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

for the

Tait T869 (216-225MHz base station)

modulated with

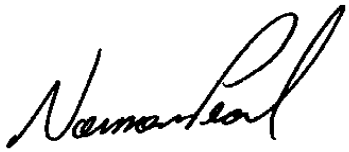
2FSK and 4FSK digital modulation (F1D)

FCC ID: CASTEL0016

July 4, 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 were prepared in support of a request for a Class II Permissive Change for CASTEL0016. All changes involved fall under the Class II Permissive Change type and they are entirely detailed within the current report.

The certificate CASTEL0016 has been granted to Tait Electronics Ltd. for the T86 200MHz (216-225MHz) base station made of a Exciter module T867 and a Power Amplifier module T869 . The Class II Permissive type of change is demonstrated with this filing. The original certificate has been granted for F3E type of modulations. The change consists of adding the digital modulation emission designator F1D. It was demonstrated that several sources of DGMSK and 4RCFSK digital modulation comply with the mask 90.210 (F). For those modulation sources their emission designator was found. This Class II permissive change involves the digital modulation source only and it is completely described with the current report.

EXISTING CONDITIONS

The unit utilized for these occupied bandwidth and mask-compliance measurements was a regular production sample. The digital input provided on the Pin 1 of SK200 “micro match to paging brd connector” was fed for the tests. A Dataradio BDLC was used to create the digital modulation scheme and test sequence.

The exciter operates on frequencies ranging from 216.000 MHz to 225.000 MHz. The frequency tolerance of the exciter is at least .00025% or 2.5 parts per million and the output power is 0.6W fixed. The Power Amplifier supplies 100W of power continuously adjustable down to 20W as granted in CASTEL0016.

PROPOSED CONDITIONS

It is proposed to accept the Class II permissive change request for the CASTEL0016 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 May 20th and May 27th, 2003.

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to be applied a Class II Permissive Change for the Certificate CASTEL0016 to add the new emission designators 7K50F1D, 7K67F1D, and 7K84F1D to the existing one, 11K0F3E.

05/30/2003

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 CASTEL0016 was granted to Tait Electronics Ltd. for its T86M 200MHz (216.0-225.0MHz) base station. The transmit side of the base station is comprised of the T867 exciter module and T869 Power Amplifier module.

The original certificate has been granted for 11K0F3E - analog type of 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 F. For this modulation source, four digital modulation schemes for a group of 5 combined 5kHz channels yielding a 25kHz channel are demonstrated:

- 19200bps, 9600bauds RC4FSK , raised cosine shaped 4FSK with the emission designator of 7K50F1D
-14400bps, 7200 bauds RC4FSK raised cosine shaped 4-FSK with the emission designator 7K67F1D.
- 16000bps, 8000bauds RC4FSK , raised cosine shaped 4FSK with the emission designator of 7K83F1D
-9600bps DGMSK Gaussian shaped 2-FSK with the emission designator 7K67F1D

The Buffer In input provided on the IO pad P271 of "T867EX – Audio Processor" (Sheet 2) board was fed for the tests. For the purpose of a digital input a 0-ohm R291 which connects the Audio Low Pass filter to the input of the FM modulator was removed. The location of the P721 is the area N1 on the schematics (Sheet2/ C6.2.20 in T867PCB information, T867 Audio Processor) The page belong to the part T867 A3 diagrams of the manual which was submitted with the initial request for FCC ID.

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

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

The characteristics affected by the first modification of 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(F)

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 base station transmitter (exciter+PA modules). The compliance with Mask F is further confirmed in Section 2, Test Data.

