Engineering Exhibit in Support of
Class II Permissive Change Request
FCC Form 731

for the

Tait T854-20 (440-480MHz 25W basestation)

modulated with

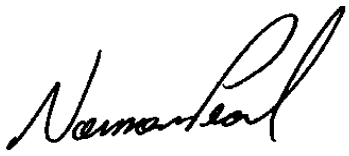
2FSK and 4FSK digital modulation (F1D)

FCC ID: CASTEL0060

November 03, 2003

AFFIDAVIT

The technical data included in this report has been accumulated through tests that were performed by me or by engineers under my direction. To the best of my knowledge, all of the data is true and correct.



Norman D. Pearl
Vice-President Engineering, Dataradio Inc.

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SECTION 1- FORM 731

Dataradio Inc., Montreal, Canada

Engineering Statement

OF CONSTANTIN PINTILEI

The application consists of the attached engineering exhibit and associated FCC form 731 which have been prepared in support of a request for a Class II Permissive Change for CASTEL0060. All changes involved fall under the Class II Permissive Change type and they are entirely detailed within the current report.

The certificate CASTEL0060 has been granted to Tait Electronics Ltd. for the T254-20 transmitter side of the T854 "slim line" base station using the F3E emission type. This filing documents a Class II Permissive Change to add the digital modulation emission designator F1D. It has been demonstrated that several types of 4RCFSK digital modulation comply with the masks 90.210 (C, D). For each of those modulating signals, the applicable emission designator was determined. This Class II permissive change involves the digital modulation source only and it is completely described within the current report.

EXISTING CONDITIONS

The unit utilized for these occupied bandwidth and mask-compliance measurements was a regular production sample. The test pin input provided on the P255 of the IOPad of the board was fed for the tests. A Dataradio BDLC (Base Station Data Link Controller) modem was used to create the digital modulation scheme and test sequence.

The transmit frequency range of the unit is 440-480 MHz. The frequency tolerance of the exciter is .00015% or 1.5ppm (parts per million) and its output power is 25W as granted in CASTEL0060.

PROPOSED CONDITIONS

It is proposed to accept the Class II permissive change request for the CASTEL0060 grant for F1D operations in the band of frequencies previously outlined. The applicant anticipates marketing the device for use in wireless transmission of data.

PERFORMANCE MEASUREMENTS

All measurements for Occupied Bandwidth and mask compliance as per 2.1043 (b)(2) were conducted in accordance with the Rules and Regulations Section 2.1041and 2.1049 of Rules Service Co rev.2-164, Jan 15,2003. The measurements were made in the engineering laboratory located at 5500 Royalmount Ave, Montreal, Canada. All measurements were made and recorded by myself or under my direction. The measurements were made between Oct 20th and 31st, 2003.

CONCLUSION

Given the results of the measurements contained herein, the applicant requests a Class II Permissive Change for the Certificate CASTEL0060 to add the new emission designators 8K67F1D, 8K00F1D, 7K84F1D, 14K4F1D and 16K0F1D to the existing ones, 16K0F3E and 11K0F3E.

11/03/2003

Constantin Pintilei
R&D Test Engineer, Dataradio Inc.

Qualifications of Engineering Personnel

NAME:	**Norman Pearl**
TITLE:	Vice-president Engineering
TECHNICAL EDUCATION:	Bachelor of Engineering (Electrical) (1979) McGill University, Montreal, Canada
TECHNICAL EXPERIENCE:	Professional engineer since 1979 27 Years experience in radio communications

NAME:	**Constantin Pintilei**
TITLE:	R&D Test Engineer
TECHNICAL EDUCATION:	Bachelor of Engineering Degree in Radiotechnique Electronic Engineering (1993) Technical University of Iasi, Romania
TECHNICAL EXPERIENCE:	10 Years experience in radio frequency measurements.

Class II Permissive Change Information - Rule part 2.1043 (b)(2)

The certificate CASTEL0060 was granted to Tait Electronics Ltd. for its T854-20 base station 25W transmitter module.

