

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

**for the**

**Tait T881-3x (890-960 MHz Exciter)**

**modulated with**

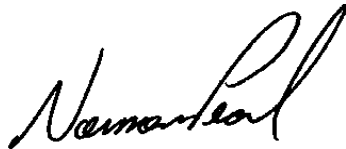
**9600 bps digital modulation (F1D)**

**FCC ID: CASTEL0045**

June 22, 2001

**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.



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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 consisting of the attached engineering exhibit and associated FCC form 731 which have prepared in support of a request for a Class II Permissive Change for CASTEL0045. All changes involved fall under the Class II Permissive Change type and they are entirely detailed within the current report.

The certificate CASTEL0045 has been granted to Tait Electronics Ltd. for the T881-35 Exciter module of its base station. It belongs to the T88M-XY (see page 6 for part# description) 800-960 MHz base station. 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 a 9600bps digital modulation source complies with the mask 90.210 (J). For this modulation source the emission designator is 9K50 F1D. 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 890.000 MHz to 960.000 MHz. The frequency tolerance of the exciter is .00015% or 1.5 parts per million and the output power is 5W continuously adjustable down to 1W as granted in CASTEL0045.

#### PROPOSED CONDITIONS

It is proposed to accept the Class II permissive change request for the CASTEL0045 grant for operation 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 2.1041 and 2.1049 of Rules Service Co rev.2-154, Mar 15,2001. 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 June 14, 2001 and June 20, 2001.

#### CONCLUSION

Given the results of the measurements contained herein, the applicant requests to be applied a Class II Permissive Change for the Certificate CASTEL0045 as follows:

- to add the new emission designators 9K50F1D to the existing one. Also a note
- to add a note that specifies that the output power is continuously variable between 5W and 1W



06/22/01

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  
25 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:** 8 Years experience in radio frequency measurements.

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

The certificate CASTEL0045 was granted to Tait Electronics Ltd. for its T881-3x 890-960MHz Exciter module. It belongs to the T88M-XY (see page bottom for part# description) 800-960 MHz base station

The original certificate has been granted for 11K0F3E-voice type of modulation for a unit equipped with audio low-pass filtering 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 for mask 90.210 J. For this modulation source, the modulation scheme is DGMSK and its emission designator is 9K50F1D.

The digital input provided on the Pin 1 of SK200 “micro match to paging board connector” was used for the tests. For the purpose of a digital input the 0-ohm resistor R291 which connects the Audio Low Pass filter to the input of the FM modulator was removed. The location of the R291 is the area R2 on the schematics ( Sheet 2 – T881 Audio processor, page C6.2.22) and area C9 on the PCB layout (T881 PCB layout – Top Side page C6.2.17). Both pages belong to the Part C 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 exciter module or of the PA module.

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(c)

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 J is further confirmed in Section 2, Test Data.

Another change in the certificate consists in the addition of a note stating that the output power is continuously variable between 5W and 1W. The data sustaining the request is available in the service manual, Part C “T881 transmitter”, subchapter C1.2.3 “Specifications”, ”RF section” paragraph “Power Output”, page C1.8. The manual was already submitted with the initial request for the FCC ID.

All this Class II permissive change 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  
 (T880 series II 800-960MHz Base Station )  
 APPLICANT Dataradio Inc.,  
 5500 Royalmount Ave, suite 200,  
 Town of Mount Royal, Quebec, Canada, H4P 1H7  
 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: T880 series 2 800-960 MHz basestation  
 PART NUMBER: T881-35-0200 Exciter module (UUT)  
 SERIAL NUMBER ( S ): 13025338  
 FCC ID NUMBER: CASTEL0045  
 FCC RULES AND REGS: FCC Part (s) 90  
 FREQUENCY RANGE: 890MHz -960 MHz as per CASTEL0045 certificate  
 MAXIMUM POWER RATING: 5Watts as per CASTEL0045 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  
 and product codes of the Tait base station (ref Tait's Service Manual page B1.12)

<u>TRADE NAME</u>		<u>DESCRIPTION</u>		<u>Product codes</u>	
T880		800-960 series 2 Base Station		T88M-XY-OOOO	
<u>M</u>	<u>Module Type</u>	<u>X</u>	<u>Freq Range</u>	<u>Y</u>	<u>Channel Bandwidth</u>
1	Exciter (5W)	1	800-870 MHz	0	25 kHz
5	Receiver	2	860-910 MHz	5	12.5 kHz
9	Power Amplifier	3	890-960 MHz		

OOOO detail the manufacturer's options.

**Data And Characteristics Not Affected By the F1D Digital Modulation 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**  
For Class II Permissive Change digital modulation **9K50F1D** (9600bps,DGMSK BT=0.3 digital filtering)

**DIGITAL MODULATION TECHNIQUES** 2.1033 (c)(13)

The digital modulation type used is DGMSK (Differential Gaussian Minimum Shift Keying). A modem using such type of modulation has two 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.