All this Class II permissive changes related with the F1D type emission designator data as per 2.1043 are 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 (T869 – 200MHz base station)
APPLICANT	Tait Electronics Ltd., Burnside Christchurch 5, New Zealand (T869 – 200MHz base station)
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:	T869 comprised of T867-16-0020 exciter and T869-10-0000 PA
SERIAL NUMBER (S):	13063351- exciter; 13078660 PA
FCC ID NUMBER:	CASTEL0016
FCC RULES AND REGS:	FCC Part (s) 90
FREQUENCY RANGE:	216-225 MHz Tx as per CASTEL0016 certificate
MAXIMUM POWER RATING:	100Watts down to 20Watts as per CASTEL0016 certificate.
NUMBER OF CHANNELS:	1 Channel selectable from 256 channels as per Tait's manual
OUTPUT IMPEDANCE:	50 ohms, Nominal
VOLTAGE REQUIREMENTS:	10.9-16.3VDC (13.6 VDC Nominal)
EQUIPMENT IDENTIFICATION	T860 series II 220-285 MHz base station (ref Tait's Service Manual section 1.3 Product Codes:T865-Receiver; T867-exciter; T869-PA)

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	**7K67F1D** (9600bps,DGMSK) **7K50F1D** (19200bps, RC4FSK) **7K67F1D** (14400bps, RC4FSK) **7K84F1D** (16000bps RC4FSK)

DIGITAL MODULATION TECHNIQUES 2.1033 (c)(13)

The digital modulation type used is DGMSK (Differential Gaussian Minimum Shift Keying) or 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 DGMSK there are only 2 symbols equated to bit 0 or 1, for 4FSK there are groups of 2 bits mapped in 4 symbols following Gray coding

Waveshape generator:
The waveshape generator filters the processed digital symbols through the pulse-shaping Nyquist-based filter, either Gaussian or Raised Cosine. The data such processed is reconverted in analog baseband signal through a DAC. This audio signal resulting is passed further to the FM modulator as modulating 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 IO pad P271 of the Exciter board of the unit was input for digital modulation signals, while the analog input was disabled by the removal of R291 0-ohm resistor. The random signal generator used passes the test sequence through a DSP implemented pulse-shaped (either Gaussian or Raised Cosine) filter to fed directly the FM modulator. The necessary bandwidth calculation for this type of modulation (DGMSK) 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/9600bauds	1.05 V_{pp}	± 2.09 kHz	± 2.14kHz	7677 Hz	7K67F1D
16000bps/8000bauds	0.80 V_{pp}	± 1.72 kHz	± 2.33 kHz	7833 Hz	7K84F1D
14400bps/7200bauds	0.91 V_{pp}	± 1.85 kHz	± 2.50 kHz	7667 Hz	7K67F1D
19200bps/9600bauds	0.57 V_{pp}	± 1.22 kHz	± 1.59 kHz	7500 Hz	7K50F1D

The set-up explanations follow.

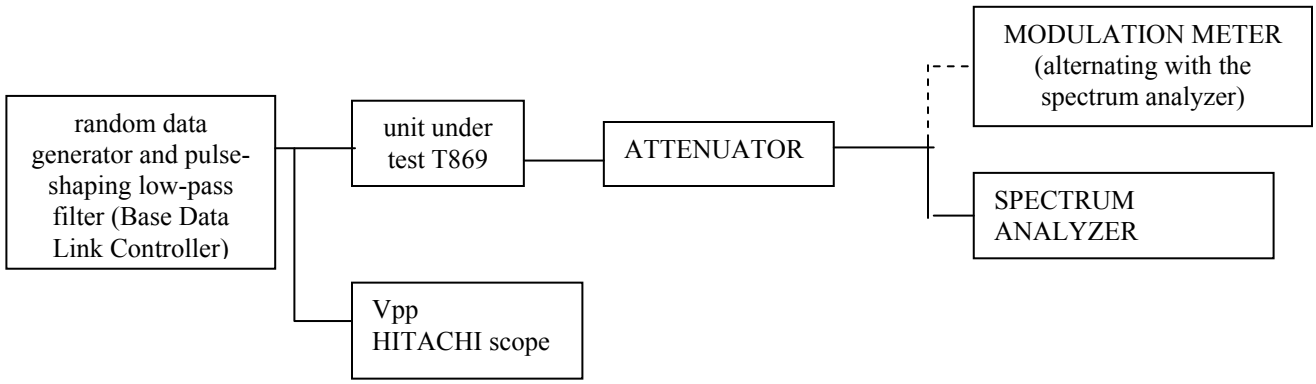
Occupied Bandwidth Measurement

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 the ***Occupied Bandwidth*** "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 mask F 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 F extended over 5 5kHz channels

