cradlepoint

Cradlepoint GPIO App Note

Affected Products: COR IBR1700, IBR11x0, COR IBR9x0, COR IBR6x0, COR IBR6x0B, COR IBR6x0C & COR IBR200

Certain Cradlepoint routers have user-configurable GPIO pins; those pins have differing capabilities and are spread across different connectors. This app note will explain how to use the GPIOs on the IBR1700, IBR11x0 Series, IBR9x0 Series, IBR6x0 Series, IBR6x0B Series, IBR6x0C Series, and IBR200 routers.

SUMMARY OF ROUTER GPIOS

Device	Power Connector I/O	Extensibility Port I/O	Other I/O
IBR6x0 IBR200	1: dedicated input 1: dedicated output	N/A	N/A
IBR6x0B IBR6x0C IBR9x0	1: dedicated input 1: dedicated output	1: dedicated input 4: user-configurable input/output 1: router power input/output	Dock 10×2 connector* 1: dedicated input 4: user-configurable input/output 1: router power input 1: 5V/50mA power output
IBR11x0	1: dedicated input 1: dedicated output	N/A	DB9 connector 3: dedicated inputs
IBR1700	1: dedicated input 1: dedicated output		1: dedicated input 4: user-configurable input/output 1: router power input 1: 5V/50mA power output 2: analog-to-digital inputs

Table 1: Summary of router GPIOs

*Inputs and outputs on Extensibility Dock are identical (passthrough) to those of extensibility port, not in addition to. Dock purchased separately.
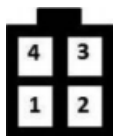
IBR200
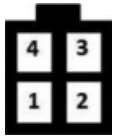
Pin	Definition	Details	Wire Color
1	Ground	-	Black
2	Power	9 − 16 V DC	Red
3	Input*	2.2 V input high threshold (16 V tolerant) 0.8 V input low threshold (16 V tolerant)	Orange
4	Output	High: 2.9 V @ 4mA Low: 0.4 V @ 4mA	Blue

Table 2: IBR200 pin information

*NOTE: The dedicated input has a weak internal pull-up to 3.3 V. It is 16 V tolerant. If higher transients can occur, the user must add additional protection.

IBR6x0B Series, IBR6x0C Series & IBR9x0 Series

Pin	Definition	Details	Wire Color
1	Ground	-	Black
2	Power	9 − 33 V DC	Red
3	Input	3.4 V input high threshold (33 V tolerant) 2.2 V input low threshold (33 V tolerant)	Orange
4	Output	Capable of sinking 250 mA	Blue

Table 3: IBR6x0B, IBR6x0C & IBR9x0 pin information

Dedicated input: This input has the high/low thresholds shown in **Table 3** over the product's full temperature range. This input is not a typical CMOS input and requires at least 0.5 mA of drive current because of an internal 13K pulldown. It is 33 V tolerant and supports ignition sensing. Ignition sense allows the user to configure the router to turn itself off a specified amount of time after the ignition signal goes away and turn on when the ignition signal returns.

Note: In mobile (vehicle) applications ignition sense should always be used to provide a graceful shutdown each time the vehicle is powered off.

Dedicated output: This pin is open-drain and can sink up to 250 mA, and is 33 V tolerant. Since it is open-drain and does not have an internal pull-up, the user must provide one if the application requires it. This output has a series diode, so when enabled it will be a minimum of one diode drop above ground. Typically this type of output would be used to drive the coil of a relay.

EXTENSIBILITY PORT

The extensibility port on the IBR6x0B, IBR6x0C, and IBR9x0 series of routers provides several more GPIO pins. This port can be used with either the Extensibility GPIO cable or the Extensibility Dock.

Use with Extensibility GPIO Cable

If an Extensibility GPIO cable (sold separately, Cradlepoint part number 170680-000) is used, the signals shown in **Table 4** are available.

GPIO1-GPIO4: These GPIOs can be configured by the user independently as inputs or outputs and are LVTTLcompatible. As inputs they are 33 V tolerant. These pins have a weak internal pull-up to 3.3 V. See **Table 5** for input and output thresholds.

