G3 RIO

Remote I/O Device

Flexible remote I/O for PLC's, SCADA systems & H.M.I's

The G3 RIO is a remote I/O device with a rich range of analog and digital options.

Analog expansion options: Process or Universal

The **process input** option offers a straightforward solution for high channel density analog applications, with inputs suited for connection to 4-20mA transmitters or sensors.

The **universal input** option offers exceptional all-round performance, with full galvanic isolation and universal input type. Directly connecting the inputs to sensors like RTDs and Thermocouples eliminates external transmitters - slashing costs AND increasing performance.

Up to 16 universal inputs can connect directly to:

- ✓ **Temperature Sensors** (RTD and T.C)
- ✓ **Process Inputs** (0/4-20mA, 0-10V)
- ✓ **Direct Voltage** (measurements from +-200mV to 0-18V)
- ✓ **3-wire Potentiometers**, and
- ✓ **Digital Pulses** (incorporating fast counting, de-bounced counting flow rate and RPM inputs)

Up to **8x 4-20mA outputs** round out the analog options.

Digital I/O

The G3 RIO comes standard with 4 high-speed digital inputs. Optional add-ons include up to **3 relays** and up to **32 opto isolated digital inputs** and **32 opto isolated transistor outputs**.

Flexible Comms Options

The unit comes standard with one **Ethernet port** and one **RS485 Modbus port**. The RS485 port can be used as a Server or Client, and the easily configurable Modbus Client can be used to get data from Modbus sensors and/or Modbus controllers.

An optional **Wi-Fi port** can also be added, to save wiring costs if a Wi-Fi network is available, or it can set up its own network to communicate with other devices.

Base Features

Included by DEFAULT

- ✓ 4x High speed Digital inputs
- ✓ 2x 4–20mA inputs (non-isolated)
- ✓ PC configuration, USB interface
- ✓ RS485 Modbus RTU client/server
- ✓ Ethernet 10/100 port
- ✓ AC/DC mains or 11–30V low power operation

+ Add-On options available - see p3

CONTENTS

ORDER CODES

Base Unit		Optional Add-Ons					
Family	Power Supply	EX Certification	Network	Relays *1	Analog IO *2	Digital IO	Factory Option *3
		All add-on columns are optional. Leave blank to omit option.					
G3-RIO	-HV -LV	-EX	-W -X	-RLY	-UI8 -UI16 -AO4 -AO8 -PI8 -PI16 -UI4-AO4 -UI8-AO8 -UI8-PI16 -PI8-AO4 -PI8-AO8	-DO8 -DI16 -DI32 -DO16-DI16 -DO32-DI32	-VV -TV -TA -TT -XX

Base Unit

Base Unit Configuration	
G3 RIO processor module base configuration: 1x Ethernet port, 1x RS485 serial port. 2x non-isolated 4-20mA inputs, 4x digital inputs.	**G3-RIO**

Power Supply	(Select)
High Voltage (85–265V AC / 120–300V DC) power supply	**-HV**
Low Voltage (11–30V DC) power supply	**-LV**

Optional Add-Ons

Certification	(Optional)
Leave blank for no Ex Certification	
ADD Ex Rated for use in hazardous locations	**-EX**

Network	(Optional)
Leave blank for default (Ethernet) Networking	
ADD Wi-Fi (802.11bgn) to default configuration	**-W**
REMOVE Ethernet port (no networking)	**-X**

Relays (*1)	(Optional)
Leave blank for no Relay Outputs	
ADD 2x Relay outputs (form A) + 1x Auxiliary power output	**-RLY**

***1** OEM customers that do not require the 'EX' add-on can request an additional 1x Form C relay (Relay A). Please enquire for further information.

