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

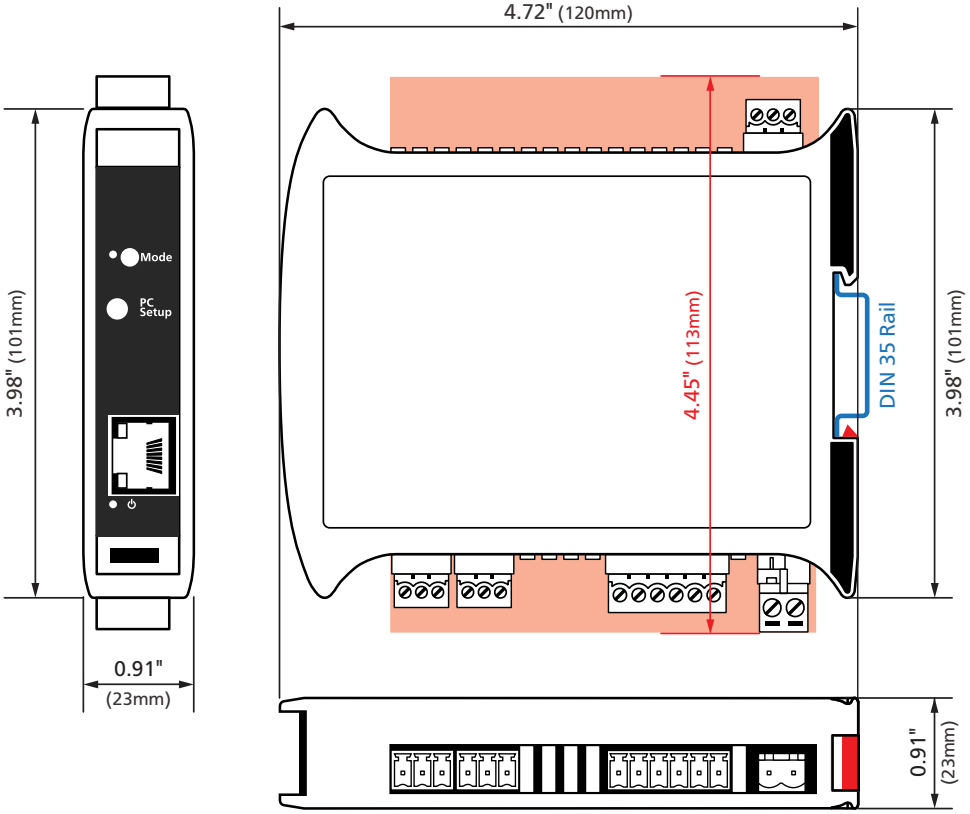
Isolation test voltage 1500V AC, 2 seconds

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



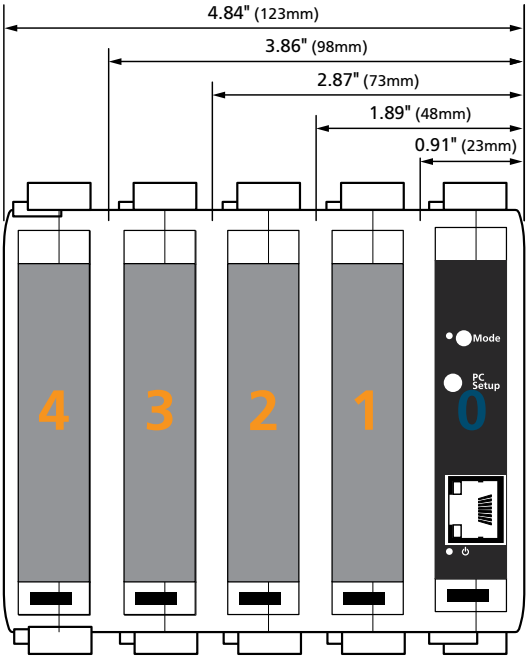
2.2 - Dimensions (Expanded Units)

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*



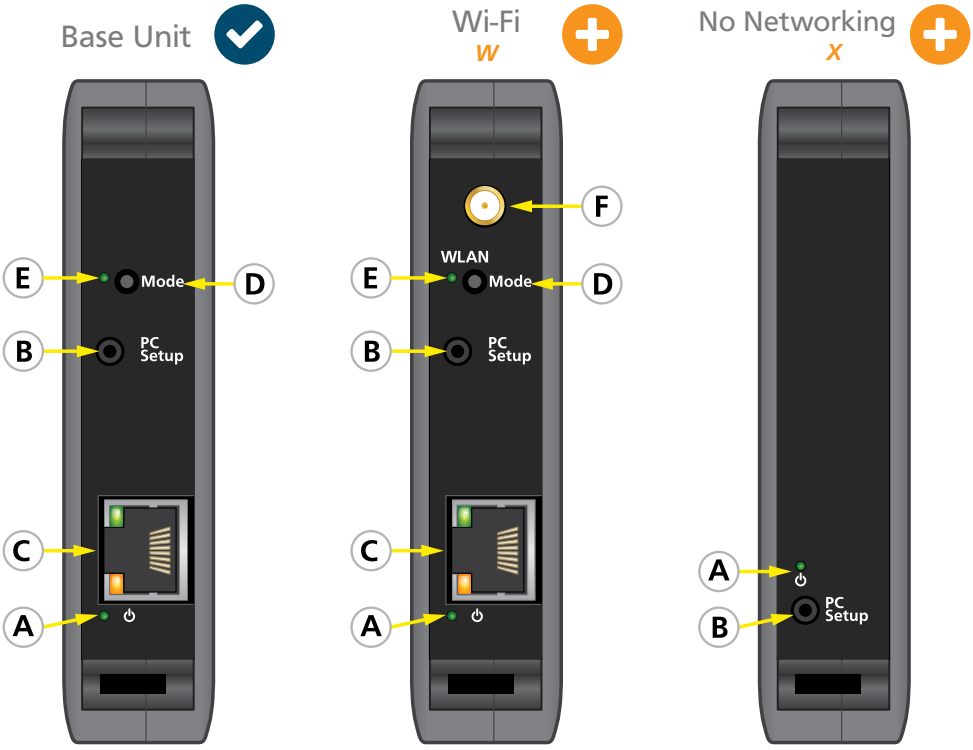
Case Expansions by Order Code

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**).

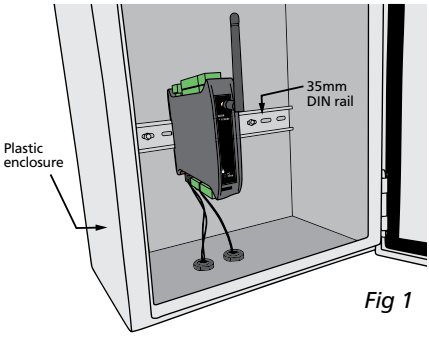


Fig 1

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.

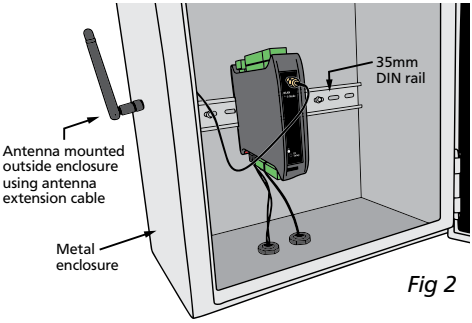


Fig 2

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.

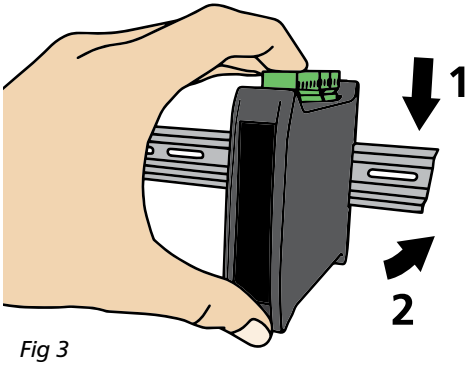


Fig 3

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**.

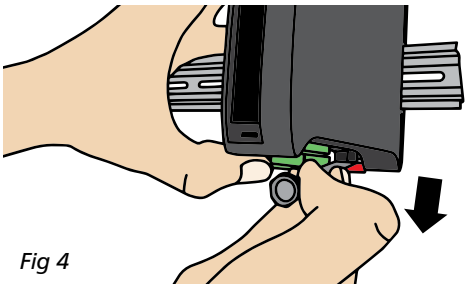


Fig 4

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

3.3 - EMC Installation Guidelines

The G3 RIO has been designed to cope with large EMC disturbances. This has been achieved by continual testing and improvement of filtering and layout techniques. The unit meets CE noise requirements, and even surpasses them in many tests. (For full details and test results, See Appendix A.)

However in some applications with less than optimum installations and large power switching, the EMC performance of the unit can be further improved by:

A Installing the unit in an earthed **Metal Enclosure** (as in Section 3.2, Fig 2). This is particularly useful if the control box is mounted close to large power switching devices like contactors. Every switching cycle there is a possibility of generating a large amount of near field radiated noise. The **Metal Enclosure**, acting as a faraday cage, will shunt this radiation to ground and away from the unit.

B Increasing the physical distance from the power devices. For example, increasing the control box distance from 6" to 12" from the noise source will reduce the noise seen by the control box by a factor of 4. (Probably the cheapest and best results in this situation could be obtained by adding RC snubbers to the contactors or power switches.)

C Using shielded cable on sensitive input and control signal lines. Good results can be obtained by grounding the shields to the metal enclosure close to the entry point. All cables act as aerials and pick up unwanted R.F. radiated signals and noise; the earthed shield acts as a faraday cage around the cables, shunting the unwanted energy to ground.