RULE PART NUMBER: 2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (F), 90.733(e)

MINIMUM STANDARD: Mask F
Sidebands and Spurious [Rule 90.210 (f)]
Authorized Bandwidth = 4 kHz/5kHz channel, 24kHz /25kHz⇔5x5kHz channel [Rule 90.209(b) (5), 90.733(e)]

Fo to 2.0 kHz	Attenuation = 0 dB
>2.0 kHz to 3.75 kHz	Attenuation=min(30+20(f_d-2),55+10logP,65)dB
>3.75 Auth BW	55 + 10*log(P) dB

limits apply to the outermost edges of the 5 contiguous channels as per 90.733(e)
Corner Points, F0 is the center frequency of the 5 contiguous channels:

Fo to 12.0 kHz	Attenuation = 0 dB
>12.0 kHz to 13.75 kHz	Attenuation= 30 dB to 65 dB linear
>13.75 Authorized BW	Attenuation = 75 dB (100 W), 68 dB (20 W)

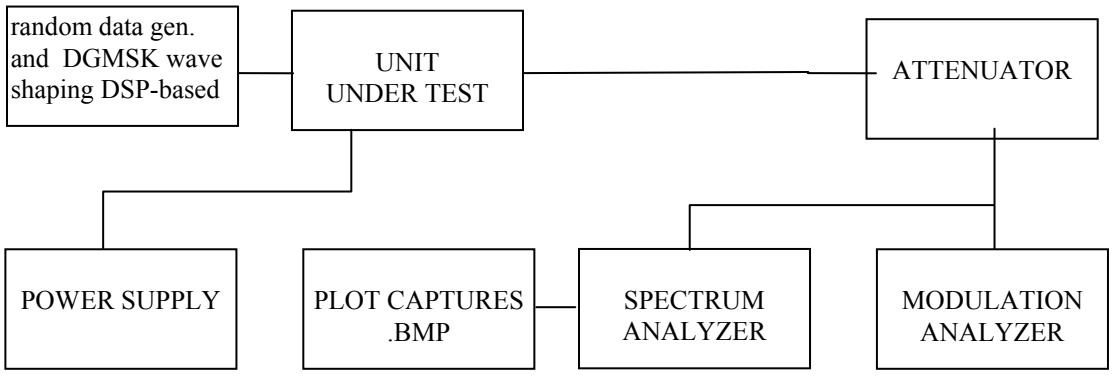
TEST RESULTS: Meets minimum standard (see data on the following pages)

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 / 150-A-FFN-03 / 3 dB / 150 Watt
DC Power Source, Model Astron VLS 25M
Communication Analyzer, Model IFR COM120B for Modulation Analyzer
Spectrum Analyzer, Model HP(Agilent) 8563EC

PERFORMED BY: Constantin Pintilei DATE: 05/28/03
Constantin Pintilei

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 (Dataradio's Base Data Link Controller) generates a 2047-long bit test sequence. This function is performed with a serial shift register and a exclusive OR two tap gate that implement the polynomial form $X^{10}+X^{8}+1$. The initial value of the register is 7FF.