Analog IO (*2)	(Optional)
Leave blank for no additional Analog IO	
ADD 8x Isolated universal input	**-UI8**
ADD 16x Isolated universal input	**-UI16**
ADD 4x Isolated process (4-20mA) output	**-AO4**
ADD 8x Isolated process (4-20mA) output	**-AO8**
ADD 8x Non-isolated 4-20mA input	**-PI8**
ADD 16x Non-isolated 4-20mA input	**-PI16**
ADD 4x Isolated universal input + 4x Isolated process (4-20mA) output	**-UI4-AO4**
ADD 8x Isolated universal input + 8x Isolated process (4-20mA) output	**-UI8-AO8**
ADD 8x Isolated universal input + 16x Non-isolated 4-20mA input	**-UI8-PI16**
ADD 8x Non-isolated 4-20mA input + 4x Isolated process (4-20mA) output	**-PI8-AO4**
ADD 8x Non-isolated 4-20mA input + 8x Isolated process (4-20mA) output	**-PI8-AO8**

***2** OEM customers may be offered additional **Analog IO** option codes constructed from a combination of any one of the following codes:
<Blank>, '-UI2', '-UI4', '-UI6', '-UI8', '-UI10', '-UI12', '-UI14', '-UI16'

Followed by any one of:
<Blank>, '-PI4', '-PI8', '-PI12', '-PI16', '-PI20', '-PI24', '-PI28', '-PI32'

Followed by any one of:
<Blank>, '-AO2', '-AO4', '-AO6', '-AO8'

Not all combinations are valid due to physical restrictions on the total number of channels. An example of an ordering code with a non-standard **Analog IO** configuration would be: '**G3-RIO-HV-UI2-PI4-AO2-DO8**'

Digital IO	(Optional)
Leave blank for no additional Digital IO	
ADD 8x Isolated open collector outputs	**-DO8**
ADD 16x Bipolar digital inputs	**-DI16**
ADD 32x Bipolar digital inputs	**-DI32**
ADD 16x Isolated open collector outputs **+** 16x Bipolar digital inputs	**-DO16-DI16**
ADD 32x Isolated open collector outputs **+** 32x Bipolar digital inputs	**-DO32-DI32**

Factory Option (*3)	(Optional)
When left blank, process inputs A and B are configured as two 4-20mA inputs. This is the standard ordering option.	
Analog inputs A and B configured as 2x 0-10V inputs	**-VV**
Analog inputs A and B configured as 1x NTC temperature input **AND** 1x 0-10V input	**-TV**
Analog inputs A and B configured as 1x NTC temperature input **AND** 1x 4-20mA input	**-TA**
Analog inputs A and B configured as 2x NTC temperature inputs	**-TT**
Analog inputs A and B omitted from the product (no connector)	**-XX**

3** **Factory Option** codes are available only to customers that meet MOQ thresholds. For normal orders this section will be blank. The **Factory Option** may be any one of: ***<Blank>, '-VV', '-TV', '-TA', '-TT', '-XX'

Accessories

Required Accessories (Sold Separately)	
USB Bridge Key, required for programming	**BRIDGE-KEY**

To get going with your device, visit:

defineinstruments.com/go/g3

SAFETY NOTICES

For your safety and the prevention of damage to the G3 RIO unit and other equipment connected to it, **please read complete instructions prior to installation and operation of the G3 RIO and carefully observe all safety regulations and instructions. Consult this manual carefully in all cases where hazard symbols are marked on the G3 RIO unit.**

Use of this instrument in a manner not specified by the manufacturer may compromise the protection provided by the instrument. This instrument should not be used to directly drive valves, motors, or other actuators, unless equipped with appropriate safeguards. It is the responsibility of the user to identify potential hazards that may arise in the event of a fault to unit, and implement safeguards for the prevention of harm to persons or equipment. The safety of any system incorporating this unit is the responsibility of the assembler of the system.

(EN) WARNING! EXPLOSION HAZARD! Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

(FR) AVERTISSEMENT! RISQUE D'EXPLOSION! Ne pas débrancher l'équipement sans avoir coupé l'alimentation ou s'être assuré que la zone est sans danger.

Symbol Definitions

(EN)

CAUTION!
Risk of electric shock
Please refer to user manual.

CAUTION!
Risk of danger
Please refer to user manual.

Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION.

Direct current.

Both direct and alternating current.

Définition Des Symboles

(FR)

DANGER!
Risque de choc electrique
Veuillez vous référer au manuel d'utilisation.

DANGER!
Risque de danger
Veuillez vous référer au manuel d'utilisation.

Matériel entièrement protégé par une DOUBLE ISOLATION ou une ISOLATION RENFORCÉE.

Courant continu.

Courant continu et alternatif.