Shields can also help with capacitively coupled noise typically found in circumstances when signal cable is laid on top of noisy switching power cables. Of course in this case you are better off to keep separate signal and power lines.

D Laying cable on earthed cable trays can also help reduce noise seen by the G3 RIO. This is particularly useful if there are long cable runs, or the unit is close to radiating sources such as two way radios.

E If the Relay option (**RLY**) is installed, Relay A's outputs have built in MOV's to help reduce EMI when switching inductive loads. EMI can further be reduced at the load by adding snubbers for AC signals or a flyback diode for DC coils.

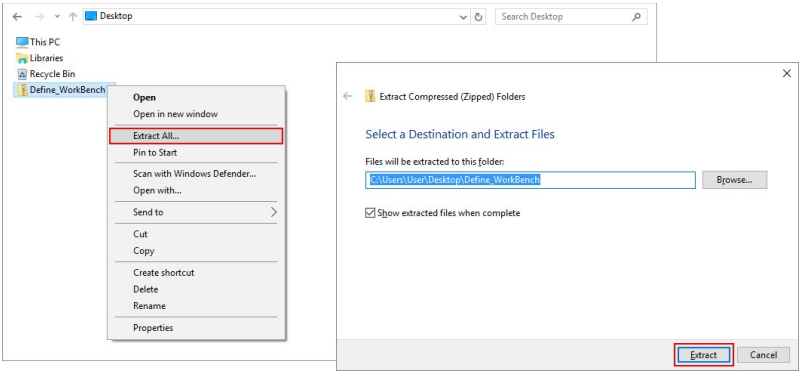
4 SOFTWARE SETUP

4.1 - Installing Define WorkBench

IMPORTANT! INSTALL WORKBENCH FIRST.
You must install WorkBench before connecting the G3 RIO to your computer.
If you have already connected using the Bridge Key, please disconnect it before continuing.

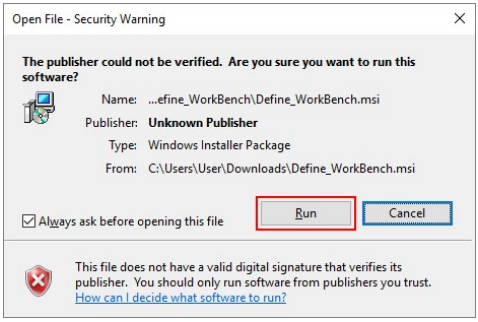
A Define WorkBench offers a comprehensive and yet simple-to-use setup tool for your G3 RIO. Download the latest version of WorkBench at: defineinstruments.com/workbench

B Extract the install file from the zip folder. Right-click on the zip folder and choose '**Extract All**', (or extract the file using another extraction utility of your choice).



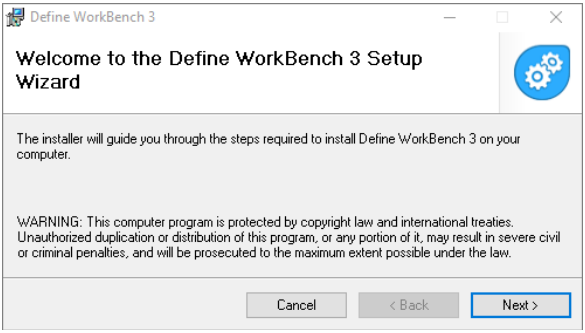
C Double-click on the extracted **.msi** install file. This will launch the WorkBench installer.

Depending on your security settings, a 'Security Warning' dialog may appear. If you see the security message, click '**Run**'.



D The WorkBench setup wizard will launch.

Click '**Next**' to get started.



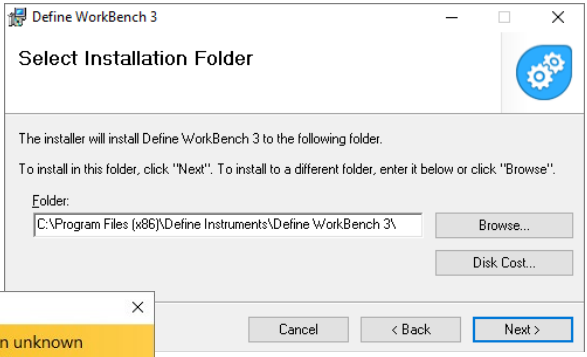
E The wizard will also ask for confirmation that you wish to begin the installation.

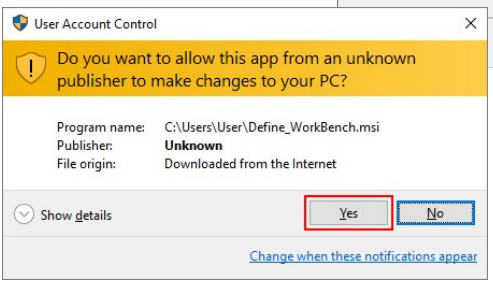
Click '**Next**' to continue.

F The wizard will then prompt you to select an installation folder.

You may accept the default installation folder, or select an alternative location by clicking '**Browse**'.

Click '**Next**' to continue.





G Depending on your security settings, the 'User Account Control' dialog may appear.

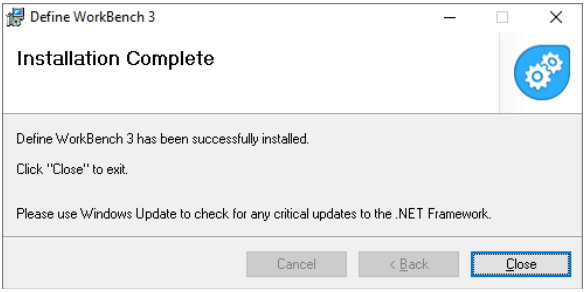
If it does, simply click '**Yes**' to allow the program to be installed on your computer.

H The install wizard will now install Define WorkBench. Please wait. This process usually takes 2–3 minutes, but may take longer in some situations.

I When the installation has successfully completed, the following dialog will appear.

Click '**Close**' to exit.

The installer will place an icon on your desktop for easy access to WorkBench.



4.2 - Connecting to your PC

CAUTION! RISK OF DAMAGE TO EQUIPMENT OR PC
Ensure that all connections between the Bridge Key and your G3 RIO are secure. Connecting your unit with cables that are not firmly 'pushed in' may result in connection faults, and in extreme cases could cause damage to your computer.
Do not unplug the Bridge Key or any connecting cables while WorkBench is busy applying changes to the G3 RIO. This may cause loss of settings, or unexpected unit behaviour.

CAUTION! NOT FOR PERMANENT INSTALLATIONS
The Bridge Key is not intended for use in permanent installations, as it is not rated for the full range of environmental conditions the unit may be subjected to. It is intended for use at room temperature only.

NOTE: BRIDGE KEY NOT UL APPROVED. The Bridge Key is sold separately to the G3 RIO, and is not UL approved.

A Connect the Bridge Key

To program your G3 RIO, connect one end of the **Interface Cable** to the 'PC Setup' port on the unit's front panel, and the other end to your **Bridge Key (sold separately)**. Then plug the **Bridge Key** into your computer's USB port (see Fig 5).

B Supply Power

Supply power to the G3 RIO (see Section 5.6).

C Connect to your G3 RIO in Define WorkBench

Launch Define WorkBench (see 4.1 for installation instructions), and select the 'Prog Port' tab. If your G3 RIO is powered up and connected via the Bridge Key, then the COM Port will be detected automatically.

Click the green 'Connect' button.

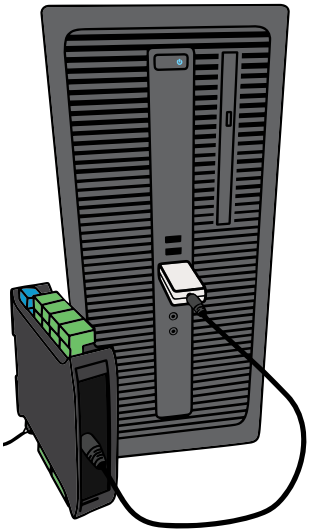


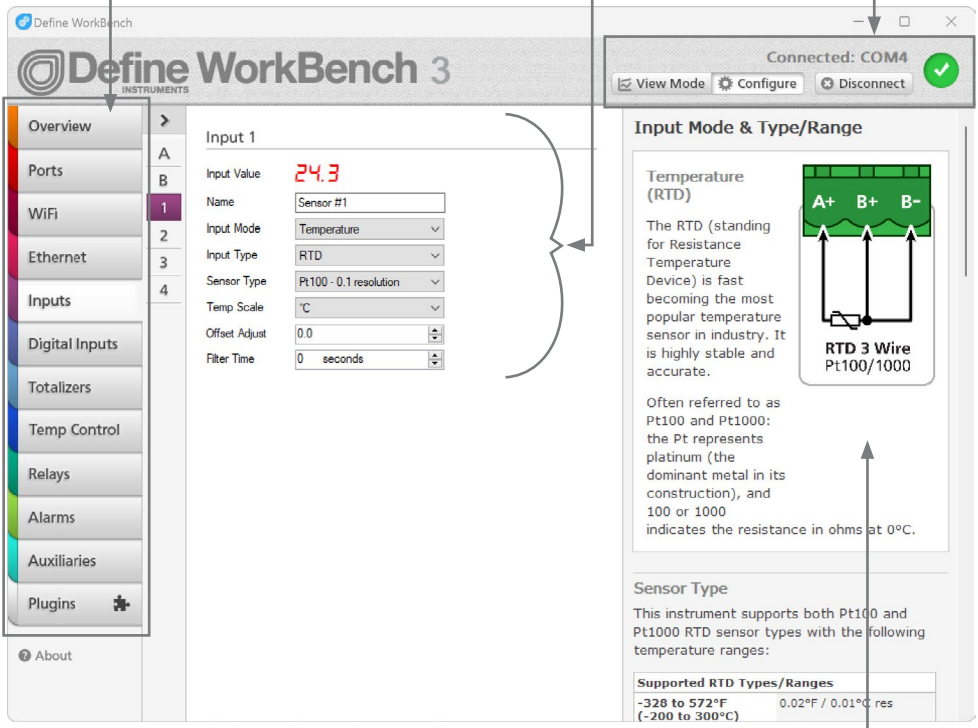
Fig 5

4.3 - WorkBench Interface

Main Navigation, including channel sub-navigation. See 4.4 for more information.

