Type Acceptance Information for TS4000 Radio Modem with 3492 Transceiver
Proposed FCC ID JWFTS4000D

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, 90 and 101 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 DL3492. This device is being used without any modifications. The DL3492 has received FCC type acceptance with an FCC ID of ATH2423492-001. All circuit descriptions and details for the radio transceiver can be found in the type acceptance document for the DL3492. A copy of this has been included with this application. The radio transceiver is available in a frequency range from 928-960 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:	TS4000-05Dff where: ff - indicates frequency range
Proposed FCC ID:	FCC ID: JWFTS4000D
Production Plans:	Teledesign Systems Inc. plans to produce this product in quantity (greater than 1) production runs.

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Radio Transceiver Manufacturer:	E.F. Johnson
Radio Transceiver Model Number:	DL3492
Radio Transceiver Part Number:	242-3492 (± 1.5 PPM frequency stability)
Radio Transceiver FCC ID:	ATH2423492-001
Frequency Range:	928 - 960 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:	25K0F1D - Part 101 20K0F1D - Part 90 (multi-bandwidth mode) 12K5F1D - Part 101 11K2F1D - Part 90 (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 two different channel bandwidths for Part 90: 20K0 and 11K2; and two different channel bandwidths for Part 101: 25K0 and 12K5. 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	25K0F1D and 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

12K5F1D:
Channel Baud Rate (B) = 16000 bps
Modulation Frequency (M) = B (1/8) = 2000 Hz
Peak Deviation = 4250 Hz
Bandwidth Calculation = 2 (D) + 2 (M)
Bandwidth Calculation = 2 (4250) + 2 (2000)
Bandwidth Calculation = 8500 + 4000
Bandwidth Calculation = 12500 or 12K5

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

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

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