# Operational Description for ITCS-A-405 Antenna

## 1 Basic Operation

The ITCS-A-405 is an RFID Bidirectional Electronically Steerable Phased Array Antenna, BESPA™, unit which incorporate an RF Controls RFID Reader Circuit Card Assembly (CCA) as its radio. The phased array creates a steerable beam using patented technology which allows RFID tags to be selectively illuminated.

The block diagram of the system shows that the RFC-A-405 Reader CCA and the Beam Steering Unit (BSU) composed of an RF Phase Feeder Card and Radiating elements are two separate and independent units used in conjunction to locate RFID tags. The BSU electronics are broad band enough to cover the 902.75-927.25MHz ISM band. This allows the RFC-A-405 Reader to operate normally, without having to be compensated for being connected to the BSU. Band limiting and pulse shaping is done completely within the RFC-A-405 Reader. The mode of operation for the RFC-A-405 Reader is the "FCC Dense" DRM mode of operation as described below.

The RFC-A-405 Reader CCA uses the AMS AS3993 EPC Class 1 Gen2 (ISO 18000-6) RFID reader integrated circuit. The AS3993 supports Dense Reader Mode, frequency hopping, low-level transmission coding data framing and CRC checking.

The modulator modulates the RF carrier with the shaped representation of the digital modulation signal. The internal modulator is capable of ASK and PR-ASK modulation.

| Benefit | Feature |
|---|---|
| High Sensitivity | DRM: 250 kHz and 320 kHz filters for M4 and M8 |
| World-wide shippable product | Frequency Hopping Support |
| Flexible modulation method | ASK or PR-ASK modulation |
| Wide temperature range | -40°C to 85°C |

Refer to the AMS AS3993 datasheet found at:
http://www.ams.com/eng/acceptpolicy/information/371263/1220977/file/AS3993_Datasheet.pdf
for details pertaining to the RF modulation, timing requirements, and bandwidth specifications.

## 2 Frequency Hopping Scheme

Per the requirements for 47 CFR Part 15.247(a), the ITCS-A-405 series meets the requirements of a frequency hopping spread spectrum system by using an FCC type certified RFID reader. The following information is a review of how the ITCS-A-405 meets these requirements when used as a BESPA™ antenna.

## *2.1 Pseudorandom Frequency Hopping Sequence*

The pseudorandom hopping Sequence is defined by the RF Controls RFC-A-405 Reader operating in Hopping Table mode. This hopping sequence uses a repeated pseudorandom sequence contained in a Hop Index list within the RFC-A-405 Reader firmware. When transmitting, the system will transmit at a given frequency slot until the end of the index list is reached and repeat.

In order to show both the randomness, and that the 2% average transmission ON time for each channel requirement is met, any frequency can be used to trigger a 20 second window. Using a slightly less than 400ms pulse, with 50 channels, the list of channels will take 0.4s x 50 channels = 20 seconds to complete.

| Slot Index | Hop Index | Frequency (MHz) |
|---|---|---|
| 1 | 47 | 926.25 |
| 2 | 39 | 922.25 |
| 3 | 17 | 911.25 |
| 4 | 34 | 919.75 |
| 5 | 15 | 910.25 |
| 6 | 31 | 918.25 |
| 7 | 24 | 914.75 |
| 8 | 13 | 909.25 |
| 9 | 38 | 921.75 |
| 10 | 46 | 925.75 |
| 11 | 6 | 905.75 |
| 12 | 0 | 902.75 |
| 13 | 23 | 914.25 |
| 14 | 2 | 903.75 |
| 15 | 48 | 926.75 |
| 16 | 1 | 903.25 |
| 17 | 22 | 913.75 |
| 18 | 12 | 908.75 |
| 19 | 36 | 920.75 |
| 20 | 45 | 925.25 |
| 21 | 25 | 915.25 |
| 22 | 3 | 904.25 |
| 23 | 11 | 908.25 |
| 24 | 5 | 905.25 |
| 25 | 9 | 907.25 |