Waveshape generator:

The waveshape generator filters the processed data bits (differentially encoded for DGMSK)through a Gaussian filter to the DGMSK baseband signal. This audio signal is passed through a low-pass filter before modulating 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 Exciter uses digital modulation signals at the dedicated input. The signal generator used passes the test sequence through a DSP implemented differential Gaussian BT=0.3 low-pass 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 simulations or measurement.

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	Deviation	Occupied Bandwidth	Emission designator
9600 bauds	± 3.0 KHz	9500 Hz	9K50

The set-up explanations follow.

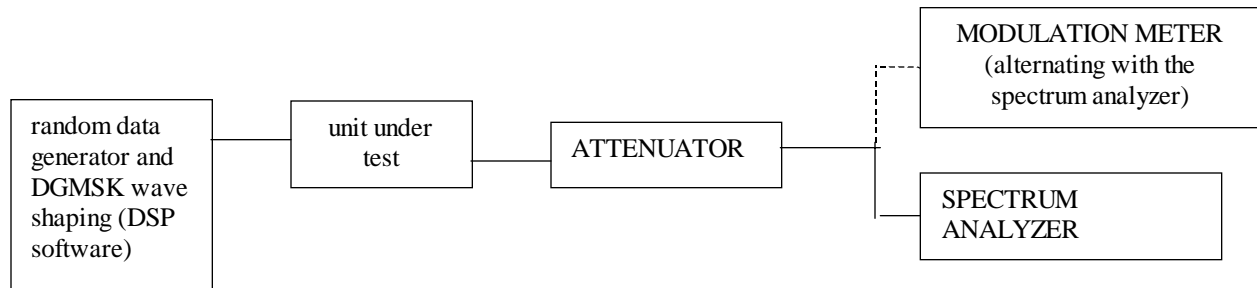
**Occupied Bandwidth Measurement**

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 J, the resulting value was recorded for the Occupied Bandwidth.

The measurement set-up is:



**NAME OF TEST: Transmitter Occupied Bandwidth**

Test data in support of Mask J compliance for the emission designator **9K50F1D**

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

MINIMUM STANDARD: Mask J

Sidebands and Spurious [Rule 90.210 (j)]

Authorized Bandwidth = 13.6 kHz [Rule 90.209(b) (5)]

Fo to 2.5 kHz	Attenuation = 0 dB
>2.5 kHz to 6.25 kHz	Attenuation= 53*log(f <sub>d</sub> KHz /2.5) dB
>6.25 kHz to 9.5kHz	Attenuation = 103 log (f <sub>d</sub> /3.9)dB
>9.5kHz	lesser of 50 + 10*log(P) or 157 log (f <sub>d</sub> /5.3) or 70dB

**Corner Points:**

f <sub>0</sub> to 2.5 kHz	Attenuation = 0 dB
>2.5 kHz to 3.8 kHz	Attenuation= 0 dB to 10 dB
>3.8 kHz to 6.25 KHz	Attenuation = 10 dB to 21 dB
>6.25 kHz to 7.6 KHz	Attenuation = 21 dB to 30 dB
>7.6 kHz to 9.5 KHz	Attenuation = 30 dB to 40 dB
>9.5 kHz to 11.2 KHz	Attenuation = 40 dB to 51 dB
>11.2 kHz to 12.3kHz	Attenuation = 51 dB to 57 dB
>12.3kHz	Attenuation = minimum 57 dB (5W)

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

TEST CONDITIONS: Standard Test Conditions, 25 C

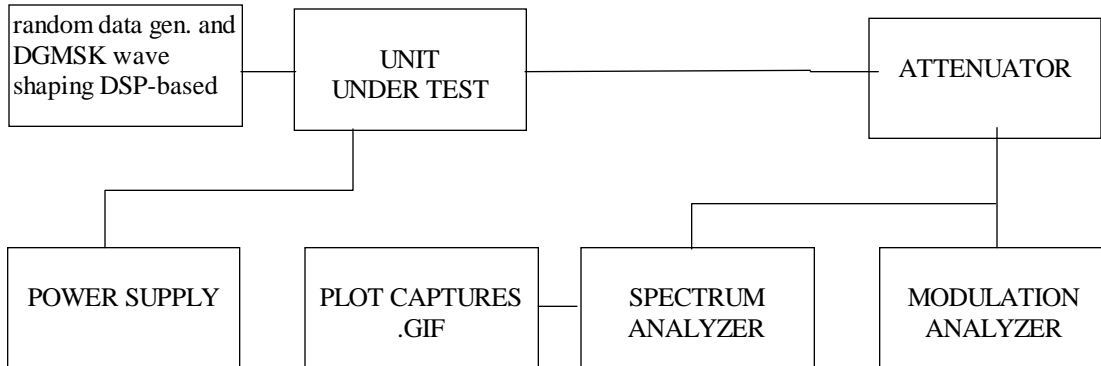
TEST EQUIPMENT: Digital pseudo-random sequence generator: Model Dataradio BDLC D212A  
 Attenuator, BIRD Model / 10-A-MFN-30 / 30 dB / 10 Watt  
 DC Power Source, Model Astron VS 20M  
 Communication Analyzer, Model IFR COM120B for Modulation Analyzer  
 Spectrum Analyzer, Model HP(Agilent) 8563EC

*Constantin Pintilei*

PERFORMED BY: \_\_\_\_\_ DATE: 06/19/01

Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)

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

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 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 digital modulation process described in the page 9 and the resulting base band signal feed the modulator's input of the Exciter.

