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

for the

T881 Exciter module of Tait's T88x 800 MHz base station

modulated with

4 FSK digital modulation from Dataradio's Base Data Link Controller (BDLC)

FCC ID: EOTBDD4T881
Trade Name: Paragon/PD

December 3rd, 2000

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.

Dataradio Inc., Montreal, Canada

ENGINEERING STATEMENT
OF CONSTANTIN PINTILEI

The application consisting of the attached engineering exhibit and associated FCC form 731 has been prepared in support of a request for a Class II Permissive Change for EOTBDD4T881.

The certificate EOTBDD4T881 has been granted to Dataradio Inc. for the T881 Exciter module manufactured by Tait Electronics Ltd. as the T88M-XY (see page 6 for part# description) 800 MHz base station. Dataradio Inc. buys this base station and uses it to build Paragon/PD, a wireless data base station. Dataradio Inc. modifies the exciter for a new proposed digital modulation scheme, does the final assembly and markets the finished Paragon/PD unit.

This is the same digital modulation scheme used in the UHF Paragon PD which has been granted authorization under FCC ID EOTBDD4T85-1 and in corresponding mobile radio, the GeminiPD, granted certificate EOTGPDA for UHF (compliance with mask C) and EOTGPDB for 800 MHz band (compliance with mask G).

The original certificate has been granted for F1D, F2D and F3E type of modulations for a unit equipped with audio low-pass filtering as per 90.210. The change consists of adding a new digital modulation source that bypasses the audio low-pass filter, therefore compliance has been demonstrated for mask 90.210 G. For this modulation source the emission designators are 14K3 and 15K9 F1D. This Class II permissive change involves the modulation source only and it is completely described with the current report. A second Class I Permissive change is detailed further in the circuit description Annex such that to clearly show all the changes related to this module.

EXISTING CONDITIONS

The unit utilized for these occupied bandwidth and mask-compliance measurements was a prototype built from production EOTBDD4T881 with beta-level firmware used to create the modulation scheme. The Exciter operates on frequencies ranging from 800.000 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 as granted in EOTBDD4T881.

PROPOSED CONDITIONS

It is proposed to accept the Class II permissive change request for the EOTBDD4T881 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 2.1041and 2.1049 of Rules Service Co rev.2-154, Mar 15,2000. Equipment performance 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 performance measurements were made between Aug 2, 2000 and Aug 11,2000.

CONCLUSION

Given the results of the measurements contained herein, the applicant requests to be applied a Class II Permissive Change for the Certificate EOTBDD4T881 to add the two new emission designators 15K9F1D and 14K3F1D to the existing list.

Constantin Pintilei
_________________________09/14/00

Constantin Pintilei
R&D Test Engineer, Dataradio Inc.

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ANNEXES:

Annex A: Instruction Manual

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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 24 Years experience in radio communications

NAME:	**Constantin Pintilei**
TITLE:	R&D Test Engineer
TECHNICAL EDUCATION:	Bachelor of Science Degree in Radiotechnique Electronic Engineering (1993) Technical University of Iasi, Romania
TECHNICAL EXPERIENCE:	7 Years experience in radio frequency measurements.

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

The certificate EOTBDD4T881 has been granted to Dataradio Inc. following an ID change request from CAS8IPT881. The original CAS8IPT881 has been granted to Tait Electronics Ltd. for its T881 Exciter module. It belongs to the T88M-XY (check at the page bottom for part# description) 800 MHz base station. Dataradio Inc. buys this base station and uses it to build Paragon/PD, a base station for wireless data networks. In order to market it under Dataradio logo the change in ID has been asked. Further, a new modulation scheme explained below has been designed. In order to accommodate this digital modulation scheme the audio low-pass filter of the exciter has to be changed. Dataradio Inc. does this change to fit the exciter to the new proposed digital modulation scheme, does the final assembly and markets the Paragon/PD unit.

The certificate has been granted for 13K6 and 16K0F1D, 13K6 and 16K0F3E and 15K0F2D types 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 G. For this modulation source, the modulation scheme is 4-level FSK and its emission designators are 14K3 and 15K9 F1D. All hardware-related changes as per 2.1033 (c) (10) are explained further in the Circuit Description Annex B. All modulator source signal-related issues as per 2.1033 (c) (4) and (13) are explained below on page 9 and on Annex E.

