Operational Description

FCC ID: PN3Y72160-301

The Hand Held Transceiver Model 2 (HHTR-2) is a device that has quite a number of applications. The HHTR-2 is to be used in the following ways:

- Orion installation
- Force link assignment from a given ORION or RMTR-2 to a given EMTR-2
- EMTR-2 Routing Table maintenance during Installation and reconfiguration
- EMTR-2 replacement
- Site surveys
- Transceiver diagnostics
- RMTR-2 installation and configuration, i.e. uploading, editing, and downloading RMTR-2 device configuration tables. (possible future development)

The HHTR communication sequence with the ORION, EMTR-2, and RMTR-2 is described below and is generally similar to the ORION to EMTR-2 communication sequences.

1 FCC 15.203 ANTENNA REQUIREMENTS

The antenna is permanently attached to the PCB. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore it meets the 15.203 Requirement.

2 GENERAL RF COMMUNICATIONS PROTOCOL

Conveying data over a radio link physical medium invariably involves issues with propagation, delays, noise, channel access, and using various techniques to minimize these problems. The major issues are briefly addressed below.

2.1 RF Link Usage

The RF link between TWACS transceivers uses a range of frequencies between 902 MHz and 928 MHz. This range is divided into 79 channels. 50 channels are needed to satisfy the FCC's minimum channel set requirements, so 50 of the 79 are chosen for use. The RF link was designed using a commercially available RFIC Integrated circuits to form a complete UHF transceiver. The RF modulation technique is 2-level FSK.

In the system, 5 of the 50 channels used for an RF session are reserved for link acquisition and the other 45 are used for data packets transmitted after a link has been acquired. The acquisition channels are spaced evenly throughout the upper end of the 50-channel set. The 45 link data channels are cycled through in a pseudo-random manner while a link is active between transceivers.

From an operation standpoint, the TWACS transceivers can play one of two roles during an RF session. A transceiver that requests a link is a *requesting* transceiver. A transceiver that replies to that request is a *granting* transceiver.

Links are always requested by sending a Request-To-Send (RTS) packet. Links can be granted by sending either a Clear-To-Send (CTS) packet or a Read or Write command packet. Either type of response indicates to a requestor that the link has been granted.

TWACS transceivers can be characterized by these roles:

Transceiver	Type	Can request a link from…	Can grant a link to…
EMTR-2	Granting	None	an HHTR-2 or an RMTR-2 (possible future development)
RMTR-2 (possible future development)	Requesting	an EMTR-2 or an HHTR-2	None
HHTR-2	Both	an EMTR-2	an RMTR

As the above table shows, EMTR-2s never request a link; they are always granting transceivers. By contrast, RMTRs never grant a link; they are always requesting transceivers. The HHTR-2, since it must be able to communicate with both EMTR-2s and RMTRs, can act as either a granting transceiver (with an RMTR) or a requesting transceiver (with an EMTR-2). With respect to the Orion, the EMTR-2 is simply a receiver as the Orion only communicates as a transmitter.

The reason this is important is that *the granting transceiver always controls the frequency hop sequence*. This means that an EMTR-2 always controls the frequency hop sequence. Also, an HHTR-2 will control the frequency hop sequence when communicating with an RMTR. An RMTR-2 never controls the frequency hop sequence.

The distinction between granting and requesting transceivers is strictly operational. It is not a functional difference because the same RF transceiver and RF engine code are used on all transceivers. For example, the EMTR-2 board electronics are capable of acting as a requesting transceiver but its firmware is designed to only act as a granting transceiver.

Since the EMTR-2, HHTR-2 and RMTR-2 all use the same RF engine; the link-level RF code is the same for all of them (with minor differences). The difference in action has to do with whether it is a requesting or granting transceiver. This is more specifically described below.

1. In order to act as a granting transceiver, an EMTR-2 or HHTR-2 must scan the 5 acquisition channels continually, watching for positive-going RSSI. This type of scan is called SCAN_ACQ, for Scan-and-Acquire.

   This is the mechanism used to detect link requests. When an EMTR-2 or HHTR-2 detects positive RSSI on one of the acquisition channels, it begins looking for bits in the RF data stream to find the start sequence (Willard code) and the rest of a packet.

2. By contrast, when an RMTR-2 or HHTR-2 needs to send an RTS packet, it first determines which of the 5 acquisition channels is the quietest. To make this determination, the requesting transceiver scans the acquisition channels once to measure their RSSI. The channel with the lowest RSSI is the quietest channel and used as the first channel for requesting a link.