The original certificate has been granted for 11K0F3E and 16K0F3E analog type of modulation as per 90.210. The change consists of adding a new digital modulation source which bypasses the audio low-pass filter, therefore compliance has been demonstrated again with mask 90.210 C or D. For this modulation source, the following digital modulation scheme for each 25kHz or 12.5 kHz channels are used:

25kHz channel:
- 9600bps, 4800 baud RC4FSK raised cosine shaped 4FSK with the emission designator 16K0F1D
- 19200bps, 9600 baud RC4FSK, raised cosine shaped 4FSK with the emission designator of 14K4F1D

12.5 kHz channel
-9600bps 4800 baudsRC4FSK raised cosine shaped 4FSK with the emission designator 8K67F1D
-14400bps, 7200 baud RC4FSK raised cosine shaped 4FSK with the emission designator 8K00F1D.
- 16000bps, 8000baud RC4FSK raised cosine shaped 4FSK with the emission designator of 7K84F1D

The digital input provided on the IOPAD P255 of the T854 board was fed for the tests. For the purpose of a digital input the 0ohm resistor R291which connects the Audio Low Pass filter to the input of the FM modulator was removed. The location of the P255 is the area L1 and the location of R291 is in the area R2 on the schematics (Sheet 2 T854 Audio Processor p/n 220-01686-03) The page belongs to Part 6.2.22 of the manual which was submitted with the initial request for FCC ID.

The change above described involves the modulation source only therefore it falls under Class II Permissive Changes as per 2.1043 (b)(2).

No other changes occur elsewhere in the circuitry of the transceiver.

The characteristics affected by the first modification above are:

Digital Modulation Techniques - part 2.1033.(c)(13)
Type of emission and Emission designators list - part 2.1033 (c)(4), 90.209
Occupied bandwidth and mask compliance requirement - part 2.1049,90.210(c, d)

They are entirely documented with the current report.

Therefore all the original test results but those related to the Mask compliance continue to be representative of and applicable to the exciter module. The compliance with Mask C, D is further confirmed in Section 2, Test Data.

All this Class II permissive change related with the F1D type emission designator data as per 2.1043 is completely described with the current report.

General Information about the Grantee and Certified Equipment -2.1043 (b)(2)

(as per Rule Part Number: 2.1033 (c).(1),(2),(5),(6),(7))

GRANTEE AND MANUFACTURER:	Tait Electronics Ltd., Burnside Christchurch 5, New Zealand (T854–20)
APPLICANT	Tait Electronics Ltd., Burnside Christchurch 5, New Zealand (T854-20)
TEST LABORATORY	The R&D Validation Laboratory of Dataradio Inc., 5500 Royalmount Ave, suite 200, Town of Mount Royal, Quebec, Canada, H4P 1H7
MODEL NUMBER:	T854-20-7200
SERIAL NUMBER (S):	13073032
FCC ID NUMBER:	CASTEL0060
FCC RULES AND REGS:	FCC Part (s) 90, 90.210
FREQUENCY RANGE:	440-480 MHz Tx as per CASTEL0060 certificate
MAXIMUM POWER RATING:	25Watts as per CASTEL0060 certificate.
NUMBER OF CHANNELS:	1 Channel selectable from 24 channels as per Tait manual
OUTPUT IMPEDANCE:	50 ohms, Nominal
VOLTAGE REQUIREMENTS:	10.9-16.3VDC (13.6 VDC Nominal)

EQUIPMENT IDENTIFICATION product codes of the T854-xx-7xxx (ref Tait Service Manual section 1.4)

Part Number of the Tait UHF base station T854-XY

M	Module Type	X	Freq Range	Y	Channel Bandwidth
4	Transmitter (25W)	1	400-440 MHz	0	25 kHz
5	Receiver	2	440-480 MHz	5	12.5 kHz
		3	480-520 MHz		

Data And Characteristics Not Affected By the F1D Emission Designator – 2.1043 (b)(2)

(as per Rule Part Number: 2.1033 (c)(3),(8),(9),(10),(11),(12),(14),(15),(16))

Instruction Book	2.1033 (c) (3)
DC Voltages And Currents Into Final Amplifier (T881)	2.1033(c).(8)
Transmitter Tune Up Procedure	2.1033 (c) (9)
Description of Circuitry (Schematics, Transistor, diode and IC functions)	2.1033 (c)(10)
FCC Label	2.1033 (c) (11)
External or/and Internal Photographs	2.1033 (c) (12)
Data addressing Rule Part Number	2.1033(c) (15),(16): this unit is not designed for the mentioned purposes
MPE limits compliance	2.1091
Test results	2.1033(c)(14), 2.1041

Test data according to:
Part 2: 2.1046, 2.1051, 2.1053, and 2.1055
Part 90, Subpart I: 90.213
as follows:

Transmitter Rated Power Output	2.1046
Transmitter Spurious and Harmonic Outputs	2.1051
Field Strength of Spurious Radiation	2.1053
Frequency Stability and Frequency Tolerance	2.1055,90.213

Data And Characteristics Affected By the F1D Digital Modulation Emission Designator

