Model RXT-300

SmartWireless™ Transceiver

Operator's Installation and Instruction Manual

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1.0 Introduction

1.1 Description

The RXT-300 SmartWireless™ Transceiver is the foundation for the Detcon family of wireless products. Each RXT-300 comes with an internal multi-channel controller function that allows for monitoring and generating alarms in an industrial detection system. Communication between RXT-300s occurs wirelessly using the internal IEEE 801.15.4 radio. Detcon products using the RXT-300 have been also designed for low power operation and can be powered using Detcon battery packs and solar panels. Since these units are both wireless and can be set up to be battery/solar powered, they become very mobile and can be deployed without installing a costly wiring infrastructure.

Several features have been incorporated in the RXT-300 design allowing the customer to create a robust wireless gas detection and alarm system.

- Internal multi-channel controller – No external controller required to manage system
- Wireless Mesh Network – multiple paths of communication between RXT-300s
- Any RXT-300 can become master of the wireless network – no single point of failure
- Each RXT-300 processes local and network data and determines alarms independently
- Alarm Zones allows grouping of RXT-300s/Sensors to specific Alarm Stations
- Up to four sensors per RXT-300
- Up to two 4-20mA sensors per RXT-300
- Up to four fully configurable Alarm Outputs per RXT-300
- Can add multiple HMI (Human Machine Interface) Panels for monitoring of network
- Low power design for extended operation on battery
- Wireless Network sleep available to further reduce power consumption
- Battery Life monitoring for one SmartWireless™ Battery Pack
- Maximum 32 RXT-300s and/or 32 Sensors per Network
- Operates with a wide DC input range from 7-30VDC
- Class 1 Div 1; Groups D, C

Detection systems normally consist of a controller, sensors and alarm stations with each placed at different locations based upon the needs of the customer. These would then be wired together to complete the system installation and provide communication throughout the system. When using the RXT-300 SmartWireless™ Transceiver, the RXT-300 would be installed at each location and communication between devices would occur wirelessly. Figure 1 shows an example of a possible system configuration.

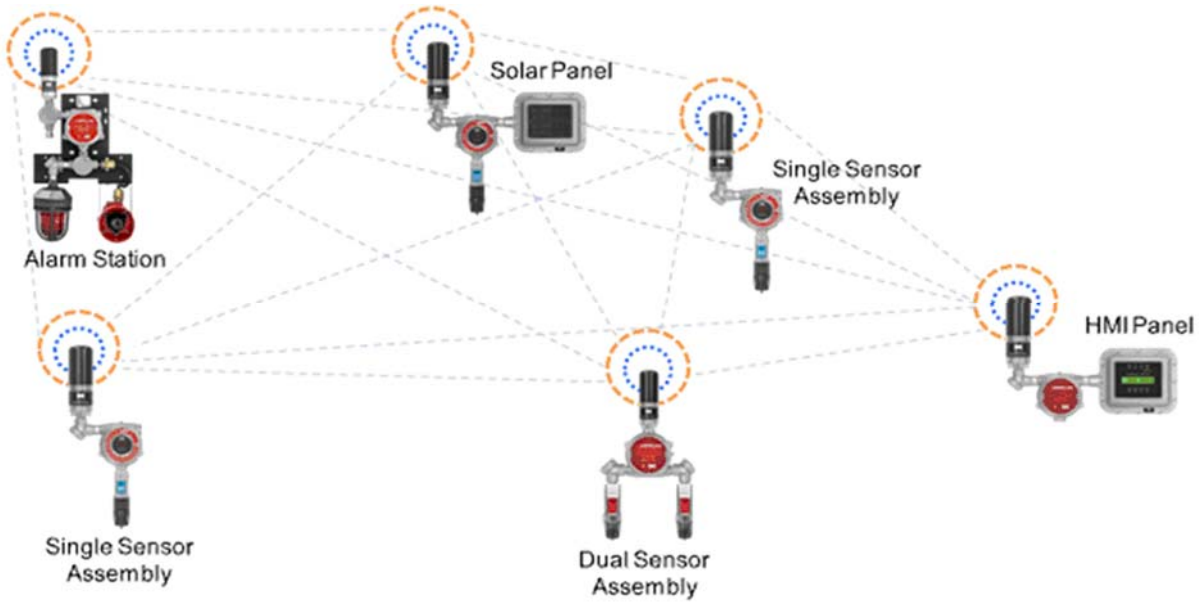


Figure 1 System Example utilizing the RXT-300

The RXT-300 is usually built up as part of an assembly to satisfy one of three different applications, the HMI (Human Machine Interface) Station for visual status of the network, the Sensor Station that has one or more sensors attached and the Alarm Station for system alarm indication. These three basic assemblies are then duplicated and located as needed by the customer. Figure 2 shows the Detcon versions of the typical SmartWireless™ assemblies. Each device within the SmartWireless™ assemblies has been chosen or designed for low power operation and can therefore be powered using the Detcon Smart Battery pack and supplemented with a solar panel.

HMI Station	Sensor Station	Alarm Station

Figure 2 SmartWireless™ Typical Product Family

The RXT-300 has been designed with multiple interfaces to support these three applications. There is a single RS-485 interface that utilizes the Modbus™ RTU protocol and can be set up as a Modbus™ Master or Modbus™ Slave. As a Modbus™ Master the interface will support up to four Modbus™ sensors and will poll the sensors and process alarms for those sensors. As a Modbus™ Slave it supports a single HMI (Human Machine Interface) Panel or Modbus™ controller to display status of the sensors and RXT-300s as well as providing control over the network such as resetting of alarms.

There are two 4-20mA inputs that can be used for monitoring 2-Wire or 3-Wire 4-20mA devices. There are four Alarm outputs that can be configured to be Energized or De-Energized, Latching or Non-Latching and Silence-able or Non-Silence-able. The RXT-300 can also monitor a single Detcon Smart Battery pack for remaining battery life allowing the user to replace the battery in a timely manner.

1.2 RXT-300 Wireless Radio

The RXT-300 transceivers utilize radios based upon the IEEE 802.15.4 standard that operate at 2.4 GHz using DSSS encoding for robustness. DSSS was initially used by the military to resist jamming but later was widely adopted for wireless implementations since it was robust in noisy environments. DSSS transmits data across a wider frequency range than the actual frequency range required for the information. This operation minimizes cross talk and interference from other transceivers and is less susceptible to noise from other sources.

The IEEE 802.15.4 defines 16 separate RF Channels that can be used in the 2.4 GHz range. The default channel is 1 but can be change if there is RF interference or if there is an existing network using that channel. Transceivers will only respond to other transceivers with the same RF Channel.

NOTE: If there are multiple Modbus™ networks in the same vicinity each system must reside on a different RF Channel to keep data from one appearing on the other.

The 802.15.4 standard also implements a mesh network allowing any RXT-300 transceiver to relay or repeat data between adjacent neighbors. This makes the network very robust and provides the following immediate benefits:

- Allows re-routing of data in case of loss of a transceiver
- Allows re-routing around wireless obstacles
- Longer distances between transceivers because data can “hop” from one transceiver to the next
- Included in sensor, controller and alarm station transceivers
- RXT-300 transceivers can be deployed with less concern about physical location

Figure 3 Mesh Network Topology

1.3 Model 100 Terminal Board (Optional)

The RXT-300 wireless transceiver can be ordered with an optional Model 100 Terminal Board mounted in a condulet/J-Box (See Figure 4). The terminal board includes connector plugs for the following:

J1:	6-Pin Phoenix Connector	RXT-300 Wireless Transceiver
J2:	5-Pin Phoenix Connector	Slave Device/HMI/Master Controller
J3:	6-Pin Connector	RXT-300 Programming Port (Detcon Factory use only)
J4:	3-Pin Phoenix Connector	Model 100 Loop Powered LED display
J5:	3-Pin Phoenix Connector	7-30VDC External power source or 24VDC Solar Panel
J6:	8-Pin Beau Connector	12VDC Battery Power (Use only Detcon's Smart Battery Pack)
J7:	3-Pin Phoenix Connector	Spare Modbus™ Connection
J8:	3-Pin Phoenix Connector	RXT Programming Interface to Wireless Transceiver

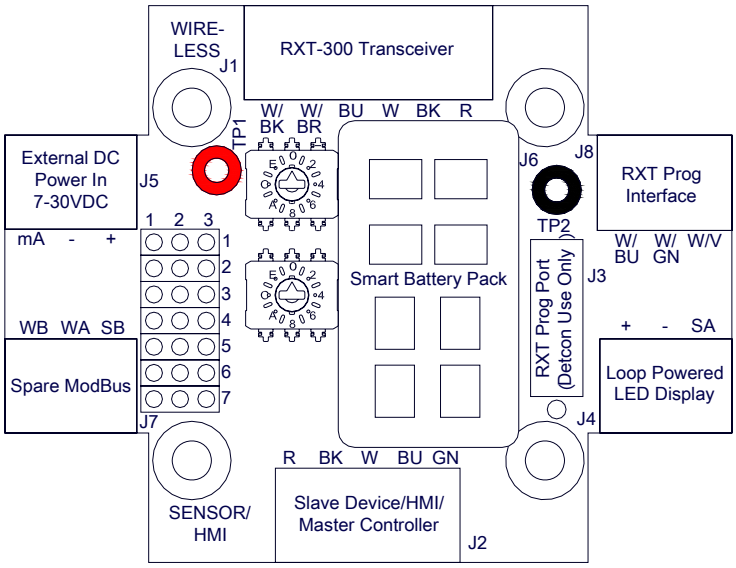


Figure 4 Model 100 Terminal Board

1.4 Smart Battery Pack (Optional)

The RXT-300 transceiver can also be powered by an optional battery pack that enables it to be remotely mounted without the need for any cables because of its wireless operation. The available battery pack is Detcon's plug-in Smart Battery Pack which provides an output of 12VDC (See Figure 5). If installed, the RXT-300 transceiver will detect the battery and will continuously query the battery pack for remaining battery life. The battery pack consists of rechargeable Lithium-Ion batteries and is equipped with integrated safety electronics that include fuel gauge, voltage, current and temperature monitoring circuits. This "smart" circuitry continuously monitors the battery's condition and reports critical status information to the wireless transceiver via the Modbus™ registers. The battery pack is designed to plug onto an 8-pin Beau connector on the Model 100 Terminal Board and should not be exposed to outside elements without being housed and protected. Only Detcon products specifically designed to utilize these battery packs should be used. Operating periods before recharge will vary based on devices attached along with the transceiver and the usage of those devices, but can be as long as 2-3 months and battery life can be up to 5 years before battery pack replacement is required. Improper use of the battery pack may be hazardous to personnel or the environment and will void the warranty.

Figure 5 Smart Battery Pack

NOTE: The RXT-300 wireless transceiver can also be powered by a customer provided external DC power source. Refer to section 0 for more details.

1.5 Quad Battery Charger (Optional)

Detcon's Smart Battery Pack can be charged as needed using Detcon's optional Quad Battery Charger which can charge up to four battery packs at one time. The Quad Battery Charger comes with a plug-in AC/DC adapter that plugs into a standard 120VAC outlet for power. The DC end of the adapter plugs into the DC power jack of the charger providing 24VDC. The Quad Battery Charger has four charging ports, each with 8-pin Beau connectors for battery pack connection. The ports and connectors are keyed to prevent incorrect positioning and connection. Each port has its own "FAULT" LED indicator and "CHARGE" LED indicator and will display either a red light or green light depending on the status of each battery being charged. Charging times will vary depending on the charge state of each battery pack, but a full charge of a depleted battery pack can take up to 24 hours.

Figure 6 Quad Battery Charger

When first powered on and with no battery packs connected to the charger, all the LED indicators on the Quad Charger should be green. When a battery pack is seated into a charging port, the "CHARGE" LED will change from green to red indicating the battery pack is not sufficiently charged. Once fully charged, the LED will change from red to green and the battery pack is ready to be used.

The "Fault" LED should remain green indicating that there are no problems with the battery pack or charging port. If the "Fault" LED turns red with the battery pack connected, then there is a problem or issue with the battery pack and it should be immediately removed and not be used. If the "Fault" LED turns red without a battery pack connected to the charge port, then there is a problem or issue with the port and that port should no longer be used.

Battery packs can remain connected to the charger even after a full charge indication (Green "Charge" LED) is shown due to the protection circuitry of the battery pack which prevents any overcharging issues.

1.6 Solar Panel (Optional)

Detcon also offers an optional solar panel to be used in conjunction with the Smart Battery Pack. It provides 24VDC output and connects to the J5 connector of the Model 100 Terminal Board. This option enables continuous operation of the wireless transceiver and charging of the battery pack eliminating the need for external recharging. It is an ideal choice for virtually any area with sufficient daily average sunlight. Since the solar panel is considered and external power supply, a special conduit installation will be required.

If the optional solar panel is installed, consideration should be given to position the panel where the most sunlight is available. The solar panel can be mounted remotely to allow for maximum sunlight exposure. If necessary, a sunshade can be used for the wireless transceiver assembly to help reduce its operating temperature.

Figure 7 Solar Panel

2.0 Installation

2.1 Guidelines for Safe Use

1. Install unit only in areas with classifications matching with those described on the approval label. Follow all warnings listed on the label.

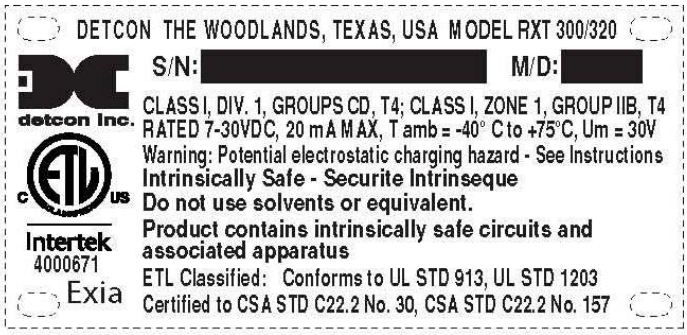


Figure 8 RXT-300 Approval Label

2. Do not use in areas containing air saturation levels of Acetic Acid, Acetone, Ammonium Hydroxide, Fuel C, Diethyl Ether, Ethyl Acetate, Ethylene Dichloride, Furfural, N-Hexane, MEK, Methanol, 2-Nitropropane, or Toluene.
3. Ensure that the transceiver is properly threaded into a suitable explosion-proof rated junction box with a female ¾" NPT threaded connection. The sensor should be threaded up at least 5 full turns until tight. Avoid use of Teflon Tape, or any type of non-conductive pipe thread coating on the NPT threaded connection.
4. A good ground connection should be verified between the sensor's metal enclosure and the junction box. If a good ground connection is not made, the sensor can be grounded to the junction box using the sensor's external ground lug. Also verify a good ground connection between the junction box and earth ground.
5. Proper precautions should be taken during installation and maintenance to avoid the build-up of static charge on the plastic weather-guard of the transceiver.
6. Do not substitute components that are not authorized by the scope of the safety approval. This may impair the intrinsic safety rating.
7. Do not operate the unit outside of the stated operating temperature limits.
8. Do not operate the unit outside the stated operating limits for voltage supply.
9. The sensor power supply common (black wire) must be referenced to the metal enclosure body (ground) during installation.
10. These units are designed to meet EN60079-0, EN60079-1, EN60079-11, UL913 7th Ed., and CSA C22.2 No.157-92.
11. These units are designed have a maximum safe location voltage of Um=30V.
12. These units pass dielectric strength of 500VRMS between circuit and enclosure for a minimum of 1 minute at a maximum test current of 5mA.

