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### Frequently Asked Questions

- 1. What is the transmit power in mW of the 418 MHz Transmitter, 433 MHz Transmitter, 900 MHz Repeater and the 2.4 GHz Transmitter?**  
418 and 433 MHz Transmitters = 1 to 1.5mW  
900 MHz Transmitter = 100mW.  
2.4 MHz Transmitter = 50mW.
- 2. What is the reception sensitivity in db for the receivers?**  
The sensitivity for the 900 MHz radios is -110dBm.  
The sensitivity for the 418/433 MHz radios is typically -112dBm.  
The sensitivity for the 2.4 GHz radio is -105dBm.
- 3. What is the on air transmit time in ms for the 418 MHz transmitter and the 900 MHz transmitter?**  
418 MHz Transmitter = about 20 ms.  
900 MHz Transmitter = about 50 ms.
- 4. What is the type of modulation for the 418 and 433MHz transmitter – AM or FM or different?**  
The modulation type is AM (OOK – On/Off Keying)
- 5. What is the analog to digital conversion resolution – 10 bit, 12 bit or 15 bit?**  
The A to D conversion is 12-bit resolution on the analog sensors.
- 6. The transmit interval is approximately 20 seconds. What is the ± time for each variable interval?**  
The packets are micro-randomized, so the actual transmit interval will be 20 to 21 seconds.
- 7. How many hops are used for the FHSS transceiver?**  
25 hops.
- 8. What is the frequency control for the FHSS radio?**  
Direct FM.
- 9. What is the communication rate from the receivers to the output modules?**  
9600 baud on a Proprietary protocol, using RS485 communication HW.
- 10. Does the temperature transmitter send a transmission on a fixed differential temperature?**  
No. The temperature only sends a transmission at normal intervals. Every 20 to 21 seconds.
- 11. Does the override contact transmit immediately if it is pushed?**  
Yes. It also transmits one second later to double the probability that the transmission will be received.
- 12. Do BAPI repeaters transmit immediately when they detect a 418MHz signal?**  
No. The radios are programmed to insert a random delay of 0, 38, 76, 114, 152 or 190 milliseconds before a test for a clear channel is checked. If the channel is found to be not clear, this process is repeated until it is clear and then all the data that has been received in the input buffer will be transmitted as one block; up to 1000 bytes (~40 packets).
- 13. Do repeaters listen for both 418MHZ and 900Mhz signals and do they repeat both?**  
Our repeaters can receive both 418MHz and 900MHz signals at the same time and repeat them at 900MHz. However, they cannot receive at the same time they are transmitting and the receiver is locked out during transmission.
- 14. If a repeater, repeats a signal and hears the same signal from a different repeater, will it know it already sent that signal and not repeat it?**  
When a packet is received (either 418 or 900MHz), it is time stamped and saved for future reference. If that same packet is received within 4 seconds, it will not be repeated.



### Frequently Asked Questions

**15. Is every 418MHz and 900MHz repeated signal identified by a time stamp or other unique identifier?**

Yes. Identical packets are considered to be repeats of the same packet if they occur within 4 seconds as the serial numbers are unique. When packets are received, a time stamp is attached and the packet is saved for future reference. When a new packet is received, it is tested against up to 128 past packets for which the 4-second time stamp has not expired. If a match is found, the packet is not repeated. If no match is found, the packet is transmitted, a time stamp is attached and it is saved. If more than 128 unique packets have been received within the past 4 seconds, the new packet is not transmitted or saved.

**16. How often is the eeprom accessed in the output modules to load the configuration file?**

The eeprom is only read at power up and even then only read if the validity check on the RAM indicates corrupted data. The standard serial number comparison for the output modules is by comparing to the RAM.

Note: The eeprom was updated on 12-15-08 so that all output modules after this date read the eeprom every time a new packet is received.

**17. What FCC regulations cover the BAPI wireless sensors/transmitters?**

Our wireless equipment is covered under FCC Part 15; specifically subpart C. Attached is a link to an FCC document that gives a more general description of the regulations covering our wireless equipment.

Understanding the FCC Regulations for Low-Power, Non-Licensed Transmitters

([http://transition.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet63/oet63rev.pdf](http://transition.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet63/oet63rev.pdf))

**18. Can one of the RS485 communication lines between the output modules be dropped (eliminated) and still provide reliable communications?**

A qualified Yes. The earth ground wire can be eliminated without affecting normal communication. However, you will lose the surge protection built into each output module because it uses the earth ground to drain off the excess energy. So if a surge voltage or current is induced into the communication line, it could damage the output module.