(as per Rule Part Number: 2.1033(c) (4),(13),(14)

TYPE OF EMISSION:	2.1033(c)(4)
Originally granted	**11K0F3E** **16K0F3E**
For Class II Permissive Change digital modulation	**16K0F1D** (9600bps, RC4FSK) **14K4F1D** (19200bps, RC4FSK) **8K67F1D** (9600bps RC4FSK) **8K00F1D** (14400bps, RC4FSK) **7K84F1D** (16000bps RC4FSK)

DIGITAL MODULATION TECHNIQUES 2.1033 (c)(13)

The digital modulation type used is RC4FSK (Raised Cosine 4-level Frequency Shift Keying). A modulation source modem using such type of modulation has three main functional blocks:

Differential encoder:
The differential encoder XOR's the current input bit with the previous bit. The differential encoder is used to make the modem insensitive to audio polarity inversion of the FM radio system.

Symbol mapper
The symbol mapper assigns incoming groups of bits to logic symbols. For 4FSK there are groups of 2 bits mapped in 4 symbols following Gray coding

Waveform generator:
The waveform generator filters the processed digital symbols through the pulse-shaping Nyquist-based filter, in this case Raised Cosine. The data such processed is reconverted into an analog baseband signal through a DAC. This resulting audio signal is passed to the FM modulation input of the RF transmitter.

TEST DATA Rule Part Number: 2.1033 (c)(14)

All applicable test data related to a new type of emission designator according to:
-Part 2: 2.1043 (b)(2), 2.1049
-Part 90, Subpart I: 90.209 and 90.210
are provided in next section

SECTION 2 - TEST REPORT Rule Part Number: 2.1033 (c)(14)

NAME OF TEST: Emission Designator

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041

For the F1D type of emission designator the IOpad P255 of the TCXO board of the unit was used as the input for digital modulation signals. The random signal generator used passes the test sequence through a DSP implemented pulse-shaped Raised Cosine filter to directly feed the FM modulator. The necessary bandwidth calculation for this type of modulation is not covered by paragraphs (1), (2) or (3) from 2.202(c), the result exceeding by far the real necessary bandwidth obtained through measurement of the 99% of the occupied bandwidth.

Therefore, the approach outlined in (2.202(c)(4)) is applicable in this case.

Necessary Bandwidth Measurement (90.209.(b))
The results of 99% Occupied Bandwidth measurement are:

Bit rate/Symbol rate	Reference voltage for 1kHz tone	Ref. Deviation for 1kHz tone	Maximum Digital Deviation	Occupied Bandwidth	Emission designator
9600 bps/4800bauds	1.366 V_{pp}	± 5.21 kHz	± 7.15 kHz	16000 Hz	16K0F1D
19200bps/9600bauds	0.992 V_{pp}	± 3.83 kHz	± 5.17 kHz	14330 Hz	14K4F1D
9600 bps/4800bauds	0.744 V_{pp}	± 2.86 kHz	± 3.91kHz	8667 Hz	8K67F1D
16000bps/8000bauds	0.460 V_{pp}	± 1.83 kHz	± 2.46 kHz	7883 Hz	7K84F1D
14400bps/7200bauds	0.556 V_{pp}	± 2.19 kHz	± 2.96 kHz	8000 Hz	8K00F1D

The set-up explanations follow.

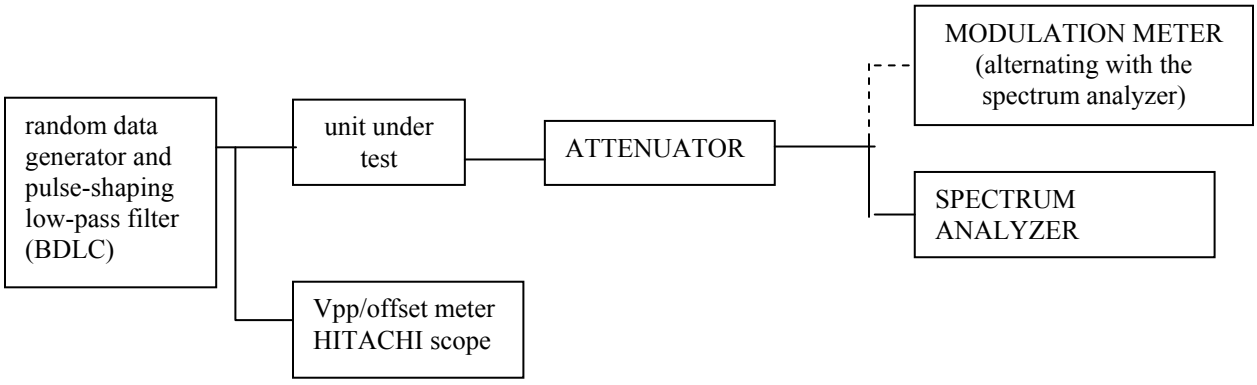
Occupied Bandwidth Measurement

The Occupied Bandwidth measurement option of the instrument (8563EC spectrum analyzer from Agilent) calculates and provides the values used above for the emission designator.

