1.0 Introduction

This document is intended to provide supporting documentation towards the Galaxy Tracking Systems, L.L.C. efforts in achieving FCC Part 90 Certification for the Vehicle Transceiver Unit (VTU) marketed under the name V-Trak™.

This documentation supports VTUs containing a UHF Data Transceiver operating in the 450 to 470 MHz frequency bands for 25 kHz and the 12.5 kHz channel operation. To achieve 25 verses 12.5 kHz channel operation requires factory installation of an appropriately configured UHF Data Transceiver deck within the VTU. Besides the UHF Data Transceiver no other physical differences exist between the 25 kHz and 12.5 kHz VTUs. VTUs are also available in two data interface configurations 1) with RS232 data interface and 2) without RS232 data interface. The with RS232 interface allows VTU operation with a digital display to enhance man machine interaction.

1.1 System Overview

A typical configuration of Galaxy's vehicle tracking system is illustrated below.

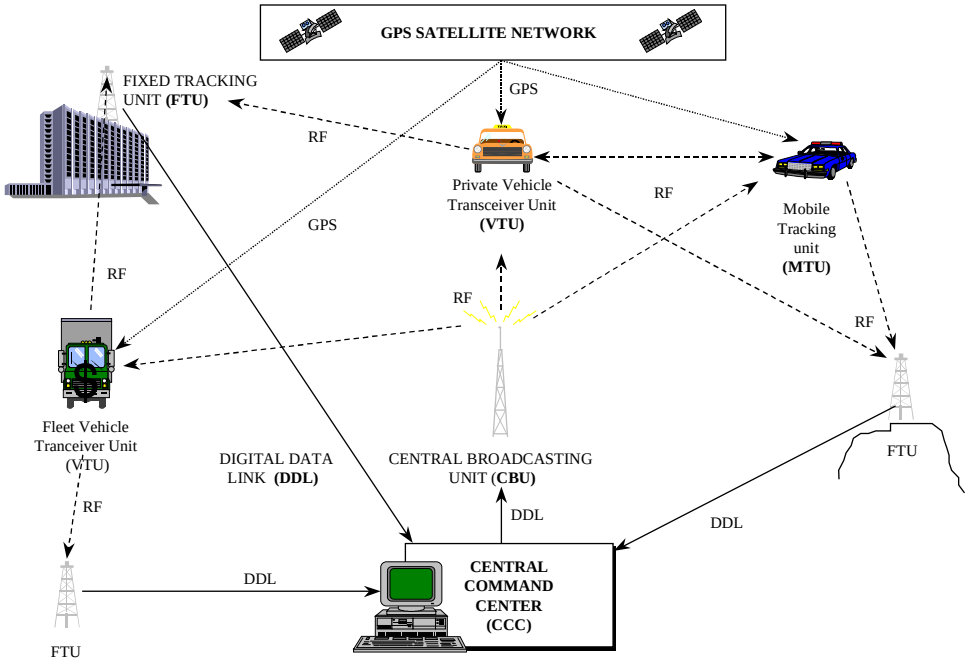


Figure 1 - Vehicle Location and Tracking System Architecture

1.1.1 Mobile Components

The VTU is the mobile component of Galaxy's vehicle location and tracking system. Each VTU contains a GPS receiver to determine location, and a UHF Data Transceiver for communications. VTUs run directly off of vehicular battery power and are small enough to be easily hidden.

Vehicles equipped with VTUs can be commanded to continuously report their position, speed, and status.

For anti-theft and security related applications, the VTU can provide limited remote control of vehicle systems (e.g., lights, horn or ignition), as well as automated and manual alarms.

1.1.2 Fixed Components

The tracking system's infrastructure is comprised a powerful transmitter, Central Broadcasting Unit (CBU), and a host of fixed receivers, Fixed Tracking Units (FTUs), placed strategically throughout the area of operations to ensure uninterrupted communications to member vehicles. The CBU operates under the direct control of the Central Command Center (CCC) which provides the primary operator interface to command and control the system. The CBU transmits aiding data, system timing data and VTU commands at precise intervals synchronized to GPS time.

Every VTU command requires an acknowledgment back to the CCC. The exact time and interval at which the VTU is to transmit its response(s) is contained in the original VTU command. Vehicle (VTU) transmissions are received by FTU(s) and forwarded by direct cable connection or telephone line back to the CCC.

1.1.3 RF Transmission Scheme

Galaxy's system currently supports sixteen radio channels. Each channel is comprised of a receive / transmit frequency pair within the radio's operating frequency range. Each channel is divided using a Time Division Multiple Access (TDMA) transmission scheme that begins on a one-hour boundary and repeats every 30 seconds. Each 30-second cycle is divided into five six-second frames. The frames are further divided into 100 msec "slots".