1 SPECIFICATIONS

1.1 - Base Unit Specifications

Included by DEFAULT

General Specifications

Power supply
HV Model: 85–265V AC 50–60Hz / 120–300V DC Overvoltage Category II
LV Model: 11–30V DC

Excitation output
HV Models: 24–27V Typ. @40mA
LV Models: DC Input Voltage @100mA (PTC Fused)

* *Limit applies to the sum of all excitation (EXC) currents.*

Power consumption 10W max, 6W typical

Linearity & repeatability <±0.1% FSO

RF immunity <±1% effect FSO typical

Noise immunity (CMRR) 160dB tested at 300V RMS 50Hz

Permanent memory (EEPROM) 100,000 writes per input parameter

Process Analog Input

2x (4–20mA) Process inputs (A & B)

Input resolution 12 bits

Accuracy <±1.0% FSO (unless otherwise stated in input specifications)

Input isolation Not isolated to power supply or digital inputs

Input add-ons available (see p9)

Digital Input

4x Built-in Digital inputs

Functions Status, up counter, up/down counter with direction, debounced counter, frequency, gated frequency

Counter register output 32 bit

Frequency range 0–10,000Hz (0–1,000Hz in Sleep Mode)

Threshold 1.65V typical

Input types NPN, PNP, Clean Contact, Voltage 0–30V DC

Debounce counter range 0–100Hz

Isolation Not isolated to power supply or analog inputs

Maximum voltage 30V DC

Input impedance >300KΩ

Digital I/O add-ons available (see p10)

Configuration

USB programmable Via 'PC Setup' port using Bridge Key* USB programmer
* *Sold separately*

Define WorkBench Simple configuration software. Free download at defineinstruments.com/workbench

Comms

Ethernet ModBus TCP (Server), HTTP. Link Speed:10/100Mbps.
IP Config: Static, DHCP Client, DHCP Server

Protocols Modbus RTU, Define ASCII, Custom (via Macro Script)

Serial Port (Port 2) RS485
Selectable baud rate 2400-230400 baud
8 bit, no parity, 1 stop bit

EIA-485 Compliant

To add or remove Comms (see p9)

Network Protocols

ModBus TCP Register access (Server)

MDNS Service Discovery

STNP Time service

Device Firmware Updates Firmware update through serial interface or via local network interface (if available)

Environmental Conditions

Operating temperature
-40°F ≤ Ta ≤ 149°F (-40°C ≤ Ta ≤ 65°C)

Storage temperature
-40°F ≤ Ta ≤ 149°F (-40°C ≤ Ta ≤ 65°C)

Operating humidity
5–85% RH max, non-condensing

Altitude Up to 6,550ft (2,000m)

Construction

Casing DIN 35 rail mounting;
Material: PC/ABS blend V0 (UL94)
IP20 rated. Installation Category II;
Pollution Degree 2; Flame resistant

Terminals Removable screw terminal connectors. Alternative spring terminal connectors available on request.*

* *Subject to ordering quantity and lead time restrictions.*

Dimensions (HxWxD)
3.98x0.91x4.72” (101x23x120mm)**

** *Base unit housing with no expansion modules. Excludes antenna and connectors.*

Compliance Approvals

EN55032: 2015 + A11: 2020 Class A device

EN 61326-1:2006
Immunity to Industrial Locations

EMC: EN61326-1: 2006 Class A

Safety requirements for electrical equipment for measurement control, and laboratory use:
EN 61010-1 General Requirements
EN 61010-2-201 Particular requirements for control equipment

FCC (Specific models) See Appendix B

ICES-003 (Specific models) See Appendix C

UL Listed File number E534675

c UL US LISTED

Ex Approved available as an optional extra (see p9)

1.2 - Expansion Options

Optional ADD ONS

Ex Approval* *EX*

File Number E539767

Class I, Division 2, Groups A, B, C, D Hazardous Locations

UL 24 ATEX 3205X

II 3 G Ex ec nC IIC T3 Gc

Standards
EN IEC 60079-0:2018
EN IEC 60079-7:2015/A1:2018
EN IEC 60079-15:2019

* *See Appendix D for more information.*

Comms *W, X*

Wireless Networking (W)