**19. Can BAPI output modules be used with Point Six transmitters?**

The Point Six 900MHz Analog Point sensor/transmitter is compatible with our output modules if you use our 900 MHz receiver.

**20. On a loss of communication (Fast Flash LED), what do the output modules fail to?**

After 15 minutes of no updated communication, the LED flashes fast and different output modules fail either High or Low depending the type. See description below:

<u>Output Module</u>	<u>Action on Loss of Communication</u>
ROM .....	Fails to the low value xxx°F
VOM (all but the %RH models, options -M and -N) .....	Fails to the low value xxx°F
COM (all but the %RH models, options -M and -N) .....	Fails to the low value xxx°F
VOM (%RH models only, options -M or -N) .....	Fails to the high value 100%RH
COM (%RH models only, options -M or -N) .....	Fails to the high value 100%RH
SOM (Resistance Output models only, options -50 through -91) ...	Fails to the low value xxx°F
SOM (Voltage Output models only, options -00 through -11) .....	Fails to the low value xxx°F
RYOM .....	Fails to the normally condition, open or closed module dependent

However, any ROM, VOM, COM or SOM module can be specially programmed to fail to last value or any value.

**21. What other temperature values can be programmed into the temperature output modules?**

The E-pot can be programmed to any 10K-2, 10K-3 or 20K thermistor sensor range between 35° amd 120°F (1° to 50°C). This includes the ROM and SOM resistance modules.

Any VOM, COM or SOM (Voltage or Current type) can be specially programmed with any range between -40 to 185°F (-40 to 85°C) with a minimum span of 30°F (15°C).



### Frequently Asked Questions

#### 22. What are the FCC ID numbers for our different RF transmitters and receivers?

- Any temp only transmitter and universal is:..... FCC ID# T4F060811TEMP
- Any temp & humidity transmitter is:..... FCC ID# T4F060811RH
- This is good for all BS2 room transmitters: ..... FCC ID# T4F061213RSO
- Any repeater: ..... FCC ID# OUR9XSTREAM
- Food probe transmitters: ..... FCC ID# T4FSM061025
- Verifier 900MHz:..... FCC ID# OUR9XSTREAM
- Verifier 418MHz:..... FCC ID# T4F061213RSO

#### 23. What antenna connection do BAPI receivers and antennas use?

An RP-SMA connector. This looks like a standard SMA connector but the male pin is replaced with a female. The bulkhead then is also reversed.

#### 24. What is the temperature resolution of the VOM module?

The VOM module has 10 bit resolution per the specification. This equates to 1024 counts over the VOM temperature span selected. The temperature resolution is calculated as the temperature span divided by the resolution counts. So a BA/VOM-10-C has a temperature range of 50 to 90F and a span of 40°F. The temperature resolution is equal to 40°F/1024 or .039°F per step. The chart below shows the temperature resolution of common BAPI Voltage Output Modules

<u>Module Part #</u>	<u>Range</u>	<u>Span</u>	<u>Counts</u>	<u>Resolution per Step</u>
BA/VOM-10-C	50 to 90°F	40°F	1024	40°/1024 = 0.039°F per step
BA/VOM-10-D	55 to 85°F	30°F	1024	30°/1024 = 0.029°F per step
BA/VOM-10-E	60 to 80°F	20°F	1024	20°/1024 = 0.0195°F per step
BA/VOM-10-F	65 to 80°F	15°F	1024	15°/1024 = 0.0146°F per step
BA/VOM-10-G	45 to 96°F	51°F	1024	51°/1024 = 0.0498°F per step
BA/VOM-10-H	-20 to 120°F	140°F	1024	140°/1024 = 0.137°F per step
BA/VOM-10-KK	32 to 185°F	153°F	1024	153°/1024 = 0.149°F per step
BA/VOM-10-MM	-40 to 140°F	180°F	1024	180°/1024 = 0.176°F per step
BA/VOM-10-M	0 to 100%RH	100%RH	1024	100%/1024 = 0.097% RH per step
BA/VOM-10-N	35 to 70%RH	35%RH	1024	35%/1024 = 0.034% RH per step

#### 25. Can an input of 0 to 5 volts on a BAPI Wireless Analog Input Transmitter (BA/WAI-05) output to a 10V Voltage Output Module (BA/VOM-10-xx)?