This Class II permissive change involves the modulation source only, with no change occurring elsewhere in the circuitry. Therefore a Class II Permissive Change has been requested.

The characteristics affected 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(g)

They are entirely documented with the current report.

Part Number of the Tait 800 MHz base station T88M-XY

M	Module Type	X	Freq Range	Y	Channel Bandwidth
1	Exciter (5W)	1	800-880 MHz	0	25 kHz
5	Receiver	2	850-960 MHz	5	12.5 kHz
9	Power Amplifier				

Part Number of the Paragon/PD 800 MHz data base station BDD4 -88XY PPPS

X	Freq Range	Y	Channel Bandwidth	PPP	Transmitted Power	S	Supply
1	800-880 MHz	0	25 KHz	005	5W	0	12VDC external
2	850-960 MHz	5	12.5 KHz	070	70W	2	dual 120V AC

General Information About The Grantee And Certificated Equipment -2.1043 (B)(2)
(as per Rule Part Number: 2.1033 (c).(1),(2),(5),(6),(7)

APPLICANT and GRANTEE of ID EOTBDD4T881	Dataradio Inc., 5500 Royalmount Ave, suite 200, Town of Mount Royal, Quebec, Canada, H4P 1H7
GRANTEE of original ID CAS8IPT881	Tait Electronics Ltd., Burnside Christchurch 5, New Zealand
MANUFACTURER:	Tait Electronics Ltd., Burnside Christchurch 5, New Zealand (T88x 800 MHz Base station) DATARADIO Inc., Town of Mount Royal, Quebec, Canada, H4P 1H7 (D212 BDLC and Paragon/PD- final assembly)
MODEL NUMBER:	Paragon/PD
PART NUMBER:	BDD4-88XY PPPS
SERIAL NUMBER (S):	D212 address 1.0 -prototype 4-level FSK BDLC T881-10 s.n 422447 Exciter module T889-10 s.n 998940 PA module T885-10 s.n 424624 and 424625 Receiver Modules
FCC ID NUMBER:	EOTBDD4T881
FCC RULES AND REGS:	FCC Part (s) 90
FREQUENCY RANGE:	800 MHz -960 MHz as per EOTBDD4T881 certificate
MAXIMUM POWER RATING:	5Watts as per EOTBDD4T881 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:	

TRADE NAME	DESCRIPTION	DRI PART NUMBER
T88x	800 MHz Base Station	T88M-XY
D212	Base Data Link Controller (BDLC)	050-03330-00x
Paragon/PD	Assembly	BDD4-88XY PPPS

Data And Characteristics Not Affected By The Change-Rule Part Number: 2.1033 (c)(8),(9),(11),(12),(15),(16)

DC Voltages And Currents Into Final Amplifier (T881)	2.1033(c).(8)
Transmitter Tune Up Procedure	2.1033 (c) (9)
FCC Label	2.1033 (c) (11)
External 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 not affected by the change	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 CHARACTHERISTICS AFFECTED BY THE CHANGE - Rule Part Number: 2.1033(c)(3),(4),(10),(12),(13),(14)

INSTRUCTION BOOK 2.1033 (c) (3)

Annex A . The attached Technical Manual for the Paragon/PD data base station using SRRC4FSK is a preliminary version.

TYPE OF EMISSION: 2.1033(c)(4)

For Class II Permissive Change 4levelFSK 25kHz BW (12800baud, 4 FSK) **14K3F1D**
25kHz BW (9600baud, 4 FSK) **15K9F1D**

DESCRIPTION OF CIRCUITRY 2.1033 (c)(10)

SCHEMATICS 2.1033 (c)(10)

TRANSISTOR, DIODE, AND IC FUNCTIONS 2.1033 (c)(10)

Annex B. The attached Circuit Description details all the changes (both Class II and Class I permissive changes types) the Exciter T881 undergo.

Annex C. Attached Production Procedure nr 164-20006-021 is a preliminary version.

INTERNAL PHOTOGRAPHS 2.1033 (c)(12)

Annex D. Shows T881 Exciter after the production procedures above mentioned are applied.