Control Area
Main control area for configuring your system. Any changes made in this area will bring up the **Apply Button**.

Connection Panel
Disconnect button
Connection status



Help Panel
Wiring diagrams, explanations and helpful tips will automatically appear in this panel as you configure the unit.

4.4 - WorkBench Navigation

Overview
View basic device information including Name, Serial Number and Firmware Version. Password protect, export a configuration certificate, and save/upload configuration settings.

Ports
Configure a range of settings for the RS485 serial port. (This tab may not be visible if you are connected to WorkBench using the RS485 serial port.)

WiFi **(WiFi models only)**
Configure Wi-Fi network settings and check connection status.

Ethernet **(Ethernet models only)**
Ethernet interface configuration and status.

Inputs
Set up and scale the input channels. Includes integrated wiring diagrams and examples.

Digital Inputs
Set up the four digital inputs and view their live status.

Totalizers
Configure up to 10 totalizers using either an input channel or a digital input as the source.

Temp Control
Configure up to 8 expanded digital outputs as on/off temperature controllers operating from analog input channels 1-8.

Relays **(Relay models only)**
Configure the relay outputs. These may be driven from one or more setpoints, or directly from one of the digital input pins.

Alarms
Configure up to 16 setpoints which can be activated by an input, a digital input or a totalizer. Configure alarms or control functions by selecting from a variety of pre-programmed modes.

Auxiliaries
Auxiliary channels are not directly associated with any physical inputs or outputs. They are generally used to store results generated by custom logic running in a plugin.

Plugins
Plugins are small programs which are loaded into the G3 RIO to expand its functionality or simplify its use. Use one of our standard applications, such as the configurable modbus client application, or write your own script for implementing custom logic and signal processing.

To get going with your device, visit:

defineinstruments.com/go/g3

5 WIRING

5.1 - Wiring Overview

Electrical Connections are made via plug in terminal blocks on the top, bottom, and front panel of the unit. All conductors must conform to the unit's voltage and current ratings, and be suitably rated for the expected temperature range to be incurred.
When wiring the unit, check all connections by comparing the terminal numbers shown on the unit label against the appropriate wiring diagrams in this manual (Sections 5 and 6), or in the Define WorkBench software.

Strip the wire, leaving around 0.25" (6mm) of bare lead exposed. The exposed conductors of stranded wires should be tinned with solder, or fitted with a ferrule to combine the individual conductors. Insert the lead into the correct plug in the correct position, and tighten until the wire is secure. Verify tightness by pulling gently on the wire.
Follow all local codes and regulations when wiring and installing the unit. Each terminal is rated to accept one wire as specified in the table below.

Terminal Pitch	Terminals (See 5.2)	Min	Max	Screw Torque*	EN
5mm	A, B, H, I, L, M, N	24 AWG	12 AWG	0.5-0.7N.m	
3.5mm	C, D, E, F, G, J, K	28 AWG	16 AWG	0.2-0.25N.m	

* *Some models may be supplied with alternate connectors that use a spring wire clamp mechanism instead of a screw, and do not have any applicable torque requirements.*

Espacement Des Bornes	Bornes (Voir 5.2)	Min	Max	Couple De Serrage*	FR
5mm	A, B, H, I, L, M, N	24 AWG	12 AWG	0.5-0.7N.m	
3.5mm	C, D, E, F, G, J, K	28 AWG	16 AWG	0.2-0.25N.m	

* *Certains modèles peuvent être fournis avec d'autres connecteurs qui utilisent un mécanisme de serrage à ressort au lieu d'une vis et pour lesquels l'exigence de couple de serrage ne s'applique pas.*

EN **CAUTION!** Cables connected to field wiring terminals should have a **minimum temperature rating of 221°F (105°C)**. Wire gauge must be chosen from the range shown in the table in Section 5.1. Use copper conductors only.

FR **DANGER!** Les câbles connectés aux bornes de câblage doivent avoir une **température nominale minimale de 221°F (105°C)**. Le calibre du fil doit être choisi dans la plage indiquée dans le tableau de la Section 5.1. N'utilisez uniquement que des conducteurs en cuivre.

5.2 - Connectors

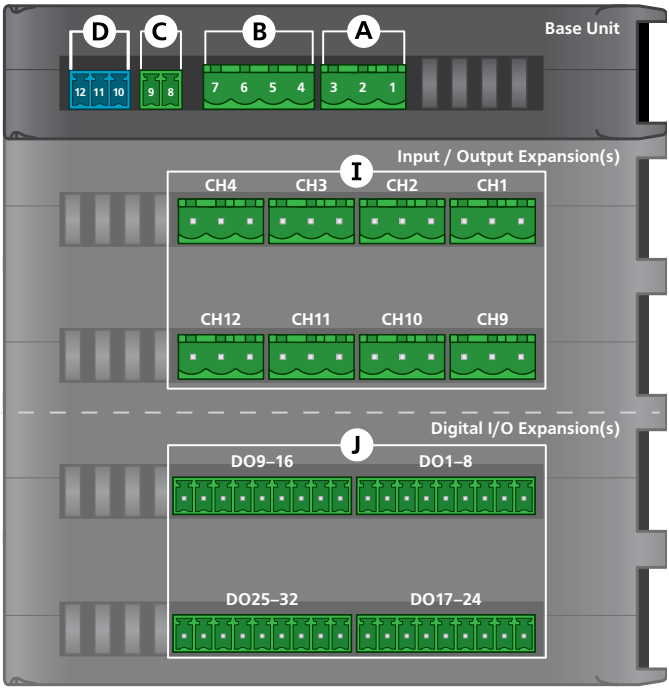
Included by DEFAULT

D	RS485 Serial Port (Port 2) *See 5.3*

Optional ADD ONS

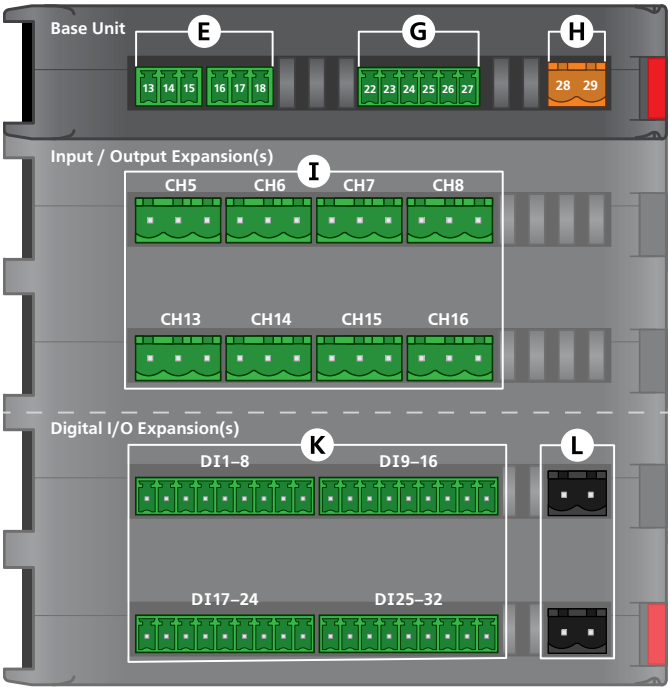
A	Relay A* *See 5.7*
B	Relays B & C *See 5.7*
C	Auxiliary Power Output (Relay D) *See 5.8*
I	Universal Input Expansion *See Section 6* Analog Output Expansion *See 5.9* 4–20mA Input Expansion *See 5.10*
J	Digital I/O Expansion – Outputs *See 5.11*

Top of Unit



*** Relay A is an OEM option which may be included on request**. It does not come standard with 'RLY' models. Refer to *1 in the Relay order codes table (p4).

Bottom of Unit



Included by DEFAULT	
E	Process Analog Inputs (Non-Isolated) *See 5.4*
G	Built-in Digital Inputs *See 5.5*
H	Power Supply (HV shown) *See 5.6*

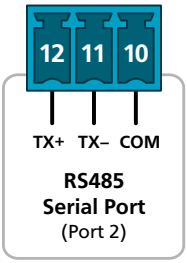
Optional ADD ONS	
I	Universal Input Expansion *See Section 6* Analog Output Expansion *See 5.9* 4–20mA Input Expansion *See 5.10*
K	Digital I/O Expansion – Inputs *See 5.11*
L	Digital I/O Expansion – Power Supply *See 5.11*

NOTE: Terminal F is not used for the G3-RIO.

5.3 - RS485 Serial Port (Port 2)

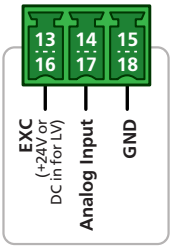
See 5.2 (D)

The RS485 Serial Port (Port 2) can be wired as shown.



5.4 - Process Analog Inputs (Non-isolated)

See 5.2 (E)

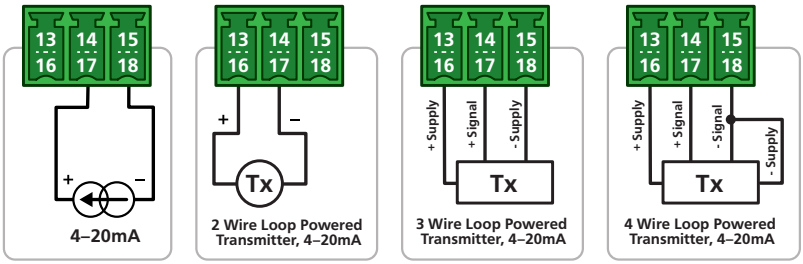


NOTE: This section is for the NON-ISOLATED PROCESS inputs which are included on the base unit.
To wire the **ISOLATED UNIVERSAL** inputs, see Section 6.

