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## **Certification Exhibit**

**FCC ID: IQ5-VOY1-2**

**FCC Rule Part: CFR 47 Part 90.259**

**ACS Report Number: 09-0301-LD**

Applicant: Data Flow Systems Inc.  
Model: Voyager 1 Radio

## **Manual**

# ***Voyager Telemetry Radio***



Oct 2009

Revision A.3



# Quick Start Procedure

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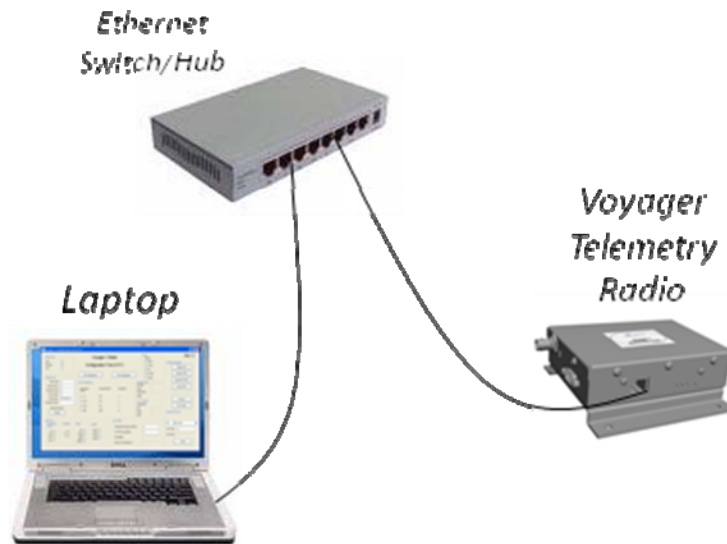
Follow the steps below to install and configure Voyager Telemetry Radio (VTR):

1. Select the location for the VTR. Must be an area free of water intrusion with a temperature range of -30 to +55 deg C (-22 to 130 deg F).
2. Locate the coaxial cable to the antenna. This should be a good quality, low-loss cable that is as short as possible. This cable should include an in-line surge arrester to prevent lightning strike damage to the radio. The cable should have a BNC (F) connector or an adapter will be needed.
3. Locate the power source. The VTR requires a 9-14 VDC input and draws about 1.5 A. Power is supplied via the DB9 connector (Pin 5: +VDC and Pin 9: Ground) or plug on the side of the radio, depending on the option selected. Verify that DC power is supplied only on Pin 5 or the power plug is available. The Table below summarizes the proper pinout for the serial data cable:

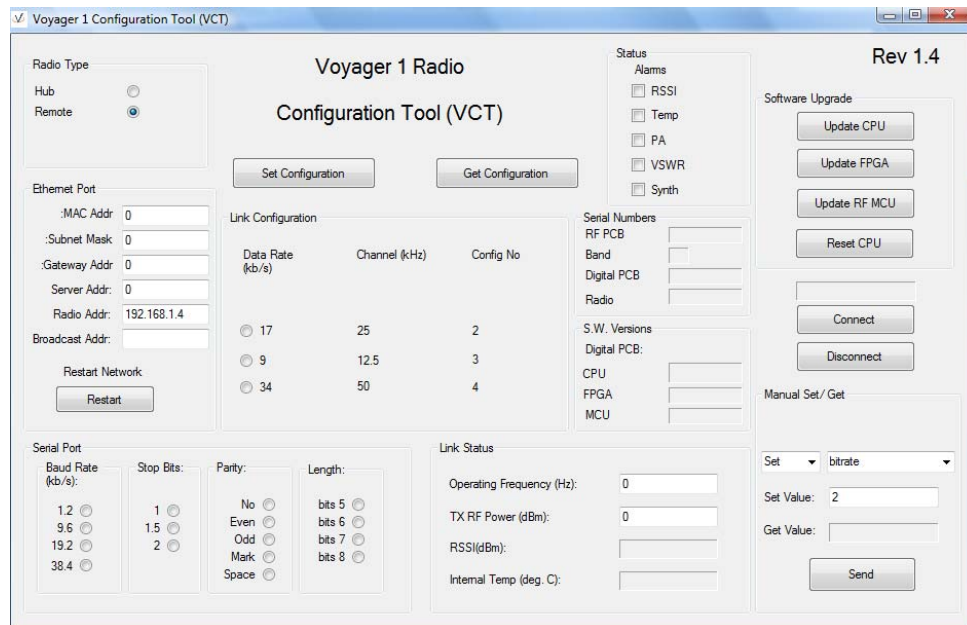
Pin	Function
1	Transmit Data (from user)
2	Receive Data (to user)
3	Transmit Enable (WSR transmits when pin is grounded)
4	Common signal & power ground
5	+10 to 14 VDC input
6	Squelch (Receive)
7	Frequency programming (Not used)
8	RSSI (Strong signal = 3 VDC)
9	Common signal & power ground