The percentage setting of the measurement has been set to 99% following the definition of ***Occupied Bandwidth*** as, "the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission" (FCC 2.202).

The measurement has been performed during the tests for compliance with masks C and D, and the resulting value was recorded for the Occupied Bandwidth. V_{pp} amplitude of the modulating signal applied to TSP910 was measured between input and ground, AC coupled at the output of MobilPac2.

The measurement set-up is:



NAME OF TEST: Transmitter Occupied Bandwidth

Test data in support of compliance with Mask C

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (C)

MINIMUM STANDARD: Mask C
Sidebands and Spurious [Rule 90.210 (c)]
Authorized Bandwidth = 20 kHz [Rule 90.209(b) (5)]

Fo to 5.0 kHz	Attenuation = 0 dB
>5.0 kHz to 10.0 kHz	Attenuation= 83*log(f_d /5) dB
>10.0 kHz to 250% Auth BW	Attenuation = Lesser of: 29*log(f_d^2 /11) dB or 50dB
>250% Auth BW	43 + 10*log(P) dB
Corner Points:	
Fo to 5.0 kHz	Attenuation = 0 dB
>5.0 kHz to 10.0 kHz	Attenuation= 0 dB to 25 dB
>10.0 kHz to 20 kHz	Attenuation = 27.8 dB to 45.2 dB
>20 kHz to 24 kHz	Attenuation =45.2 dB to 50 dB
>24 kHz to 50kHz	Attenuation =50dB
>250% Authorized BW	Attenuation = 57 dB (25 W))

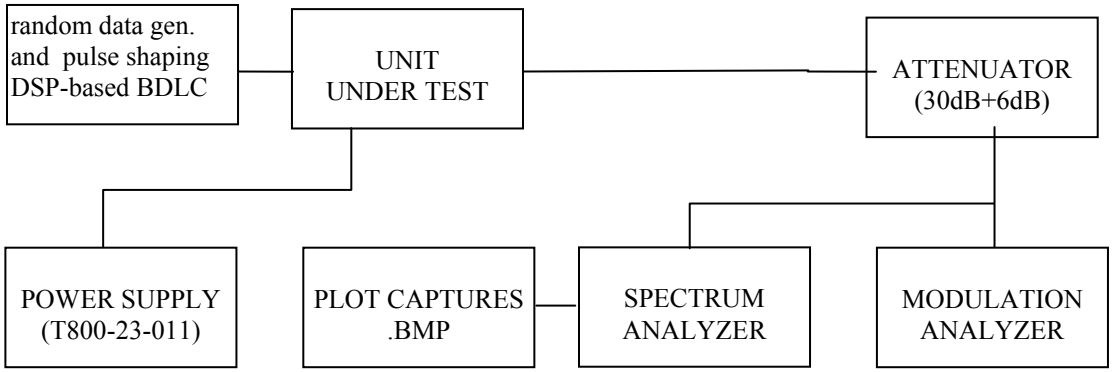
TEST RESULTS: Meets minimum standard (see data on the following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Digital pseudo-random sequence generator: modem Model Dataradio MobilPac II
Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt
Attenuator, BIRD Model / 5-A-MFN-06 / 6 dB / 5 Watt
DC Power Source, Tait model T800-23 –part of the basestation T854
Communication Analyzer, Model IFR COM120B for Modulation Analyzer
Spectrum Analyzer, Model HP(Agilent) 8563EC

PERFORMED BY: Constantin Pintilei DATE: 10/31/03

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)

MODULATION SOURCE DESCRIPTION:(Part 2.1047 (d), 90.209 (b), 90.210(c):

Other types of equipment: the digital modulation input of the exciter bypasses the audio low-pass filter, the filtering is entirely result of the digital modulation source.