The G3 RIO has two non-isolated process inputs that are included with the base unit, and can be wired as shown. **Analog inputs A and B are fixed function; they will be supplied as 4–20mA inputs for all standard orders, and cannot be reconfigured by the end user.** *0–10V or NTC temperature input signals are available as non-stocked options. Minimum quantity and lead time restrictions may apply.*

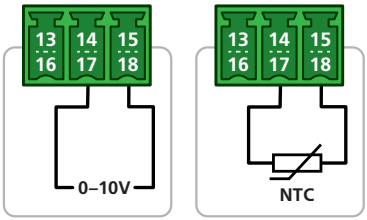
4–20mA Input

DEFAULT



0–10V or NTC

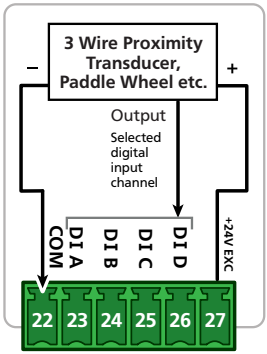
SPECIAL ORDER



See Factory Option (p5) for 0-10V or NTC Special Order options.

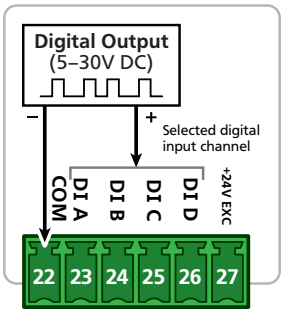
5.5 - Digital & Logic Input

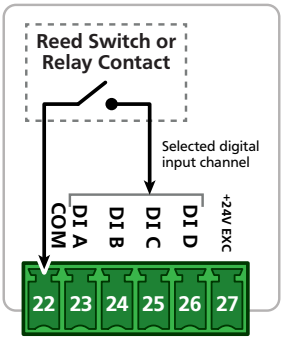
See 5.2 G

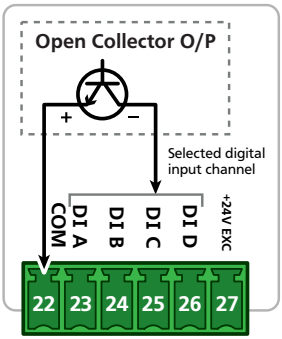


The G3 RIO has four Digital Inputs (A–D) which can be configured and scaled using Define WorkBench from the "**Digital Inputs**" tab, as per the list below:

- **Status** (active/inactive - can be read by a SCADA system as a general digital input)
- **Counter** (up to 10KHz, or 100Hz Debounced)
- **Frequency** (up to 10KHz)
- **Flow count** (up to 10KHz)
- **Flow rate** (up to 10KHz)
- **RPM** (up to 10KHz)

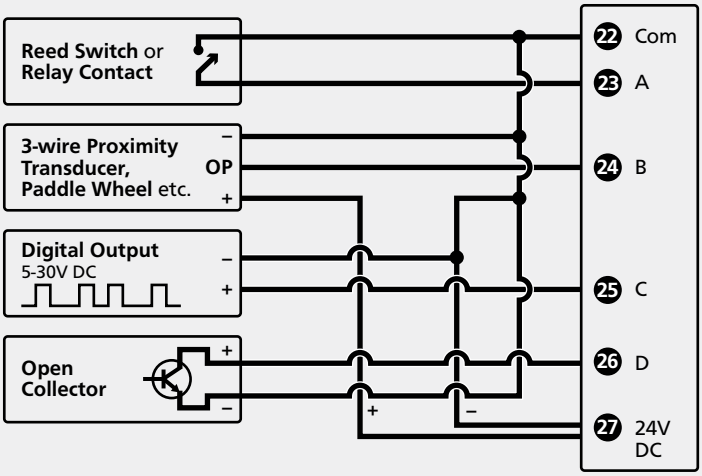






NOTE: The Digital Inputs can be configured in software to be either Sinking (active low input) or Sourcing (active high input). The diagrams in this manual are for **Sinking** wiring, which is the default configuration. To view **Sourcing** wiring, please refer to the help information provided in Define WorkBench.

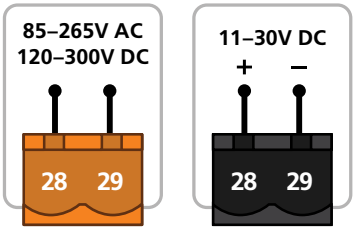
Connection example for digital inputs (A–D) using excitation from G3 RIO



Note 1 All cables must be screened, with screen earthed at one end only.

5.6 - Power Supply

See 5.2 (H)



Wire your power supply for either HV or LV:

HV Model 85–265V AC 50–60Hz / 120–300V DC (orange connector)

LV Model 11–30V DC (black connector)

(EN) CAUTION! RISK OF ELECTRIC SHOCK.

High Voltage AC/DC power supplied to the unit must be protected by a UL approved 10A circuit breaker. **Low Voltage DC power** must be supplied by a UL rated SELV/PELV Class III* power supply and further protected by a UL rated 2A, 250V fuse.

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

(FR) DANGER! RISQUE DE CHOC ÉLECTRIQUE.

L'alimentation haute tension CA/CC de l'unité doit être protégée par un disjoncteur 10A certifié UL. L'alimentation CC basse tension doit être fournie par une alimentation électrique SELV/PELV Classe III* homologuée UL et protégée par un fusible homologué UL de 2A, 250V.

** Équipement De Classe III: Voir L'Annexe E.1*

5.7 - Relay Outputs

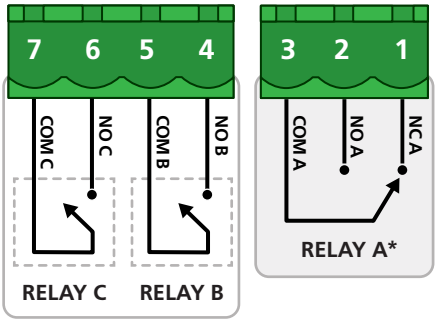
See 5.2 (A) + (B)

Optional ADD ON

If you ordered the **RLY** relay expansion, your G3 RIO unit is supplied with **2 Relay Outputs** and **1 Auxiliary Power Output** (See 5.8).

Relays B & C (3A 250V AC or 3A 30V DC) should be wired as shown (right).

Relay A* (8A 250V AC or 8A 30V DC) is **NOT** included with the 'RLY' add-on by default.



*** A third relay output (Relay A - Form C relay)** may be requested by OEM customers who do not require the 'EX' add-on. Refer to *1 in the Relay ordering table (p4).

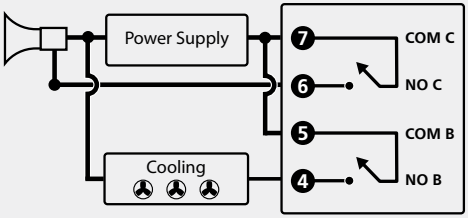
(EN) **CAUTION!** All relay terminals 1 to 7 are considered **hazardous live** if any contact is connected to a hazardous live voltage.

(FR) **DANGER!** Toutes les bornes de relais 1 à 7 sont considérées comme soumis à une **tension dangereuse** si l'un des contacts est soumis à une tension dangereuse.

Connection example for Relay Outputs B & C

Note 1 Example uses relays B and C

Note 2 3A (Form A) relays at 250V AC



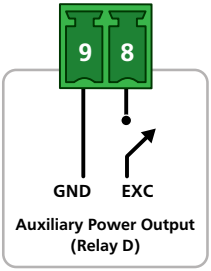
5.8 - Auxiliary Power Output (Relay D)

See 5.2 (C)

Optional ADD ON

If you ordered the **RLY** relay expansion, your G3 RIO unit is supplied with **2 Relay Outputs** (See 5.7) and **1 Auxiliary Power Output**.

The **Auxiliary Power Output** is is a switched DC output supply. It can used as excitation for low power equipment, or to drive an external relay. It is referred to as 'Relay D' in Define WorkBench.



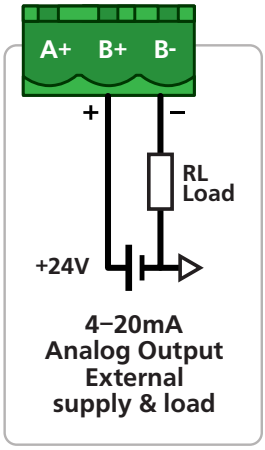
5.9 - Analog Output Expansion

See 5.2 I

Up to **8x Analog Outputs** are available as an optional add-on, and can be wired as shown, referring to the labelling on the unit.

Optional
ADD ON

NOTE: To wire the **ISOLATED UNIVERSAL INPUTS** also located in the **5.2 I** connectors, see Section 6.



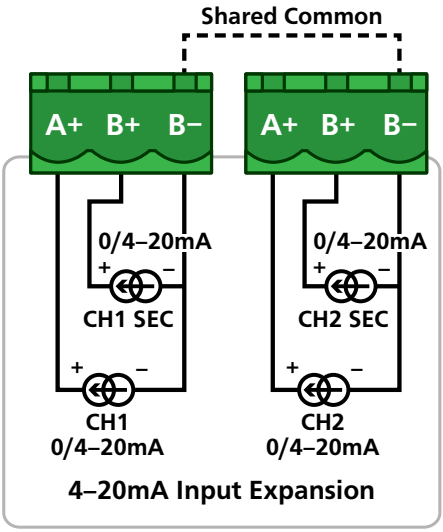
5.10 - 4–20mA Input Expansion

See 5.2 I

Up to **16x 4–20mA Process Inputs** can be added to your unit.