DIGITAL MODULATION TECHNIQUES 2.1033 (c)(13)

Annex E. Explains DBA protocol and digital modulation technique used to create modulator signal

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

All applicable test data according to:
- -Part 2: 2.1043 (b)(2), 2.1049
- -Part 90, Subpart I: 90.209 and 90.210

are provided in next section of this Engineering Report

Modulation Characteristic Part 2.1047 (d), 90.209 (b), 90.210(g): Other types of equipment: this equipment is not provided with hardware audio low-pass filters, the filtering is entirely the result of DSP firmware.

The following reports have been generated for Class II Permissive Change request for EOTBDD4T881 Exciter module. Paragon/PD is comprised of the Tait Electronics Ltd. T88x 800 MHz Base station with the Dataradio Inc D212 Base Data Link Controller (BDLC). Dataradio Inc does the changes to fit the T881 Exciter to digital modulation, does final assembly and markets the Paragon/PD unit

Unless otherwise noted, all of the measurements were conducted following the procedures set forth in the TIA/EIA-603 standards.

NAME OF TEST:
Transmitter Occupied Bandwidth

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

Emission Designator Determination

Necessary Bandwidth Measurement (90.209.(b))

This Exciter uses digital modulation signals, passing through a DSP implemented low-pass filter to an FM modulator. The necessary bandwidth calculation for this type of modulation (SRRC4FSK) 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.

The results of 99% Occupied Bandwidth measurement are:

Baud rate	Deviation	Occupied Bandwidth	Emission designator
12800 bauds	± 4.15 KHz	14280 Hz	14K3
9600 bauds	± 4.7 KHz	15820 Hz	15K9

The measurement theory and set-up explanations follow.

Occupied Bandwidth Measurement

Theory of Measurement
The way to define the ***Occupied Bandwidth*** is “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), so the mathematics for it are:

$$0.005*TP=P_{(f1)}=\int_0^{f1} PSD_{(f)}df$$

$$0.995*TP=P_{(f2)}=\int_0^{f2} PSD_{(f)}df$$

$$OBW=f2-f1$$

where TP (total mean power) is

$$TP=\int_0^{+\infty} PSD_{(f)}df =(1/t)\int_{-\infty}^{+\infty} |z_{(t)}|^2dt$$

and PSD (power spectral distribution) is

$$PSD_{(f)}=|Z_{(f)}|^2+|Z_{(-f)}|^2 \qquad 0\leq f<4$$

and expresses the positive frequency representation of the transmitter output power for z(t) signal.

By applying this mathematics to the measurements, it is possible to measure the Occupied Bandwidth using the RF signal’s trace provided by a digital spectrum analyzer and processed further by computational methods.

The Occupied Bandwidth measurement is in two parts relatively independent of each other. The first gives the RF spectrum profile, and the second calculates the frequency limits and they result in the Occupied bandwidth. While the first involves RF measurement instrumentation, the second is strictly a computational part related to measured trace.

Getting an equally-sampled RF power spectrum profile requires a Digital Spectrum Analyzer. In addition to the instrument's usual requirements, a special attention must be paid to the analyzer's span (bandwidth to be investigated).

This bandwidth must be large enough to contain all the power spectral components created by the transmitter. The frequency step Δf, where the samples are picked, is directly dependent on the span's value.

Δf= span/number of points displayed

The frequency resolution will determine the measurement accuracy. So for greater accuracy, less bandwidth will give better values because of the constant number of points that can be displayed. Taking into account the purpose of transmitter, an acceptable balance can be set. For channel-limited transmitters all the power spectral components can be found in main channel and a number of adjacent channels, upper and lower, from the main channel. The relation between these two requirements, number of channels and accuracy, is depicted by:

$a(\%) \cong (2*k*n/N)*100$,

where a is desired accuracy, in percentage units, n is the number of channels in span, including main channel, N is displayed number of points and k= (authorized bandwidth) /channel bandwidth.

For usual spectrum analyzers $N \cong 500$, k=0.8 (20/25) for 25kHz channel transmitters or k=0.9 (11.25/12.5) for 12.5kHz channel transmitters, so $a \cong n/2.5$ (%) can estimate the expected precision for measurement.