Wi-Fi Protocol
802.11b/g/n. 150Mbps max. 2.4GHz*

* *Not compatible with 5GHz Wi-Fi networks. Check your configuration as most access points can run 2.4GHz and 5GHz simultaneously*

Antenna height 3.35" (85mm)

Required mounting height with antenna 6.69" (170mm)

Remove Ethernet Port (X)

Remove Ethernet Port Specify order code 'X' to remove the default Ethernet port for a no networking option*

* *Minimum order quanitites apply*

Relays *RLY*

Add Relay Outputs B, C & D (RLY)

2x Form A Relays (Relays B & C)
3A 250V AC or 3A 30V DC (resistive load)

Life expectancy (Relays B & C)
100K Cycles at max load rating

1x Auxiliary power output (Relay D)
HV Models: 40mA max*
LV Models: 100mA max*

* *Maximum total Excitation (EXC) limit applies.*

OEM Option - Relay A*

1x Change over Form C Relay (Relay A)
8A 250V AC or 8A 30V DC (resistive load)

Life expectancy (Relay A)
100K Cycles at max load rating

* *OEM customers that do not require the 'EX' add-on can request an additional 1x Form C relay (Relay A). Please enquire for further information.*

Isolated Universal Input* *UI4, UI8, UI16*

Isolation 50V DC max working voltage between any input, and digital ground or other isolated inputs or outputs

Isolation test voltage 1500V AC, 2 seconds

Input resolution 16 bits

Accurate to <±0.1% FSO

* *See Section 6 (p35) for universal input specifications and wiring.*

Isolated Analog Output *AO4, AO8*

Analog output type Loop powered, isolated 4–20mA or 20–4mA DC

Loop power supply User supplied, must be a UL rated SELV/PELV Class III* power supply between 12V and 26V DC

* *Class III Equipment: See Appendix E.1*

Isolation 50V DC max working voltage between isolated analog output(s), and digital ground and all other isolated inputs or outputs

Isolation test voltage 1500V AC, 2 seconds

Minimum external loop load
500Ω @24V, 250Ω @18V, 0Ω @ 12V

Internal loop drop 10V max

Resolution 15 bits, 16000 steps

Linearity & repeatability 0.1% FSO max

Accuracy 0.1% FSO max

4–20mA Input Expansion *PI8, PI16*

0(4)–20mA Process inputs (Ch 1–16)*

* *These are additional to the 2x Process analog inputs (A & B) that come with the base unit*

Input voltage 24V DC max

Input impedance 50Ω

Input resolution 16 bits

Accurate to < 0.1% FSO

Isolation A common ground is shared between groups of four process input signals. (E.g. CH1/CH1_SEC + CH2/CH2_SEC).
The common reference is isolated to the main controller ground and all other isolated inputs and outputs, to a max working voltage of 50V DC

Isolation test voltage 1500V AC, 2 seconds

Digital I/O Expansion *DO8, DI16, DI32 DO16–DI16, DO32–DI32*

Digital open collector outputs Outputs are separated into isolated groups of 16 channels. 0.5A max per channel, 4A max total per group

Bipolar digital inputs +/-11–25V DC
1.6mA typ @12V, 3.5mA typ @24V
Inputs are separated into 2 isolated groups of 8 channels per 16 channel module

Power supply User to supply an 11–25V DC SELV/PELV Class III* UL rated power supply (or supplies) to power digital inputs and supply digital outputs

* *Class III Equipment: See Appendix E.1*

Over voltage protection 30V DC max

Isolation Max 50V DC working voltage between user supplied supply, and digital ground of controller and any isolated inputs or outputs