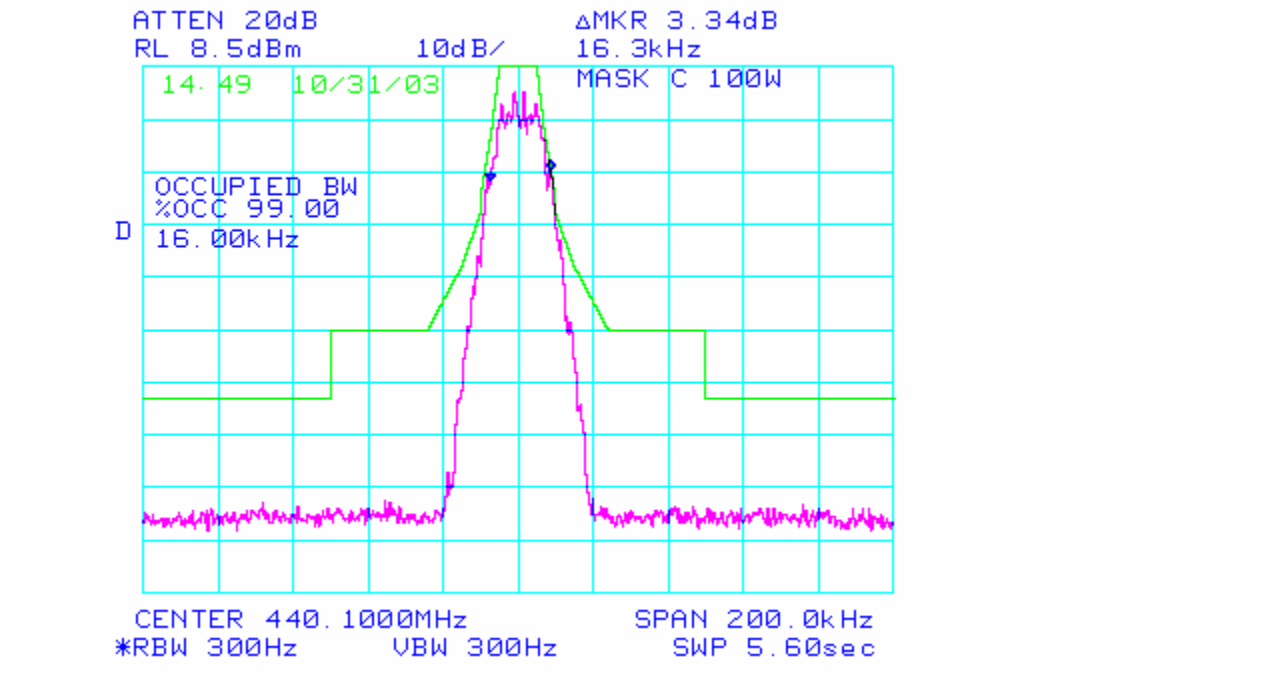
TEST PATTERN GENERATOR:
The random data generator function of the BDLC generates a 2047-long bit test sequence. This function is performed with a serial shift register and an exclusive OR two-tap gate which implements the polynomial form $X^{10}+X^{8}+1$. The initial value of the register is 7FF.

After this, the data follows the RC4FSK digital modulation process described on page 9 and the resulting baseband signal feeds the modulator input of the transceiver.

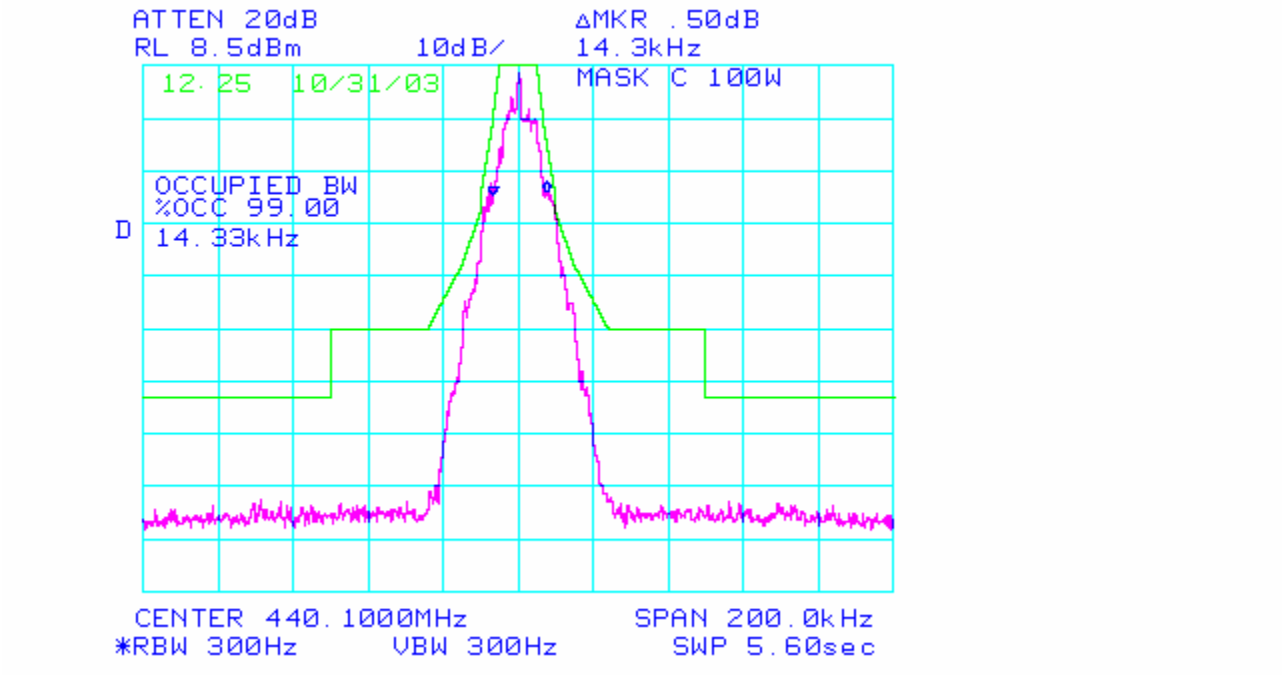
The modulation source's rates and output voltages are set through the DSP/DAC as explained in pages 9,10. The resulting FM deviation for maximum deviation was read using the modulation analyzer of an IFR COM120B. For the deviation measurements on the modulation analyzer an IF filter bandwidth of 30KHz has been used.