The Wireless Analog Input Transmitters and Analog Output Modules are interchangeable. You can have a 4 to 20mA input attached to a 0 to 10V output, 1 to 10V output, 0 to 20K output, 0 to 5V output, etc.

All inputs are scaled 0 to 100%/0 to 4095. The outputs can also be scaled to anything full range or part of a range.

#### 26. What is the center frequency of the 900MHz repeater or receiver?

916MHz

#### 27. When does the repeater LED flash - on reception of a good packet or on the transmission of the packet?

The repeater LED flashes on the reception of a good packet. This is also true for the receivers.

#### 28. The repeater does not work as soon as I plug it in. Is there a waiting time before it starts to work?

Yes, there is a 30 second internal diagnostic performed before a newly powered repeater starts to operate.

#### 29. What is the voltage and current draw of our battery powered wireless transmitters?

The voltage of the battery starts at 3.6 VDC and will operate as low as 2.8VDC. The standby current is about 25uA. The wake-up & transmission power draw is in the low mA range ~(<9mA).

#### 30. Does the transmitted power go down or accuracy go down as the battery power drains?

No. The transmitter operates at peak power until a low battery stops the transmitter and accuracy is unaffected by a low battery voltage.



### Frequently Asked Questions

**31. If two sensors transmit at the same time, will the receiver still receive the data from each sensor?**

If two room transmitters transmit at exactly the same time (16ms for each transmission), they will interfere with each other and both signals will be lost. Room sensors transmit randomly every 20 to 21 seconds so the probability of interference on the next transmission is very slim. If the higher signal strength transmitter (10/1 ratio) started its transmission first, then it will not be interfered with by the second transmitter signal.

**32. What happens if more than one repeater catches the temperature from the same sensor? Will the repeaters corrupt messages from each other?**

Repeaters receive the room sensor signal and randomly apply a delay and then listen for clear air before they transmit the 900 MHz signal. In this way repeaters try to avoid interfering with each other's signals. However, if two repeaters transmit at exactly the same time (50ms for each transmission), then both signals will be corrupted and lost. If the higher signal strength transmitter (10/1 ratio) started its transmission first, then it will not be interfered with by the second transmitter signal.

**33. Can repeaters re-transmit other repeated signals?**

Repeaters can listen to other repeaters that are on the same channel and within range. These repeaters will then repeat the 900 MHz signals from the other repeaters in addition to the signals from any 418 MHz transmitters that are within range. If there are many repeaters within range of each other and on the same channel, then the air time (or bandwidth) can be used up which chokes the system. In order to get a 96% transmission success rate, the number of transmissions must be limited to 100 per minute. As an example, let's look at a system with 20 room transmitters all filtering through multiple repeaters that can all hear each other. In this system, the first repeater handles 20 transmissions (from the 20 room transmitters). The second repeater handles 40 transmissions (20 from the room transmitters plus the 20 repeated signals from the first repeater). The third repeater handles 80 transmissions (20 from the room transmitters, 20 from the first repeater, and 40 from the second repeater: 20 + 20 + 40 = 80). So in a system with 20 room transmitters, the maximum number of repeaters that can operate with a 96% transmission success rate is 3 repeaters. Adding another repeater pushes the total number of transmissions over the 100 per minute limit. This calculation is only true if all repeaters are within range of each other and on the same channel. BAPI's repeaters are available with 7 different channels to avoid this situation. Using multiple 418 MHz receivers in the space is another possible solution.

**34. Can the transmit interval time be changed?**

Before 2012 the answer was no. Since then the interval time for all BAPI transmitters can be changed between 10 seconds and 10 minutes in 5 second increments. This value can only be set at BAPI, not in the field, and the typical ordering convention is shown below as the suffix to a transmitter sales name.