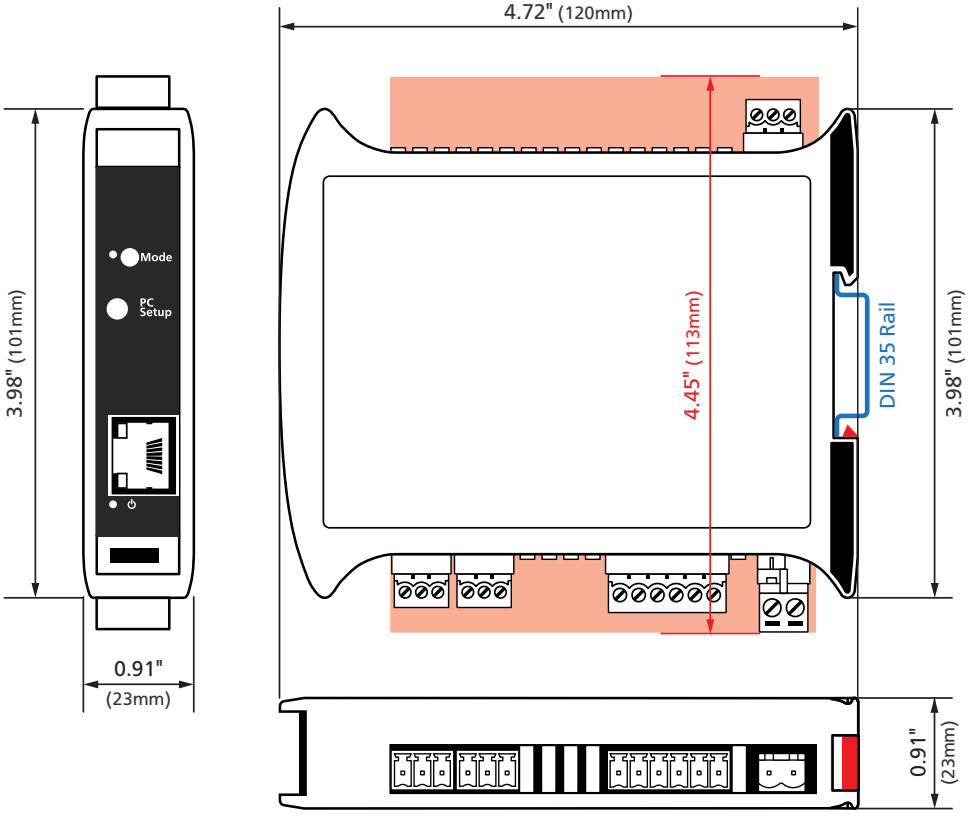
Isolation test voltage 1500V AC, 2 seconds

NOTE: See page 3 (Order Codes) for ordering information for optional add-ons.

2 DIMENSIONS & FRONT PANEL

2.1 - Dimensions (Base Unit)

Included by DEFAULT



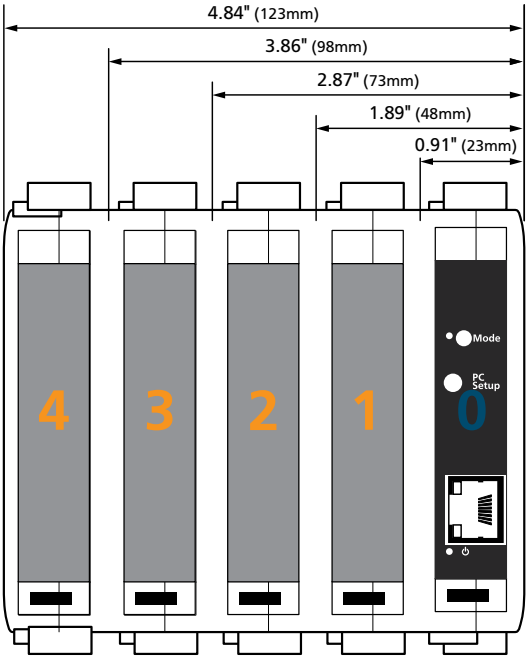
2.2 - Dimensions (Expanded Units)

Optional ADD ONS

Total Device Width & Weight

Case	Total Width	Weight*
0**	0.91" (23mm)	8oz (220g)
1	1.89" (48mm)	14oz (390g)
2	2.87" (73mm)	19oz (550g)
3	3.86" (98mm)	23oz (650g)
4	4.84" (123mm)	26oz (750g)

* *Device weights are approximate*
** *Case 0 is the Base Unit with no expansions*