2.2 Mounting

The RXT-300 wireless transceiver should be vertically oriented and mounted to an explosion-proof enclosure or junction box. The J-Box contains the optional Model 100 Terminal Board. If a battery pack is used, Detcon's custom J-Box is needed to accommodate both the terminal board and the battery pack plus a T-Outlet box with a drain is required (See Figure 9). The RXT-300 wireless transceiver assembly is typically mounted on a wall or pole.

Obstacles between RXT transceivers can impact RF line-of-sight and may result in communication problems. Each transceiver should be in view of at least one other transceiver. In some cases, it may be necessary to extend and elevate the RXT transceiver away from the J-Box/device assembly. Refer to section 2.2.1 for such remote mounting applications

Detcon offers an optional mounting plate that can be used for mounting the wireless transceiver assembly on a wall or pole. If ordered with this option, secure the wireless transceiver assembly to the mounting plate using two of the four 3/8" diameter holes located on the top face of the mounting plate (If not already done so from the factory). The whole assembly can now be mounted on a secure wall using the four 7/16" diameter holes located on the base of the mounting plate (See Figure 9). The assembly can also be mounted to a pole with two U-Bolts secured through the 7/16" holes on the base.

NOTE: If wall mounting without the mounting plate, make sure to use at least 0.5" spacers underneath the J-Box's 1/4" mounting holes to move the wireless transceiver assembly away from the wall and allow clearance to the transceiver.

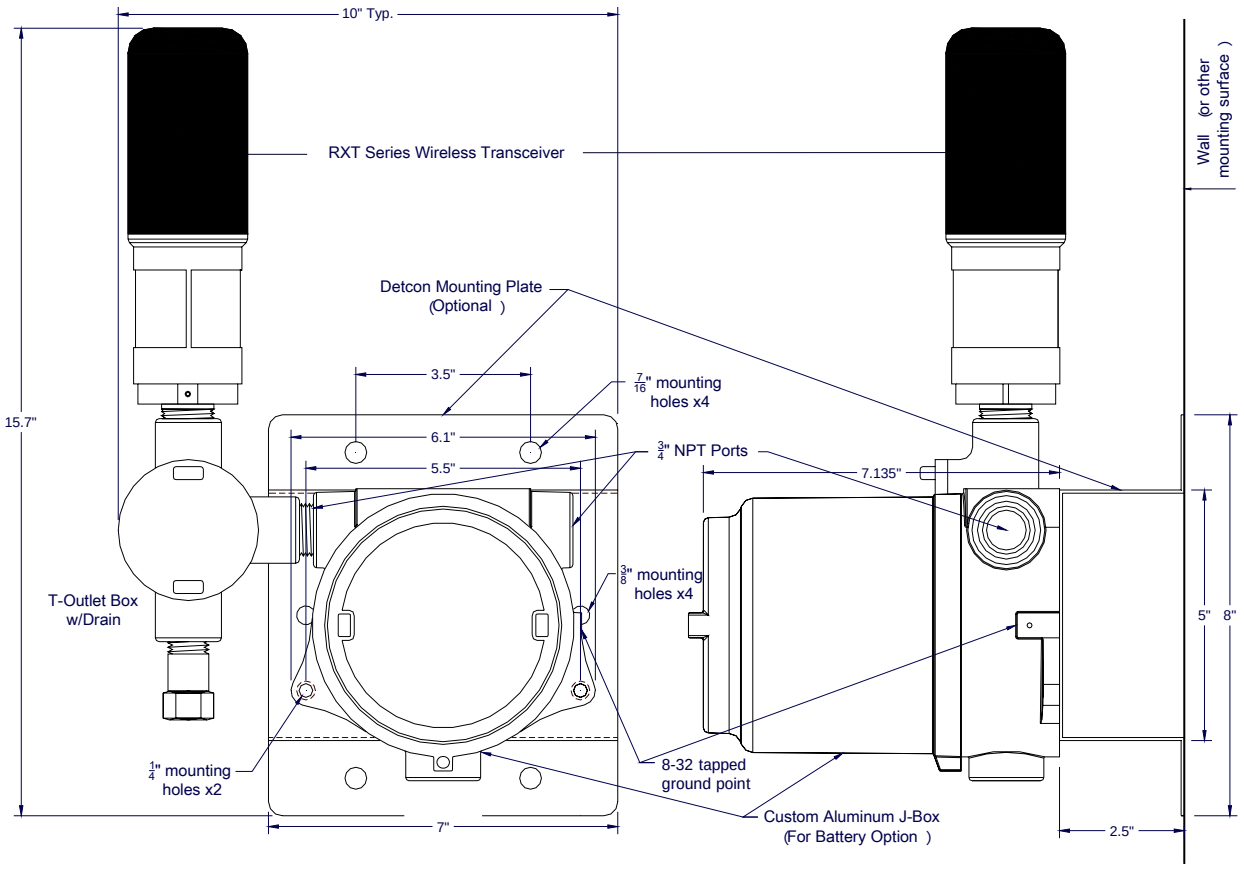


Figure 9 RXT-300 Wireless Transceiver w/Battery Assembly and Mounting Dimensions

2.2.1 Remote Mounting

The RXT-320 wireless transceiver is normally connected directly to the J-Box containing the battery/terminal board assembly. In situations where RF line-of-sight is diminished by obstructions, it may be necessary to remotely mount the wireless transceiver away from this J-Box. Remote separation distances of up to 15 feet are possible with the recommended cable. Such an installation will require an additional J-Box which connects to the separated transceiver and houses Detcon's 8-position terminal board with Ground board plus additional hardware (See Figure 10).

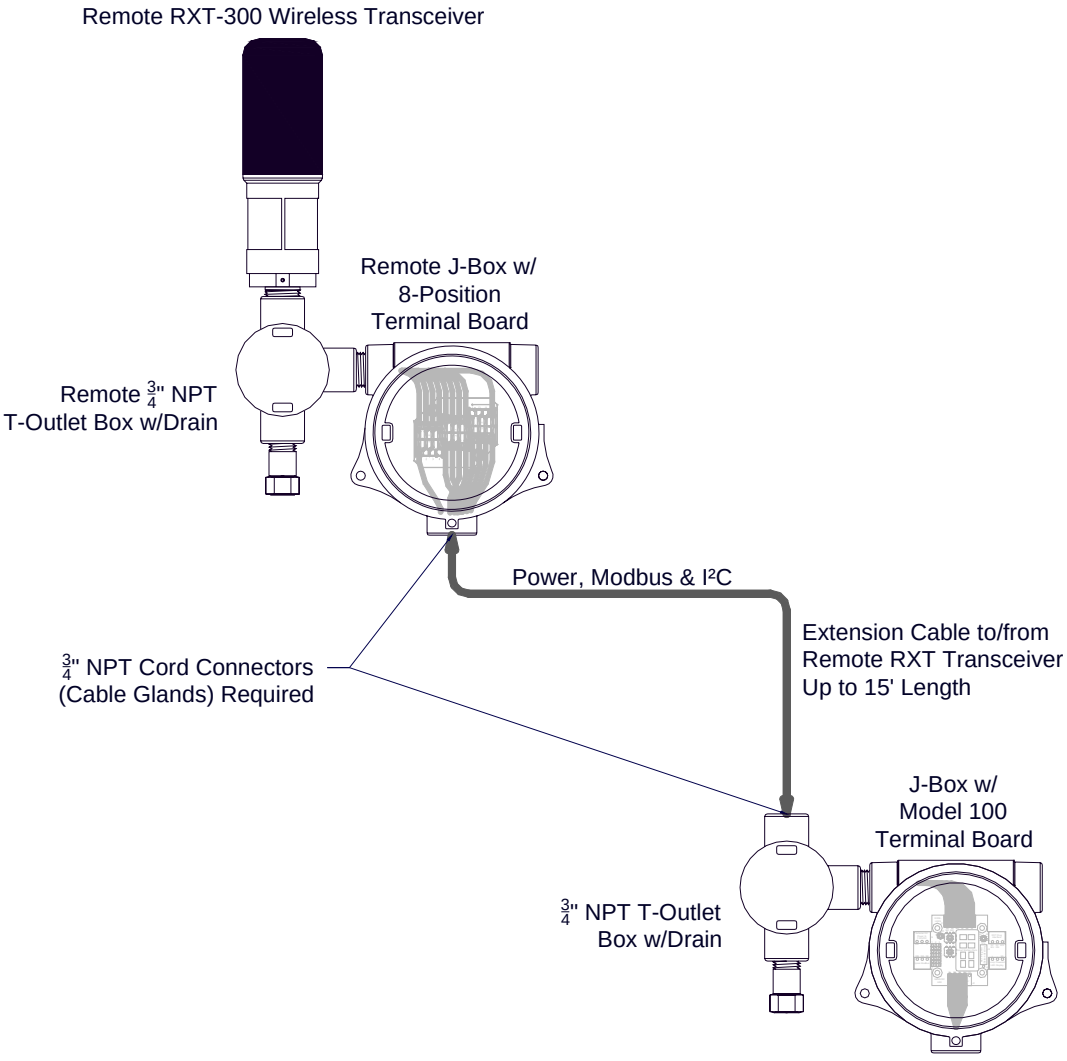


Figure 10 RXT-300 Wireless Transceiver Remote Mounting

A custom extension cable needs to be built per Figure 11 to interface the remote transceiver to the Model 100 Terminal Board. The recommended cable for remote transceiver separation is Belden 1421A (24AWG shielded twisted pair, 4 pairs w/drain wire).

NOTE: It is highly recommended to install the extension cable inside rigid metal conduit to eliminate potential EMI and RFI interference and to maintain a Class I Division I rating.

NOTE: Color coding of the cable will no longer match the color coding on the Model 100 Terminal Board for the J1 connector.

NOTE: Programming of RXT transceiver from the Model 100 Terminal Board will be disabled.

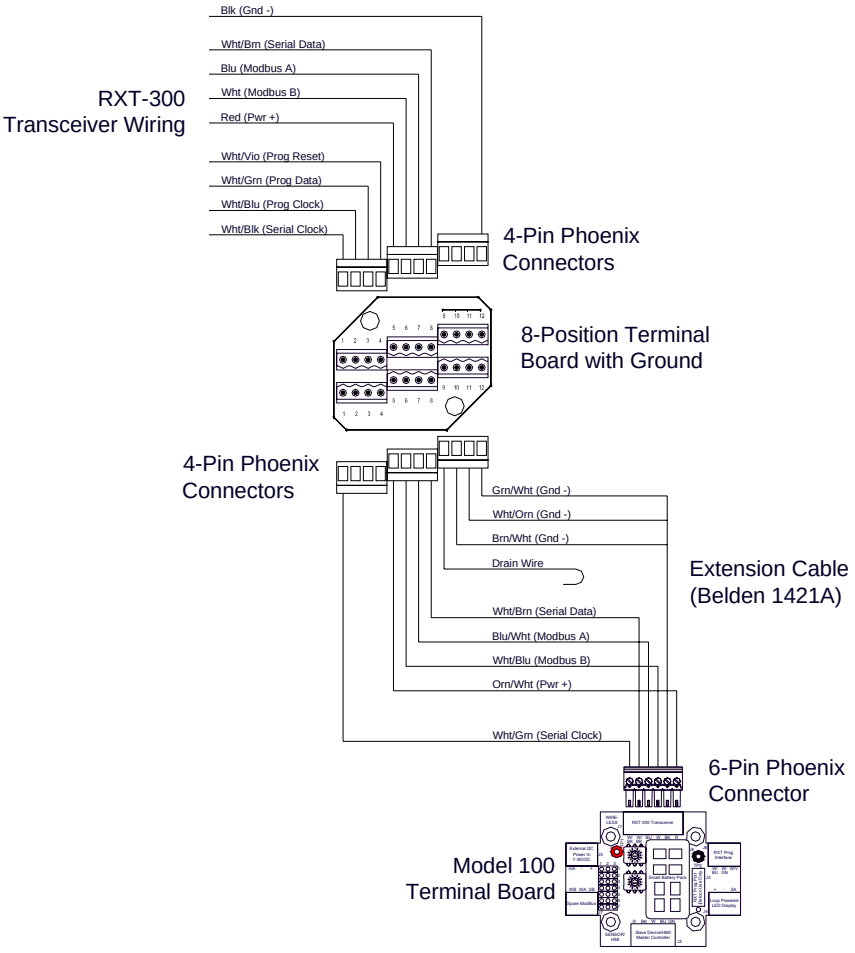


Figure 11 Wiring Diagram for Remote RXT-300 Transceiver Mounting

Remote Mounting Steps

1. Remove the J-Box cover of the RXT-300 wireless transceiver assembly.
2. If the wireless transceiver assembly has the Smart Battery Pack, unplug the battery pack from the terminal board by pulling the battery pack out of the junction box.
3. Identify the J1 6-pin Phoenix connector and the J8 3-pin Phoenix connector on the Model 100 Terminal Board and disconnect from the board. Remove all transceiver wire connections from the connectors. Reconnect the 3-pin connector to its corresponding place and save the 6-pin connector for step 13.
4. Use a wrench at the bottom section of the RXT transceiver and unthread the RXT until it can be removed.
5. Feed the RXT transceiver wires through the ¾" NPT hole of the remote T-Outlet box connected to the remote J-Box and thread the transceiver into the remote T-Outlet box until tight.
6. Remove all 6 of the 4-pin Phoenix connectors from the 8-position terminal board with Ground in the remote J-Box and connect the RXT transceiver wires to 3 of the Phoenix connectors per the wiring

diagram in Figure 11. Reference Table 2 **RXT-300 Transceiver Wire Identification** for color code identification.