Snap shots: Refer to the following plots.

Plot 1. SPECTRUM FOR EMISSION **16K0F1D,** 9600bps, RC4FSK factor=0.4
PEAK DEVIATION = 5210 Hz, SPAN = 20kHz/div



Plot 2. SPECTRUM FOR EMISSION **14K4F1D,** 19200bps, RC4FSK factor=0.4
PEAK DEVIATION = 3830 Hz, SPAN = 20kHz/div



Test data in support of compliance with Mask D

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (D)

MINIMUM STANDARD: Mask D
Sidebands and Spurious [Rule 90.210 (d)]
Authorized Bandwidth = 11.25 kHz [Rule 90.209(b) (5)]

Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= 7.27(f_d -2.88kHz) dB
>12.5 kHz	Lesser of [50 + 10*log(P)] dB or 70dB
Corner Points:	
Fo to 5.625 kHz	Attenuation = 0 dB
>5.625 kHz to 12.5 kHz	Attenuation= 20 dB to 70 dB
>12.5 kHz	Attenuation =64dB (25W)

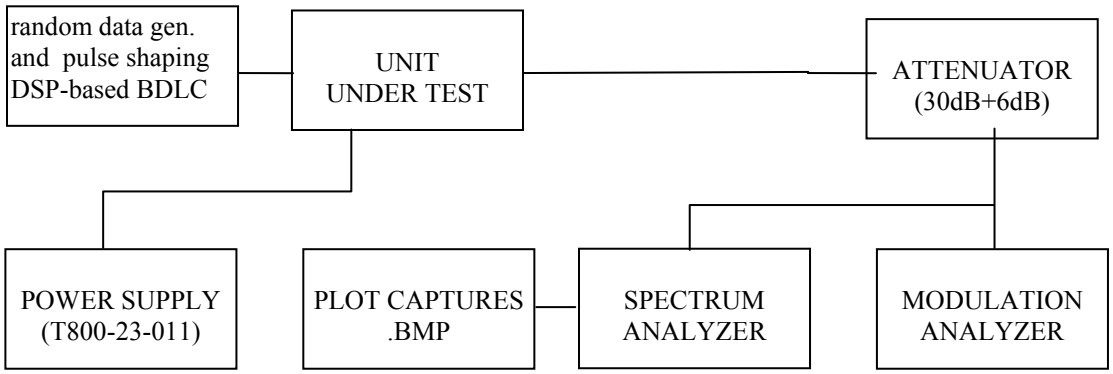
TEST RESULTS: Meets minimum standard (see data on the following pages)

TEST CONDITIONS: Standard Test Conditions, 25 C

TEST EQUIPMENT: Digital pseudo-random sequence generator: modem Model Dataradio MobilPac II
Attenuator, BIRD Model / 50-A-MFN-30 / 30 dB / 50 Watt
Attenuator, BIRD Model / 5-A-MFN-6 / 6 dB / 5 Watt
DC Power Source, Tait model T800-23 –part of the basestation T854
Communication Analyzer, Model IFR COM120B for Modulation Analyzer
Spectrum Analyzer, Model HP (Agilent) 8563EC

PERFORMED BY: Constantin Pintilei DATE: 10/31/03

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)

MODULATION SOURCE DESCRIPTION: (Part 2.1047 (d), 90.209 (b), 90.210(d):

Other types of equipment: The digital modulation input of the exciter bypasses its audio low-pass filter and the filtering is entirely the result of the digital modulation source.