Process Inputs are grouped in lots of four - the diagram on the right shows example wiring for four inputs using the CH1 and CH2 connectors.

Optional
ADD ON



5.11 - Digital I/O Expansion

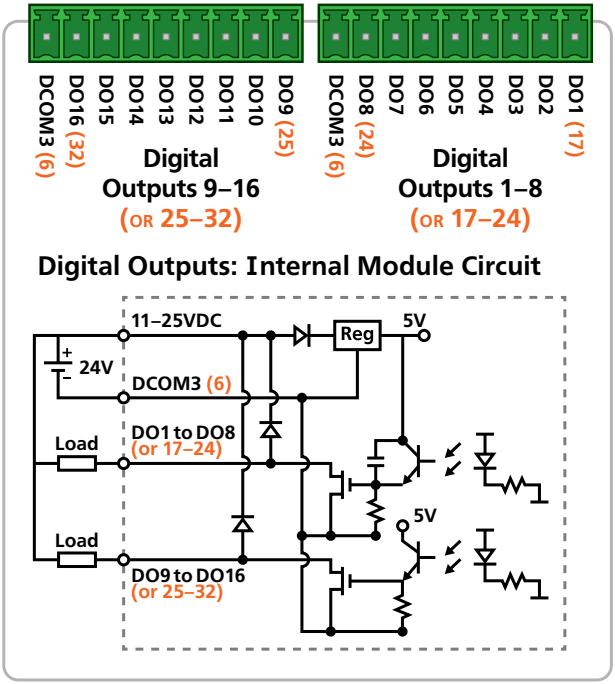
Digital Outputs

See 5.2 J

Additional Digital I/O's are available as an optional expansion to the four digital inputs (DI A - DI D) included on all models (See 5.5).

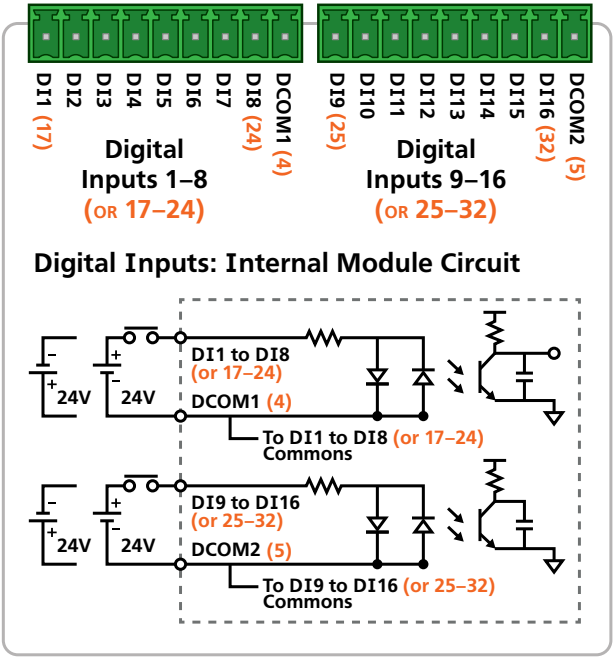
If installed, they can be wired as shown (right and overleaf), also referring to the labelling on the unit.

Optional
ADD ON



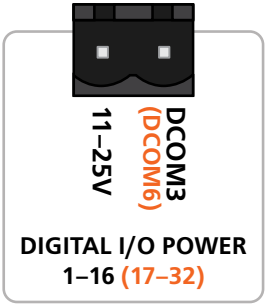
Digital Inputs

See 5.2 (K)



Digital I/O Power Supply

See 5.2 (L)



(EN) CAUTION! RISK OF ELECTRIC SHOCK.
User to supply a 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*

(FR) DANGER! RISQUE DE CHOC ÉLECTRIQUE.
L'utilisateur doit fournir une (ou des) alimentation 11-25V CC SELV/PELV Classe III* UL pour alimenter les entrées et sorties numériques.
* *Équipement De Classe III: Voir L'Annexe E.1*

6 UNIVERSAL INPUT SPECIFICATIONS & WIRING

(EN) CAUTION! RISK OF ELECTRIC SHOCK.
The external circuits connected to the universal inputs must be isolated from any mains supply or hazardous live voltages and should meet UL requirements for SELV/PELV Class III* circuits.
Temperature sensing elements (Thermocouple or RTD) connected to the universal inputs **can not be used for measuring the temperature of hazardous live parts**.
* *Class III Equipment: See Appendix E.1*

(FR) DANGER! RISQUE DE CHOC ÉLECTRIQUE.
Les circuits externes connectés aux entrées universelles doivent être isolés de toute alimentation secteur ou de toute tension dangereuse et doivent répondre aux exigences UL pour les circuits SELV/PELV Classe III*.
Les éléments de détection de température (thermocouple ou RTD) connectés aux entrées universelles **ne doivent pas être utilisés pour mesurer la température de pièces sous tension dangereuses.**
* *Équipement De Classe III: Voir L'Annexe E.1*

(EN) CAUTION! RISK OF DANGER.
The isolated universal inputs detailed in this section are rated for a maximum working voltage of 50V (any terminal with respect to ground) in normal operating conditions.

(FR) ATTENTION DANGER!
Les entrées universelles isolées détaillées dans cette section sont conçues pour une tension de fonctionnement maximale de 50V (n'importe quelle borne par rapport à la terre) dans des conditions de fonctionnement normales.

NOTE: This section is for the ISOLATED UNIVERSAL INPUTS which are available as an optional add-on.
To wire the **NON-ISOLATED PROCESS** inputs (included on the base unit), see Section 5.4 (p28).

6.1 - Current Input

Range 0–20mA, 4–20mA

Input impedance 45Ω

Maximum over-range protected by PTC to 24V DC

Accuracy 0.1% FSO max

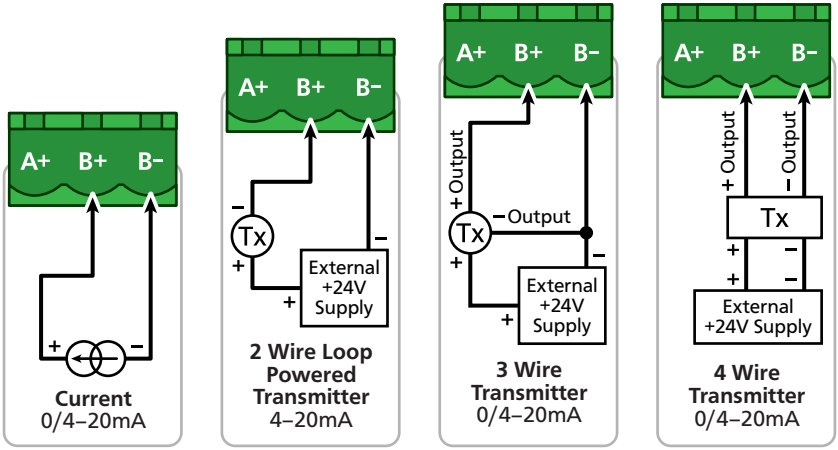
Linearity & repeatability 0.1% FSO max

Channel separation 0.001% max

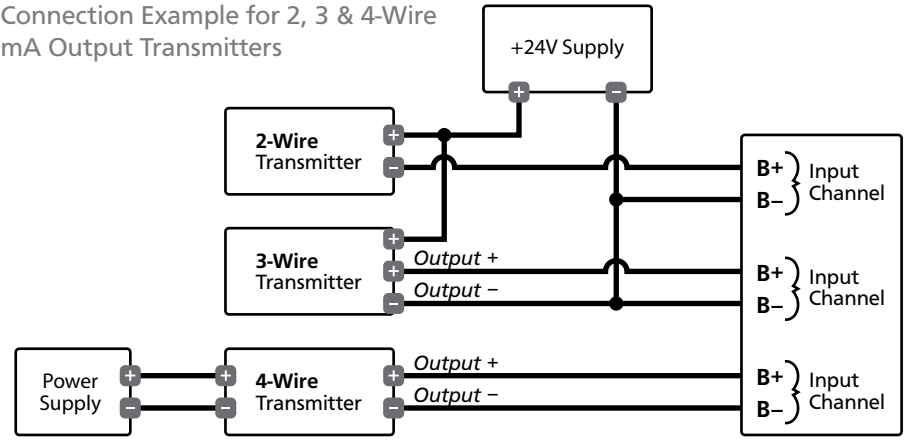
Ambient drift 0.003%/°C FSO typical

RF immunity 1% effect FSO typical

0/4–20mA DC is the most commonly used analog signal in industry, and is universally accepted. As a current loop, it is unaffected by voltage drops in cables, and can be transmitted over long distances without signal degradation.



Connection Example for 2, 3 & 4-Wire mA Output Transmitters



Note 1 All analog inputs are isolated to other channels and all other voltages. They also have built in over voltage protection to 24V, protecting the unit if the 24V supply is inadvertently connected to the unit when configured for mA input.

Note 2 All cables must be screened, with screen earthed at one end only.

Note 3 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimise RFI effects, of which magnitude cannot be easily predicted.