NOTE: Wires that are not used should be individually capped off and secured out of the way in the T-Outlet box so that they are not exposed to any active components, power, or ground.

7. Reconnect these 3 Phoenix connectors to their corresponding places back on the 8-position terminal board with Ground.
8. Measure out the cable to be used for the extension cable to be no more than 15 feet long. Feed one end of the cable through a ¾" NPT cord connector (cable gland) and then into the ¾" NPT hole located on the bottom of the remote J-Box.
9. Connect the cable wires of the extension cable to the remaining three 4-pin Phoenix connectors from step 6 per the wiring diagram in Figure 11. Reference Table 1 **Extension Cable Wire Identification** for color code identification.
10. Reconnect these 3 remaining Phoenix connectors to their corresponding places back on the 8-position terminal board with Ground and thread the ¾" NPT cord connector to the bottom of the remote J-Box.
11. Install the J-Box cover of the remote J-Box.
12. Feed the other end of the cable through another ¾" NPT cord connector and then into the ¾" NPT hole of the T-Outlet box connected to the J-Box housing the Model 100 Terminal Board.
13. Connect the cable wires to the 6-pin Phoenix connector from step 3 per the wiring diagram in Figure 11. Reference Table 1 **Extension Cable Wire Identification** for color code identification.
14. Reconnect the 6-pin Phoenix connector back to J1 of the Model 100 Terminal Board and thread the ¾" NPT cord connector to the T-Outlet box.

NOTE: Color coding of the cable will no longer match the color coding on the Model 100 Terminal Board for the J1 connector.

NOTE: Programming of RXT transceiver from the Model 100 Terminal Board will be disabled.

15. Plug battery pack back in place and reinstall the J-Box cover from step 1.

Table 1 Extension Cable Wire Identification

Function	Color Reference
VDC Power (+)	Orange/White
VDC Return (-)	Green/White
Modbus A (+)	Blue/White
Modbus B (-)	White/Blue
Serial Clock (SCL)	White/Green
Serial Data Line (SDA)	White/Brown
Common Ground	White/Orange
Common Ground	Brown/White
Drain Wire	Bare (No Color)

2.3 Wiring Connections / Functions

Depending on use and function, the RXT-300 wireless transceiver can be wired in different ways to different devices. It is important to insure that the wiring is correct for the device to operate properly. Wire identification for the transceiver can be found in Table 2 **RXT-300 Transceiver Wire Identification**.

Table 2 RXT-300 Transceiver Wire Identification

Function	Color Reference
VDC Power (+)	Red
VDC Return (-)	Black
Modbus™ A (+)	Blue
Modbus™ B (-)	White
Alarm 0	Brown
Alarm 1	Orange
Alarm 2	Violet
Alarm 3	Gray
4-20mA A	Green
4-20mA B	Yellow
Serial Clock (SCL)	White/Black
Serial Data Line Data (SDA)	White/Brown
Programming Data	White/Green
Programming Clock	White/Blue
Programming Reset	White/Violet

NOTE: Reference Figure 18 through Figure 25 at the end of this manual for multiple wiring examples.

2.3.1 VDC Power & VDC Return

All RXT-300 wireless transceivers need to have DC power applied to the transceiver's red (VDC power) and black (VDC return) wires. The power requirements for the transceiver are such that the DC voltage input range is 7 to 30 volts. This power will normally be supplied by the device the transceiver is connected to, but can come from alternate DC sources such as the optional Smart Battery Pack, solar panel or external customer supplied DC source.

If an external power source is installed, the RXT-300 wireless transceiver requires two conductor connections for the power supply. External DC power can be customer provided with an output voltage range between 7 to 30VDC or by Detcon's optional 24VDC solar charging panel. Both of these alternatives will provide continuous operation of the assembly and can be installed in conjunction with the optional battery pack, providing a constant power source. The external power supply will also maintain the battery pack fully charged with no overcharging issues to be concerned with due to the battery pack's "smart" circuitry. In this configuration, external charging of the battery pack will not be necessary. In the event the external power fails, the battery pack will continue to power the wireless transceiver assembly until external power is restored or the battery is discharged.

If the Model 100 Terminal Board option is not used, power to the transceiver should be directly applied to its red and black wires accordingly. If the terminal board is used, wiring designations for power are '+' and '-' (External DC Power In) on the J5 connector of the Model 100 Terminal Board. The maximum wire length between the transceiver assembly and a 24VDC source is shown in Table 3 **Wire Gauge vs. Distance**.

Table 3 Wire Gauge vs. Distance

AWG	Wire Dia.	Meters	Feet	Over-Current Protection
22	0.723mm	700	2080	3A
20	0.812mm	1120	3350	5A
18	1.024mm	1750	5250	7A
16	1.291mm	2800	8400	10A
14	1.628mm	4480	13,440	20A

NOTE: Wiring table is based on stranded tinned copper wire and is designed to serve as a reference only.

NOTE: The supply of power should be from an isolated source with over-current protection as stipulated in table. The output voltage range must be between 7-30VDC.

Before applying power, make sure that all wiring is correct. Not all wires from the wireless transceiver are used in most configurations. Wires that are not used should be individually capped off and secured out of the way in the T-Outlet that mounts the transceiver to the J-Box/condulet. This prevents exposure to any active components, power or ground.

2.3.2 Modbus™ A & B

The RXT-300 transceiver features a Modbus™ compatible communication port. The connections are Modbus™ A (blue wire) and Modbus™ B (white wire) and are polarity dependent. Modbus™ communication is accomplished by two wire half duplex RS-485, 9600 baud, 8 data bits, 1 stop bit, no parity, through the transceiver's connection to the Modbus™ device. It is necessary to set a Modbus address for the RXT-300 unless operating in transparent mode.

2.3.3 Alarm 1-4

Each RXT-300 wireless transceiver provides outputs for up to four alarms (Alarm 1, Alarm 2, Alarm 3 and Alarm 4) which can drive relays on custom terminal boards provided by Detcon. The outputs are controlled by the RXT-300 based upon the configuration and current alarm state of the whole network. The outputs are open drain and rated for up to 300mA at 50V (See Figure 12). They are not intended to drive alarm devices directly, but rather to drive relay coils (interposing relays) which in turn will drive a higher current output.

When using interposing relays, the customer must protect the RXT-300 Alarm outputs against the voltage spike that can be over 1000V when the relay is de-energized. This voltage spike will damage the Alarm output since it is well over the rated maximum voltage of 50V and will cause the output to fail. A transient protection diode (1N4001 or equivalent) can be placed across the relay coil to mitigate the voltage spike.

NOTE: External relays used with this circuit must not exceed voltage/current requirements and must have transient protection to minimize the voltage spike when the coil is de-energized.

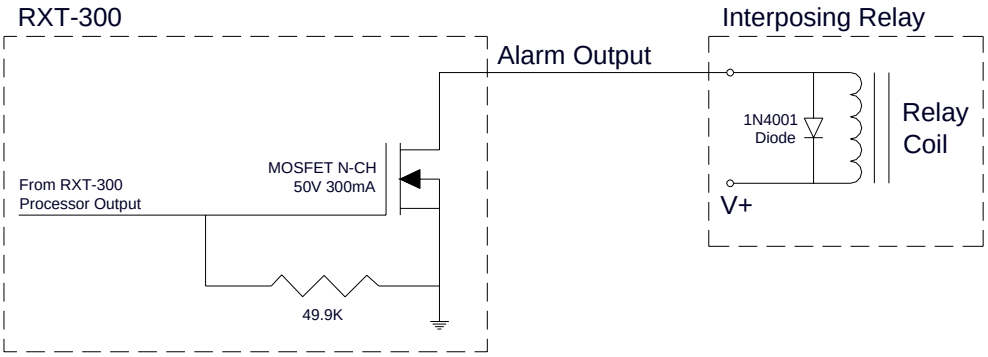


Figure 12 Internal Alarm Output Circuit

Detcon alarm terminal boards are available that allow either AC or DC/Battery operation with the relays built onto the board. These boards provide a complete solution to connecting an RXT-300 to power and providing high-current relay closures. Figure 13 shows as an example, the DC/Battery Alarm board that take two of the four RXT-300 Alarm outputs and generates two 24VDC outputs to drive audio and/or visual alarms. Any two of the four Alarm outputs can be used and will be based on how alarms are configured for the system. This board is designed to operate off of the 12VDC Detcon Smart Battery pack.

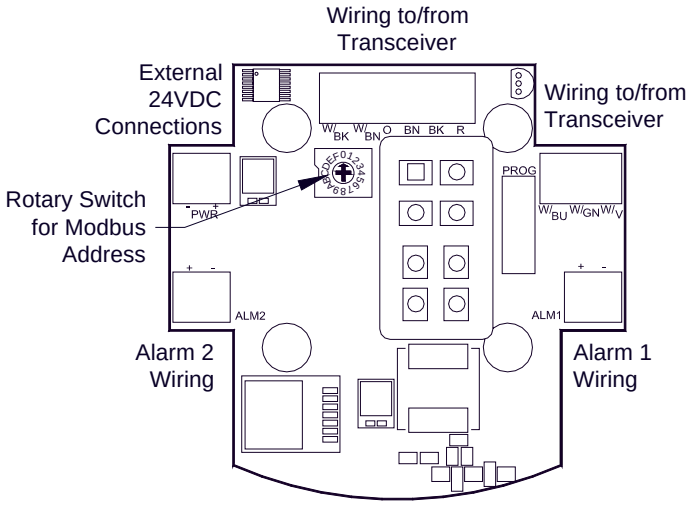


Figure 13 DC/Battery Alarm Board

2.3.4 4-20mA A & B

The RXT-300 supports up to two 4-20mA signal inputs (A and B) used for monitoring 4-20mA devices (See Figure 14). For the primary 4-20mA signal input, use A (green wire). For the secondary 4-20mA signal input, use B (yellow wire). The input values are continuously read by the RXT-300 and stored in registers accessible locally through two Modbus™ registers. During system configuration, these registers can be assigned to sensors and the RXT-300 will then monitor and report on any alarm conditions.

Readings on a 4-20mA input are converted to representative values, for example, 4mA is read as a value of 400 and 20mA is read as a value of 2000. These inputs present a load of 162 ohms to ground so a current of 20mA will develop around 3.4V across the input and ground. This will consume a third less power versus the 250 ohm load used in other implementations. The inputs are protected for voltages up to 30V but the input

reading will reach a maximum of 2048 for currents greater than 20mA. Electrically the 4-20mA interface supports 2-wire and 3-wire devices.

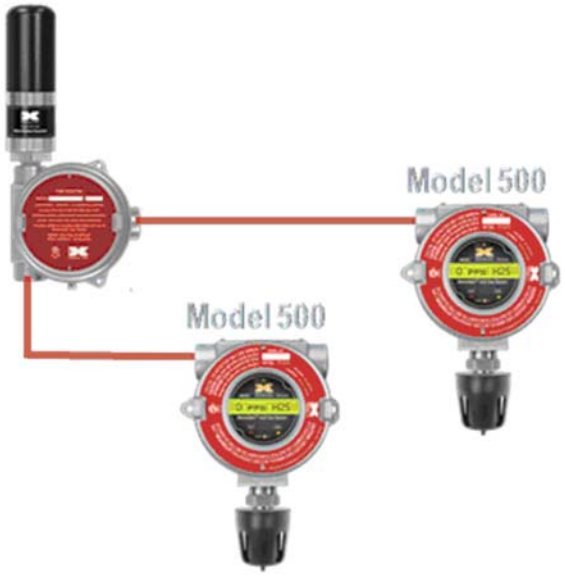


Figure 14 Up to two Sensors using two 4-20mA Interfaces

NOTE: The 4-20mA inputs do NOT support 4-wire implementations

2.3.5 Serial Clock & Serial Data Line

This is the I^2C interface for the transceiver consisting of a serial clock (SCL) and serial data line (SDA). These are used to monitor the status of the battery pack (if installed).

2.3.6 Programming Data, Clock & Reset

These connections are used to program the RXT-300 transceiver and should be used by Detcon personnel only.

3.0 System Operation

The gas detection system built with the RXT-300 SmartWireless™ Transceiver operates similar to one using a single Modbus™ controller that polls (queries) sensors connected to it. Generally upon each poll of a sensor, data is collected, stored and processed for alarm conditions that are set by the user. If an alarm is detected the controller activates alarms to alert the user.

In a system using the RXT-300 SmartWireless™ Transceiver, sensors that are attached to a RXT-300 as part of a Sensor Station are located at different physical locations around the site. Data must be collected from all of these sensors as if they were wired to a single controller. In addition to sensor data, RXT-300 status such as battery life and status of the wireless communication between the RXT-300s must be collected. The data for the whole system is collected by every RXT-300 on the network so that each RXT-300 has a complete picture of the system. This allows every RXT-300 to operate independently in processing system wide alarm conditions and allows a HMI Station to display information for the whole system.

To facilitate this, the RXT-300s with sensors attached will poll their own sensors, collect the data and process the data for alarm conditions and store it locally. It operates essentially like a Modbus™ controller for its own sensors. To gather the information from across the network, one of the RXT-300s is automatically chosen to become the Master of all the RXT-300s of the network and will poll each RXT-300 on the network. Upon

each poll a different RXT-300 is queried and will transmit its data stored locally to the rest of the RXT-300s on the network. This continues until all RXT-300s are polled across the network. As part of the polling process the Master RXT-300 will also transmit its own data to the network at the appropriate time.

The Master RXT-300 can be any one of the RXT-300s in the network but the "election" process can be guided by the user when the RXT-300s are configured and set up. If a Master RXT-300 fails this will be detected by all the other RXT-300s and a new Master RXT-300 will be elected. The network polling will continue after the election is complete. This alleviates a single point of failure.

3.1 Station Configuration

For the RXT-300s to operate differently based upon the application they must be configured. This is done with the RXT-300 Wireless Configuration Tool (WCT) and is covered in more detail in Section **Error! Reference source not found.**. For purposes of this discussion it is sufficient to state that each RXT-300 in the system is configured to perform a specific set of tasks. A single configuration file with all this information is generated by the WCT and loaded wirelessly into the RXT-300s in the system. At power up the RXT-300s will search through the configuration file and determine its own operation as well as what type of function it will perform and whether it is a HMI Station, Sensor Station or an Alarm Station

3.2 HMI Station Operation

The RXT-300 RS-485 Modbus™ port can be configured to connect to a Modbus™ Master and allows the Wireless HMI or a another Modbus™ controller to obtain status of the whole system. Since every RXT-300 maintains a complete status of the system much of this data has been made available for access through Modbus™ registers on the RXT-300.

