

**Type Acceptance Information for TS4000 Radio Modem with 3422 Transceiver  
Proposed FCC ID JWFTS4000C**

**PURPOSE**

The purpose of this document is to provide information in support of type acceptance testing and report generation in pursuit of a Grant of Equipment Authorization under FCC Parts 15 and 90 and Industry Canada RSS-119, RSS-210 and ICES-003 for Teledesign's TS4000 Radio Modem.

**INTRODUCTION**

The TS4000 is a high-speed radio modem that consists of a modem board, radio transceiver board and metal enclosure. The radio transceiver board connects to the modem board with a flexible printed circuit.

**Radio Transceiver Board**

The radio transceiver board for this application is an E.F. Johnson DL3422. This device is being used without any modifications. The DL3422 has received FCC type acceptance with an FCC ID of ATH2423422-007. All circuit descriptions and details for the radio transceiver can be found in the type acceptance document for the DL3422. A copy of this has been included with this application. The radio transceiver is available in a frequency range from 132-174 MHz and includes a temperature stable reference oscillator with a frequency stability of  $\pm 2.5$  PPM.

**Modem Board**

The modem board provides the serial data interfaces that the user's equipment interfaces to. The modem board also controls the operation of the radio transceiver. This control includes controlling the radio power and frequency and also controlling the modulation, data rate and frequency deviation of the transmit signal. Note that it is this transmit signal that defines the emission bandwidth and spectral efficiency.

**Radio Flex Circuit**

A flex circuit is used to interconnect the radio transceiver board to the modem board. This flex circuit is also used to interconnect the serial port 2 connector to the modem board. The J11 interconnecting diagram included with the modem board schematic provides the specific connections provided by the flex circuit for connecting the radio transceiver to the modem board.

**Configuration Software**

IBM compatible configuration software is used to control all aspects of configuration, tune up and test of the TS4000 radio modem.

**General Information**

<b>Manufacturer:</b>	Teledesign Systems Inc. 2635 North First Street, Suite 205 San Jose, CA 95134 408-232-0180
<b>Contact Person:</b>	Mark Hubbard
<b>Product Trade Name:</b>	TS4000 Radio Modem
<b>Product Model Number:</b>	TS4000-05Cff where: ff - indicates frequency range
<b>Proposed FCC ID:</b>	FCC ID: JWFTS4000C
<b>Production Plans:</b>	Teledesign Systems Inc. plans to produce this product in quantity (greater than 1) production runs.
<b>Radio Transceiver Manufacturer:</b>	E.F. Johnson

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**Radio Transceiver Model Number:** DL3422

**Radio Transceiver Part Number:** 242-3422 ( $\pm 2.5$  PPM frequency stability)

**Radio Transceiver FCC ID:** ATH2423422-007

**Frequency Range:** 132 - 174 MHz

**Maximum RF Power Rating:** 5 watts

**RF Power Range:** 0.1 - 5.0 watts, software selectable

**Method of Modulation:** Direct FM

**Types of Modulation:** 4 Level FSK  
GMSK with BT = 0.3  
GMSK with BT = 0.5

**Type of Emissions:** 20K0F1D (multi-bandwidth mode)  
16K0F1D (multi-bandwidth mode)  
11K2F1D (single bandwidth mode)  
6K00F1D (for subparts 90.63(d)(7), 90.65(c)(18),  
90.67(c)(14), 90.73(d)(13), 90.75(c)(19)  
and 90.79(d)(6) only).

**Emission Designator Calculations:**

Modulation Types:

The TS4000 is designed to use three modulation types: 4 level FSK, GMSK with a BT=0.5 and GMSK with a BT=0.3. The 4 level FSK modulation is provided to allow a high spectral efficiency for a given channel bandwidth. The GMSK modulations are provided in order to be compatible with other products and data communications standards.

Channel Bandwidths:

Our goal is to certify the TS4000 at four different channel bandwidths: 20K0, 16K0, 11K2 and 6K00 (the use of the 6K00 bandwidth is limited to the subparts shown above). This is to allow the TS4000 to be setup for the most efficient operation for a given channel bandwidth that a user is licensed for.