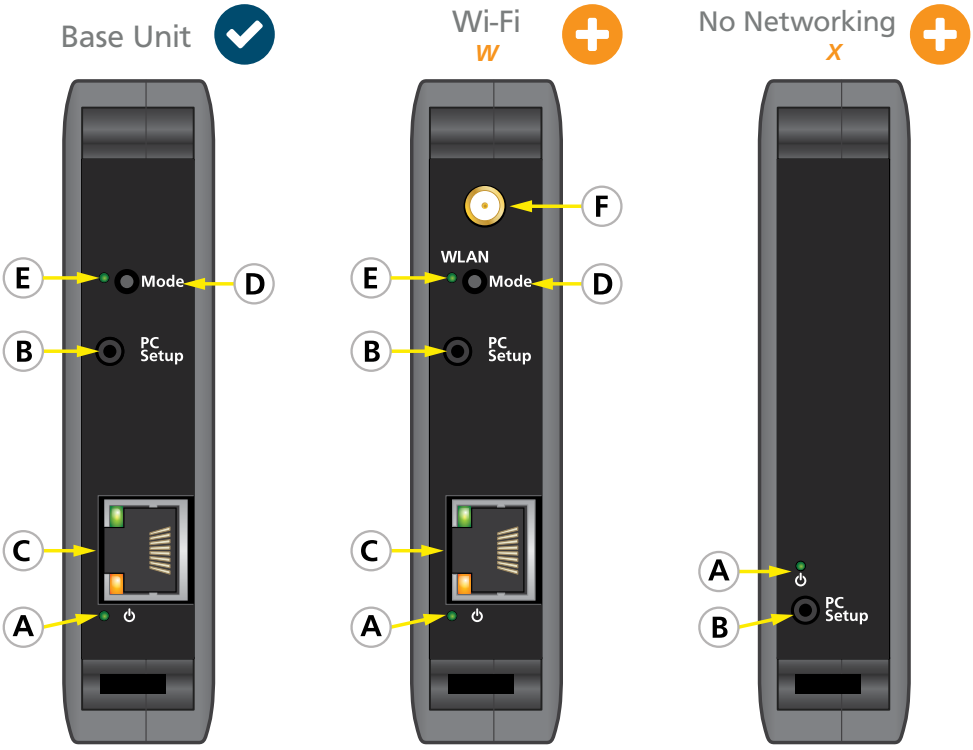
Case Expansions by Order Code

Refer to the following table for the number of case expansions to add for different model codes.

Note that **Power Supply**, **Certification**, **Network**, **Relay** and **Factory Option** are installed on the base unit and do not require any expansion units.

Model	Power	Certification	Network	Relay	Analog IO	Digital IO
G3–RIO	–HV –LV	–EX	–W –X	–RLY		
+1 EXPANDER					**+1 EXPANDER** –UI8 –AO4 –AO8 –PI8 –PI16 –UI4–AO4	**+1 EXPANDER** –DO8 –DI16 –DO16–DI16
+2 EXPANDERS					**+2 EXPANDERS** –UI16 –UI8–AO8 –UI8–PI16 –PI8–AO4 –PI8–AO8	**+2 EXPANDERS** –DI32 –DO32–DI32

2.3 - Front Panel



Included by DEFAULT		
A	Power LED	*See 2.4*
B	PC Programming Port	*See 4.2*
C	Ethernet Port	
D	Mode Button	*See 2.6*
E	Mode LED (Network Controller Status)	*See 2.5*

Optional ADD ONS		
F	Wi-Fi Antenna Port	*See 2.7*

2.4 - Power LED

Off | Green | Orange | Red

LED Pattern		Device Status
	Slow green flash	**Normal.** Device is operating normally.
	Continuously red for more than 10 seconds	**Critical Error.** A critical error is preventing the device from operating normally.
	Slow red flash	**Configuration Error.** The device can still operate, but configuration has been compromised, which may affect measurement data, alarms or control. *Use WorkBench or Define Dash to get more information on the specific error number.*
	Fast orange flash, followed by a pause	**Warning.** Faster orange flashes followed by a brief pause indicate a warning. Count the number of flashes between pauses to determine the warning code. *Warning codes are application specific.*
	Very short red flash, once every 10 seconds	**Low Supply Voltage (LV Only).** A quick red flash every 10 seconds indicates that the supply voltage is insufficient for the device to run correctly. (This is for low voltage models only.)
	Very short green flash, once every 10 seconds	**Low Power Shutdown (LV Only).** A quick green flash every 10 seconds indicates that the device has entered low power shutdown mode to conserve power. It will not run any updates in this mode, but should return to normal mode after the prescribed time period. (This is for low voltage models only.)
	Changes green to orange to red and back again	**Boot Loader Mode.** Slowly changing from green to orange to red and back again indicates the device is running in boot loader mode. It may be doing a firmware update during this time. *Do not turn it off for several minutes to allow it to finish the update.*