> **NOTE:** An HMI Station/Modbus™ controller only monitors the network and does not perform the actual polling of sensors and processing of alarms. It only provides the user a visual status of the system and managing of alarms events such as alarm reset/inhibit/silence.

The RXT-300 will allow a direct access to sensor data as if it were directly attached to the controller through Modbus™. The RXT-300 will perform a lookup based upon the sensor Modbus™ address/registers and respond with data obtained from the network and stored locally. If the Modbus™ address/registers do not match a configured sensor it will ignore the request or generate a Modbus™ exception.

If more than just sensor data is desired there are groups of registers that provide access to the status of each RXT-300, network status and alarm status. There are additional registers that allow for sending commands across the network. These commands are alarm reset, alarm silence, alarm inhibit, alarm test and RF silence. Each RXT-300 in the system is assigned a unique Modbus™ address during configuration just like the sensors. This address is used for all Modbus™ accesses.

The wireless HMI Panel has been designed to take advantage of all aspects RXT-300, both displaying sensor status, alarms, RXT-300 status and network status. It also performs all control functions available. Another great advantage is the HMI can read the RXT-300 configuration and automatically configure itself to display everything about the system.

3.3 Sensor Station Operation

There are two ways sensors or devices can be attached to the RXT-300, using the Modbus™ interface and using the 4-20mA interface. Sensors are added specific RXT-300s in the configuration along with the Modbus™ address / registers and the alarm thresholds for each one. If a RXT-300 configured to have sensors attached to either or both interfaces it will poll these sensors continuously and maintain a local copy of the data

as well as process and store the alarm state of the sensor. The Sensor Station RXT-300 will transmit all its sensor data to the rest of the network when it is polled by the Master RXT-300. This data is then stored by every RXT-300 on the network and available for those RXT-300s to perform alarm processing or for user visibility through a HMI Station.

The Modbus™ interface only supports sensors or a controller not both, so if one or more sensors are attached it the Modbus™ interface it will not support a controller or HMI. If the sensors only use the 4-20mA inputs then a Modbus™ controller or HMI can be attached.

The Modbus™ sensors are defined in the system configuration as being attached to a particular RXT-300 and the Modbus™ address and registers that are to be read. Additionally the register that contains the sensor concentration is identified and what alarm thresholds are. The RXT-300 will read all registers as configured, store them locally and then process the concentration for an alarm event. If Detcon sensors are used, additional fault or calibration info is also processed and made available for display on the HMI Stations.

The two 4-20mA sensor inputs can represent up to two separate sensors if enabled. Their Modbus™ address becomes the RXT-300 they are attached to. The RXT-300 will actually store the readings for the two inputs into two separate registers on the RXT-300. A 4-20mA sensor type can be setup that will read this register and process alarms much like sensors on the Modbus™ interface.

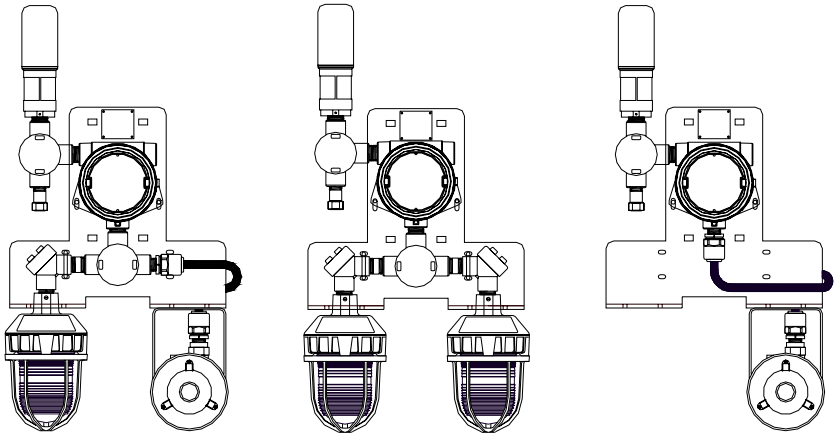
3.4 Alarm Station Operation

Alarms can come from several different sources. These not only include sensors but RXT-300s and network based alarm events. These alarm events are eventually mapped to just four alarm outputs, Alarm 1-4 on an RXT-300. All RXT-300s will generate alarms on their alarm outputs but most stations do not have any alarm devices attached. A list of possible alarm events are shown below:

- Sensor Threshold Settings, Ascending or Descending
- Sensor Communication Errors
- Sensor Fault conditions – Detcon sensors types only
- Battery Threshold on remaining time
- Battery Communication Error (fault)
- Network Communication Error – one of more RXT-300s offline
- Network Down – no Master RXT-300

Mapping of these alarm events is configurable to any one of the Alarm 1-4 outputs on a device by device basis but defaults are generally used. Alarms can also be grouped using Zones which is covered later. Each RXT-300 will process all alarms for itself which will include sensors if any, battery status and network status. Upon detection of an alarm event the local Alarm outputs will be updated. This information is disseminated later when that RXT-300 is polled by the Master RXT-300 and at this point all RXT-300s will receive the new alarm state and update their alarm outputs accordingly.

Detcon Alarm Stations that can operate off of a single Detcon Smart Battery pack will have two alarm devices attached. Alarm devices were selected to minimize the power consumption and yet maximize the alarm coverage. Figure 15 shows units designed for installation and use in Hazardous duty, corrosive work environments rated at Class 1, Division 2, Groups E, F, and G.



AV1-DV2
Strobe Horn Combo
Alarm Station

V2-DV2
Dual Strobe
Alarm Station

A1-DV2
Horn Only
Alarm Station

Figure 15 Basic C1D2 Wireless Alarm Stations

Although not at Alarm station, the HMI Panel has four LEDs that provide a visible indication of the four alarm outputs. The HMI LEDs will follow the state of the alarm outputs and are labeled ALM 1, ALM 2, ALM 3 and FAULT. Alarm 4 in Detcon detection systems is usually mapped to fault conditions such as communication errors or sensor faults where Alarm 1-3 are usually mapped to threshold settings for sensors

3.4.1 Alarm Output Properties

Alarm outputs on RXT-300s can be configured with certain properties such as Energized / non-Energized, Latching / non-Latching and Silence-able / non-Silence-able. These are configured for each RXT-300 and only affect the Alarm outputs on that RXT-300. Energized / non-Energized determines the active state of the Alarm output where Energized means the open collector output is grounded when the alarm is active and non-Energized is the opposite. Latching / non-Latching determines whether the Alarm output is latched. With Latching selected, if an alarm event ever occurred the Alarm output will be active regardless of the current state of the alarm. Non-Latching causes the Alarm output to just follow the current state of any alarm condition. The Silence-able property allows the user to turn off the Alarm output even though there is an existing alarm. If the alarm goes away and comes back again, silence is removed and the Alarm output will become active again. The Non-Silence-able setting does not allow the Alarm output to be silenced.

NOTE: At power up or reset, the default for Energize / non-Energize on the RXT-300 is set to Energized until the configuration is fully loaded. If the RXT-300 is configured for non-Energize there will be a short period of time at power up or reset the external Alarm will activate until power-up configuration is complete.

3.4.2 Alarm Zones

RXT-300s can be grouped into alarm Zones to allow Alarm Stations to generate alerts for a group of sensors in a Zone. There can be up to 16 Zones defined by the user each RXT-300 can be assigned to one or more Zones. For example if there were two sets of 3 Sensor Stations that were separated by a large distance the user can define two Zones one for each set of 3 and the user could place an Alarm Station in each Zone. When an alarm event occurs in Zone 1 only that Alarm Station would activate and the same would be true for Zone 2. Now if an HMI Station were added it could be placed in both Zone 1 and Zone 2 and any alarm in the system would show up on the four Alarm LEDs on the HMI. A “global” Alarm Station could also be added and placed in both Zone 1 and Zone 2 and that Alarm Station would activate for any alarm in the system.

3.4.3 Alarm Setup Summary

In summary, there are alarm events that are generated for multiple conditions around the system. For every alarm event they can be either ignored or they can be mapped into one of four Alarm Outputs. Alarm Zones provides additional mapping of these Alarm Outputs to specific groups of RXT-300s. Finally, the Alarm Outputs on each RXT-300 have properties to configure the way the Alarm Outputs operate. Each of these settings is part of the configuration that the user creates and stores in each RXT-300 of the system.

3.5 Network Sleep

In systems where batteries are used to power the different RXT-300 based Stations, the RXT-300 network can be put to sleep after polling all RXT-300s in the network. In this way battery life can be extended since the wireless radios consume most of the power on an RXT-300. If the user enables this feature, the Master RXT-300 will poll all the RXT-300s on the network and then issue a sleep command. During sleep the wireless radios are put in a low power state and no updates across the network will occur during this time. As sleep time is increased battery life is extended but the time between data being updated is also increase. A simplistic formula would be:

Sensor Data Update = Poll Cycle Time + Sleep Time

The Poll Cycle time will also increase as the number of devices and RXT-300s are added to the network.

NOTE: If Network Sleep is used to conserve battery life, there will be a tradeoff between sleep time and real time updates of sensor data.

NOTE: Even though the network may be asleep, since all network data is updated and stored locally within a RXT-300, external Modbus™ controllers can still poll this data continuously as if the devices are still available. When the RXT-300s wake up this data will be updated to the latest values.

Sleep can be disabled in systems where battery life is not an issue or if the RXT-300s are not battery powered. With sleep disabled the sensor updates will occur faster and will equal the poll cycle time.

3.6 Network Control

There are multiple controls provided to allow a HMI Station or Modbus ™controller attached to a RXT-300 to manage a RXT-300 system. These commands are Alarm Reset, Alarm Silence, Alarm Inhibit, Alarm Test and RF Silence. An HMI Station or Modbus ™controller attached to a RXT-300 can use a Modbus™ write to control registers on the RXT-300 to execute these commands. Once a command is given it is executed immediately on that RXT-300 but if it is a Slave RXT-300 (not Master) there will be a delay until it is polled and then the command is sent to the rest of the system. There is a network command status register that can be monitored to determine when the command is sent to the rest of the network. The worst case delay from the time the Modbus™ controller sends the command to the time it is executed across the whole network is equal to the Poll Cycle Time + Sleep Time.

3.6.1 Alarm Reset and Alarm Silence

Alarm Reset and Alarm Silence are similar commands and will both de-active Alarm outputs on RXT-300s depending on their configuration. The HMI Panel actually executes both commands simultaneously when an Alarm Reset is executed. The following rules apply to whether an Alarm Output is de-activated for an Alarm Reset or Silence:

Alarm Reset
Only valid for Alarm Outputs with Latched property set.
Will de-activate an Alarm Output that is Latched, but NOT if there is an existing Alarm.
After alarm reset, a new Alarm event will cause latching of Alarm output again.

Alarm Silence
Only valid for Alarm Outputs with Silence-able property set.
Will de-activate any Alarm Output, Latching or non-Latching.
After alarm silence, a new Alarm event clears silence and will re-active Alarm Output.

NOTE: On an HMI Panel, the front panel LEDs, that indicate Alarms, will ignore Alarm Silence.

3.6.2 Alarm Inhibit

Alarm Inhibit allows the user to force all Alarm outputs to an in-active state for a period of time. It can be used to prevent invalid alarms from occurring if the user is performing maintenance on the system. On the HMI Panel the Alarm Inhibit menu allows the user to input an amount of time to inhibit Alarms in minutes. There is a Start / Stop in this same menu that starts the timer. This command is sent to the rest of the network and all RXT-300s would disable their Alarm outputs and begin a countdown. When the time is complete the Alarm outputs would be enabled again and immediately would start outputting any alarm conditions. If the user is done with maintenance of the system prior to the timeout, an Alarm Inhibit stop command can be given which would disable Alarm Inhibit.

3.6.3 Alarm Test

Alarm Test is used to test all Alarm thresholds and outputs in a system. Placing the RXT-300s in Alarm test causes every RXT-300 with sensors to increment sensor values in 5% increments and when the range is reached it will then decrement by the same amount. These values increment based upon the RXT-300s poll cycles (not time). The HMI Panel will display the incrementing / decrementing values as well as Alarm conditions.

3.6.4 RF Silence

RF Silence is used to force all RXT-300s to disable their transmit functions and only allow receive. It is a manual ON/OFF function that can be executed from any HMI Station. It allows a user to shut down the wireless network at periods of time where wireless communications could be hazardous. If RF Silence is turned ON, the network would be completely shutdown and no sensor updates would occur during this time. The RXT-300s are capable of receiving and consequently when RF Silence is turned OFF, a command is sent to the rest of the network that starts the wireless network back up again.

Since this function can be a critical one, powering the RXT-300s during RF Silence is also critical. If powered by battery, there must be enough life in the battery to maintain RF Silence for that period. If there is not the RXT-300 will loose power momentarily when the battery is low and then may come up again long enough to transmit some startup messages wirelessly. This may happen multiple times until the battery is depleted.

If a RXT-300 is in silence mode and a RXT-300 looses power momentarily, the RXT-300 will restart and will communicate briefly with the network. It will determine from the rest of the network that RF Silence is ON and will shut down its transmitter immediately. This was implemented to try to recover from any unforeseen power events during RF Silence with a minimal of wireless traffic.

NOTE: RF Silence can only be maintained while RXT-300 power is maintained. Any loss of power can cause a RXT-300 to reset and will cause some amount of wireless traffic to be generated as a result. It is up to the user to guarantee that power is maintained. As another option the user can remove power from any RXT-300 Stations where there may be a concern about power loss.

NOTE: No sensor updates will occur during RF Silence. In effect, the detection system will be in a non-operational state during RF Silence.

4.0 System Configuration

4.1 Overview

As mentioned earlier the RXT-300 SmartWireless™ Transceiver must operate differently based upon the application it is used in, a HMI Station, Sensor Station or Alarm Station. To accommodate these different applications the RXT-300s within a system must be configured accordingly. This is done using the Detcon RXT-300 Wireless Configuration Tool (WCT) which allows the user to build the system configuration. The user will save the final configuration to a file on the WCT and then load it wirelessly to all of the RXT-300s that are part of that system configuration.