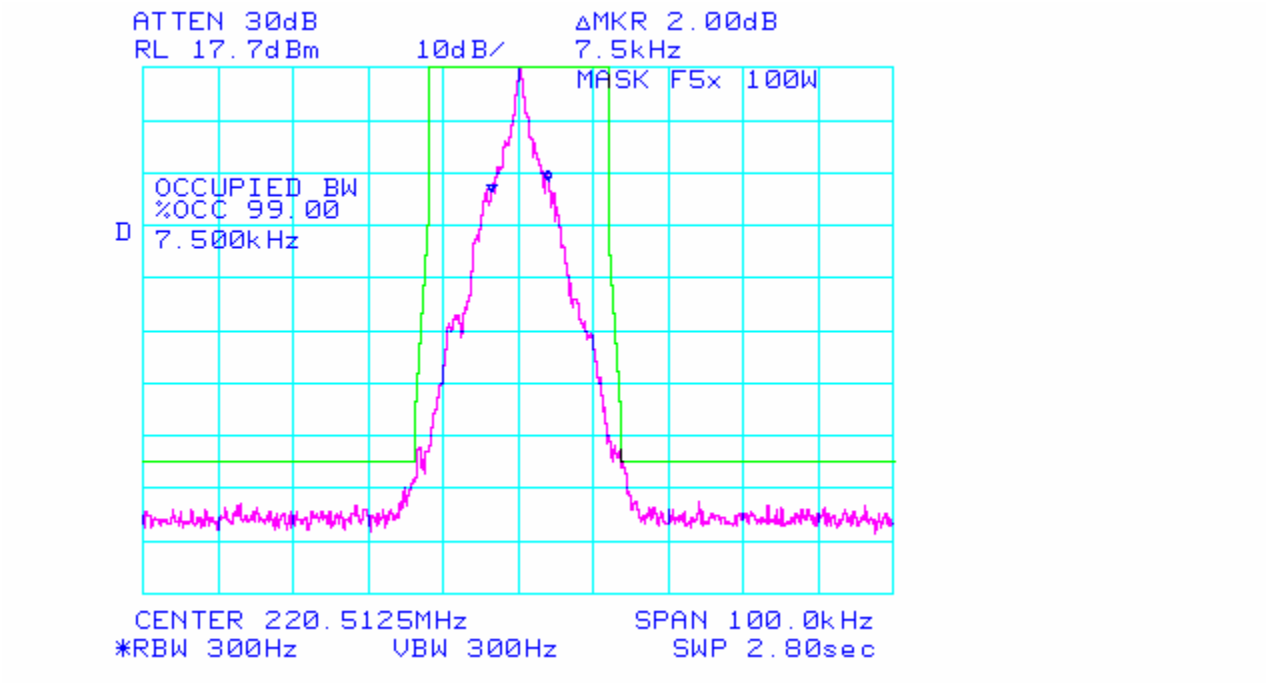
After this, the data follow the DGMSK/RC4FSK digital modulation process described in the page 8 and the resulting base band signal feed the modulator's input of the transceiver.

The modulation source's rates and output voltages are set through the DSP/DAC as explained in pages 8,9. 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.

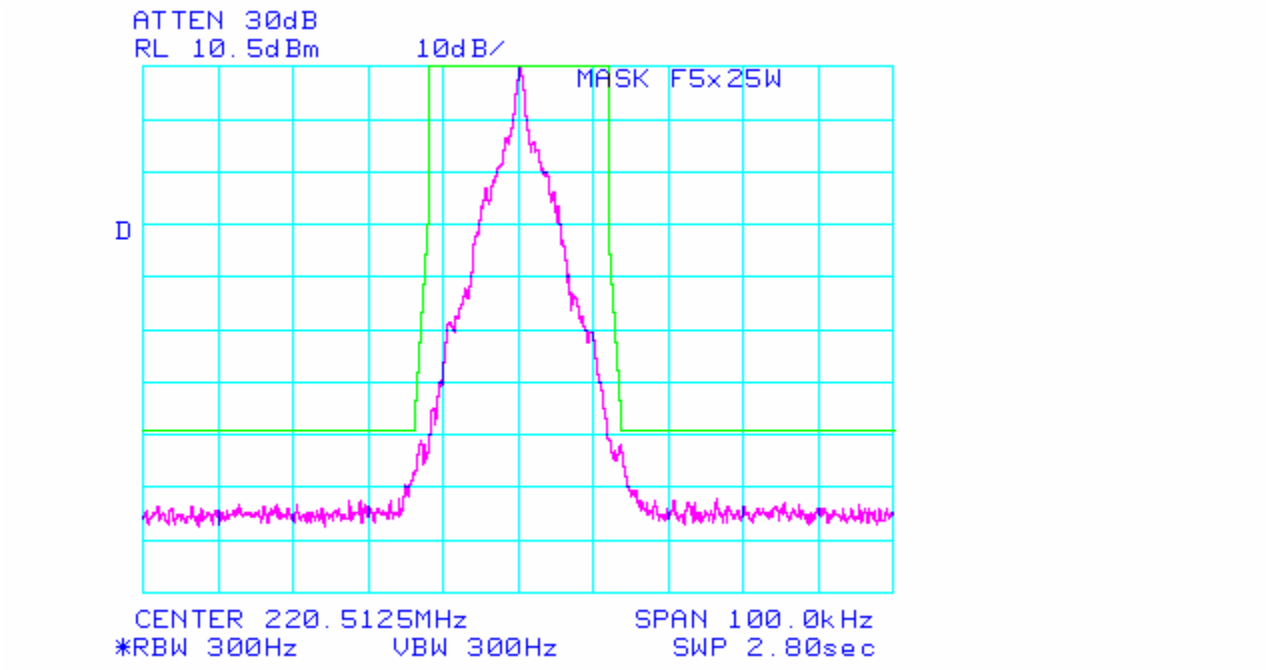
Snap shots: Refer to the following plots.