Wire	Signal
Black (2)	GND
Yellow	GPIO1
Blue	GPIO2
White	GPIO3
Green	GPIO4
Orange	Ignition sense
Red (2)	Router power

Table 4: IBR6x0B/GPIO cable additional pin information

Definition	Details for IBR6x0B	Details for IBR9x0 & IBR6x0C
Input	Low threshold: 0.8 V High threshold: 2.0 V	Low threshold: 0.8 V High threshold: 2.0 V
Output	Low maximum: 0.4 V @ 2 mA High minimum: 2.4 V @ 2 mA	Low maximum: 0.4 V @ 4 mA High minimum: 2.4 V @ 4 mA

Table 5: IBR6x0B/GPIO cable GPIO1–GPIO4 I/O information

Ignition sense: The ignition sense dedicated input on this connector has all the same properties and can be configured the same as the ignition sense input on the power connector. Note that if ignition sensing is needed, only one of the two available ignition sense inputs should be used. The reason is that the router cannot power itself off if either of the two ignition sense inputs is high, regardless of their configurations.

Note: In mobile (vehicle) applications ignition sense should always be used to provide a graceful shutdown each time the vehicle is powered off.

Router power: These two pins can provide power to the router or draw unconditioned power from the router. When providing power to the router, the voltage limits are the same as the normal power connector. When drawing power from the router, power is unconditioned and will be one diode drop lower in voltage than the power input at the normal power connector. These power pins can also be used to provide redundant power to the router in combination with the standard power connector. Note that if redundant power is provided, both power supplies should be at the same voltage, and if used in an automotive environment, both power supplies should have appropriate fuses.

Use with Extensibility Dock

If a COR Extensibility Dock is connected (sold separately, Cradlepoint part number 170700-000), the user has access to the same GPIO signals as with the Extensibility GPIO Cable, but located on the 2×10 dock connector (Figure 1). Basically, the GPIO signals are passed through to the dock connector. GPIO1–GPIO4 and ignition sense pins have the same properties as before. The Router+Dock power (see **Table 6**) pins can be used to provide power to the router and dock or provide redundant power to the router and dock if used with the normal power connector. The Router+Dock power pins cannot be used to draw power from the dock. The low current 5 V output pin provides 5 V DC at a max of 50 mA for any user need, e.g. to power sensors. This pin is current limited to a minimum of 50 mA.
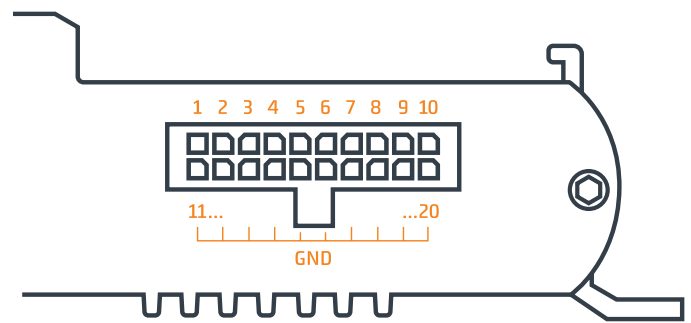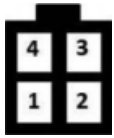

Figure 1: COR Extensibility Dock

Table 6: IBR6x0B/Extensibility Dock pin information

Pin	Details
1	Router+Dock power (input only - 24 W min.)
2	Router+Dock power (input only - 24 W min.)
3	Reserved
4	Reserved
5	GPI (ignition sense)
6	GPIO1
7	GPIO2
8	GPIO3
9	GPIO4
10	Low current 5 V output (50 mA max.)
11-20	Ground

IBR1700

Pin	Definition	Details		Wire Color
1	Ground	-		Black
2	Power	9–36 V DC		Red
3	Input	3.4 V input high threshold (36 V tolerant) 2.2 V input low threshold (36 V tolerant)		Orange
4	Output	Capable of sinking 250 mA		Blue

Table 7: IBR1700 pin information.