The configuration settings include much of the same information needed when setting up a control system for a gas detection system. This would include both sensor settings and alarm settings. The sensor settings are parameters such as Modbus™ addresses, registers to be read that include the concentration, settings for alarm thresholds and whether these are ascending or descending. System settings would be for alarms, how they are associated with sensors and their properties such as Energized/De-Energized, Latching and Silence-able. The added configuration is related to the system and wireless setup as well as the RXT-300 with its Modbus™ addressing and alarm conditions.

This configuration data is captured using the RXT-300 Wireless Configuration Tool (WCT). It is a portable unit that includes a LCD touch panel display with an application installed that help the user build a system configuration as well as load it wirelessly. The configuration is entered in three stages, the first defines System wide operation, the next defines RXT-300 operation and the last defines the sensors themselves. When the user has completed all three levels of configuration there is a single file that is generated that includes the whole system configuration. This file is then loaded only on the RXT-300s that are included in that configuration. Upon reset or power-up each RXT-300 will process the configuration file to determine its own operation within the system and fulfill the role as a HMI Station, Sensor Station or Alarm Station.

4.2 Building a System

Certain pieces of physical information must be collected prior to completing a system configuration. These are needed at different stages of building a configuration using the WCT. Many parameters will default to values that can be used without change. Others will have to be determined by the user and the specific application such as sensor types, alarm thresholds and for each RXT-300 what devices are attached and how are they configured. Most of this data will be entered in a top-down approach, starting with system parameters, then RXT-300 parameters and finally the sensor parameters. The following sections give a general overview of what is needed to build the system using the top-down organization of the WCT.

4.2.1 System Build Info

There are two main settings of importance here. The wireless network and the network sleep time.

Wireless Network

The wireless network is the RF Channel and Network ID that the system will use to communication between RXT-300s. The main purpose here is to select a wireless network that is not in use by any other RXT-300s and that has minimum RF interference. If the user has no other RXT-300 systems in the area this meets the criteria of the first requirement. If the user is unsure or does not remember what wireless networks are in use, the WCT has the capability to browse all wireless networks for RXT-300 radios.

The second criterion is to avoid RF interference which can be due to other wireless devices such as IEEE 802.11a/b/g/n (WiFi) networks used for networking PCs and other devices. Figure 16 shows IEEE 802.15.4 channels at the top numbered 11-26 which equates to the RXT-300 RF Channels 0-15. The bottom shows the IEEE 802.11 (WiFi) channels used by PCs with the most common three channels shown that do not overlap. As can be seen, the IEEE 802.15.4 channels 15, 20, 25 and 26 (RXT-300 channels 4, 9, 14 and 15) do not interfere with the most common WiFi channels used. Of course, if there are less WiFi channels in use, then there will be more RXT-300 RF channels available.

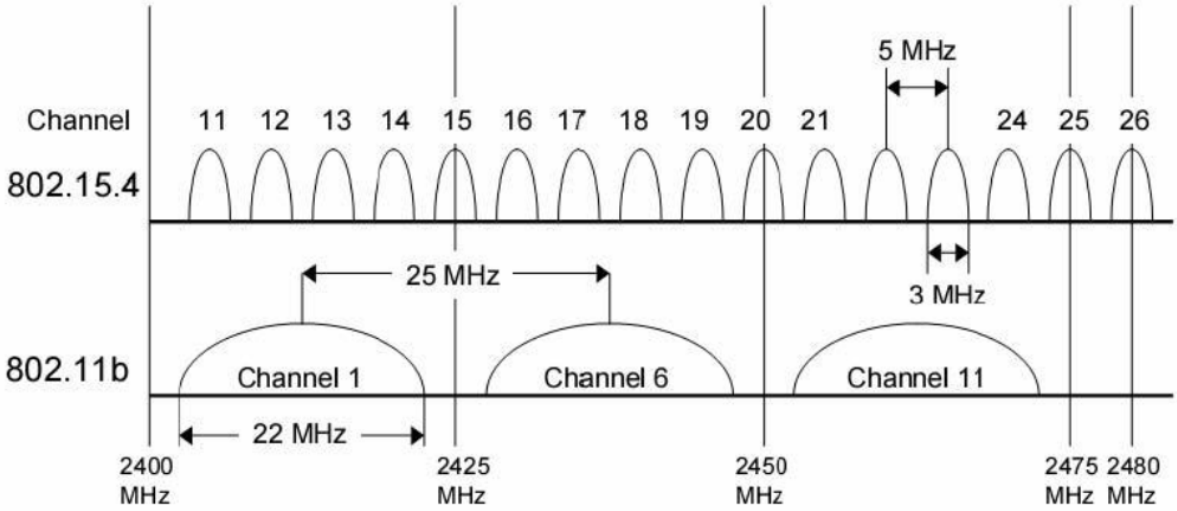


Figure 16 RF Channel Comparisons between 802.15.4 and 802.11

If interference is suspected or determined using the figure above, a different RF Channel can be selected and tried. The RF Channel can be changed multiple times if needed to find better a channel if needed.

Network Sleep

Network sleep is also applied across the whole system. The default sleep time is 10 seconds but can be changed. Lengthening this time will extend battery life but will increase the time between sensor updates. Shortening the time will shorten battery life but sensor updates will occur faster. If there are no batteries used in the system this time can be set to 0 to disable sleep and minimize time between sensor updates.

4.2.2 Alarm Zone Build Info

Zone(s)

This is really a system wide setting like the wireless network and network sleep since it affects all RXT-300s in the system. This user can just leave one Zone defined if all Alarm Stations will respond to the same Alarm conditions. Otherwise the user will need to determine the number of Zones in the system and which RXT-300s will be included in those zones. Remember a single RXT-300 can be in multiple zones. As each Zone is created the user can choose a meaningful name to represent that Alarm Zone. These Zone names will be selectable during the configuration of the RXT-300s in the system.

4.2.3 RXT-300 Build Info

This section gives an overview of the data needed to configure a RXT-300. More may be needed as the complexity increases.

RXT Name

As each RXT-300 is added the user can choose a meaningful name to represent that RXT-300. The first several characters of this name will appear on an HMI Panel when displaying data about that RXT-300. When adding sensors later the user will be presented with a list of RXT-300 names and will select the RXT-300 name that the sensor is attached to.

Unique Device ID

Every Detcon RXT-300 transceiver has been marked with a unique serial number on the body of the transceiver and is used to uniquely identify it on the network. This serial number consists of 6 characters in the form of XX.XX.XX where the X can be characters 0-9, A-F. This is really the lower portion address of the MAC address of the radio itself. The user can use the WCT to search for wireless radios on a given RF Channel and the serial number will appear on the screen as each one is found.

Station Application

The RXT-300 Modbus™ interface usage has to be defined – either a HMI (controller) is attached, or Sensor(s) or none. If an HMI (controller) is attached that uses Modbus™ Exceptions, then these can be enabled. Finally if it is used as an Alarm Station then this is enabled. The Alarm Station selection has no operational significance. All of the RXT-300s process alarms and generate appropriate values on the Alarm Outputs. It only allows the HMI to determine which units have Alarm devices attached to those Alarm Outputs.

NOTE: The Modbus™ address is automatically generated by the WCT as each RXT-300 is added. This address is then used by the HMI Panel to communicate over the Modbus™.

Battery Attached

If there is a battery installed, this will be selected in the RXT-300. The user will need to determine when a low battery alarm will be generated if there is a battery. Time remaining alarm is set in Days / Hours / Minutes.

Alarms

There are two sets of parameters here that will be set for alarms and a third set is necessary if it is performing the Alarm Station function. The first set is what Alarm events will be monitored for each RXT-300 which are really the battery alarm if a battery attached and any network issues the user desires to monitor. The second set is what Alarm Zones that the RXT-300 will be a part of. Last if it is an Alarm Station with Alarm devices attached then how will the Alarm Output properties need to be configured. Many of these will default to common settings but need to be reviewed by the user for their application.

4.2.4 Device (Sensor) Build Info

Devices / Sensors are added as the last step in the configuration process once the RXT-300s have been defined. There are three main sets of parameters, the RXT-300 the sensor is associated with, the Modbus™ address / register definition and last, the range and alarm thresholds.

Device Name

As each Sensor is added the user can choose a meaningful name to represent that device. The first several characters of this name will appear on an HMI Panel when displaying data about that device.

Device Type

This defines the type of sensor that is in use. If it is a Detcon based sensor such as a 100 Series or 700 Series sensor most of the other parameters will be filled out since it is a known device. A device type of “Other” can be selected and all parameters will need to be entered manually.

RXT
This is the specific RXT-300 that the sensor is attached to and will be presented to the user in the WCT as a pull down list of RXT Names that were entered when adding RXT-300s earlier.

Modbus™ Parameters
This defines how the sensor will be accessed through Modbus™. All devices in a Modbus™ based system must have unique Modbus™ addresses which are addresses 1-247. In a RXT-300 system up to 32 sensors can be added and will have addresses 1-32 and up to 32 RXT-300s can be added and these will be address 161-192. When using Detcon 100 series sensors, these are all fixed to address 1 and the RXT-300 will translate this to a unique system-wide Modbus™ address when the sensor is added. For the rest of the sensors the RXT-300 configuration and the sensor Modbus™ address must be set to the same value for proper operation.

The rest of the Modbus™ settings define the registers to be accessed during a read as well as indentifying the reading register that provides the concentration. The reading register is the one display on the HMI Station and is used to process Alarms based upon the thresholds set. If a Detcon sensor type is selected in the list of device types, these parameters will be filled in automatically. If "Other" is selected these will need to be set manually and include the starting register address, the number of registers and the reading register.

Alarm Parameters
The range and alarm threshold settings are used to facilitate alarm threshold processing. This allows the user to generate up to three Alarms based upon threshold, ascending or descending. These three alarms can then be mapped to any of the Alarm Outputs 1-4. Range is set to the range of the device output and is used to scale 4-20mA values during alarm threshold processing and to determine over / under range for known Detcon types. Most of these settings will default to common values but should be reviewed by the customer.

4.3 System Parameters Detailed

This section covers in detail settings that affect operation of the RXT-300s system wide. There are two other major groups of settings covered later, one when adding RXT-300s and one when adding sensors. All these settings are entered using the RXT-300 Wireless Configuration Tool (WCT) and are presented below in the general order that they will be entered. For specific WCT menus and selection process refer to the RXT-300 Wireless Configuration Tool manual itself. Many of the configuration parameters relate directly to the operational features already discussed so they should be easier to understand.

As part of the configuration data, the user can assigns names to RXT-300s, Sensors, Alarm Zones and even the wireless network itself. This is purely to help the user in identifying each of these more easily in a system and does not make any difference in system operation. It can help later when editing an existing configuration or differentiating between multiple systems that may be fielded. Also if the HMI Panel is used the first several characters of the RXT-300 and Sensor Names are actually displayed along with their respective data.

4.3.1 Network Parameters
These parameters set up the RF Channel and Network ID for all radios in the system. Network Sleep is also set up here.

System Name	Alphanumeric name for the Wireless Network – no operational significance
RF Channel	Sets all RXT-300 radios in system to an RF channel (Values: 0-15)
Network ID	Sets all RXT-300 radios in system to Network ID (Values: 0-65535). Networks with different network IDs can occupy the same RF channel.

NOTE: RXT-300s will only communicate with other RXT-300s with the same network ID and RF channel.

NOTE: Suggest using same Network ID as RF Channel which would allow for up to 16 systems (RF Channel / Network ID = 0-15). If configure two or more systems on same RF Channel but different Network IDs that are nearby they will have to share that channel, consequently it will take longer to poll and will cause data retransmits to occur.

Network Sleep Sets the time in seconds that the network will sleep after polling all devices in the system (Values: 0-1000). Used to extend battery life but also lengthens time between sensor updates. Set to 0 to disable Network Sleep.

4.3.2 Zones

Zones section allows user to create more than one Alarm Zone. As each Zone is added the WCT will create a default name. The user can change these to a more a meaningful name.

Zone Name The user will enter Alarm Zone names here. Up to 16 Zones can be added.

4.4 RXT-300 Parameters Detailed

After setting up the system parameters, the user must identify and add the RXT-300 transceivers that will be used in the system. Since this is the heart of each of the Station types there are several parameters that must be set. These include Modbus™ settings and Alarm settings. The Alarm settings include RXT-300 Alarm event mapping to Alarm Outputs, the Zone(s) that the RXT-300 will be placed in and the Alarm Output property settings. Some of these are grouped and set within submenus on the WCT.

4.4.1 RXT-300 Main Settings

RXT Name Alphanumeric name for the RXT-300 in the system. Set to a meaningful name for the user and the first several characters will appear on the HMI Panel display. Has no operational significance.

Unique Device ID Precisely identifies the RXT-300 using the serial number that is stamped on the body of the RXT-300 itself.

Modbus Address This is the Modbus™ address of the RXT-300 and is incremented to the next address starting at 161 each time a RXT-300 is added. It is used such things as addressing 4-20mA sensors local to that RXT-300.

Priority Used in guiding the election of the Master RXT-300 and can have a value of 0-255. Priority is incremented starting at 1 each time a RXT-300 is added. The RXT-300 with a priority of 1 will be the first to be elected as a Master if is it is powered on and working and a RXT-300 with priority of 255 would be the last one elected as Master. If two or more RXT-300s have equal priority, the one with the lowest serial number will be selected. If a priority of 0 is assigned to a RXT-300 it will never try to become Master of the network.

Low Battery If a battery is attached the user will set the low battery threshold here. It is set in number of Days / Hours / Minutes and represents the time remaining before the battery is depleted. The user should set the threshold based upon when the battery can be replaced which includes having a fully charged battery and how long it will take to get personnel out to the site.

Associated Zones This is a submenu that allows the user to select which Alarm Zones this RXT-300 will be a part of. One or more Zones can be selected. There will only be one Zone if the default was taken in defining Zones.

RXT Functions This is a submenu that defines the operation of Modbus on this RXT-300, if it is an Alarm Station and if it has a battery installed. The Modbus™ settings are Sensors attached, HMI attached and if Modbus™ exceptions are generated if a HMI is attached. An Alarm Station generally will not have sensors or an HMI attached so neither would be selected.

Alarm Events This is a submenu that allows the user to select which RXT-300 events will generate alarms and what Alarm Outputs these will be placed on. There are four events that are monitored, Network Down, RXT Offline, Battery Fault and Battery Alarm. These individually can be assigned to any of the Alarm outputs but default to Alarm 4. Network Down occurs when no Master has been detected for an extended period. RXT Offline occurs when communication is lost to one or more RXT-300s in the system. Battery Fault occurs when a battery is attached or detected and then communication is lost with the battery. Battery Alarm occurs when the battery life remaining drops below the Low Battery threshold set previously.

