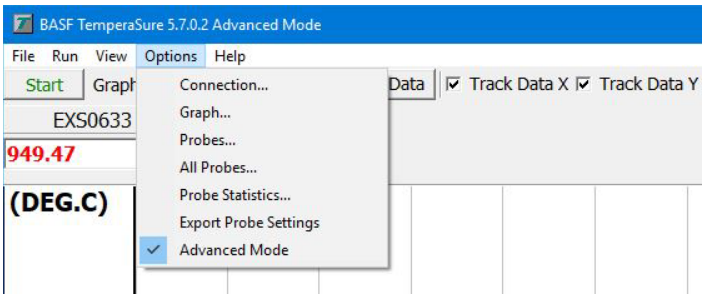
With an active Ethernet or USB connection the IFX-21 may be configured through the included TemperaSure software by selecting “IFX Settings” from the pyrometer channel menu.

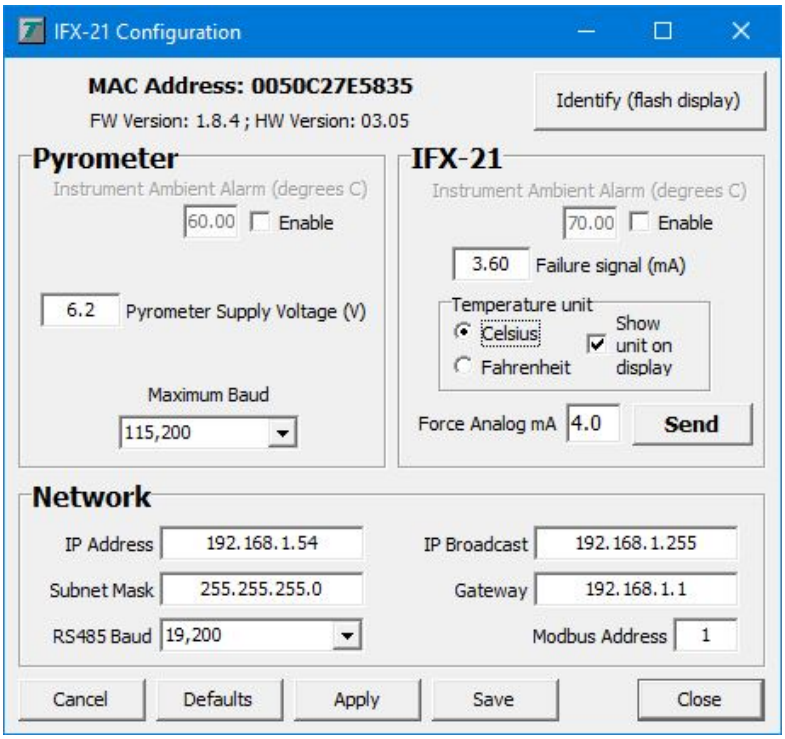


5.4.2. IFX-21 Configuration

The IFX-21 has a configuration menu which allows the user to set several internal parameters.

Note: TemperaSure must be in ‘Advanced Mode’ to access. Selected under “Options”.





5.4.3. USB Driver installation

When operating an IFX21 over USB use Windows 10. No drive install is required.

5.5. Analog Output Operation

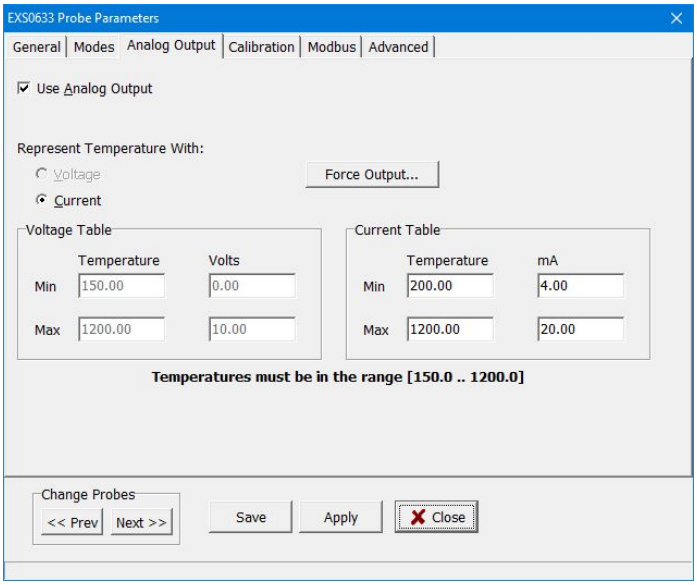
The analog output value will depend on the status of the full setup and connections.