2.5 - Mode LED (Network Controller Status)

Off | **Green** | **Orange** | **Red**

Station	Access Point	LED Pattern	
OFF	**OFF**		One short red blink, every 2 seconds
TRYING	**OFF**		Fast toggle between green/red, 4 times per second
OK	**OFF**		Slow green flash
SLEEP	**OFF**		Very short green flash, once every 2 seconds
OFF	**ON**		Slow orange flash
OFF	**TEMP**		Slow orange double flash
TRYING	**ON**		Fast red/green toggle interlaced with slow orange
OK	**ON**		Alternating green/Orange slow flash
OK	**TEMP**		Alternating green/Slow orange double flash

The **Mode LED** should never stay the same color for longer than 2 seconds. Wi-Fi *Station Mode* and *Access Point Mode* can both operate at the same time in some circumstances (see *Section 2.7, Wi-Fi Operating Modes* for more information).

2.6 - Mode Button

Pressing the **Mode Button** will temporarily enable the Wi-Fi *Soft Access Point Mode* for 60 minutes (or until restart). You can connect to this network from your phone or computer, and you will be directed to a setup page (or visit **http://192.168.4.1**) where you can configure the device internet connection.

The **Mode Button** can also be used to perform a factory reset or a firmware point rollback. To perform a reset, **REMOVE the Bridge Key cable from the device**, and then re-power the device while holding this button down, referring to the table below for hold times.

IMPORTANT! Remove the Bridge Key cable before performing a reset.

Hold Time	Bridge Key	Wi-Fi LED State	Action
10–20sec	Disconnected	 Fast red flash	**Factory Reset.** Some user settings, network names, passwords etc. are reset to default values
20–30sec	Disconnected	 Fast green flash	**Firmware Rollback.** Attempts to find an older version of firmware and revert to it.
>30sec	Disconnected	Normal operation	**None.** Normal boot.

2.7 - Wi-Fi Operating Modes

Station Mode

The most common operating mode for a Wi-Fi enabled G3 RIO is the **Station (or Client) Mode**. Station mode allows your device to connect to an existing network (i.e. router/access point etc.) as a client. This is the same mode your phone runs in when it connects to your home Wi-Fi, for example.

Depending on the plugin (See 4.4), it can be set up to automatically configure its IP address using DHCP (default setting), or can have a fixed (or static) IP address. The user must enter the SSID and passphrase of the Wi-Fi network that it is attempting to connect to.

Access Point Mode

Some WorkBench plugins also allow a Wi-Fi enabled G3 RIO to be run as an access point that other devices can connect to, and which is totally independent of any other networks. This can be useful if there are no Wi-Fi networks available, or if they are not accessible for security reasons.

When running in **Access Point Mode**, the G3 RIO will function as a DHCP server and can work with up to 5 Clients. You will be able to see the network it creates from your phone or computer, and set your own SSID, passphrase, and also which Wi-Fi channel to use.

The Access Point can be temporarily enabled by pushing the **Mode** button on the front panel. This mode allows you to set up an internet connection, or view status information from a mobile device while on site, without requiring access to a PC.
(See 2.6 for more info.)

NOTE:

The G3 RIO is capable of running **Station Mode** and **Access Point Mode** concurrently. **Access Point Mode** can only provide local access to device data and settings. It does not allow the device to connect to the internet.

3 INSTALLATION

3.1 - Installation Environment

The G3 RIO should be installed in a location that does not exceed the maximum operating temperature, and at a safe distance from other devices that generate excessive heat. The installation environment should provide good air circulation to the unit.