6.2 - Voltage Input

Ranges ±200mV, ⁻200mV to 1V, 0–10V, 0–18V

Input impedance >500KΩ on all ranges

Maximum over-voltage 24V DC

Accuracy 0.1% FSO max

Linearity & repeatability 0.1% FSO max

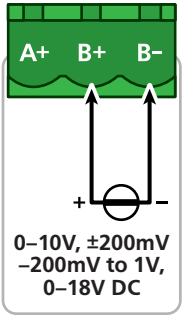
Channel separation 0.001% max

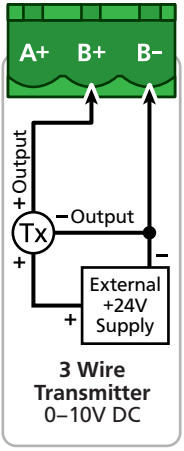
Ambient drift 0.003%/°C FSO typical

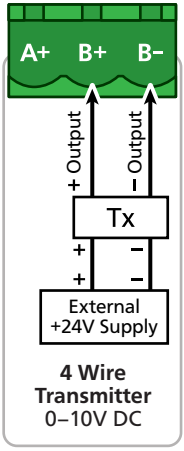
RF immunity 1% effect FSO typical

This unit accepts both voltage and millivolt inputs: the standard 0–10V DC range, as well as a variety of other ranges to suit various applications.

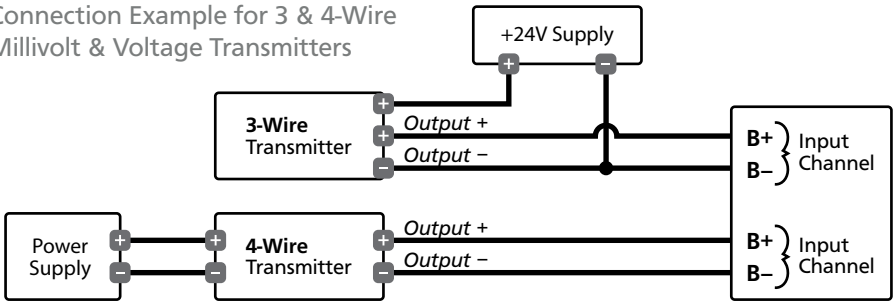
These can all be selected using the WorkBench software and easily scaled into engineering units. The ±200mV DC and -200mV to 1V DC ranges are ideal for low signal applications, such as measuring large DC currents using external current shunts, or interfacing to sensors with low voltage output. A 0–18V general purpose voltage range is also provided.







Connection Example for 3 & 4-Wire Millivolt & Voltage Transmitters



Note 1 Each voltage input must not see more than 18V peak between the negative and the input, otherwise permanent damage may occur.
Note 2 All cables must be screened, with screen earthed at one end only.
Note 3 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray (to minimise RFI effects, of which magnitude cannot be easily predicted).

6.3 - RTD Input

RTD Pt100 3 wire RTD DIN 43760: 1980

RTD Pt1000 3 wire RTD standard

Resolution
-328–572°F (-200–300°C) = 0.02°F (0.01°C)
-328–1472°F (-200–800°C) = 0.1°F (0.1°C)

Lead resistance 10Ω/lead max recommended

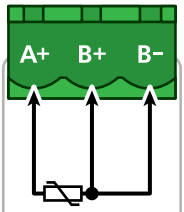
Sensor current 0.6mA continuous

Sensor fail upscale

Accuracy
-328–572°F (-200–300°C) = ±0.1°C
-328–1472°F (-200–800°C) = ±0.3°C

Ambient drift 0.003°C/°C typical

The RTD (standing for Resistance Temperature Device) is highly stable and accurate, and is fast becoming the most popular temperature sensor in industry. Often referred to as Pt100 and Pt1000, the Pt represents platinum (the dominant metal in its construction), and 100/1000 is the resistance in ohms at 0°C.

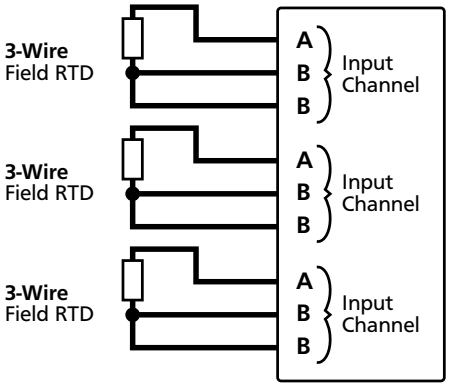


RTD 3 Wire
Pt100/1000

Supported RTD types/ranges

Pt100/Pt1000 (0.02°F/0.01°C res)	-328 to 572°F (-200 to 300°C)
Pt100/Pt1000 (0.1°F/0.1°C res)	-328 to 1472°F (-200 to 800°C)

Connection Example for 3-Wire RTD Inputs



Note 1 All RTD inputs are isolated from each other.

Note 2 All RTD cables must be screened, with screen earthed at one end only. All three wires must be the same resistance (i.e. the same type and size).

Note 3 To minimize lead resistance errors, 3-wire RTD's should be used. Offset errors for 2-wire RTD's may be compensated for in the software.

Note 4 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

6.4 - Thermocouple Input

Thermocouple types B, E, J, K, N, R, S or T type (see table below for ranges)

Cold junction compensation 14 to 140°F (–10 to 60°C)

CJC drift <0.02°C/°C typical for all inputs

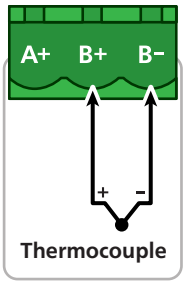
Sensor open Upscale

TC lead resistance 100Ω max

Input impedance >500KΩ

Accuracy 0.1% of FSO ±1°C typical

The thermocouple is one of the most common temperature sensors used in industry. It relies on the Seebeck coefficient between dissimilar metals.

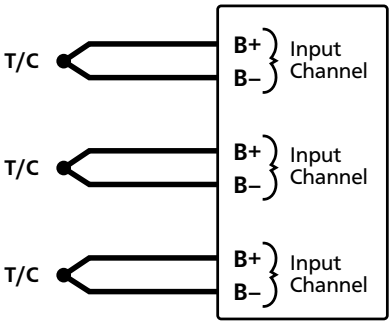


The thermocouple type is selected with reference to the application temperature range and environment, with J and K type being the most common.

Supported thermocouple types/ranges

B	32 to 3272°F	(0 to 1800°C)
E	-328 to 1292°F	(-200 to 700°C)
J	-328 to 1832°F	(-200 to 1000°C)
K	-328 to 2300°F	(-200 to 1260°C)
N	-328 to 2372°F	(-200 to 1300°C)
R	32 to 3092°F	(0 to 1700°C)
S	32 to 3092°F	(0 to 1700°C)
T	-328 to 752°F	(-200 to 400°C)

Connection Example for T/C Inputs



Note 1 All thermocouple inputs are isolated from each other. There is no need to buy expensive isolated thermocouples.

Note 2 For accurate thermocouple measurements (especially at low temperatures) the top cover must always be fitted. Avoid draughts and temperature differences across terminals. Once installation is complete, close the cabinet door and allow the cabinet to reach equilibrium. This may take several hours. Place all thermocouple probes into a calibrated thermal bath at temperature of interest. Any offsets can be zeroed out in the software.

Note 3 All thermocouples are referenced to a combination of four CJC temperature sensors on the main G3 RIO board. This minimizes errors caused by the mounting orientation of the unit, and temperature differences in enclosures. However, for high accuracy applications it is still recommended to zero errors (see Note 2).

Note 4 All cables must be screened, with screen earthed at one end only.

Note 5 When thermocouple inputs are selected, an upscale resistor is automatically connected to the T/C + input, resulting in an overflow condition for open or broken sensors.

(Continued on page 41...)

Note 6 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

6.5 - Digital Pulse

(Alternate operating mode of analog universal inputs)

Frequency range 0–2500.0Hz

Fast counter range 0–2500.0Hz

Sensors Open collector (NPN, PNP), TTL or Clean Contact

Frequency resolution 0.1Hz

Debounce counter range 0–50Hz max

Counter register output 32 bit

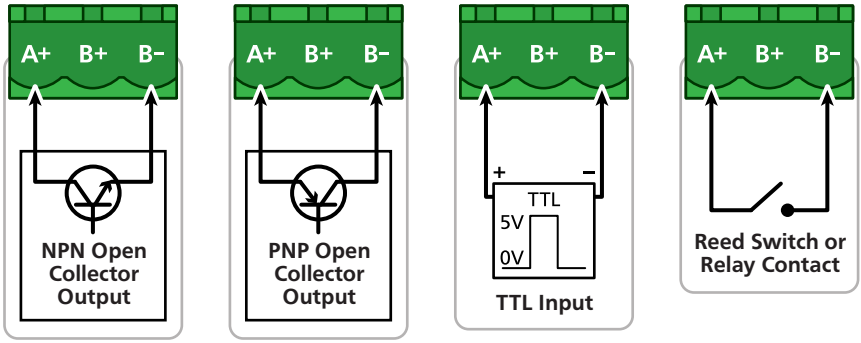
Accuracy ±0.5%

This unit's universal input terminals accept digital inputs from NPN, PNP or TTL sensors as well as Clean Contacts. Pulses up to 2.5kHz can be counted (except for the debounced counter, which has a range of 0–50Hz).

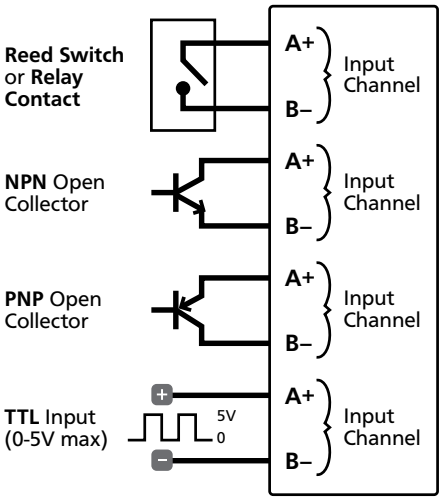
A variety of operating modes are software programmable to suit your application.