With the loop powered, the output value could be the following:

IFX Power	Pyro Connection	Output Value
Yes/No	Yes/No	≤1.8mA, Analog Output malfunction or failure
No	Yes/No	2.2mA, Default Output
Yes	Yes	2.7mA, Analog Output is NOT enabled in Pyrometer settings
Yes	No	“Failure signal (mA)” [Default 3.6mA]
Yes	Yes	Measured Temperature Reading

5.6. Analog Output Configuration

Use TemperaSure to configure the analog output scales.



6. Maintenance

Periodically check device for signs of water, oil, dirt, etc. If necessary, clean it by disconnecting the DC power and wiping with a soft, slightly damp cloth.

7. SPECIFICATIONS

7.1. GENERAL

Display	5 character, 8 Segment LED
Supply	20 to 28VDC, 150mA
Operating Temperature	-20 to 70°C
Humidity	5 to 90% RH non-condensing
Storage temperature	-40 to 85°C (-40 to +185°F)
Din rail mount	35mm DIN
Weight	150g
Dimensions	23mm wide x 119mm high x 114mm deep (0.89”x4.67”x4.5”)
EMC standards	IEC61326-1 Ed2:2012, EN61326-1 Ed2:2013 Industrial Environment, NAMUR NE21 (09.05.2012)
Safety standards	IEC61010-1 Ed3:2010
Atmosphere	Not suitable for explosive or corrosive atmospheres

7.2. TECHNICAL

7.2.1.1. ANALOG OUTPUT

Absolute Accuracy	0.2% of reading, 4-20mA
Accuracy vs. Ambient Temperature	±15ppm/°C, 4-20mA
Connector	Removable 4 pin, 5.00/5.08mm plug
Isolation	2.5kV
Linearity Error (End to End)	±0.01% of full scale, Monotonic, 4-20mA
Max. Update Rate per Channel	1KHz
Max. Voltage At Output Pins	30VDC (≤24VDC recommended)
Min. Voltage At Output Pins	6VDC
Number of Outputs	2 (Mirrored output)
Output Range	1.8 - 24mA
Output Ripple	0.003% of full scale
Output Signal	See Section 5.5 Analog Output Operation
Output Stability and Repeatability	±0.4µA after 10min. Warm-up typical
Output Type	Current modulator
Over-Current Protection	Limited to 70mA

Pin Assignments	Pin 1: Channel 2 - Pin 2: Channel 2 + Pin 3: Channel 1 - Pin 4: Channel 1 +
Resolution	16-bits 0.37µA/LSB
Reverse Polarity Protection	Yes
Settling Time, Full Scale Change	500 µs

7.2.1.2. ETHERNET PORTS

Communications	10/100 Base T Ethernet
Connector	RJ45
Data Transfer Rate	10/100 Mbps
Ethernet Protocols	TCP/IP, Modbus TCP/IP, Telnet configuration, DHCP (Default Protocol IP Address assigned)
Isolation	2.0kV
Exposed Ethernet Ports	23: Telnet Port for configuration 502: Modbus/TCP Port
Max. Link Distance	100 meters (328 feet)
Port Type	Switch

7.2.1.3. PYROMETER PORT

Connector	RJ45
Electrical Protocol	RS-422 Full Duplex
Bit Protocol	Asynchronous, 8-bit, 1 stop, parity none
Data Rate	EX#-#10: 115,200-921,600 bits/second EX#-100: 115,200-230,400 bits/second
Isolation	700 V
Protection	ESD protection on all communication lines, Pyrometer power supply protected against shorts
LED Indicators	Green: Data from pyrometer Amber: Data to pyrometer
Pin Assignments	Pin 1: Tx+ (A) to pyrometer Pin 2: Tx- (B) to pyrometer Pin 3: Rx+ (A) from pyrometer Pin 4: NC Pin 5: NC

	Pin 6: Rx- (B) from pyrometer
	Pin 7: Supply +6 to 8VDC (user configurable), 110mA
	Pin 8: Ground

7.2.1.4. Power Input

Connector	Removable 4 pin, 5.00/5.08 mm plug
Input Voltage Range	20 to 28 VDC
Power Consumption	150mA, 2.9 W Max, 100mA typical with pyrometer
Isolation	700V
Pin Assignments	Pin 1: +V
	Pin 2: +V
	Pin 3: -V
	Pin 4: -V

7.2.1.5. Modbus TIA 485-A (RS485)

Connector	Removable 4 pin 5.00/5.08mm, plug
Electrical Protocol	RS-485 Half Duplex
Bit Protocol	Asynchronous, 8-bit, 1 stop
Data Rate	1,200 - 1,250,000 bits/second
Isolation	1.5kV
Protection	ESD protection on all communication lines
Pin Assignments	Pin 1: Data (B) D+
	Pin 2: Data (A) D-
	Pin 3: Data Ground
	Pin 4: NC

7.2.1.6. USB

Connector	Mini-B USB
Data Rate	12mb/s
Isolation	2.5kV
USB Protocol	USB 2.0

8. WARNINGS

Failure to follow the instructions and specifications contained in this user manual may result in impaired device function.