Alarm Properties This is a submenu where the user sets the property for the Alarm outputs on this RXT-300. It can be ignored if the Alarm outputs are unused. It sets the Energize / non-Energize, Latching / non-Latching, Silence-able / non-Silence-able properties for each Alarm output.

Advanced This is a submenu of advanced settings that can be adjusted such as Modbus™ timeouts and retries or network timeouts and retries. These would not be changed normally unless directed by Detcon personnel.

4.5 Device Parameters Detailed

After setting up the RXT-300 parameters, the user must identify and add the devices (sensors) that will be used in the system. These settings define the Sensor type, Modbus™ settings and Alarm settings. All sensors are accessed using Modbus™ including the 4-20mA sensors. Alarm settings include thresholds and mapping of Alarm events to Alarm outputs.

Device Name Alphanumeric name for the sensor in the system. Set to a meaningful name for the user and the first several characters will appear on the HMI Panel display. Has no operational significance.

Device Type The user can select from a pre-defined list of Detcon devices or sensors which will populate many of the rest of the parameters for the user. A device type of “Other” allows the user to add their own Modbus™ based device and then enter the parameters manually.

RXT The user selects from a list of RXT-300 using their RXT Name that identifies the RXT-300 this device is attached to. If the RXT-300 has not been added yet the user must do this first.

Modbus™ Address Sets the system wide Modbus™ address of this device. The address will auto-increment to the next Modbus™ address as each device is added and starts at address 1.

Device Address Sets the address of the device local to this RXT-300. This will be the same as the Modbus™ address set above unless it is a 100 series sensor with a fixed address of 1. The system wide Modbus™ address is translated on this RXT-300 to the Device address. For example if the Modbus™ address is set to 4 and the Device address is set to a 1 the RXT-300 will poll address 1 on its local Modbus™ interface but will present this to the network

as Modbus™ address 4. So the HMI Panel will actually request sensor data from Modbus™ address 4 in this instance.

Starting Address Defines the starting address used for poll the Modbus™ device

Registers to Read Defines the number of Modbus™ registers to read. This is limited to 22 registers.

Reading Register Defines the register that contains the concentration (reading) value used for Alarm processing and for displaying on the HMI Panel. It is the physical register number with 0 being the first register on a Modbus™ device.

Range Generally set to 100 but defines the range of readings that will be read from a device. For 4-20mA devices the Detcon a reading of 400 to 2000 represents 4mA to 20mA. If a range of 100 is entered internally the RXT-300 will translate Alarm thresholds entered later into the appropriate 4-20mA thresholds internally. So if an Alarm threshold is set to a value of 10 this is 10% of the 4-20mA reading which equates to a reading of 560 internally.

Alarm Setpoints There are three setpoints, Alarms 1, 2 and 3 that represent the three Alarm thresholds for the sensor reading. A value is placed here and whether it is an ascending or descending threshold. Every time the device is read the reading value is compared with this threshold and will generate an Alarm event if the threshold is crossed.

Alarm Events This is a submenu that allows the user to select which device events will generate alarms and what Alarm Outputs these will be placed on. There are six events that are monitored: Alarm 1, 2, 3 Thresholds, Fault, Communication Error and Modbus Exception. These can be mapped to any of the four Alarm outputs. Alarm 1, 2, 3 Thresholds events occur when the user defined setpoints are crossed. Fault is monitored if it is a Detcon device type and the device has fault status that can be read. Communication Errors occur when there is no response when a Modbus™ read is performed. Modbus™ exceptions occur when the device returns Modbus™ exceptions during a read. The default settings can be taken though.

5.0 Modbus Operation

The RXT-300 wireless transceiver incorporates a single RS-485 two-wire interface for communication with various Modbus™ devices such as a control system or sensor. In a gas detection system, there can be up to 32 devices attached to one or more RXT-300 transceivers and up to 32 RXT-300. Per Modbus™ all slave devices in the system will have a unique Modbus™ address assigned to them. In the RXT-300 based system every RXT-300 and sensor is automatically assigned a unique Modbus™ address to allow each to be accessed through Modbus™.

When a HMI Panel or controller is attached to a RXT-300, the RXT-300 Modbus™ interface is configured to become a slave interface so the HMI / controller can poll that RXT-300. Additionally that HMI / controller can use the Modbus™ address of any sensor in the system and perform a read of the sensor. The RXT-300 will return the sensor data that is updated from the network as if the HMI / controller were attached directly to that sensor.

When one or more Modbus™ sensors are attached to a RXT-300, it will poll these sensors and store the data locally. This data is updated in all the other RXT-300s when that RXT-300 it polled by the network Master RXT-300.

5.1 Modbus Addressing – Special Cases

5.1.1 Address Translation

The RXT-300 has the capability to take a unique Modbus™ system address and translating it to a different address on the local Modbus™ interface. In this way there can be local Modbus interfaces on multiple RXT-300s that have sensors with the same address but are addressed with unique system wide Modbus™ addresses. Each RXT-300 would be configured to perform the proper translation.

This is specifically used with Detcon 100 series sensors which are factory set to be fixed at Modbus™ address = 1. So if there were five 100 series sensors in a system there would need to be at least 5 RXT-300s where each would translate the unique system address to the local address = 1. This feature can be used to field RXT-300s with sensors that have each been set to the same local Modbus™ addresses but during configuration would be re-assigned to unique system Modbus™ addresses.

5.1.2 Accessing RXT-300 4-20mA Sensors

The RXT-300s support up to two 4-20mA inputs for 4-20mA sensors. Since these sensors are not attached to the RXT-300 local Modbus™ interface they do not have unique Modbus™ addresses assigned. They can be accessed through Modbus™ by using the Modbus™ address of the RXT-300 they are attached. When configuring a RXT-300 4-20mA sensor then, the user would override the unique system address assigned and use the RXT-300 Modbus™ address instead. The reading register would correspond to the RXT-300 Modbus™ register for that 4-20mA input.

5.2 General Modbus™ Description

Modbus™ communication operates basically the same on a RXT-300, whether the Modbus™ interface is configured as a slave for a HMI / controller or as a master to poll local sensors attached. The physical interface for Modbus™ is a two-wire half duplex RS-485 interface and runs at 9600 baud, 8 data bits, 1 stop bit, no parity. The RXT-300 performs Modbus™ communication using the RTU transmission mode per the Modbus™ specification.

The basic frame format for Modbus™ is shown in Figure 17 and consists of a Modbus™ address, function code, data and CRC. As stated earlier, the Address Field is the unique Modbus™ address of each device for the whole system. The Function Code is the function to be performed. The Data contains read or write data and is formatted according to the function being performed. The CRC (Cyclic Redundancy Code) is used to detect errors in the frame. Frames with errors are considered invalid and ignored.

Address Field	Function Code	Data	CRC

Figure 17 Modbus™ Frame Format

Modbus™ transactions consist of both a request by the controller and response from the device being addressed so there are two frames transferred for every transaction. Every request is evaluated by the RXT-300 to determine if it is addressed to it and whether it falls within the register address range. If these two conditions are true, the RXT-300 will then check to see if it is a valid Function Code. Function Codes supported by the RXT-300 are:

Function Code 03 (03h) – Read Holding Registers
Function Code 06 (06h) – Write Single Register
Function Code 16 (10h) – Write Multiple Registers

If an invalid function code is performed, then the RXT-300 will ignore the request by default and the controller will timeout and continue with the next transaction.

5.2.1 Modbus™ Exceptions

The RXT-300 is capable of returning Modbus™ exceptions when it cannot service a Modbus™ request meant for that RXT-300. By default this is turned off in the configuration since it can cause issues with some controllers that do not process Modbus™ exceptions. The following exception codes are supported and returned when Modbus™ exceptions are enabled:

Table 4 Exception Codes

Exception Code	Name	Meaning
01	Illegal Function	Unsupported function code. Only 03, 06 and 16 are supported.
02	Illegal Data Address	The registers being requested falls only partially within the valid RXT-300 register ranges. For example, the RXT-300 registers start at 8192. If an access is perform requesting registers 8191 to 8192 then this is an Illegal Data Address since 8191 does not fall completely within the valid register range. This would not be an exception though if register address 8190 to 8191 were used – this would be passed on to the Modbus™ interface for a local device to respond.

There are other exception codes defined in Modbus™ but these are the only ones returned by the RXT-300.

5.3 Modbus™ Register Map & Description

When a HMI Panel or controller is attached to a RXT-300, all sensors can be read using their unique system Modbus™ address. Additional control and status is available using various the Modbus™ address of the RXT-300 itself. There are many registers that are reserved and if written to may cause the system to malfunction. The following sections will describe each register or register set for the register maps.

NOTE: A write to a Read Only register is allowed and returns a response but it does not change the value of the register. In some devices this would return an exception code.

Table 5 RXT-300 Register Map

Register	Access	Name	Description
0	R	Detcon Type	Detcon Register Type = 13 for RXT-300
1	R	Alarm 1 Output	Current Alarm 1 Output state (0 = Open, 1 = GND)
2	R	Alarm 2 Output	Current Alarm 2 Output state (0 = Open, 1 = GND)
3	R	Alarm 3 Output	Current Alarm 3 Output state (0 = Open, 1 = GND)
4	R	Alarm 4 Output	Current Alarm 4 Output state (0 = Open, 1 = GND)
5	R	4-20mA A	Reading for 4-20mA Sensor Input (A)
6	R	4-20mA B	Reading for 4-20mA Sensor Input (B)
7	R	Battery Life Percent	Battery Life remaining in %
8	R	Battery Life Minutes	Battery Life remaining in minutes
9	R	Battery Millivolts	Battery Voltage in Millivolts
10 – 15	--	Reserved	
16	R	RXT-300 Count	Number of RXT-300s in System
17 – 18	--	Reserved	
19	R	Sensor Count	Number of Sensors in System
20 – 44	--	Reserved	
45	R	uC F/W Version	Microcontroller Firmware Version
46	R	uC F/W Month/Day	Microcontroller Firmware Month / Day
47	R	uC F/W Year	Microcontroller Firmware Year
48	R	Radio F/W Version	Radio Firmware Version
49	R	Radio F/W Build	Radio Firmware Build
50	R	Radio S/W Version	Radio Software Version
51 – 66	--	Reserved	
67	R/W	Control	Control Register
51 – 71	--	Reserved	
72	R	Status	Status Register
73 – 98	--	Reserved	
99	R	Timestamp Secs Hi	Time from Startup – Seconds High
100	R	Timestamp Secs Lo	Time from Startup – Seconds Low
101	R	Timestamp MSecs	Time from Startup – Milliseconds
102 – 4418	--	Reserved	

5.3.1 Register – Detcon Type

The Detcon Type is a unique identifier of the type of device and associated register map. A controller can therefore perform a search and determine what Detcon devices are present on a Modbus™ system. A controller can look for this value when search Modbus™ addresses 161 to 192 to find the Modbus™ address of the RXT-300 that it is attached to.

5.3.2 Register – Alarm Outputs

There are four registers that give the status of the four open collector Alarm Outputs. A value of 0 denotes the Alarm Output is not grounded and a value of 1 or non-zero value denotes the Alarm Output is grounded. The default value for all Alarm Outputs upon power up or reset is 0.

5.3.3 Register – 4-20mA Reading

There are two 4-20mA inputs and their current value is stored in the 4-20mA A and B registers. The value of these register will range between 0 to 2048 with 0 being 0mA and 2048 being 20.48mA. Therefore a 4mA input will read 400 and a 20mA input will read 2000. Any currents above 20.48mA will remain at 2048 since this is the maximum value for this register.

5.3.4 Register – Battery Info

If a Detcon battery pack is connected to the RXT-300 transceiver, there are multiple registers associated with information about that battery. The RXT-300 utilizes the I2C interface to read battery status and only one Detcon battery pack can be read per RXT-300.

The controller can determine if a battery is present by reading the Status Register (register 72). There are three bits in this sixteen bit register pertaining to the battery, Battery Attached – bit 15 (lowest bit is 0), Battery Alarm – bit 7 and Battery Fault – bit 6. The Battery Alarm and Fault bits default to a value of 0. Battery Attached will be set once a read of the battery over the I2C interface was successful or it is set by the user in the configuration. Battery Alarm will be set if the RXT-300 determines the remaining life is below the threshold configured by the user. Battery Fault will be set if a battery was Attached (or detected) but the last read failed. Battery Fault is re-evaluated upon every read of the battery which is set to approximately every 60 seconds.

Once the battery has been detected and has no fault, the controller can read the battery life (registers 7 and 8) and the voltage (register 9). The battery adjusts the battery life values based upon the average current usage. If the current usage varies widely over time it will take some time to re-adjust the battery life readings. For instance, an Alarm Station with no alarms will consume a very small amount of battery but when Alarms are active this will jump to a much higher level of usage. So in this case battery life may go from several weeks down to several hours.

The battery life is presented in two forms, life remaining in percentage (register 7) and life remaining in minutes (register 8). The battery Life remaining is percentage is a value between 0 and 100 and battery life in minutes is an unsigned value between 0 and 65535. Both readings are generally necessary to provide appropriate feedback to the user. Life in minutes is the best for determining when to change the battery. The RXT-300 configuration is set to days / hours /minutes so the user could set it to 1 day to allow time to replace the battery.

Since 65535 is the maximum value for life remaining in minutes, this represents a maximum of 45.5 days. The battery life for an application can be much greater than this value and will remain at a reading of 65535 until it drops below this. Life in percentage was added for this reason. Percentage will track starting at 100 percent and drop down as battery life decreases.

5.3.5 Register – uC Firmware Version

This is set to a value based upon the version of firmware programmed into the RXT-300 microcontroller. It is stored as two byte value representing the major and minor revision numbers. So a 0119h (281 decimal) represents a major version of 01 and minor version of 19. As software is updated this will be incremented appropriately.

5.3.6 Register – Radio Firmware Version and Build

This is set to a value based upon the version of firmware programmed into the RXT-300 radio microcontroller. It is stored as three byte value representing the major / minor in register 48 and build revision in register 49. So a value in register 48 of 0204h in the (516 decimal) represents a major version of 02 and minor version of 04 and a 0009h in register 49 represents build version of 9. As software is updated this will be incremented appropriately.