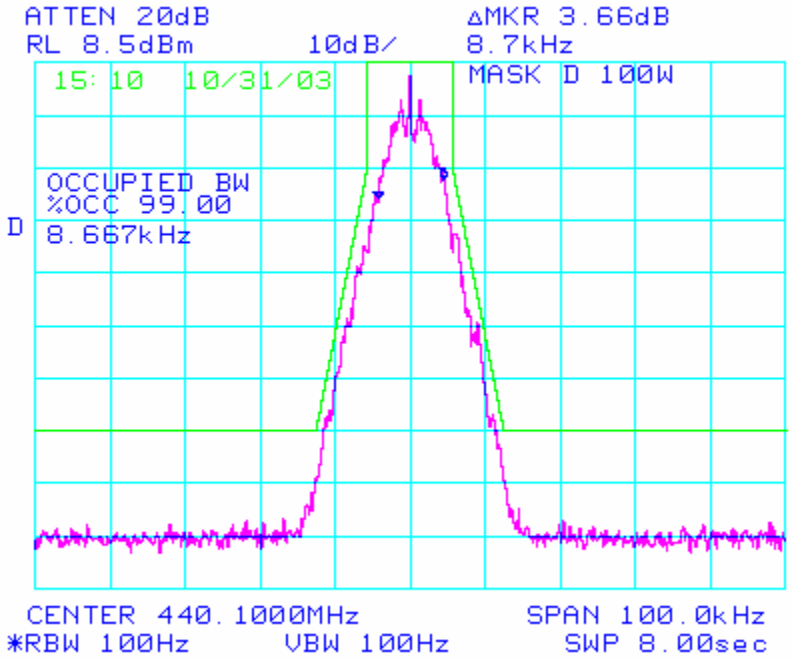
TEST PATTERN GENERATOR:
The random data generator function of the BDLC generates a 2047-long bit test sequence. This function is performed with a serial shift register and an exclusive OR two-tap gate which implements the polynomial form $X^{10}+X^{8}+1$. The initial value of the register is 7FF.

After this, the data follow the DGMSK/RC4FSK digital modulation process described in the page 9 and the resulting base band signal feed the modulator's input of the transceiver.

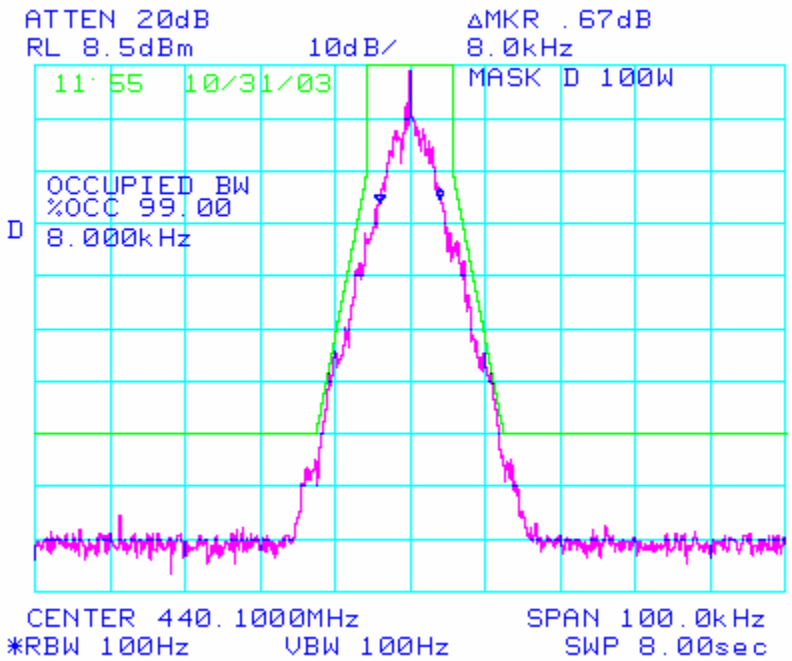
The modulation source's rates and output voltages are set through the DSP/DAC as explained in pages 9,10. The resulting FM deviation for maximum deviation was read using the modulation analyzer of IFR COM120B. For the deviation measurements on the modulation analyzer an IF filter of 30KHz has been used.