Software programmable modes include:

- General counter
- General debounced counter (ideal for mechanical relay contacts which are subject to bouncing)
- General frequency
- Flow count (uses K-factor)
- Flow rate (uses K-factor)
- RPM (uses pulses per revolution)



Connection Example for Digital Pulse Inputs



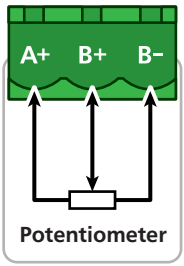
Note 1 All digital inputs are isolated from each other. Inputs from various sources can be connected without fear of crating unwanted and troublesome ground loops.
Note 2 Software selectable functions include: frequency to 2kHz, debounced counter for contact closures to 100Hz maximum, fast counter to 20KHz.
Note 3 All cables must be screened, with screen earthed at one end only.
Note 4 Do not run input cables in close vicinity to noisy power supplies, contactors or motor cables. The best practice is to run input cables on a separate earthed cable tray. This will minimize RFI effects, of which magnitude cannot be easily predicted.

6.6 - Potentiometer Input

Potentiometer input 3-wire	**Field prog span** 0.1–100%
Excitation voltage Variable	**Linearity and repeatability** <±0.05% FSO typical
Potentiometer resistance <2kΩ low pot; >2kΩ high pot	**Response time** 100msec
Field prog zero 0–90% of span	**Temperature drift** <50ppm/°C

A 3 wire potentiometer is typically used to measure position. A low or high potentiometer range can be programmed to your unit using the WorkBench software.

These ranges must be calibrated using the two point calibration method.



6.7 - AC Current Sensor

Sensor type Current transformer
ACCS-420, ACCS-420-L and ACCS-010

Header selectable amperage range
ACCS-420/010 = 100/150/200A
ACCS-420-L = 10/20/50A

Output (Representing 0–100% of full scale input range)
ACCS-420(-L) = 4–20mA DC loop powered
ACCS-010 = 0–10V DC

Power supply
ACCS-420(-L) = Loop powered, 15–36V DC
ACCS-010 = Self powered

Overload (continuous)
ACCS-420/010 = 175/300/400A respectively
ACCS-420-L = 80/120/200A respectively

Accuracy 1% of full scale

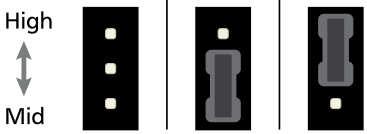
Response time 250ms (10–90%)

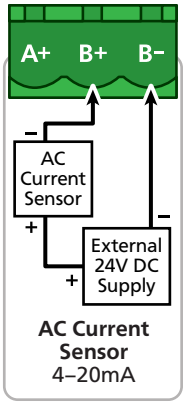
Frequency 50–60Hz

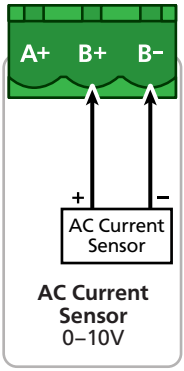
This unit accepts input from a Define Instruments AC current sensor (sold separately). Set the jumper on the top of the current sensor to the desired current range, as shown below.

ACCS Jump Ranges

010/420:	0–100A	0–150A	0–200A
420-L:	0–10A	0–20A	0–50A







6.8 - Attenuator

(Sold separately – order code: HVA-1000)

Max input voltage 1000V DC

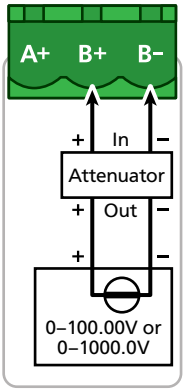
Attenuation factor 1000 ±0.1%

Input impedance 3.8MΩ

Output impedance 3.8kΩ

Attenuator type
Differential resistive

Ambient drift 50ppm/°C max



This unit accepts input from a high voltage attenuator (HVA-1000, sold separately). Wire the attenuator as shown.

7 G3 RIO COMMON REGISTERS

Below is a list of the commonly used G3 RIO registers, displayed first in Modicon addressing format, and then as a direct address (brackets). For a full register list, please see: defineinstruments.com/g3-registers

Function	32 bit signed registers	Floating point
Process Analog inputs (Non-Isolated)		
ChA	40765 (764) / 40766 (765)	42045 (2044) / 42046 (2045)
ChB	40767 (766) / 40768 (767)	42047 (2046) / 42048 (2047)
Universal Analog inputs (Isolated)		
Ch1	40645 (644) / 40646 (645)	41193 (1192) / 41194 (1193)
Ch2	40647 (646) / 40648 (647)	41195 (1194) / 41196 (1195)
Ch3	40649 (648) / 40650 (649)	41197 (1196) / 41198 (1197)
Ch4	40651 (650) / 40652 (651)	41199 (1198) / 41200 (1199)
Ch5	40653 (652) / 40654 (653)	41201 (1200) / 41202 (1201)
Ch6	40655 (654) / 40656 (655)	41203 (1202) / 41204 (1203)
Ch7	40657 (656) / 40658 (657)	41205 (1204) / 41206 (1205)
Ch8	40659 (658) / 40660 (659)	41207 (1206) / 41208 (1207)
Ch9	40661 (660) / 40662 (661)	41209 (1208) / 41210 (1209)
Ch10	40663 (662) / 40664 (663)	41211 (1210) / 41212 (1211)
Ch11	40665 (664) / 40666 (665)	41213 (1212) / 41214 (1213)
Ch12	40667 (666) / 40668 (667)	41215 (1214) / 41216 (1215)
Ch13	40669 (668) / 40670 (669)	41217 (1216) / 41218 (1217)
Ch14	40671 (670) / 40672 (671)	41219 (1218) / 41220 (1219)
Ch15	40673 (672) / 40674 (673)	41221 (1220) / 41222 (1221)
Ch16	40675 (674) / 40676 (675)	41223 (1222) / 4124 (1223)
Analog Expansion Channel Secondary Results		
Ch1 Secondary	40737 (736) / 40738 (737)	42017 (2016) / 42018 (2017)
Ch2 Secondary	40739 (738) / 40740 (739)	42019 (2018) / 42020 (2019)
Ch3 Secondary	40741 (740) / 40742 (741)	42021 (2020) / 42022 (2021)
Ch4 Secondary	40743 (742) / 40744 (743)	42023 (2022) / 42024 (2023)

Function	32 bit signed registers	Floating point
Analog Expansion Channel Secondary Results (continued)		
Ch5 Secondary	40745 (744) / 40746 (745)	42025 (2024) / 42026 (2025)
Ch6 Secondary	40747 (746) / 40748 (747)	42027 (2026) / 42028 (2027)
Ch7 Secondary	40749 (748) / 40750 (749)	42029 (2028) / 42030 (2029)
Ch8 Secondary	40751 (750) / 40752 (751)	42031 (2030) / 42032 (2031)
Ch9 Secondary	40753 (752) / 40754 (753)	42033 (2032) / 42034 (2033)
Ch10 Secondary	40755 (754) / 40756 (755)	42035 (2034) / 42036 (2035)
Ch11 Secondary	40757 (756) / 40758 (757)	42037 (2036) / 42038 (2037)
Ch12 Secondary	40759 (758) / 40760 (759)	42039 (2038) / 42040 (2039)
Ch13 Secondary	40761 (760) / 40762 (761)	42041 (2040) / 42042 (2041)
Ch14 Secondary	40763 (762) / 40764 (763)	42043 (2042) / 42044 (2043)
Counters		
CounterA	40525 (524) / 40526 (525)	41805 (1804) / 41806 (1805)
CounterB	40527 (526) / 40526 (527)	41807 (1806) / 41808 (1807)
CounterC	40529 (528) / 40526 (529)	41809 (1808) / 41810 (1809)
CounterD	40531 (530) / 40526 (531)	41811 (1810) / 41812 (1811)
Auxiliary Registers		
Aux1	40315 (314) / 40316 (315)	41595 (1594) / 41596 (1595)
Aux2	40317 (316) / 40318 (317)	41597 (1596) / 41598 (1597)
Aux3	40319 (318) / 40320 (319)	41599 (1598) / 41600 (1599)
Aux4	40321 (320) / 40322 (321)	41601 (1600) / 41602 (1601)
Aux5	40323 (322) / 40324 (323)	41603 (1602) / 41604 (1603)
Aux6	40325 (324) / 40326 (325)	41605 (1604) / 41606 (1605)
Aux7	40327 (326) / 40328 (327)	41607 (1606) / 41608 (1607)
Aux8	40329 (328) / 40330 (329)	41609 (1608) / 41610 (1609)
Aux9	40331 (330) / 40332 (331)	41611 (1610) / 41612 (1611)
Aux10	40333 (332) / 40334 (333)	41613 (1612) / 41614 (1613)
Aux11	40335 (334) / 40336 (335)	41615 (1614) / 41616 (1615)
Aux12	40337 (336) / 40338 (337)	41617 (1616) / 41618 (1617)
Aux13	40339 (338) / 40340 (340)	41619 (1618) / 41620 (1619)
Aux14	40341 (341) / 40342 (341)	41621 (1620) / 41622 (1621)

Function	32 bit signed registers	Floating point
Auxiliary Registers (continued)		
Aux15	40343 (342) / 40344 (343)	41623 (1622) / 41624 (1623)
Aux16	40345 (344) / 40346 (345)	41625 (1624) / 41626 (1625)
Totalizers		
Total1	40289 (288) / 40290 (289)	41569 (1569) / 41570 (1569)
Total2	40291 (290) / 40292 (291)	41571 (1570) / 41572 (1571)
Total3	40293 (292) / 40294 (293)	41573 (1572) / 41574 (1573)
Total4	40295 (294) / 40296 (295)	41575 (1574) / 41576 (1575)
Total5	40297 (296) / 40298 (297)	41577 (1576) / 41578 (1577)
Total6	40299 (298) / 40300 (299)	41579 (1578) / 41580 (1579)
Total7	40301 (300) / 40302 (301)	41581 (1580) / 41582 (1581)
Total8	40303 (302) / 40304 (303)	41583 (1582) / 41584 (1583)
Total9	40305 (304) / 40306 (305)	41585 (1584) / 41586 (1585)
Total10	40307 (306) / 40308 (307)	41587 (1586) / 41588 (1587)