4. Connect the DB9 or power cable to the VTR and turn the power source on. Observe that the green power LED is illuminated. It takes about 10 seconds for the VTR to boot-up. After this, only the green power LED should be on.

5. Connect a laptop to the VTR as shown in the figure below (via Ethernet Hub or Switch). Load and start the Voyager Configuration Tool (VCT) software.



6. The default IP address of the VRT is 192.168.1.4. This address is automatically loaded in the Radio Address field of the VCT. Click on the connect button (See Figure below).



The word 'Connected' will appear in the box above the button when an IP connection has been established between the VCT and the VTR.

- 7.** Click on the 'Get Configuration' button. The VCT screen will then be updated with the current configuration information stored within the VRT.
- 8.** Ethernet Port Configuration: Enter the desired changes to the Subnet Mask, Server, Gateway, Broadcast and Radio addresses. Be sure to record the new Radio Address. Click on the 'Set Configuration' button. The VCT will automatically close. Re-start VCT and enter the new Radio IP address in the appropriate field on the screen and press the 'Connect' button. The word 'Connected' should appear after a few seconds indicating a connection has been established using the new radio IP address.
- 9.** Radio Type and Link Configuration: Select the desired Link Configuration from the menu choices in the Link Configuration box (1-4). Select the Radio Type as Hub, Remote or FTU from the Radio Type box. Click on the 'Set Configuration' button. The VCT will automatically close as the VTR will restart with the new configuration information permanently stored in memory (until changed in the future). Re-start VCT and enter the new Radio IP address in the appropriate field on the screen and press the 'Connect' button. The word 'Connected' should appear after a few seconds indicating a connection has been established using the new radio IP address.
- 10.** Transmit RF Power and Operating Frequency: Enter the desired operating frequency of the VTR in the appropriate field. This must be a value between 217.0 and 220.0 MHz. The frequency must be divisible by 12.5 kHz. Enter the desired transmit RF power in the appropriate field on the screen. This must be a value in dBm between 14 and 33. Click on the 'Set Configuration' button.
- 11.** Click on the 'Get Configuration' button to retrieve all the configuration stored within the VTR. Verify that each configuration parameter is correctly set to the desired value. Note some parameters are read only and cannot be changed. These include the RSSI, Internal Temperature, Alarms and MAC Address.
- 12.** Verify that there are no Alarms indicated in the Status box.

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## Copyright Notice

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## Operational and Safety Notices



### RF Exposure

The radio described in this manual transmits RF energy. The concentrated energy from the antenna may pose a health hazard. All antennas used with this radio must be installed to provide a minimum separation from all persons of 90 cm (36 inches). The above separation distance must be maintained at all times. More information can be obtained from the FCC at the following website:

[http://www.fcc.gov/Bureaus/Engineering\\_Technology/Documents/bulletins/oet65/oet65.pdf](http://www.fcc.gov/Bureaus/Engineering_Technology/Documents/bulletins/oet65/oet65.pdf)



### FCC Part 15 Notice

The transceiver complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any unauthorized modification or changes to this device without the express approval of Data Flow Systems may void the user's authority to operate this device. Furthermore, this device is intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user's authority to operate this device.

# 1.0 Product Description

The Voyager Telemetry Radio (VTR) shown in Figure 1.1 below is design to provide a reliable wireless connection for digital communication in selected bands in the 200 and 400 MHz frequency bands.