All other requirements for spectrum analyzer are the same as they are for mask compliance determination.

The second part has computational requirements related to the trace's values processing.

The following operations must be performed over the trace's (x,y) points:

1. convert y value in dBm (or the analyzer's display y units) units power sample
2. convert y value in W units power sample,
3. add to total power every power sample and get total power value (W units for total power)
4. set low level (0.5%*total power)
5. detect x1-sample which pass low level (convert f1 integrals to sample summing)
6. convert (x1-1)-sample value in frequency units (the x-sample is already in occupied bandwidth),
7. store first frequency correspondent to (x1-1)-sample
8. set up level (99.5%*total power)
9. detect x2-sample which pass up level (convert f2 integrals to sample summing)
10. convert (x2)-sample value in frequency units (the x-sample is now out of occupied bandwidth),
11. store second frequency correspondent to (x2)-sample
12. read the frequency difference , this is ***Occupied Bandwidth***, and display the result.

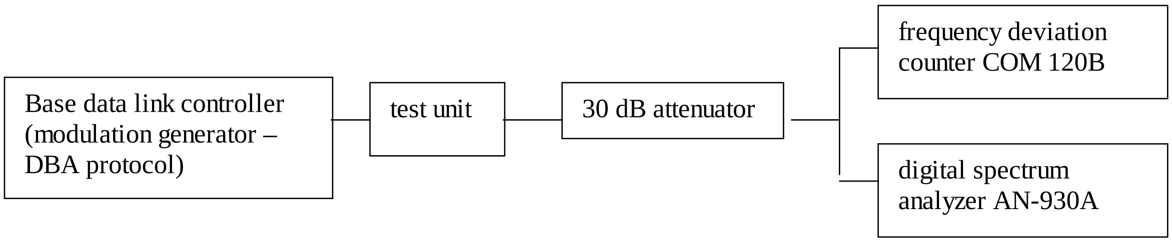
Standard calculation precision is all that is required. The main error factor being the y display resolution is covering calculation precision.

The absolute error for this measurement is $-0/+2*(\Delta f)$. It is not possible to decrease span bandwidth under 2 channels bandwidth because this will affect the significance of result by cutting off the power's spectral distribution edges.

2. Dataradio's Measurement Set-Up

For the above requirements, the occupied bandwidth of a transmitter was measured using an IFR AN930 A spectrum analyzer having adequate macrofunction to perform computational part. The number of power spectrum samples (N) is 500. Because in test results frequency deviation was also a parameter, measurement instruments were completed with an IFR COM-120 B for frequency deviation determination.

The measurement set-up is:



The AN-930 A spectrum analyzer's parameters are adjusted as follow:
-total span is adjusted at 2.8*channel space this means 70 kHz for 25 kHz channel and 35 kHz for 12.5 kHz channel. This setting will result in frequency sample step (f) of 140 Hz for 25 kHz channel and 70 Hz for 12.5 kHz channel.
-RBW is set to 300 Hz, this is better than 1% of total span bandwidth.
-video filter is set to 1Khz;
-all other parameter of the instrument are automatically adjusted to obtain calibrated measurements (sweep time 4s).
-central frequency and reference level are adjusted to the unmodulated carrier frequency and level.

The AN 930 A spectrum analyzer's Occupied Bandwidth macrofunction input parameters are:
-central frequency, same as above, the unmodulated carrier frequency.
-channel spacing, 25 kHz or 12.5 kHz according to the signal,
-percentage of Occupied Bandwidth 99%.

The macro operations are:
-a peak hold trace is created after a large enough nr. of sweeps to ensure the relevance for OBW. This trace is read;
-follow all the computational steps required.

Each sample is converted from dBm to mW and add to total power (tpow) variable. Then are computed the limits of 0.5% and 99.5% by using variable remaining percent (RemPer), and in same time are stored sample number where these two percentage meet. Then are assigned to the markers the correspondent frequencies of numbers.

- Occupied Bandwidth is then displayed as Delta mode marker (difference between markers).
-return to operational mode.

NOTE 1: The computational part could be performed on any instrument featured with data acquisition.
NOTE 2: An approximation of the occupied bandwidth calculation can be performed by measuring at the points at which the spectrum, measured with a spectrum analyzer of 300 Hz resolution bandwidth, is 25dB down relative to the unmodulated carrier reference level.