5.3.7 Register – Radio Software Version

This is set to a value based upon the version of software programmed into the RXT-300 radio. It is stored as two byte value representing the major and minor revision numbers. So a 0106h (262 decimal) represents a major version of 01 and minor version of 06. As software is updated this will be incremented appropriately.

5.3.8 Register – Control

The Control register is must be written to carefully. It should be read first and then only change those bits required by user. Using the control register, Alarms can be silenced or reset, the RXT-300 can be reset and Modbus™ exceptions can be enabled. The listing below shows the bit assignments.

Bit 15: Reset the microcontroller and wireless radio
Bit 14: Reset the microcontroller
Bit 13 – 06: Reserved
Bit 05: Enables Modbus Exceptions
Bit 04: Enables Alarm Test Mode (not started until shows in status register)
Bit 03 – 02: Reserved
Bit 01: Performs an Alarm Silence when set to a 1; Cleared upon completion on local RXT-300.
Bit 00: Performs an Alarm Reset when set to a 1; Cleared upon completion on local RXT-300.

5.3.9 Register – Status

This register contains status of the RXT-300 and some of the bits have already been covered in the battery description. These default to 0 upon reset. The bit assignment and description are given below.

Bit 15: Battery Attached or Detected
Bit 14 – 10: Reserved
Bit 09: One or more RXT-300s offline
Bit 08: Reserved
Bit 07: Low Battery Alarm Threshold detected (valid if bit 15 = 1)
Bit 06: Battery communication fault detected on last read (valid if bit 15 = 1)
Bit 05: Reserved
Bit 04: In Alarm Test Mode and has started
Bit 03: In RF Silence Mode
Bit 02: In Alarm Inhibit Mode
Bit 01: Network is sleeping
Bit 00: Network Master RXT-300 = set to 1; Network Slave RXT-300 = set to 0

5.3.10 Register – Timestamp

Three registers are utilized to maintain a timestamp that increments on the microcontroller after power up. These are all set to 0 upon power up or a microcontroller reset. The first two registers 99and 100 are internally combined into a single 32 bit register and incremented each second. The last register 101 maintains the millisecond count and will count from 0 to 999 and start over again.

6.0 Troubleshooting Guide

Power Problems
Probable Causes: Depleted battery/Low Charge, battery not seated properly.
Recharge or replace battery.
Reseat battery.

Transceiver not Responding
Probable Causes: Incorrect jumper settings on term board, incorrect wiring, connectors not seated properly.
Verify jumper settings are properly configured.
Verify transceiver wiring matches color coding on term board.
Verify connectors are seated correctly and not offset. Reseat connector is necessary.

Modbus™ Communication Problems
Probable Causes: Incorrect Modbus™ address, incorrect wiring.
Verify there are no duplicate Modbus™ addresses on the network.
Verify correct polarity on Modbus™ wiring.

Condensation Problems
Probable Causes: Loose cover on T-Outlet box, loose cover on transceiver housing, loose NPT connections to condulet/j-box, expired condensation prevention packet.
Verify cover is tight on T-Outlet box and transceiver housing.
Verify all NPT connections are secure and tight.
Replace condensation prevention packet.

7.0 Warranty

Detcon, Inc., as the manufacturer, warrants under intended normal use each new Model RXT-300 wireless transceiver to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Should the transceiver fail to perform in accordance with published specifications within the warranty period, return to Detcon, Inc. for necessary repair or replacement. All warranties and service policies are FOB the Detcon facility located in The Woodlands, Texas.

8.0 Specifications

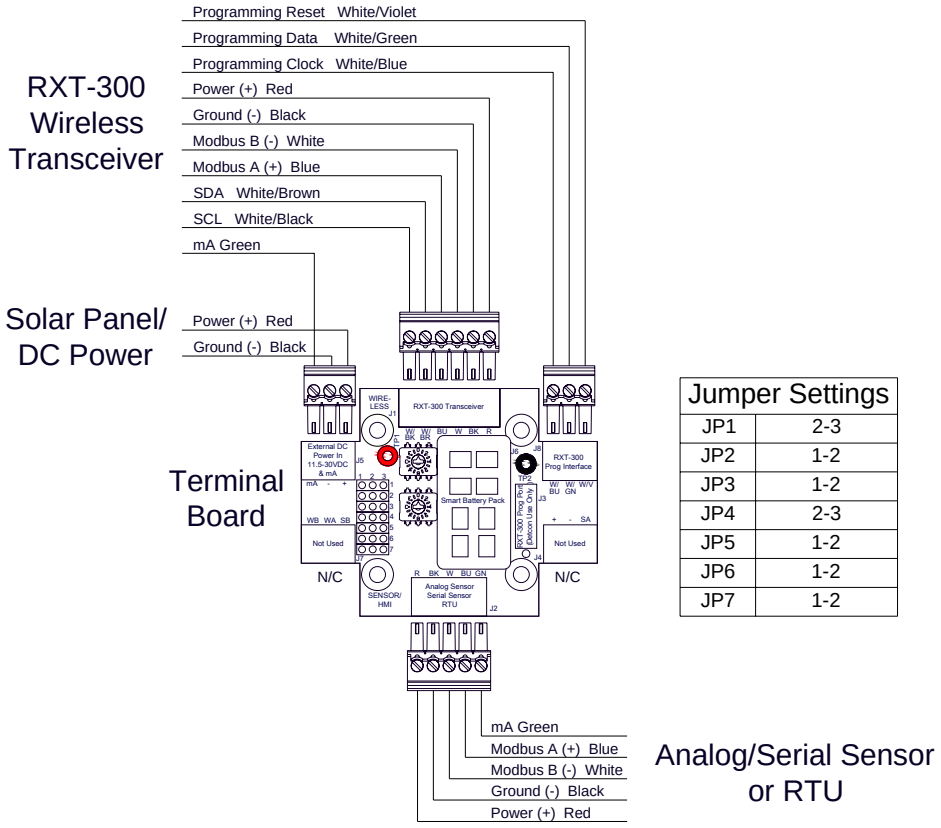
Frequency
ISM 2.4GHz
Range
Indoor/No Line of Sight: 1,000ft
Outdoor RF Line of Sight (with external antenna): 3 Miles.
Spread Spectrum
Digital-Sequence Spread Spectrum (DSSS)
Modulation
0-QPSK
Sensitivity
-102dBm (1% PER)
Inputs
Two 4-20mA inputs
Inputs/Outputs
RS-485 Modbus™ RTU (9600bps)
Power Input
7-30VDC
Power Consumption
Base RXT-300 unit: <500mW, 20 mA max at 24VDC
Total Power is dependent on communication update rate between RXT-300 transceivers.
Operating Temperature Range
-40°C to 85°C
Approvals
cETLus Class 1, Division 1, Groups CD
ATEX II 2 G Ex d [ib] ib IIB T6 (pending)
CE Marking (pending)
Dimensions
8.3” (H) x 2.4” (Dia)
Weight
30oz/850g

8.1 Spare Parts

Part Number	Spare Parts
976-000300-316	RXT-300 Wireless Transceiver
Part Number	**Optional Accessories**
897-850800-010	NEMA 7 Aluminum Condulet Base
897-850400-010	NEMA 7 Aluminum Condulet Solid Cover
897-850902-010	**NEMA 7 Tall Aluminum Condulet w/Window Cover (Required for Battery Option)**
960-202200-000	Condensation prevention packet (For condulet, replace annually)
800-004221-000	Mounting Plate
8522-750	¾" NPT Plug
899-15075	¾" NPT x 1.5" Nipple
897-044400-34T	¾" NPT T-Outlet Box w/Aluminum Cover
898-52310	½" NPT Drain
899-07550	¾" NPT to ½" NPT Adapter (Required for Drain)
500-005143-100	Model 100 Terminal Board
976-000303-012	12V Smart Battery Pack
976-000304-004	Quad Charger w/AC Adapter
500-003198-000	8-position terminal board with Ground (Remote Mounting)
301-58205	¾" NPT Cord Connector (Remote Mounting)

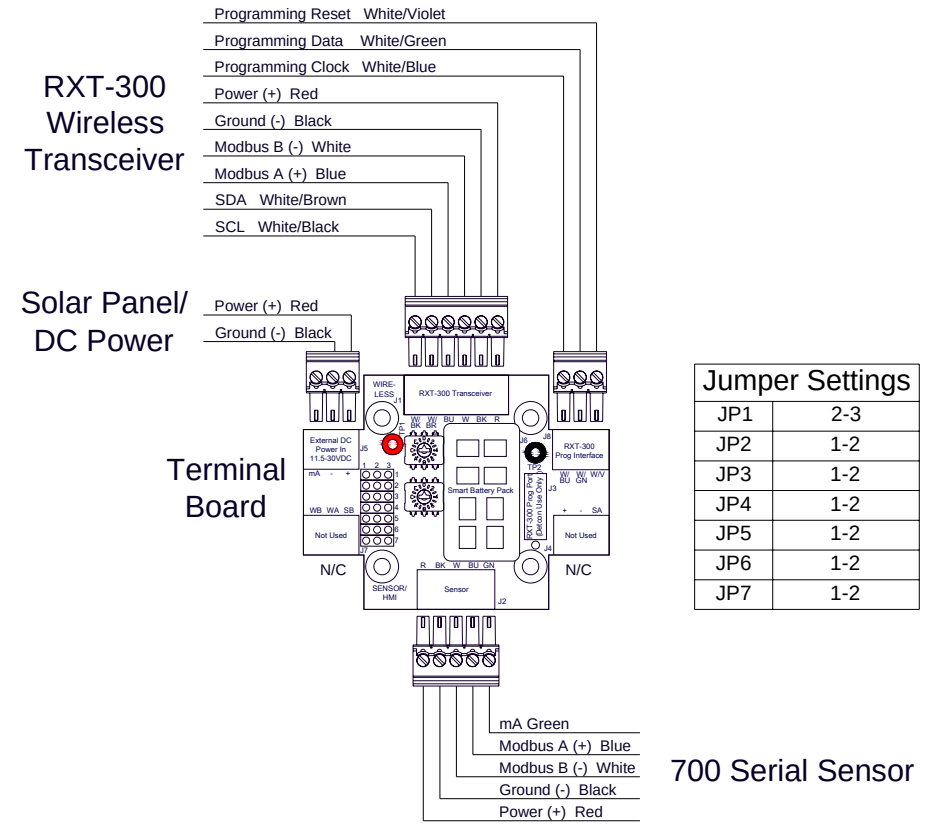
8.2 Revision Log

Revision	Date	Changes made	Approval
1.0	05/19/10	Original Release.	LBU
1.1	11/12/10	Update to table 1 Wire Identification	LBU
2.0	01/03/12	Extensive revision and detail added to all aspects of manual.	LBU