The modulation source has 9600 bit rate rate and its output voltage is 52 mVpp set through the DSP. The resulting FM deviation yields 3kHz. For the deviation measurements on the modulation analyzer an IF filter of 30KHz has been used.

**Snap shots:** Refer to the following plots.

Plot 1: MASK J, 9K50F1D, 5W

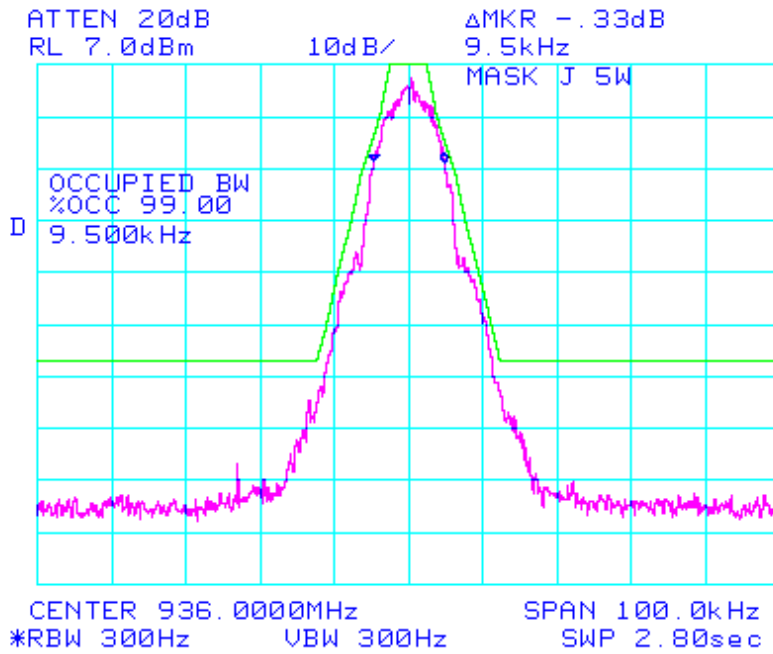
SPECTRUM FOR EMISSION 9K50F1D

OUTPUT POWER: 5 Watts

9600bps, DGMSK BT factor=0.3

PEAK DEVIATION = 3000 Hz

SPAN = 5kHz/div



Plot2: MASK J, 9K50F1D ,1W

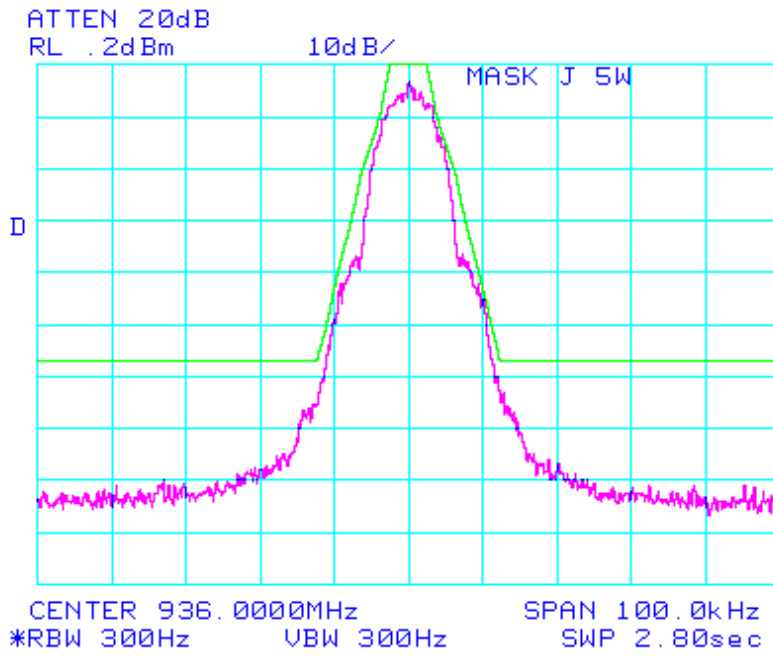
SPECTRUM FOR EMISSION 9K50F1D

OUTPUT POWER: 1 Watts

9600bps, DGMSK BT factor=0.3

PEAK DEVIATION = 3000 Hz

SPAN = 5kHz/div



LIST OF THE TEST EQUIPMENT:

Equipment	Manufacturer and model	serial number	inventory
Digital pseudo-random sequence generator	Dataradio BDLC D212A	NA	R&D-A322
Attenuator 30 dB / 10 Watt	BIRD Model / 10-A-MFN-30	NA	DR1121
Communication Analyzer (used for Modulation Analyzer)	IFR COM120B	500008432	T612
Spectrum Analyzer	HP(Agilent) 8563EC	4103A01135	DR231
DC Power Source	Astron VS 20M	200030003	DR1447