4 Level FSK

20K0F1D:

Channel Baud Rate (B) = 32000 bps  
Modulation Frequency (M) =  $B (1/8) = 4000$  Hz  
Peak Deviation (D) = 6000 Hz  
Bandwidth Calculation =  $2 (D) + 2 (M)$   
Bandwidth Calculation =  $2 (6000) + 2 (4000)$   
Bandwidth Calculation =  $12000 + 8000$   
Bandwidth Calculation = 20000 or 20K0

16K0F1D:

Channel Baud Rate (B) = 24000 bps  
Modulation Frequency (M) =  $B (1/8) = 3000$  Hz

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Peak Deviation (D) = 5000 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (5000) + 2 (3000)  
Bandwidth Calculation = 10000 + 6000  
Bandwidth Calculation = 16000 or 16K0

11K2F1D:  
Channel Baud Rate (B) = 15000 bps  
Modulation Frequency (M) = B (1/8) = 1875 Hz  
Peak Deviation (D) = 3750 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (3750) + 2 (1875)  
Bandwidth Calculation = 7500 + 3750  
Bandwidth Calculation = 11250 or 11K2

6K00F1D:  
*(for subparts 90.63(d)(7), 90.65(c)(18), 90.67(c)(14),  
90.73(d)(13), 90.75(c)(19) and 90.79(d)(6)).*  
Channel Baud Rate (B) = 4800 bps  
Modulation Frequency (M) = B (1/8) = 600 Hz  
Peak Deviation (D) = 1800 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (1800) + 2 (600)  
Bandwidth Calculation = 3600 + 1200  
Bandwidth Calculation = 4800 or 4K80

GMSK with BT = 0.3

20K0F1D:  
Channel Baud Rate (B) = 19200 bps  
Modulation Frequency (M) = B (1/3) = 6400 Hz  
Peak Deviation (D) = 3600 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (3600) + 2 (6400)  
Bandwidth Calculation = 7200 + 12800  
Bandwidth Calculation = 20000 or 20K0

16K0F1D:  
Channel Baud Rate (B) = 19200 bps  
Modulation Frequency (M) = B (1/3) = 6400 Hz  
Peak Deviation (D) = 1600 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (1600) + 2 (6400)  
Bandwidth Calculation = 3200 + 12800  
Bandwidth Calculation = 16000 or 16K0

11K2F1D:  
Channel Baud Rate (B) = 9600 bps  
Modulation Frequency (M) = B (1/3) = 3200 Hz  
Peak Deviation (D) = 2400 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (2400) + 2 (3200)  
Bandwidth Calculation = 4800 + 6400  
Bandwidth Calculation = 11200 or 11K2

6K00F1D:  
*(for subparts 90.63(d)(7), 90.65(c)(18), 90.67(c)(14),  
90.73(d)(13), 90.75(c)(19) and 90.79(d)(6)).*

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Channel Baud Rate (B) = 2400 bps  
Modulation Frequency (M) = B (1/3) = 800 Hz  
Peak Deviation (D) = 1500 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (1500) + 2 (800)  
Bandwidth Calculation = 3000 + 1600  
Bandwidth Calculation = 4600 or 4K60

GMSK with BT = 0.5

20K0F1D:  
Channel Baud Rate (B) = 14000 bps  
Modulation Frequency (M) = B (1/2) = 7000 Hz  
Peak Deviation (D) = 3000 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (3000) + 2 (7000)  
Bandwidth Calculation = 6000 + 14000  
Bandwidth Calculation = 20000 or 20K0

16K0F1D:  
Channel Baud Rate (B) = 10000 bps  
Modulation Frequency (M) = B (1/2) = 5000 Hz  
Peak Deviation (D) = 3000 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (3000) + 2 (5000)  
Bandwidth Calculation = 6000 + 10000  
Bandwidth Calculation = 16000 or 16K0

11K2F1D:  
Channel Baud Rate (B) = 7200 bps  
Modulation Frequency (M) = B (1/2) = 3600 Hz  
Peak Deviation (D) = 2000 Hz  
Bandwidth Calculation = 2 (D) + 2 (M)  
Bandwidth Calculation = 2 (2000) + 2 (3600)  
Bandwidth Calculation = 4000 + 7200  
Bandwidth Calculation = 11200 or 11K2