SPECTRUM FOR EMISSION **7K50F1D**, 19200bps, 9600bauds RC4FSK
PEAK DEVIATION = 1220 Hz, SPAN = 10kHz/div

Plot 1a:MASK F, 7K50F1D, OUTPUT POWER: 100 Watts

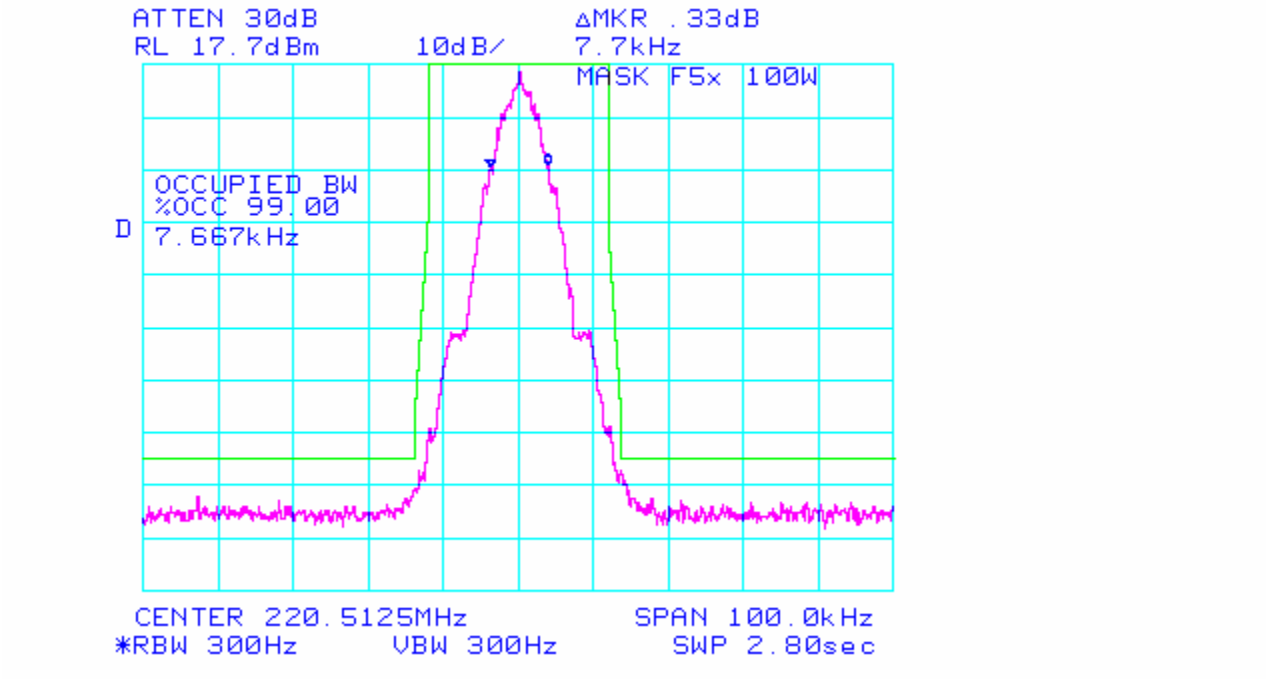