| Slot Index | Hop Index | Frequency (MHz) |
|---|---|---|
| 26 | 32 | 918.75 |
| 27 | 42 | 923.75 |
| 28 | 33 | 919.25 |
| 29 | 8 | 906.75 |
| 30 | 44 | 924.75 |
| 31 | 16 | 910.75 |
| 32 | 37 | 921.25 |
| 33 | 27 | 916.25 |
| 34 | 7 | 906.25 |
| 35 | 40 | 922.75 |
| 36 | 29 | 917.25 |
| 37 | 21 | 913.25 |
| 38 | 10 | 907.75 |
| 39 | 26 | 915.75 |
| 40 | 35 | 920.25 |
| 41 | 41 | 923.25 |
| 42 | 19 | 912.25 |
| 43 | 30 | 917.75 |
| 44 | 4 | 904.75 |
| 45 | 49 | 927.25 |
| 46 | 14 | 909.75 |
| 47 | 28 | 916.75 |
| 48 | 43 | 924.25 |
| 49 | 18 | 911.75 |
| 50 | 20 | 912.75 |

**Hop Table shown in two halves with Time Slot index for the Sequence, Hopping Index, and Transmitted center Frequency in MHz.**

### *2.2 Equal Hopping Frequency Use*

Since the hopping sequence uses each index in the hopping table only once, each of the fifty channels is used for each transmission cycle. Each channel will get equal use because the transmitter hops through all 50 channels prior to the start of a new sequence.

### *2.3 System Receiver Hopping Capability*

The RFC-A-405 Reader RFID reader uses the homodyne principle. In other words the receiver does not have an intermediate frequency and the transmitter carrier frequency is used as the local oscillator for the receiver. The receiver does not have a separate local oscillator. This design methodology dictates that the receiver frequency is always synchronous with the transmitter frequency.

In RFID applications, the transmitter emits a signal which is backscattered by the passive backscatter tags present within the transmitter field. The RFC-A-405 Reader receiver detects and demodulates the backscatter modulated signal from the passive backscatter tag.

## 3 Antenna requirements per 15.203

The ITCS-A-405 antennas are professionally installed systems, and therefore are not restricted to use of unique connectors. The criteria for professional installation are broken down into application, installation requirements, and marketing method.

### *3.1 Application*

The application of this system is RFID tag detection and location tracking. Per section 15.203, the ITCS-A-405 system will only be installed by professional installation crews. The antennas are permanently attached to the array through circuit board connections. The system also employs an antenna sensing circuit to ensure that the RFID reader is properly connected to all components within the antenna system. Any unauthorized changes disable operation. The installer and user are not able to substitute other antennas. See FCC publication number 239743 for further information.

### *3.2 Installation Requirements*

Per the User Guide, the installation of the ITCS-A-405 antenna will be done by a professional installation crew. The ITCS-A-405 antenna is intended to be installed and operated indoors or under-cover where the operating temperature is within the range of -10 to 55°C and humidity is non-condensing and does not exceed 95%.

### *3.3 Marketing Method*

The ITCS-A-405 series are marketed using a business to business model whereby the installation is either reviewed by View Technologies, or a suitable installation and integration company employed for the purpose of system installation and verification.

## 4 Suitable antennas per 15.204

The ITCS-A-405 antennas are integral units. No other antennas are proposed to be used with this system.

## 5 Parts List/ Tune Up Info

There is no tune-up procedure for the ITCS-A-405 BESPA™ antenna. The maximum output power level setting is Factory set via software to the RFC-A-405 Reader firmware during production Testing. Maximum Output power cannot be adjusted by the installer or user.

The ITCS-A-405 sealed enclosure and is not user serviceable. With the exception of connectors there are no user-serviceable parts. The removal of any equipment covers will void the warranty and may result in voiding FCC type approval status. In the event of failure or faulty operation please contact RF Controls Technical Support.

## 6 RF Exposure Info

Per previous discussion, ITCS-A-405 series complies with 15.247(b)(4) with the following label:

THE ANTENNA USED ON THIS EQUIPMENT MUST BE INSTALLED TO PROVIDE A SEPARATION DISTANCE OF AT LEAST 23CM FROM ALL PERSONS AND MUST NOT BE CO-LOCATED OR OPERATED IN CONJUNCTION WITH ANOTHER ANTENNA OR TRANSMITTER.