Use of an ***EXACTUS***® pyrometer without an ***EXACTUS***® retransmission device, such as the IFX-21 or IMF8, may degrade measurement quality.

Device temperatures above or below the recommended operating range will affect temperature measurement accuracy. Temperatures exceeding 60ºC may result in device shutdown. Use radiation shielding or the optional purge air where appropriate to keep the device within operational limits.

9. TROUBLESHOOTING

9.1. TROUBLESHOOTING INSTRUCTIONS

Symptom	Cause	Remedy
Display inactive	No power supply connected	Check power supply of the device
	Power supply applied, device is defective	Device must be replaced
No analog output	Analog output is disabled	Enable probe analog output in TemperaSure
	Probe is not plugged in	Check probe connection
Device operation is intermittent	Probe cable is too long (>15m [49ft])	Increase probe power supply voltage in the IFX-21 configuration menu
	Power supply is defective	Replace power supply
	Power supply is underrated	
	Voltage drop between device and supply	Check voltage at device input. Increase power supply voltage if necessary
TemperaSure cannot connect to the IFX-21 over Ethernet	IFX-21 device IP address is not set properly	Use Telnet or the USB service port to change the device IP. If necessary contact your network administrator.

9.2. Repair, Service, and Returns

Repairs may only be carried out by BASF or BASF authorized agent, this device contains no user serviceable parts. Devices returned to BASF must be shipped in protective packaging. Use the Contacts listed in Section 1 for further instructions and to obtain an RMA number.

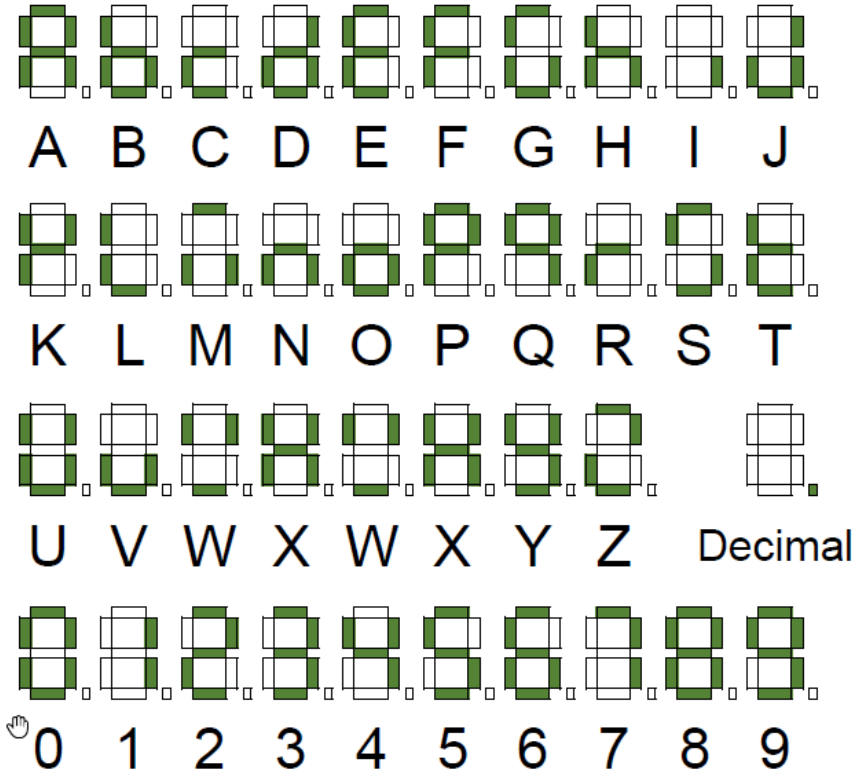
9.3. Disposal

This device contains electronic components and in the event of disposal must be treated as electronic waste. Consult your local regulations before disposal.

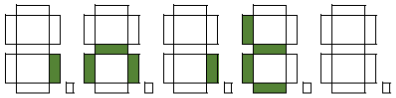
10. Appendix

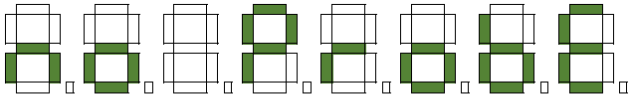
10.1. 7-Segment Display

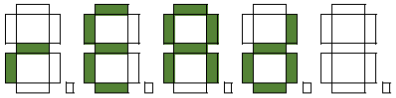
10.1.1. Alphabet



10.1.2. Messages







INIT = Shows on power-up until pyrometer (probe) is discovered.

NO PROBE = Shows when pyrometer (probe) fails to connect or is disconnected. The full text will scroll to be readable.