Plot 1b:MASK F, 7K50F1D, OUTPUT POWER: 20 Watts

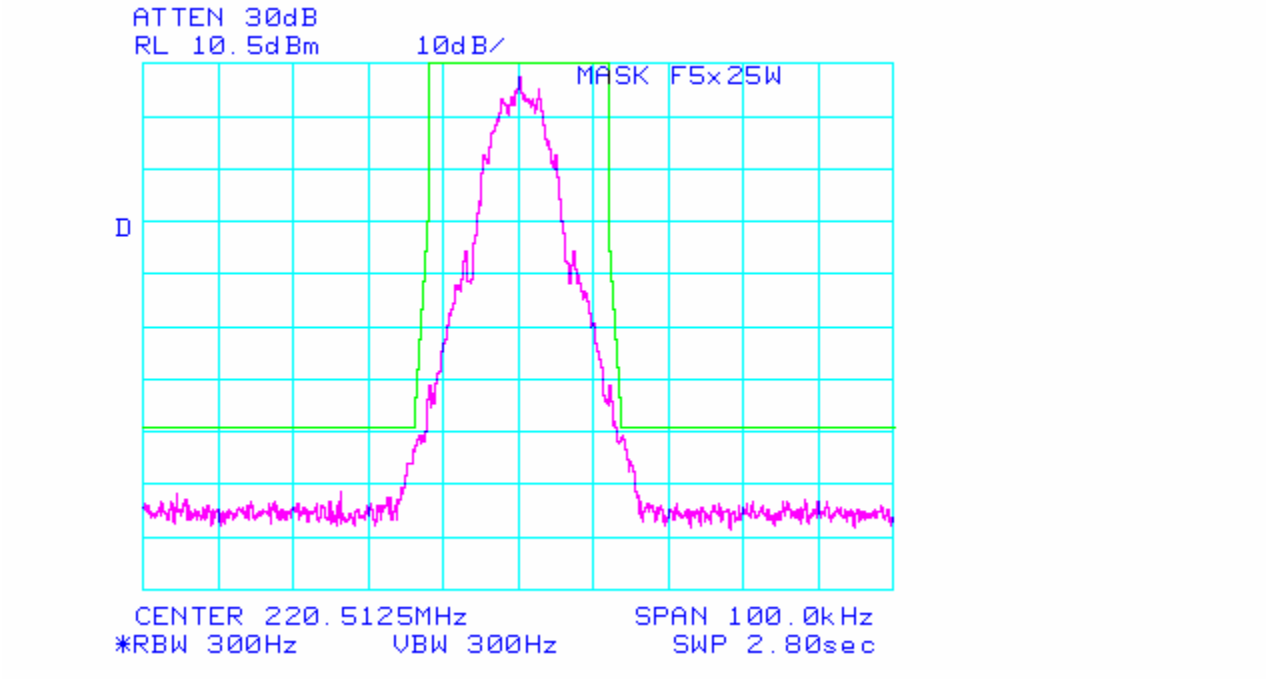


SPECTRUM FOR EMISSION **7K67F1D,** 9600bps, DGMSK BT factor=0.3
PEAK DEVIATION = 2090 Hz, SPAN = 10kHz/div

