

**Type Acceptance Information for TS4000 Radio Modem with 3412 Transceiver
Proposed FCC ID JWFTS4000B**

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 DL3412. This device is being used without any modifications. The DL3412 has received FCC type acceptance with an FCC ID of ATH2423412-004. All circuit descriptions and details for the radio transceiver can be found in the type acceptance document for the DL3412. A copy of this has been included with this application. The radio transceiver is available in a frequency range from 403-512 MHz and includes a temperature stable reference oscillator with a frequency stability of ± 1.5 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

Manufacturer:	Teledesign Systems Inc. 2635 North First Street, Suite 205 San Jose, CA 95134 408-232-0180
Contact Person:	Mark Hubbard
Product Trade Name:	TS4000 Radio Modem
Product Model Number:	TS4000-05Bff where: ff - indicates frequency range
Proposed FCC ID:	FCC ID: JWFTS4000B
Production Plans:	Teledesign Systems Inc. plans to produce this product in quantity (greater than 1) production runs.
Radio Transceiver Manufacturer:	E.F. Johnson

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Radio Transceiver Model Number: DL3412
Radio Transceiver Part Number: 242-3412 (± 1.5 PPM frequency stability)
Radio Transceiver FCC ID: ATH2423412-004
Frequency Range: 403 - 512 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)

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 three different channel bandwidths: 20K0, 16K0 and 11K2. 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 = 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
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

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11K2F1D:

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

GMSK with BT = 0.3

20K0F1D:

Channel Baud Rate (B) = 19200 bps
Modulation Frequency (M) = B (1/3) = 6400 Hz
Peak Deviation = 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 = 2400 Hz
Bandwidth Calculation = 2 (D) + 2 (M)
Bandwidth Calculation = 2 (2400) + 2 (3200)
Bandwidth Calculation = 4800 + 6400
Bandwidth Calculation = 11200 or 11K2

GMSK with BT = 0.5

20K0F1D:

Channel Baud Rate (B) = 14000 bps
Modulation Frequency (M) = B (1/2) = 7000 Hz
Peak Deviation = 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

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11K2F1D:

Channel Baud Rate (B) = 7200 bps

Modulation Frequency (M) = B (1/2) = 3600 Hz

Peak Deviation = 2000 Hz

Bandwidth Calculation = 2 (D) + 2 (M)

Bandwidth Calculation = 2 (2000) + 2 (3600)

Bandwidth Calculation = 4000 + 7200

Bandwidth Calculation = 11200 or 11K2