LS RESEARCH
Wireless Product Development

GTT MODULE THEORY OF OPERATION

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1 Introduction

1.1 Purpose & Scope

The purpose of this document is to provide theory of operation for the module design of a 2.4GHz FHSS / TDMA radio module for GTT.

1.2 Background / Technology

The GPS based priority control system uses a proprietary 2.4 GHz FHSS/TDMA transceiver to transfer data between any vehicles, and traffic intersection controllers within radio range. Figure 1 provides a block diagram one node in the system.

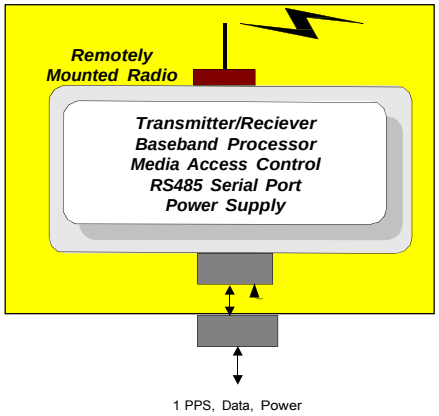

Figure 1: GTT Module Block Diagram – High-Level

Figure 2 provides some High-level specifications for module design.

SPECIFICATIONS	GTT MODULE
Frequency	2400 – 2483.5 MHz
TX Power	+27 dBm
RF Data Rate	384.0 kpbs
RF Modulation	Filtered FSK
Operating Temp	-35 to +75C

Figure 2: GTT Module General Specifications

2 Module Theory of Operation

2.1 OVERVIEW

The module is a half duplex (transmit or receive) transceiver.

Figure 3 shows a top level block diagram of the module.

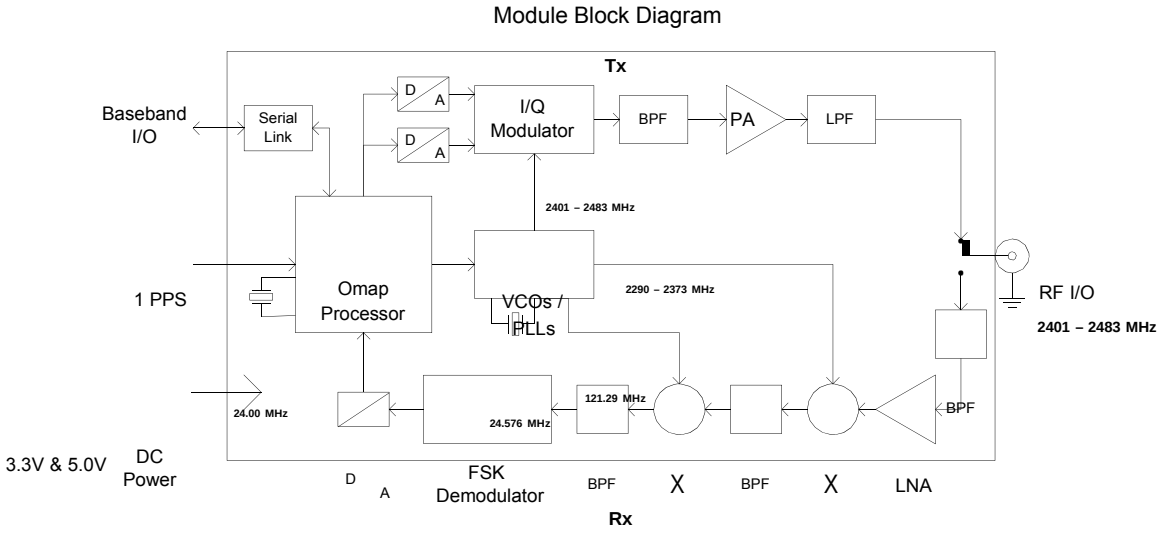

Figure 3: Radio Top Level Block Diagram

2.2 TRANSCEIVER SYSTEM

2.2.1 Receiver

The receiver is a dual conversion design with a FSK discriminator based demodulator. The discriminator output is connected to an A/D converter. The A/D converter samples the discriminator output using multiple samples per bit. The A/D converter is connected to a high speed data port (uPP) on the processor. The Omap processor recovers the data using signal processing algorithms. The first IF frequency is 110.59 MHz and the second IF is 10.7 MHz.

2.2.2 Transmitter

In order to duplicate the modulation of the legacy system without the need for tuning, the modulation is performed digitally. The processor calculates the in-phase and quadrature components of the signal. The signal is transferred to a pair D/A converters which directly modulates the RF carrier signal. The output of the RF modulator is bandpass filtered, and then drives the RF power amplifier. The frequency of the oscillator the feeds the modulator is at the

transmit frequency. The RF amplifier output is lowpass filtered before connecting to the antenna.

Output power is adjustable by means of a programmable attenuator following the modulator but before the power amplifier.

2.2.3 Channel Selection

Frequency selection is by means of an integrated phase lock loops and local oscillators. The three oscillators will only have to tune to a new hop frequency and not from receiver IF frequency to transmit frequency during the frame. Since this only has to be done once per frame, it allows longer tuning time and lower phase noise of the oscillators.

PSEUDORANDOM HOPPING SEQUENCE.

A new hop channel is selected every 333ms.

2	50	58
4	52	6
8	60	10
48	42	12
46	44	40
62	38	64
14	16	66
18	32	20
68	22	30
72	1	74
34	36	24
28	26	3
70	53	5
55	59	9
49	7	47
51	11	45
61	13	63
41	39	15
43	65	19
37	67	69
17	21	73
31	29	33
71	75	27
35	25	23
56	57	54

RECEIVER SYNCHRONIZATION AND RECEIVER INPUT BANDWIDTH.

The receiver input bandwidth is 1.1 MHz.
The receiver is a dual conversion design with a FSK discriminator based demodulator. The discriminator output is connected to an A/D converter.