Plot 2a:MASK F, 7K67F1D, OUTPUT POWER: 100 Watts

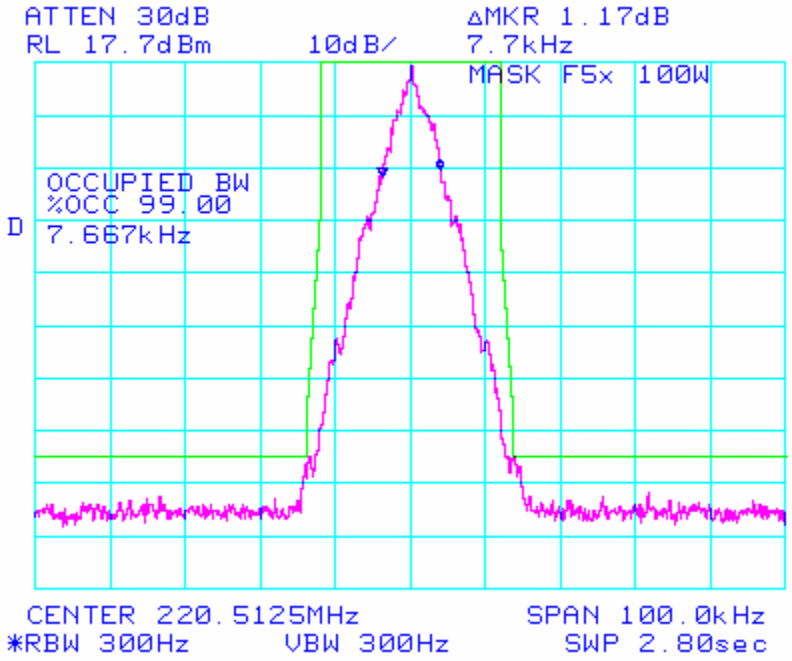


Plot 2b:MASK F, 7K67F1D, OUTPUT POWER: 20 Watts

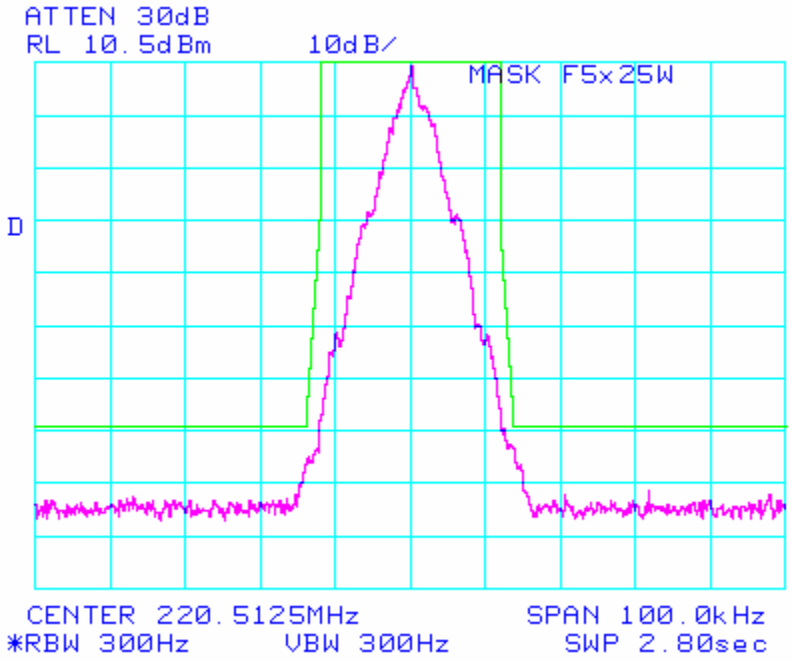


SPECTRUM FOR EMISSION **7K67F1D**, 14400bps, 7200bauds, RC4FSK
PEAK DEVIATION = 1850 Hz, SPAN = 10kHz/div