Function	16 bit unsigned registers	
Expanded Digital Inputs		
Digital Inputs Low	**44458 (4457)**	**b0-15 = I/P 1-16 (1st digital expander module)**
Digital Inputs High	**44459 (4458)**	**b0-15 = I/P 17-32 (2nd digital expander module)**
Expanded Digital Outputs (Digital Output Schemes = 0x01 or 0x02)		
Digital Inputs Low	**44452 (4451)**	**b0-15 = O/P 17-32 (2nd digital expander module)**
Expanded Digital Outputs (Digital Output Scheme 0x03)		
Digital Outputs Low	**44452 (4451)**	**b0-15 = O/P 1-16 (1st digital expander module)**
Digital Outputs High	**44453 (4452)**	**b0-15 = O/P 17-32 (2nd digital expander module)**

Function	8 bit unsigned registers	
Internal Relays (When Relay Source = Disabled [DCS Control])		
Relay Control	**48205 (8204)**	**b0-3 = Relay A-D, b4-7 not used**

Notes on Modbus Addressing

1 This unit uses a swapped word order for Modbus 32 bit values (integers and floats). It sends/receives a 32 bit value as least significant word first, followed by the most significant word.
Integer Example: if the integer value is 100,000 (0x000186A0), the LSW 0x86A0 will be sent first, followed by the MSW 0x0001.

Float Example: if the float is value is 1.234 (0x3F9DF3B6), the LSW 0xF3B6 will be sent first, followed by the MSW 0x3F9D.

2 Modicon address notation specifies the valid range for holding registers to be between 40,001 to 49,999.
This notation convention imposes a 10,000 register limit that doesn't exist in the underlying protocol. You may see the alternate notation 400,001 to 465,536 being used to denote registers outside the standard Modicon range.

For example, 400,001 is equivalent to 40,001, and 412,345 would be equivalent to 40,001 + 12,344.

8 CALIBRATION & TROUBLESHOOTING

8.1 - Calibration

Your G3 RIO has been fully calibrated at the factory, and can be recalibrated in software using Define WorkBench (see Section 4). Scaling to convert the input signal to a desired display value is also done using WorkBench

If your unit appears to be behaving incorrectly or inaccurately, refer to troubleshooting before attempting to calibrate it. When recalibration is required (generally every 2 years), it should only be performed by qualified technicians using appropriate equipment. Calibration does not change any user programmed parameters. However, it may affect the accuracy of the input signal values previously stored.

8.2 - Troubleshooting

This table shows a brief list of common problems and how to resolve them. Any error detected by the unit will be displayed on the front panel LED's - see Section 2 for more information.

Issue	Resolution
Power LED stays red continuously	If the power LED stays red continuously this indicates an internal error which will need to be assessed by the manufacturer. Please return the unit to the manufacturer for analysis and repair.
Cannot power up unit	Check the power supply connections and supply range.
Power LED flashes orange multiple times followed by a 2-3 second pause	The unit has encountered a non-critical error. Count the number of orange flashes between the pauses and contact our service center for further instruction. (Note: the meaning of this condition may change with custom applications so be sure to mention if you are running a custom application)
Power LED is mostly off but flashes a short red pulse every 3 seconds	The unit does not have enough power supplied for it to run correctly. Check that the power supply voltage meets the requirements shown in Section 5 of this manual.

A APPENDIX A - EMC TEST RESULTS

Statement of Compliance

The Define Instruments 'G3 RIO' complies with EN 61326-1:2006.

Results Summary

The results from testing carried out in March 2023 are summarized in the following tables.

Immunity - Enclosure Ports

Phenomenon	Basic Standard	Test Value	Performance Criteria
EM Field	IEC 61000-4-3	10V/m (80MHz to 1GHz) 3V/m (1.4–2.7GHz)	Meets Criterion A
Electrostatic Discharge (ESD)	IEC 61000-4-2	4kV/8kV contact/air	Meets Criterion A (Note 1) Meets NAMUR NE 21 recommendation

Immunity - Signal Ports

Phenomenon	Basic Standard	Test Value	Performance Criteria
Conducted RF	IEC 61000-4-6	3V (150kHz to 80MHz)	Meets Criterion A
Burst	IEC 61000-4-4	1kV (5/50ns, 5kHz) 1kV (5/50ns, 100kHz)	Meets Criterion A (Note 1) Meets NAMUR NE 21 recommendation
Surge	IEC 61000-4-5	1kV L-E	Meets Criterion A (Note 1)

Immunity - AC Power

Phenomenon	Basic Standard	Test Value	Performance Criteria
Conducted RF	IEC 61000-4-6	3V(150Khz to 80Mhz)	Meets Criterion A
Burst	IEC 61000-4-4	2kV (5/50ns, 5kHz) L-N 1kV (5/50ns, 5kHz) L-L	Meets Criterion A Meets Criterion A
Surge	IEC 61000-4-5	2kV L-E 1KV L-L	Meets Criterion A Meets Criterion A (Note 1)
Voltage Dips	IEC 61000-4-11	0% during 1 cycle 40% during 10/12 cycles 70% during 25/30 cycles	Meets Criterion A Meets Criterion A Meets Criterion A
Short Interruptions	IEC 61000-4-11	0% during 250/300 cycles	Meets Criterion A (Note 1)

Performance Criteria

Performance Criterion A

During the test, normal performance within the specification limits.

Performance Criterion B

During testing, temporary degradation, or loss of performance or function which is self-recovering.

Performance Criterion C

During testing, temporary degradation, or loss of function or performance which requires operator intervention or system reset occurs.

Notes

***1** EN61326-1 calls for a Criterion B pass; unit exceeds this by meeting Criterion A.

B APPENDIX B - FCC COMPLIANCE

NOTE: Model codes apply where **'YY'** is replaced with **HV**, **LV**, **HV–EX**, or **LV–EX**, and **'ZZ'** is empty, or any combination of **Relays**, **Inputs/Outputs**, **Digital I/O** or **Factory Option** ordering options, as shown in the *Optional Add-Ons* table (see p3).

B.1 - Compliant Models

The following models have been tested according to Part 15 of the FCC rules:

G3–RIO–[YY]–X–[ZZ] (Models with no networking)
G3–RIO–[YY]–[ZZ] (Models with default Ethernet networking)
G3–RIO–[YY]–W–[ZZ] (Models with Ethernet & Wi-Fi networking)

Statement of Compliance

This Device Complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause interference, and
(2) This device must accept any interference that may cause undesired operation

FCC Part 15 Subpart A+B
Including Sections 15.107 & 15.109
As a Class A Unintentional Radiator when the methods as described in ANSI C63.4 - 2013 are applied

This product includes the following radio transmitter modules:
ESP32_WROVER-IE WiFi Module
FCC ID: 2AC7Z-ESP32_WROVER-IE

C APPENDIX C - ICES-003 COMPLIANCE

C.1 - ICES-003 Statement of Compliance

The G3 RIO complies with ICES-003, Issue 7, October 15, 2020 as a Class A device when tested in accordance with the methods contained within ANSI C63.4 - 2014.

This product includes the following radio transmitter modules: IC: 21098-ESPWROVERE

D APPENDIX D - EX APPROVED

D.1 - Ex Specifications

UL 24 ATEX 3205X

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

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

File Number E539767

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

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

NOTE: The 'EX' Add-on is not compatible with OEM 'Relay A' Option.

Statements

- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.
- The equipment shall be installed in an enclosure that provides a minimum ingress protection of IP 54 in accordance with IEC 60079-0.
- Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.

E APPENDIX E - DEFINITIONS

E.1 - Class III Equipment

IEC 61010-2-201 : 6.5.2.101.4 Class III Equipment

Equipment in which protection against electric shock is provided by circuits supplied by safety extra-low voltage (SELV/PELV). And additionally, the voltages generated by or within the equipment do not exceed the limits for SELV/PELV.

Connection to the earth TERMINALS for functional purposes is acceptable (such as radiofrequency interference suppression).

Wiring for SELV/PELV circuits shall be either segregated from the wiring for circuits other than SELV/PELV, or the insulation of all conductors shall be RATED for the higher voltage. Alternatively, earthed screening or additional insulation shall be arranged around the wiring for SELV/PELV circuits or around the wiring of other circuits, based on IEC 60364-4-41.

E.1 - Équipement De Classe III

IEC 61010-2-201 : 6.5.2.101.4 Équipement De Classe III

Équipement dans lequel la protection contre les chocs électriques est assurée par des circuits alimentés par très basse tension de sécurité (SELV/PELV). De plus, les tensions générées par ou à l'intérieur de l'équipement ne dépassent pas les limites SELV/PELV.

La connexion aux BORNES de terre à des fins fonctionnelles est admise (telle que la suppression des interférences radiofréquences).

Le câblage des circuits SELV/PELV doit être soit séparé du câblage des circuits autres que SELV/PELV, soit l'isolation de tous les conducteurs doit être CERTIFIEE pour la tension la plus élevée. Alternativement, un blindage mis à la terre ou une isolation supplémentaire doit être disposé autour du câblage des circuits SELV/PELV ou autour du câblage d'autres circuits, sur la base de la norme CEI 60364-4-41.

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