Dedicated input: This input has the high/low thresholds shown in **Table 7** over the product's full temperature range. This input is not a typical CMOS input and requires at least 0.5 mA of drive current because of an internal 13K pulldown. It is 36 V tolerant and supports ignition sensing. Ignition sense allows the user to configure the router to turn itself off a specified amount of time after the ignition signal goes away and turn on when the ignition signal returns.

Note: In mobile (vehicle) applications ignition sense should always be used to provide a graceful shutdown each time the vehicle is powered off.

Dedicated output: This pin is open-drain and can sink up to 250 mA, and is 36 V tolerant. Since it is open-drain and does not have an internal pull-up, the user must provide one if the application requires it. This output has a series diode, so when enabled it will be a minimum of one diode drop above ground. Typically this type of output would be used to drive the coil of a relay.

2X10 GPIO PORT

The GPIO port on the IBR1700 routers provides several more GPIO pins. This port can be used with either the 2x10 GPIO Cable (Cradlepoint part number 170712-000) or a custom cable.

GPIO1-GPIO4: These GPIOs can be configured by the user independently as inputs or outputs and are LVTTL compatible. As inputs they are 36 V tolerant. These pins have a weak internal pull-up to 3.3 V. See **Table 8** for input and output thresholds.

Definition	Details
Input	Low threshold: 0.8 V High threshold: 2.0 V
Output	Low maximum: 0.4 V @ 4 mA High minimum: 2.4 V @ 4 mA

Table 8: IBR1700 GPIO1-GPIO4 i/0 information.

Ignition sense: The ignition sense dedicated input on this connector has all the same properties and can be configured the same as the ignition sense input on the power connector. Note that if ignition sensing is needed, only one of the two available ignition sense inputs should be used. The reason is that the router cannot power itself off if either of the two ignition sense inputs is high, regardless of their configurations.

Note: In mobile (vehicle) applications ignition sense should always be used to provide a graceful shutdown each time the vehicle is powered off.

Router power: These two pins can provide power to the router. The voltage limits are the same as the normal power connector. These power pins can also be used to provide redundant power to the router in combination with the standard power connector. Note that if redundant power is provided and if used in an automotive environment, both power supplies should have appropriate fuses.
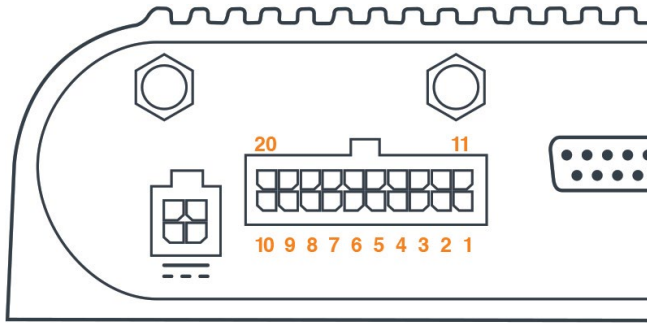

Figure 2: IBR1700

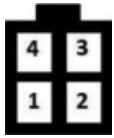| Pin	Details
1	Router power (input only - 36 W min.)
2	Router power (input only - 36 W min.)
3	ADC CH1
4	ADC CH2
5	GPI (ignition sense)
6	GPIO1
7	GPIO2
8	GPIO3
9	GPIO4
10	Low current 5 V output (50 mA max.)
11-20	Ground

Table 9: IBR1700 pin information

ADC Inputs

ADC CH1: Selectable 0.5-36 V or 0.1-5 V ranges
ADC CH2: 0.5-36 V range
Accuracy: Typical ± 0.5%, maximum ± 1%

The analog-to-digital inputs can be used to measure voltages from things such as batteries or sensors. The ADC has 12-bit resolution. For increased accuracy on low voltage inputs such as sensors, CH1 should be used with the 0.1-5 V range. The ADC inputs have configurable low and high alerts and can be set to turn off the router at a configurable voltage. It cannot turn back on until ignition sense voltage is present and it cannot turn off unless ignition sense voltage is low.