Plot 3a:MASK F, 7K67F1D, OUTPUT POWER: 100 Watts

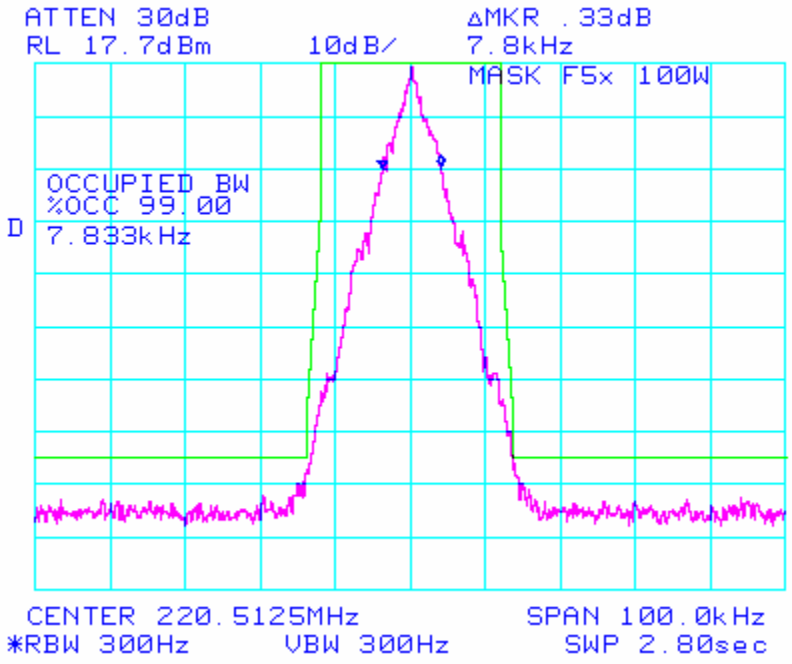


Plot 3b:MASK F, 7K67F1D, OUTPUT POWER: 20 Watts

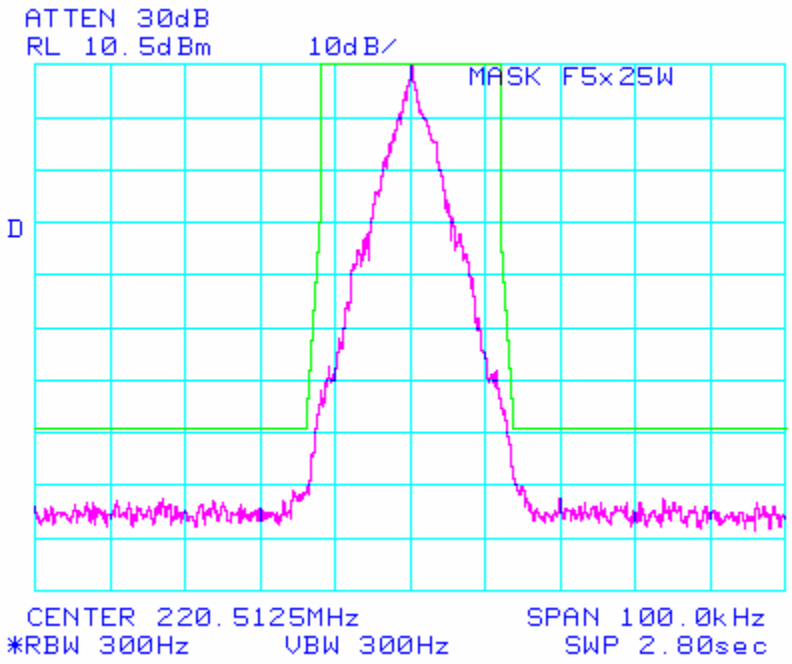


SPECTRUM FOR EMISSION **7K84F1D,** 16000bps, 8000bauds, RC4FSK
PEAK DEVIATION = 1720 Hz, SPAN = 10kHz/div

Plot 4a:MASK F, 7K84F1D, OUTPUT POWER: 100 Watts



Plot 4b:MASK F, 7K84F1D, OUTPUT POWER: 20 Watts



Annex A LIST OF THE TEST EQUIPMENT:

Equipment	Manufacturer and model	serial number	inventory
Digital pseudo-random sequence generator	Dataradio BDLC Base Data Link Controller model Paragon^{PD+}	NA	R&D Generic BDLC#2
Attenuator 30 dB / 50 Watt	BIRD Model / 50-A-MFN-30	NA	DR1121
Attenuator 3 dB / 150 Watt	BIRD Model / 150-A-FFN-03	NA	DR1001
Communication Analyzer (used for Modulation Analyzer)	IFR COM120B	500008432	T612
Spectrum Analyzer	HP(Agilent) 8563EC	4103A01135	DR231
DC Power Source	Astron VLS 25M	200010004	DR1444
Oscilloscope	HITACHI VC6545	4110320	DR213