READ = Shows during downloading of pyrometer (probe) settings.

10.1.3. Pyrometer Serial Number

Typical pyrometer models are listed above with an example of unit's full serial number. All serial numbers will have 7 digits (3 alpha and 4 numerical).

10.2. MODBUS/TCP

10.2.1. Conventions

This section describes the MODBUS/TCP protocol implementation in the BASF ***EXACTUS***® IFX-21. Where hexadecimal constants are used, they are preceded by 0x (e.g. decimal 15 is 0x0f.) This document does not describe the details of the MODBUS/TCP protocol (see www.modbus.org for more information)

10.2.2. TCP/IP Port

MODBUS/TCP is implemented over port 502, the standard port number for MODBUS/TCP.

10.2.3. MODBUS Addressing

Each MODBUS device has an 8-bit address. All of the pyrometers are configured to respond to the MODBUS address 0x01. When using MODBUS/TCP, always leave the pyrometer address at 0x01. Use a unit ID (UID) of 1 in the poll.

10.3. MODBUS/RTU (RS485) Implementation

The IFX21 must be configured with a MODBUS address. This value is the slave address for the IFX21 interface itself. No MODBUS registers are presently defined for the IFX21; however this address is reserved. To address the pyrometer attached to the IFX21, use the next address.

For example, if the IFX21 is assigned the MODBUS slave address 1, the attached pyrometer will be automatically assigned the address 2. This translation is done by the IFX21 itself and does not relate to the MODBUS address assigned to the pyrometer in TemperaSure. The pyrometer address should ALWAYS be left at the default of 1 in TemperaSure. The IFX21 automatically translates the RS485 network address to the pyrometer address and back.

NOTE: Since the automatic address feature causes two addresses to be allocated, one for the IFX21 and one for the pyrometer, make sure no other device on the network uses either of those addresses. For example, if an IFX21 is assigned the MODBUS slave address 1, addresses 1 and 2 will be allocated, and no other MODBUS device on the RS485 network may be assigned either of those addresses. If a network has multiple IFX21 devices, they must be addressed at least 2 slave addresses apart (i.e., first device at 1, second device at 3, third device at 5.) In this example, the pyrometers would be addressed at 2, 4, and 6.

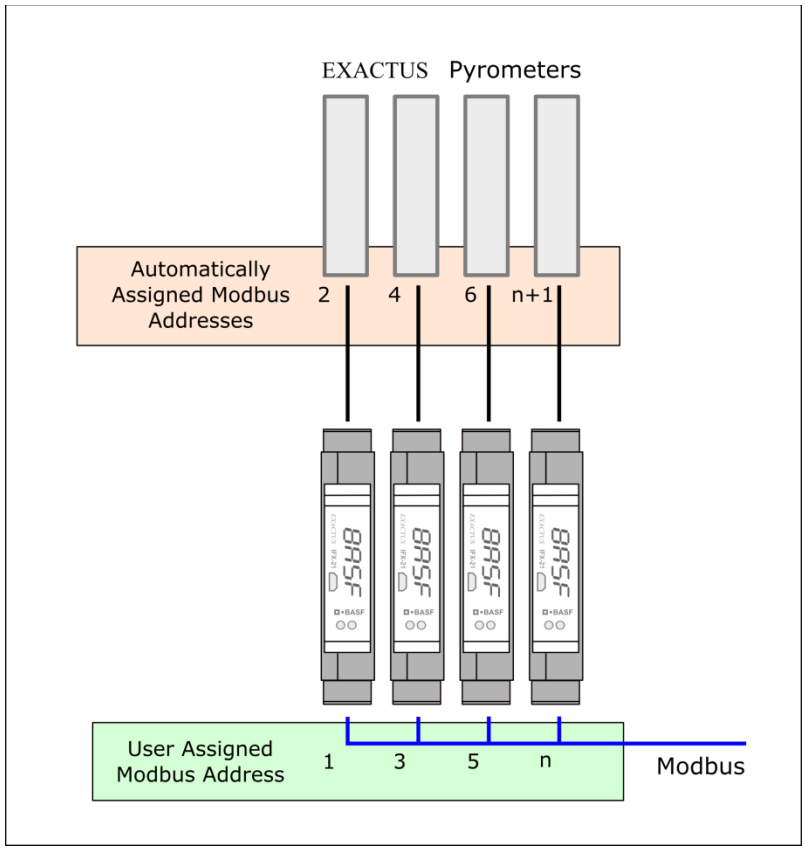


FIGURE 11: AUTOMATIC ADDRESSING

10.4. MODBUS REGISTER MAP

The MODBUS/TCP register map is identical to the pyrometers. No MODBUS locations are added or removed. See the pyrometer documentation “BASF Communication Specification.pdf” for details.