The first six time slots of each frame are allocated to CBU transmissions. The remaining time slots are allocated dynamically to specific VTUs under control of the command center.

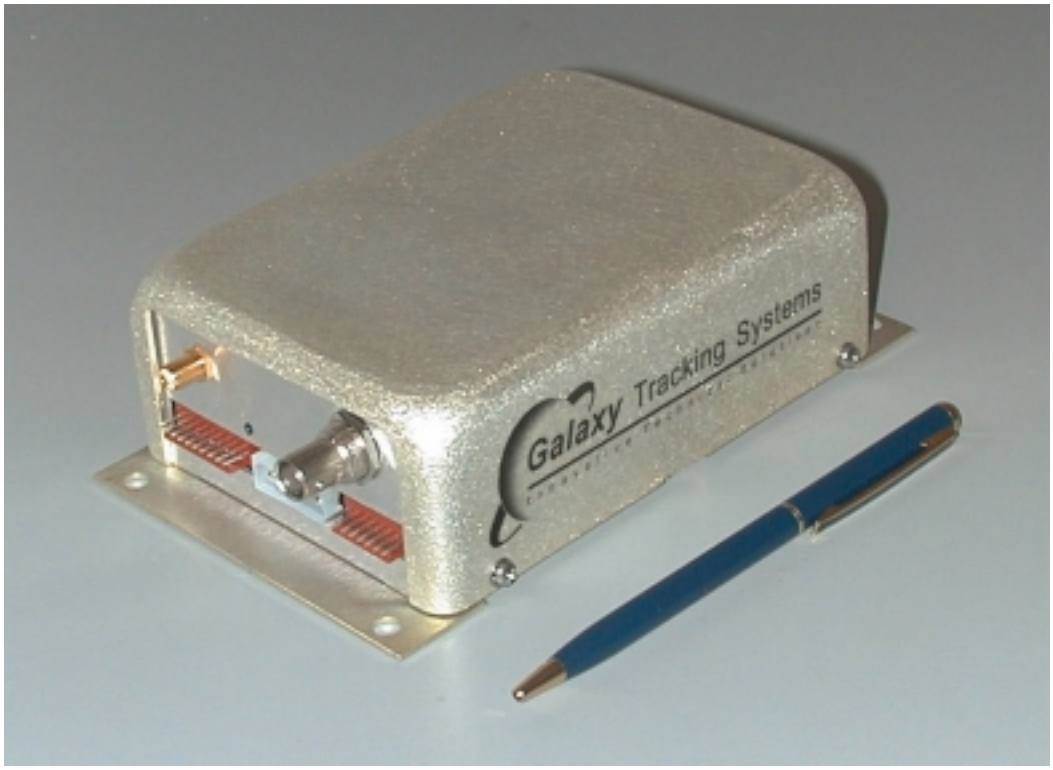
1.1.4 System Timing

Accurate time is required to maintain the TDMA transmission scheme employed for UHF communications. All system components are synchronized to within a few milliseconds of each other using the GPS 1 PPS output pulse.

1.2 VTU Specification Sheet

V-Trak™

GPS-based Vehicle Location and Tracking Unit



All-in-one Vehicle Tracking Unit

V-Trak™ is a self-contained Automatic Vehicle Location device, for use with the Vehicle Location and Tracking System (VLATS). V-Trak™ can be used for:

- Fleet Tracking and Management- Taxis, buses, armored cars, delivery vehicles.
- Personal Safety and Security: Use in case of emergency to summon police, medical or mechanical assistance.

V-Trak™ includes everything necessary for accurate vehicle tracking: differential GPS receiver, digital wireless RF link, and micro-processor control. It requires only 12 VDC vehicle power, a GPS antenna and UHF antenna to operate.

Advanced TDMA Communications Link:
V-Trak™ incorporates a high-speed bi-directional communications link. Precise timing allows tens of thousands many V-Trak™ units to operate simultaneously. The communications link incorporates advanced Forward Error Correction (FEC) and data interleaving, providing superior performance in difficult urban environments

V-Trak™ features:

- *SOS Alarm*: Pressing this notifies Command Center of emergency and exact location
- *Unauthorized movement alarm*: vehicle movement (theft) notifies Command Center.
- *xternal Vehicle Controls*: Controls lights, horn or shuts off engine remotely.