**Figure 1.1: Voyager Telemetry Radio (VTR)**

The VRT is a software-defined radio (SDR) making it very flexible and upgradable. The modem functionality is comprised of software which is loaded at the time of manufacturing. It can be upgraded in the future to add additional features.

The unit is housed in an aluminum enclosure which is not weather-tight. Two printed circuit boards are included; RF and Digital. The RF board is provided in one of three configurations as outlined below:

Low Band: 145 to 225 MHz

Middle Band: 210 to 470 MHz

High Band: 470 to 930 MHz



These RF cards all provide a common differential baseband I/Q interface to the Digital board. The RF board includes transmit, receive, synthesizer and control sections. The transmit section includes an Intermediate Power Amplifier (IPA), Power Amplifier (PA), Variable Attenuator and Forward and Reverse Power Detectors. The PA provides nearly 2 Watts (32 dBm) of RF output power at the antenna connector. The Variable Attenuator is used by the Control system processor to set and maintain the transmitted RF power level. A closed-loop process is used with the Forward Power Detector to maintain the desired output level under all conditions. The Reverse Power Detector is used to detect impedance mismatches which may occur with an antenna or cable failure.

The receive section of the RF board includes a Tunable Bandpass Filter (TBPF), Low Noise Amplifier (LNA) and Variable Attenuator. The TBPF is centered by the control processor about the radio's operating frequency and has a 20 MHz passband. The LNA provides gain and a noise figure of about 4 dB. An Automatic Gain Control (AGC) loop is managed by the control processor using the Variable Attenuator. A constant level is maintained into the Digital board.

The synthesizer section includes a 20 MHz Frequency Reference which is a Temperature-Compensated Crystal Oscillator (TCXO) with Stratum 3 frequency stability. This reference is multiplied up to the desired operating frequency within the Synthesizer. The output is applied to the Digital Up and Downconverters. This provides direct modulation and demodulation of the baseband, modulated signal.

The control section includes a processor with on-board memory, analog to digital converters and general purpose I/O. It also includes a serial port which is used to communicate with the processor on the Digital board. The processor manages the transmit power control and receive AGC loops. It also programs the synthesizer to tune to the operating frequency. The memory contains the processor code along with critical calibration tables which are generated during manufacturing. These tables provide accurate transmit power setting across the band, receive power estimation and tunable filter control.

The Digital board provides the user ports, message routing and radio management functions. The radio provides a serial and Ethernet ports for connection to user devices. These can be used simultaneously when certain modes are selected. Serial port is available via a DB9 connector and has the pin-out shown in the table below.

Pin	Function
1	Transmit Data (from user)
2	Receive Data (to user)
3	Transmit Enable (WSR transmits when pin is grounded)
4	Common signal & power ground
5	+10 to 14 VDC input
6	Squelch (Receive)
7	Frequency programming (Not used)
8	RSSI (Strong signal = 3 VDC)
9	Common signal & power ground

Table 1.1: DB9 Pin Definitions

## 2.0 Applications

The most common application for the VTR is a 'star' network where a single hub site communicates to a collection of remote sites as shown in Figure 2.1.