The plastic casing and product label may be cleaned, if required, using a soft, damp cloth and neutral soap product. **Caution should be exercised when cleaning the unit to avoid water dripping inside, as this will damage the internal circuits.**

3.2 - Installation Instructions

This unit is rated IP20, and should be mounted in a protective enclosure to protect the unit from weather conditions and dust. If using Wi-Fi, the unit must be located within range of a Wi-Fi network. The maximum distance is 1476ft (450m) with Line Of Sight.

A - Plastic Enclosure (Fig 1)

Prepare a **Plastic Enclosure** (not supplied) as illustrated by mounting a **DIN 35 rail**, cable glands, and any other required components.

If your unit is fitted with the Wi-Fi addon, the antenna may be mounted directly on the G3 RIO (inside the **Plastic Enclosure**).

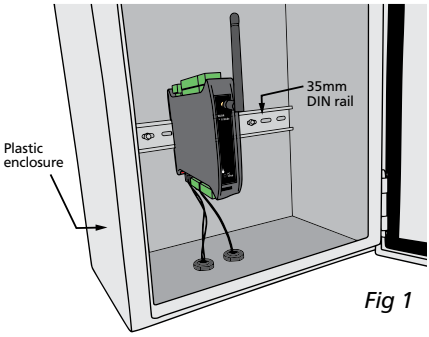


Fig 1

B - Metal Enclosure (Fig 2)

Prepare a **Metal Enclosure** (not supplied) as illustrated by mounting a **DIN 35 rail**, cable glands, and any other required components. *This enclosure type should be earthed.*

If your unit is fitted with the Wi-Fi addon, the **Metal Enclosure** will impede signal strength. In these cases, the antenna should be installed on the outside of the enclosure using a compatible antenna extension cable.

N.B. Exterior mounting is only suitable for indoor/covered outdoor environments where antenna is protected from rain or wet conditions.

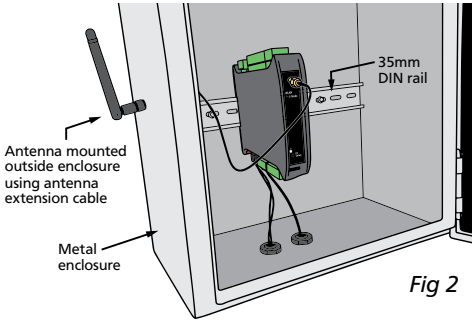


Fig 2

C - DIN Rail Mounting (Fig 3)

To clip the unit onto the DIN rail:
(**1**) Hook the upper part of the unit onto the rail, and then (**2**) Press down towards the rail until the red hook clicks into place.
Leave at least 0.79" (2cm) clear on either side of unit, and at least 1.97" (5cm) above and below, as space for airflow and wiring.

IMPORTANT! The device should be mounted in the vertical orientation as shown in Fig 1.

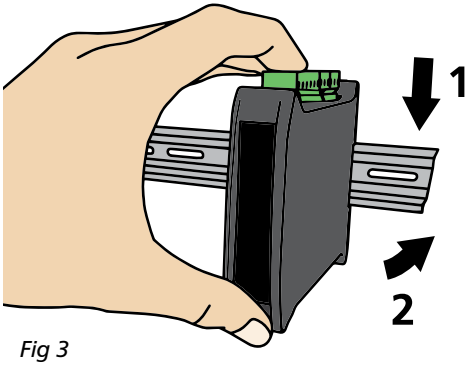


Fig 3

D - Wiring

Refer to Sections 5–6 in this manual.

E - Removal from DIN Rail (Fig 4)

To unclip the unit from the DIN rail, power the unit down and remove the power connector.

Then insert a small screwdriver into the slot on the red hook (just visible when the power connector is removed), and lever it down. This will release the hook, allowing the unit to be detached from the **DIN rail**.

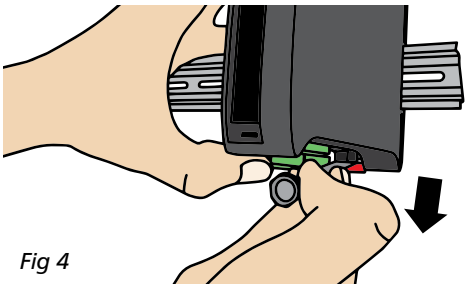


Fig 4

IMPORTANT!
The antenna supplied with Wi-Fi enabled models is **not suitable for outdoor or wet environments.**