<u>Part # Suffix</u>	<u>Time between Transmissions</u>
-T10 .....	~10 seconds (default factory setting, March 2015 and earlier)
-T20 .....	~20 seconds (default factory setting, after March 2015)
-T30 .....	~30 seconds
-T45 .....	~45 seconds
-T60 .....	~60 seconds
-T90 .....	~90 seconds
-T120 .....	~120 seconds
-T180 .....	~180 seconds
-T300 .....	~300 seconds

**35. What is the possible interval times available for BAPI transmitters?**

Every 5 seconds starting at 10 seconds and going up to 10 minutes. The formula is:

TI = Transmission Interval Time in Seconds

The "Setup Time x 16mS" variable is used to set the TI using this formula:

$$TI = ((value - 128) + 2) * 5 \text{ seconds}$$

So the standard interval is:  $TI = ((128-128) + 2) * 5 = 10 \text{ seconds}$

So calculating the value is:  $Value = ((sec/5) - 2) + 128$     Sec = desired seconds



### Frequently Asked Questions

#### 36. Can a Field Verifier be set to listen to a specific transmitter?

The 418MHz Verifier can be set to listen to a specific room transmitter, to its own test transmitter or to all 418MHz transmitters. The 900 MHz Repeater Verifier listens only to its own 900 MHz test transmitter.

#### 37. Can having too many repeaters affect the operation of the output modules?

Multiple repeaters can reduce the communication throughput success rate which can affect the operation of the output modules. The output modules will fail safe to a low temperature if they do not receive a signal for 15 minutes.

#### 38. What is the difference between the SMA connector and RP-SMA connector?

SMA (SubMiniature version A) connectors are coaxial RF connectors developed in the 1960s as a minimal connector interface for coaxial cable with a screw type coupling mechanism. The connector has a 50  $\Omega$  impedance. It offers excellent electrical performance from DC to 18 GHz.

RP-SMA connectors were introduced to separate professional (SMA) and commercial (RP-SMA) equipment, preventing unintentional or intentional connection of high-gain professional antennas (with SMA connectors) to commercial wireless equipment (with RP-SMA connectors), violating federal or international laws.

The RP stands for Reverse Polarity. The RP-SMA "Male" connector has inside threads and pin hole in the middle. This is what BAPI uses on the antennas. The RP-SMA connector "Female" has outside threads but has an inner pin. This is what BAPI uses on the receivers. Both are often used for commercially available antennas.



**Figure 1:** A Male RP-SMA connector is the opposite in both respects: It has a female inner pin hole contact and a female connector body with inside threads. (Antenna leads)



**Figure 2:** Female RP-SMA (RP-SMA-F or RSMA-F) socket connector: Inner pin contact with a female connector body and outside threads. (Receiver jack)

#### 39. How do you differentiate the different food probe clips?

The Fixed Stainless Steel Bin Clip has a black plastic base, BA/FP-CLP4.

The Fixed Plastic Bin Clip has an amber plastic base, BA/FP-CLP5.

The Adjustable Stainless Steel Bin Clip has an "7" stamped on the flat, BA/FP-CLP7.

The Adjustable Plastic Bin Clip has a "6" stamped on the flat, BA/FP-CLP6.

#### 40. What is meant by "interval dither time"?

Dither is a term used to describe the slight change in interval time before the next transmission. Each time a transmission ends, the next transmission starts at the programmed interval time plus a randomly selected dither time so that each transmitter never gets in synchronization with another transmitter.

#### 41. How is the dither time for BAPI transmitters calculated?

A random number generator selects a new number 1 and 7 after each transmission. This number is multiplied times 20ms and then added to the base interval time of the transmitter. So the dither time can be anything from 20ms to 140ms more than the base interval time. Each transmission is about 16ms. So the chances of two transmitters getting in sync with each other for two transmissions in a row is very small.

#### 42. How does a room transmitter send so many parameters in the wireless payload? The possible parameters include Temperature, %RH, Temperature Setpoint and Override all in one sensor/transmitter.

Each wireless transmission has one serial number. The combination %RH and Temperature room sensor (BA/BS2-WTH) has one serial number and thus transmits both the temperature and %RH in a single payload using one serial number. The full multi-combo %RH and Temperature room sensor with Temperature

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### **Frequently Asked Questions**

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Setpoint and Override (BA/BS2-WTH-SO) uses two transmissions and thus two serial numbers. When this full multi-combo sensor is used, it should be treated as 2 transmitters when figuring the maximum number of transmissions in a system. It should also be treated as 2 points for pricing if it is used in the Wireless Asset Monitoring (WAM) website.

The %RH and Temperature transmission alternates with the Setpoint and Override transmission. So %RH and Temperature will be transmitted every 40 seconds, and alternately the Setpoint and Override will be transmitted every 40 seconds. In this way, there is a transmission every 20 seconds but with different values.