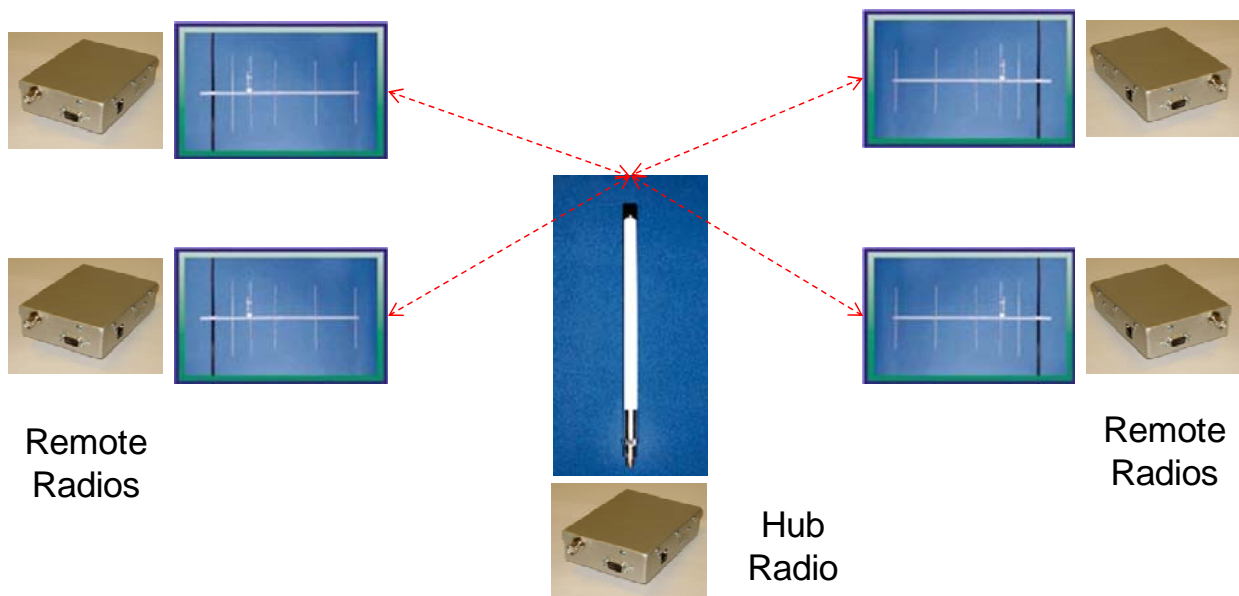


Figure 2.1: Star Network Configuration

The Hub VTR is connected to an omnidirectional antenna via a length of coaxial cable. The signal transmitted by the Hub VTR is transmitted in a 360-degree pattern to all remote sites within a range supported by the configured transmitted power. Each remote site VTR is typically connected to a directional antenna via a length of coaxial cable. These antennas are 'pointed' toward the Hub to achieve maximum gain.

Radios can be configured to operate in two modes. Mode 1 is selected when the VTR is to emulate the current T-200 radio and operate at 2.4 kb/s using a compatible waveform. The VTR in this mode is interchangeable with the T-200 and there is no difference in the operation of Hub and Remote configurations. All VTRs in a Mode 1 network should be configured as a Remote. In Mode 1, only the Serial Port is used to exchange data with the user device and the port speed is 2.4 kb/s.

In Mode 2, VTRs must be configured as a Hub or Remote. The Hub VTR will accept user messages over the Ethernet LAN Port. These are ASCII-formatted messages with recognized SOM and EOM characters that are encapsulated in IP packets. The Hub user device will address these to the configured Radio IP Address. The Mode 2 Remote VTR will exchange user data over the serial port. User messages will be removed from the IP Packets and sent to the local user device over the serial port.

All messages sent by the Hub VTR will be forwarded to the serial ports of all VTRs.

## 3.0 Specifications

### Electrical

Frequency bands	
Low Band	145 to 225 MHz
Mid Band	225 to 470 MHz
High Band	470 to 930 MHz
RF Transmit Power	17 to 32 dBm
Noise Figure	4 dB
Spurious & Harmonic Emissions	FCC Part 15 & 90 compliant
Data Rates	2.4 to 34 kb/s
Channel Bandwidths	12.5, 25 or, 50 kHz
Modulation	2-FSK
Frequency Selection	12.5 kHz steps
Operating mode	Burst, Time-division duplexing
Microprocessor	Freescale i.MX27, 400 MHz
Processor Memory	
RAM	32 MB
FLASH	2 MB
Modem FPGA Memory	1 MB

## Mechanical

Dimensions	3.5" x 5.0"x1.4"
Enclosure material	AL, clear anodized finish
Weight (wall mount)	300 g
Mounting	table-top or wall

## Environmental

Operating Temperature Range	-30 to 55 <sup>0</sup> C
Operating Humidity	Up to 95%, non-condensing

## Power

Input Voltage	9 to 14 VDC
Consumption	
Transmit	1.5 A
Receive	0.5 A

Specifications subject to change without notice.