Snap shots: Refer to the following plots.

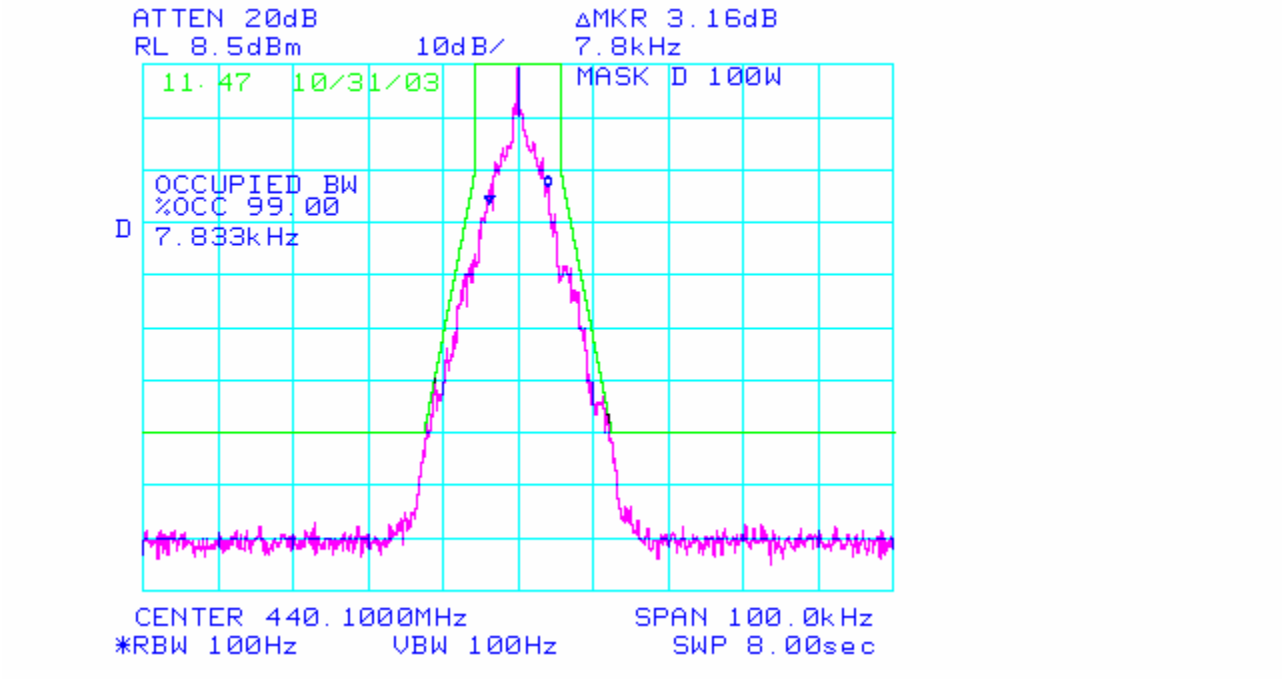
Plot 3. SPECTRUM FOR EMISSION **8K67F1D,** 9600bps, RC4FSK factor=0.4
PEAK DEVIATION = 2860 Hz, SPAN = 10kHz/div



Plot 4. SPECTRUM FOR EMISSION **8K00F1D**, 14400bps, 7200bauds, RC4FSK factor 0.4
PEAK DEVIATION = 2190 Hz, SPAN = 10kHz/div



Plot 5. SPECTRUM FOR EMISSION **7K84F1D,** 16000bps, 8000bauds, RC4FSK factor 0.4
PEAK DEVIATION = 1830 Hz, SPAN = 10kHz/div



Annex A LIST OF THE TEST EQUIPMENT:

Equipment	Manufacturer and model	serial number	inventory	calibration date
Digital pseudo-random sequence generator	Dataradio BDLC model BDD4 firmware 3.08.21 DSP v5.01	NA	R&D-A523	NA
Attenuator 30 dB / 50 Watt	BIRD Model / 50-A-MFN-30	NA	DR999	before test
Attenuator 6 dB / 5 Watt	BIRD Model / 5-A-MFN-06	NA	DR974	before test
Communication Analyzer (used for Modulation Analyzer)	IFR COM120B	500009691	DR620	10-2003
Spectrum Analyzer	HP(Agilent) 8563EC	4103A01135	DR231	01-2002
DC Power Source	Tait T800-23-0011 part of the base station	13075936	test file 660	before test
Oscilloscope	HITACHI VC6545	4110320	DR213	12-2002