IBR11x0 Series

Pin	Definition	Details	Wire Color
1	Ground	-	Black
2	Power	9 − 36 V DC	Red
3	Input	3.4 V input high threshold (36 V tolerant) 2.2 V input low threshold (36 V tolerant)	Orange
4	Output	Capable of sinking 250 mA	Blue

Table 10: IBR11x0 pin information

Dedicated input: This input has the high/low thresholds shown in **Table 10** over the product's full temperature range. This input is not a typical CMOS input and requires at least 0.5 mA of drive current because of an internal 13K pulldown. It is 36 V tolerant and supports ignition sensing. Ignition sense allows the user to configure the router to turn itself off a specified amount of time after the ignition signal goes away and turn on when the ignition signal returns.

Note: In mobile (vehicle) applications ignition sense should always be used to provide a graceful shutdown each time the vehicle is powered off.

Dedicated output: This pin is open-drain and can sink up to 250 mA, and is 36 V tolerant. Since it is open-drain and does not have an internal pull-up, the user must provide one if the application requires it. This output has a series diode, so when enabled it will be a minimum of one diode drop above ground. Typically this type of output would be used to drive the coil of a relay.

DB9 CONNECTOR

The DB9 connector can be used either as an RS232 port or a GPIO port. A signal breakout cable (Cradlepoint part number 170676-000) is handy for use when in GPIO mode.
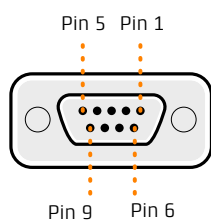
Figure 3: RS232 pin schema

Pin	Name	Direction (relative to IBR11xx)
1	DCD	out
2	TX	out
3	RX	in
4	DSR	in
5	GND	n/a
6	DTR	out
7	CTS	in
8	RTS	out
9	RI	out

Table 11: IBR11x0 RS232 port information

GPIO mode has certain limitations. Up to three pins can be used as dedicated inputs. These three pins are meant to be wired as a dry contact with output pins from the same DB9 connector biasing the contact. **Figure 4** depicts a typical wiring scenario.
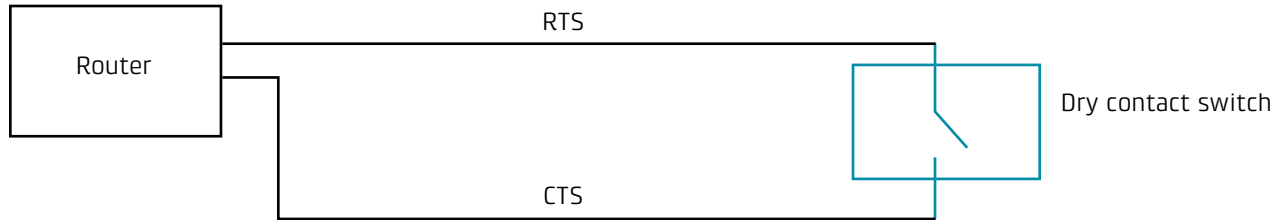

Figure 4: DB9 typical wiring scenario

As depicted in **Figure 4**, when the switch is open, the input on the router reads as high (it is physically low on the connector pin, but logic high to the router). When the switch is closed, the input on the router reads as low (it is physically high on the connector pin, but logic low to the router). Essentially, **switch closed means low** and **switch open means high.**

IBR6x0 Series
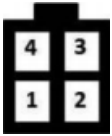
Pin	Definition	Details	Wire Color
1	Ground	-	Black
2	Power	$9 - 18$ V DC	Red
3	Input*	2.2 V input high threshold (12 V tolerant) 0.8 V input low threshold (12 V tolerant)	Orange
4	Output	High: 2.2 V @ 16 mA Low: 0.4 V @ 16 mA	Blue

Table 12: IBR6x0 pin information

*NOTE: The dedicated input has a weak internal pull-up to 3.3 V. It is 12 V tolerant. If higher transients can occur, the user must add additional protection.