Jumper Settings	
JP1	2-3
JP2	1-2
JP3	1-2
JP4	2-3
JP5	1-2
JP6	1-2
JP7	1-2

Figure 18 Analog/Serial Sensor or RTU to RXT-300



Jumper Settings	
JP1	2-3
JP2	1-2
JP3	1-2
JP4	1-2
JP5	1-2
JP6	1-2
JP7	1-2

Figure 19 700 Serial Sensor to RXT-300

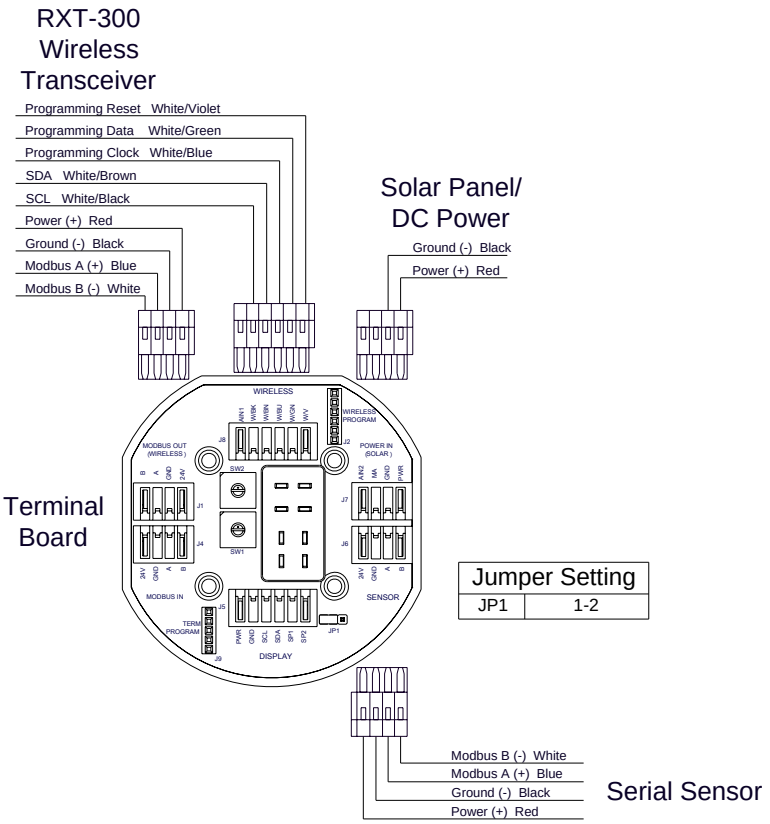


Figure 20 Serial Sensor to RXT-300

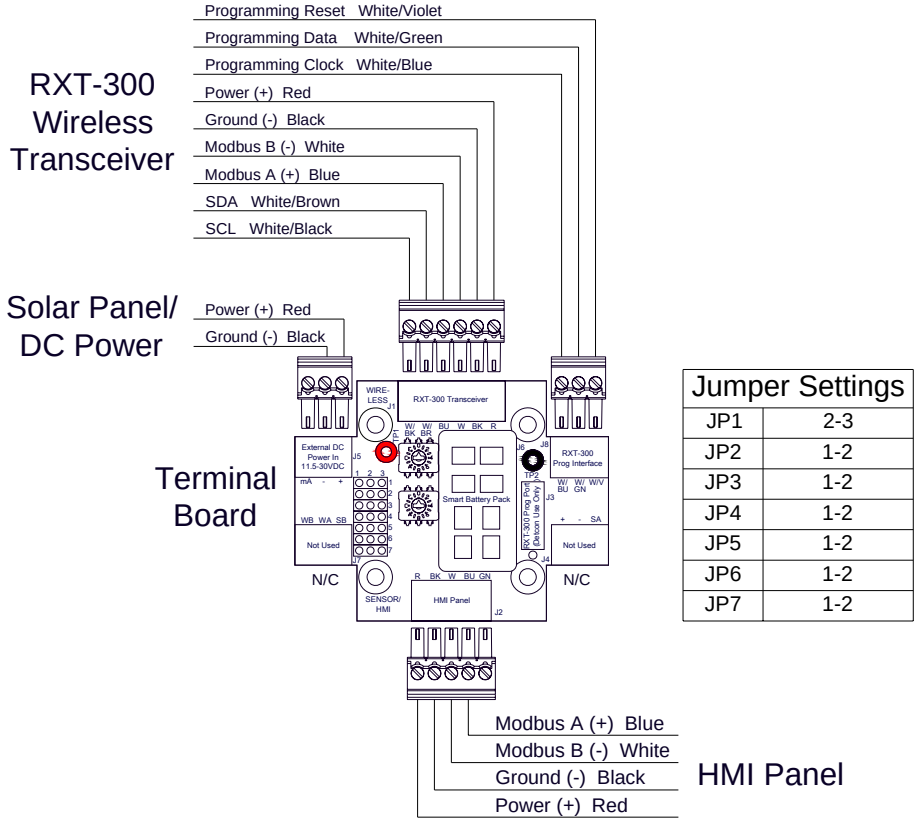
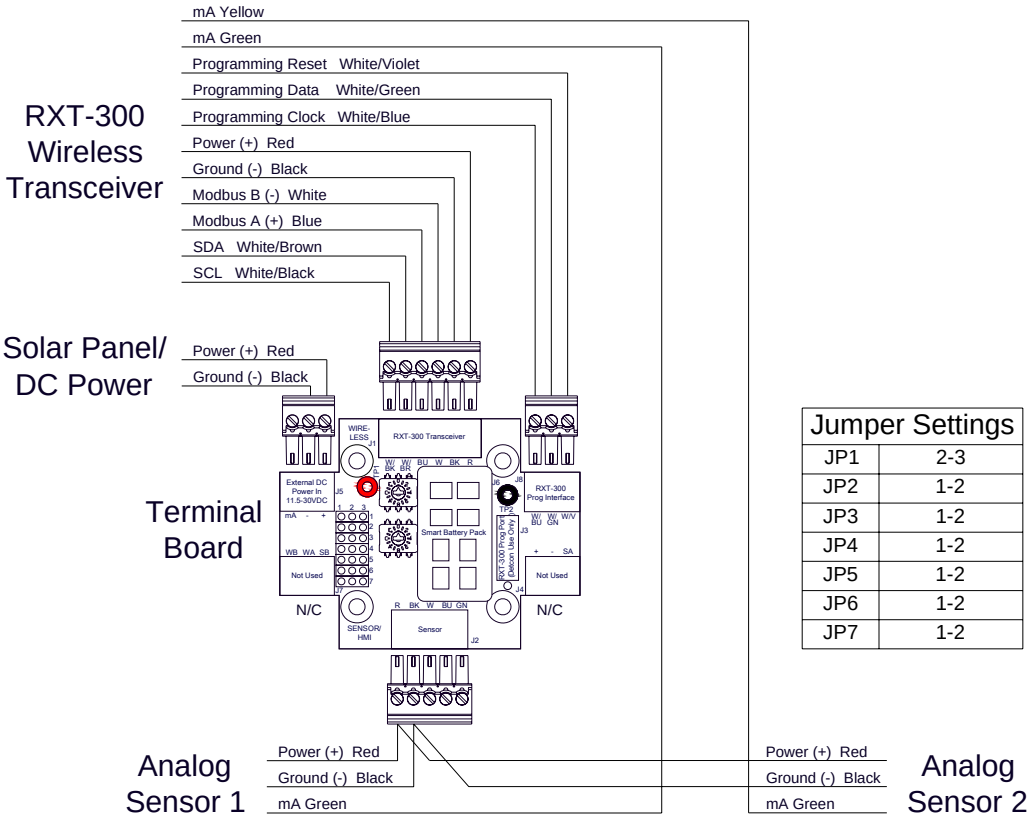
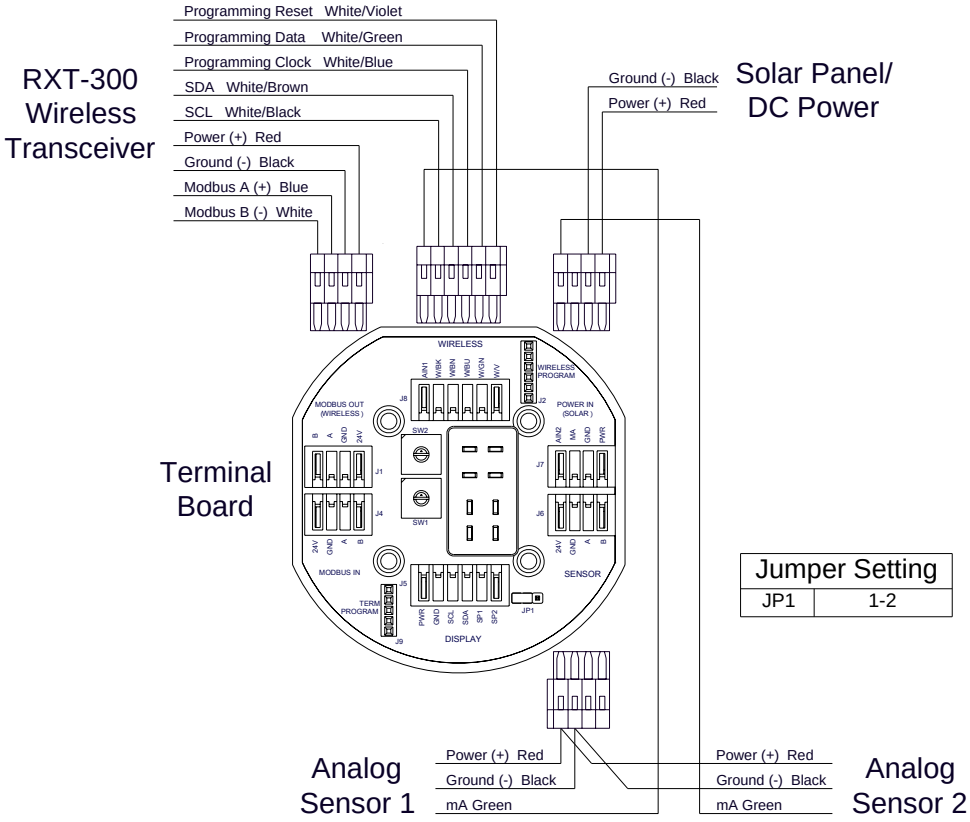


Figure 21 HMI Panel to RXT-300



Jumper Settings	
JP1	2-3
JP2	1-2
JP3	1-2
JP4	1-2
JP5	1-2
JP6	1-2
JP7	1-2

Figure 22 Two Analog Sensors to RXT-300



Jumper Setting	
JP1	1-2

Figure 23 2 Analog Sensors to RXT-300

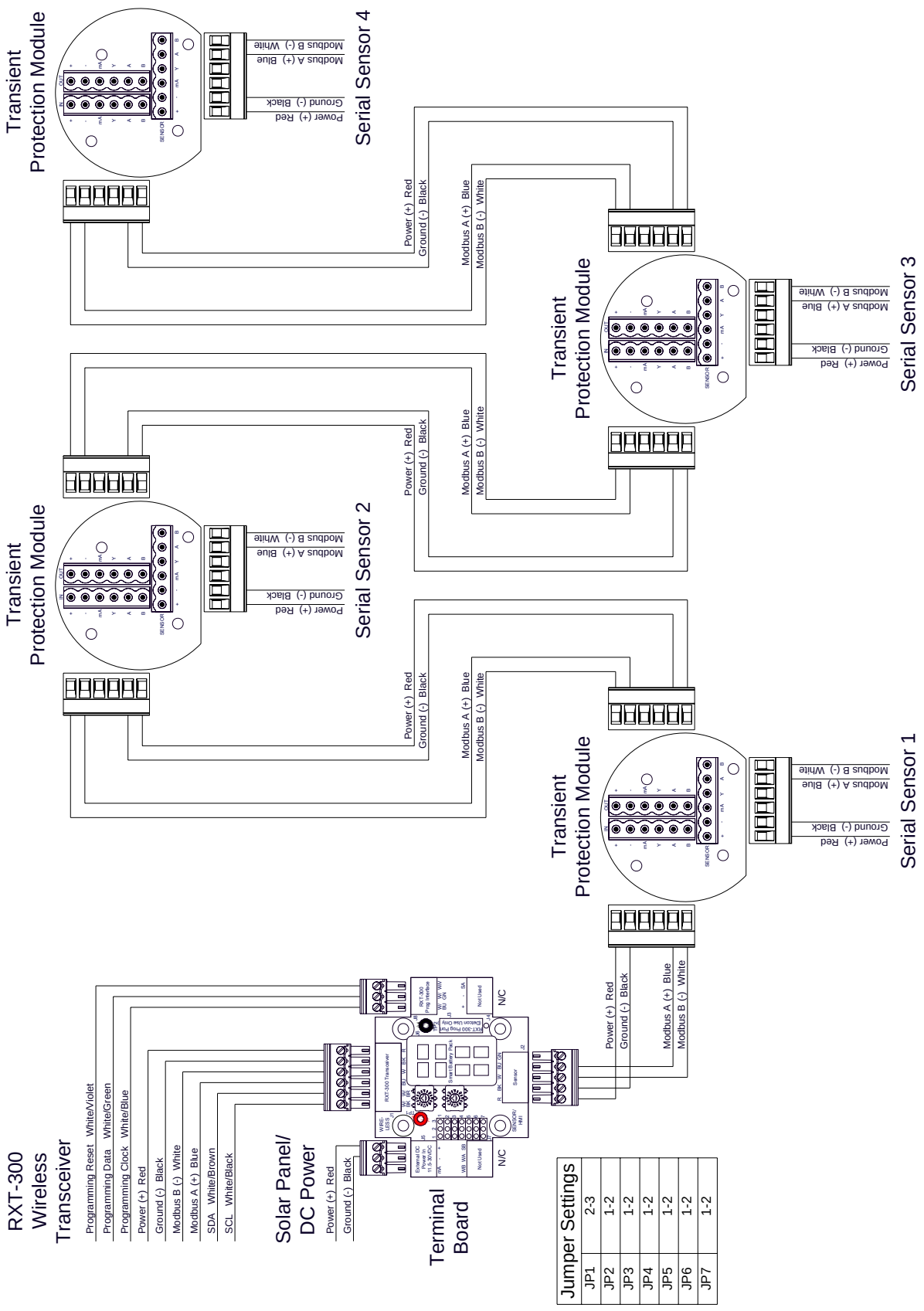


Figure 24 Four Serial Sensors to RXT-300

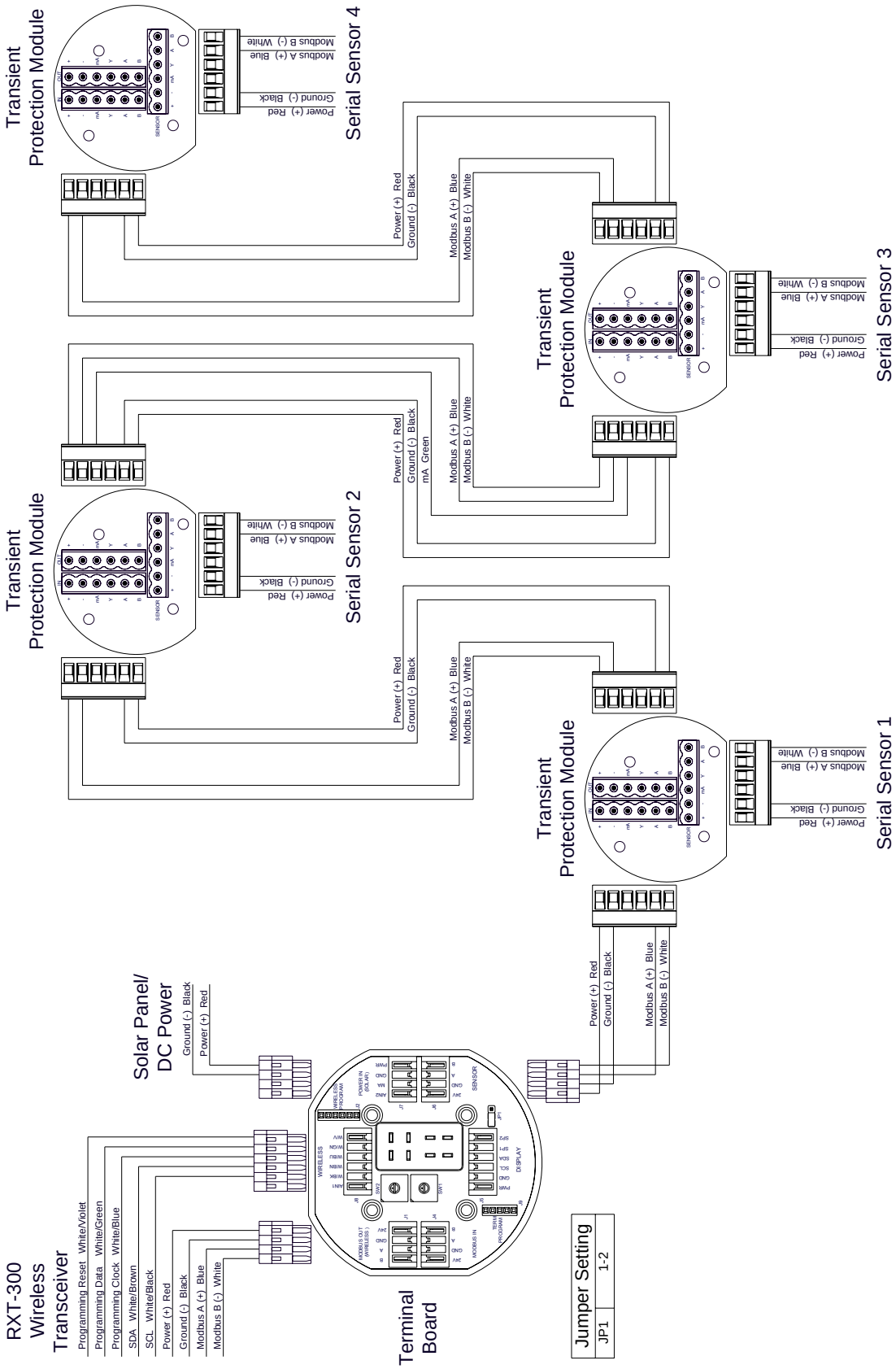


Figure 25 Four Serial Sensors to RXT-300