Specifications

UHF Receiver:

Frequency:	Multiple frequency operation within band
Frequency Band:	450 - 470 MHz band typical, others available from 403- 512 MHz
Modulation Format:	GMSK
Deviation:	+/-5 kHz
Transmission Rate:	19,200 Baud, 7-bit even parity, 1 stop bit (25 kHz BW) or 9,600 Baud, 7-bit even parity, 1 stop bit (12.5 kHz BW)
Sensitivity:	-114 dBm

UHF Transmitter:

Frequency:	Multiple frequency operation within band
Frequency Band:	450 - 470 MHz band typical, others available from 403- 512 MHz
Internal Stability:	+/- 1.5 ppm
Modulation Format:	GMSK
Deviation:	+/- 4.5 kHz
Transmission Rate:	19,200 Baud, 7-bit even parity, 1 stop bit (25 kHz BW) or 9,600 Baud, 7-bit even parity, 1 stop bit (12.5 kHz BW)
Transmit Power:	2.0 Watts (at 13.5 VDC)
Harmonic Suppression:	>50 dBc

GPS Receiver:

Update rate:	1 Hz
Position Accuracy:	2m 2D RMS with Differential GPS (included) 100 m 2D RMS when Differential not available
Velocity Accuracy:	0.1 m/sec
Time Accuracy:	130 ns w/ SA on
Acquisition Time:	Hot Start: < 3 seconds Warm Start: < 20 seconds Cold Start: < 2 minutes
Number of Channels:	12 (All-in-View)

Inputs / Outputs

Inputs:	4 Discrete Switch Inputs
Outputs:	4 Discrete Outputs, 15 mA

Options

Input Switch Box:	Connects to V-Trak™, Provides driver with Panic Button / assistance request functions; alternatively used for status indications
Output Relays:	High current relays allow V-Trak™ outputs to be used to control vehicle: engine kill, unlock door, honk horn, etc.
Antennas:	Magnetic mount, permanent mount, and hidden GPS and UHF antennas
Backup Battery:	4 hour or 16 hour operation

Power Requirements:

Voltage:	12 VDC nominal
Current Draw:	250 mA at idle, 1.1 amp while transmitting

Physical / Environmental

Dimensions:	16.5 cm x 10 cm x 5 cm
Operating temperature:	-30°C to +60°C

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1.3 UHF DM 3474 Data Transceiver Specification Sheet

GENERAL INFORMATION

The following are general specifications intended for use in testing and servicing this transceiver. For current advertised specifications, refer to the specification sheet available from the Marketing Department. Specifications are subject to change without notice.

GENERAL

Frequency Range	403-512 MHz
Frequency Control	Synthesized
Channel Spacing	12.5/20/25 kHz
Mode of Operation	Simplex or Half Duplex
Operating Voltage	+7.5V DC ±10%
Regulated Supply Voltages	+5V DC ±5%
RF Input/Output	MCX Jack
Power and Data Interface	14-pin in-line socket, 100 mil center
Operating Temperature	-30° to +60° C (-22° to +140° F)
Maximum Dimensions	2.83" L (7.19 cm), 2.19" W (5.56 cm), 0.64" H (1.70 cm)
Weight (w/o Loader Bd)	2.3 oz (65 g)
FCC Compliance	DM3474 customer must apply

RECEIVER

Bandwidth	16 MHz
Frequency Stability	±1.5 PPM
Sensitivity - 12 dB SINAD	0.45 µV
RF Input Impedance	50 ohms
Spurious and Image Rejection	-70 dB
Selectivity	-60 dB (12.5 kHz), -70 dB (20/25 kHz)
Intermodulation	-70 dB
FM Hum and Noise	-40 dB (12.5 kHz), -45 dB (20/25 kHz)
Conducted Spurious	-57 dBm
Receive Current Drain	< 70 mA nominal
Receive Attack Time	< 7 ms (dependent on synthesizer loading implementation)
Audio	
Distortion	< 3%
Output Level DM3474	600-1200 mV P-P or 200-400 mV RMS (1 kHz at ±3 kHz)
Response	
DM3474	±2 dB from DC to 5 kHz (reference to 1 kHz)
Minimum Load Impedance	1k ohms

TRANSMITTER

Bandwidth	16 MHz
Frequency Stability	±1.5 PPM
TCXO Coupling	DC
RF Power Output	2W nominal adjustable to 500 mW (-XX0) 500 mW nominal
RF Output Impedance	50 ohms
Modulation Distortion	< 3%

Part No. 001-3474-002

GENERAL INFORMATION

Duty Cycle	50%, 60 seconds maximum transmit
Transmitter Attack Time	< 7 ms (dependent on synthesizer implementation)
Spurious and Harmonic FM	-37 dBm
FM Hum and Noise	-40 dB 12.5 kHz, -45 dB 25 kHz
Audio Response	±1.5 dB from DC to 5 kHz (reference to 1 kHz) Programmable to ±1 dB at the RF band edges via J201, pin 14.
Data Input Impedance	100k ohm
Modulation Response	±1 dB from DC to 5 kHz (reference to 1 kHz)
Current Drain	< 800 mA at 2W, +7.5V DC