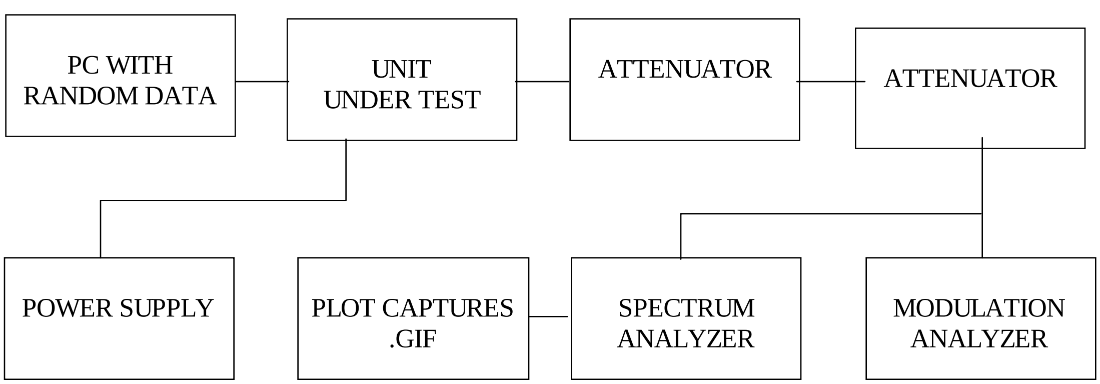
NAME OF TEST: Transmitter Occupied Bandwidth
Paragon/PD Modem at 9600 and 12800 baud 4FSK

Mask compliance data in support of Emission Designator **14K3F1D and 15K9F1D**

RULE PART NUMBER:	2.201, 2.202, 2.1033 c (14), 2.1049 (h), 2.1041, 90.209 (b)(5), 90.210 (g)	
MINIMUM STANDARD:	Mask G	
	Sidebands and Spurious [Rule 90.210 (g)]	
	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 KHz /5) dB
	>10.0 kHz to 250% Auth BW	Attenuation = Lesser of: 116*log(f_d KHz /6.1) dB, 50+10$\log_{10}$(P) OR 70 dB
	>250% Auth BW	43 + 10*log(P)
	Corner Points:	
	f_0 to 5.0 kHz	Attenuation = 0 dB
	>5.0 kHz to 10.0 kHz	Attenuation= 0 dB to 25 dB
	>10.0 kHz to 25.0 KHz	Attenuation = 25 dB to 70 dB
	>25.0 kHz to 50kHz	Attenuation = 70dB (minimum 57dB -5W)
	>250% Auth BW	Attenuation = 50 dB (minimum 50 dB -5 W)
TEST RESULTS:	Meets minimum standard (see data on the following pages)	
TEST CONDITIONS:	Standard Test Conditions, 25 C	
TEST EQUIPMENT:	Attenuator, BIRD Model / 100-A-MFN-30 / 30 dB / 100 Watt	
	Attenuator, BIRD Model / 5-A-MFN-20 / 20dB / 5 Watt	
	DC Power Source, Model Astron VS 20M	
	Communication Analyzer, Model IFR COM120B for Modulation Analyzer	
	Spectrum Analyzer, Model HP E4401	

PERFORMED BY: ______________________________ DATE: 11/30/00
Constantin Pintilei

TEST SET-UP:



NAME OF TEST: Transmitter Occupied Bandwidth (Continued)
Paragon/PD Modem at 9600 and 12800 baud 4FSK
In Support of Emission Designators **15K9F1D and 14K3F1D**

MODULATION SOURCE DESCRIPTION:

TX Data Pattern:

The transmit data pattern is DBA protocol- type of "idle" packets data pattern as described in Annex E "Digital Modulation Techniques". After this data follows the modulation process described, the resulting base band signal feed the modulator's input of the Exciter.

For 9600 baud rate, the deviation is set to 4.7 kHz. For 12800 baud rate, the deviation is set to 4.15kHz. For deviation readings it has been used the IF filter of 30KHz

NECESSARY BANDWIDTH (Bn) CALCULATION

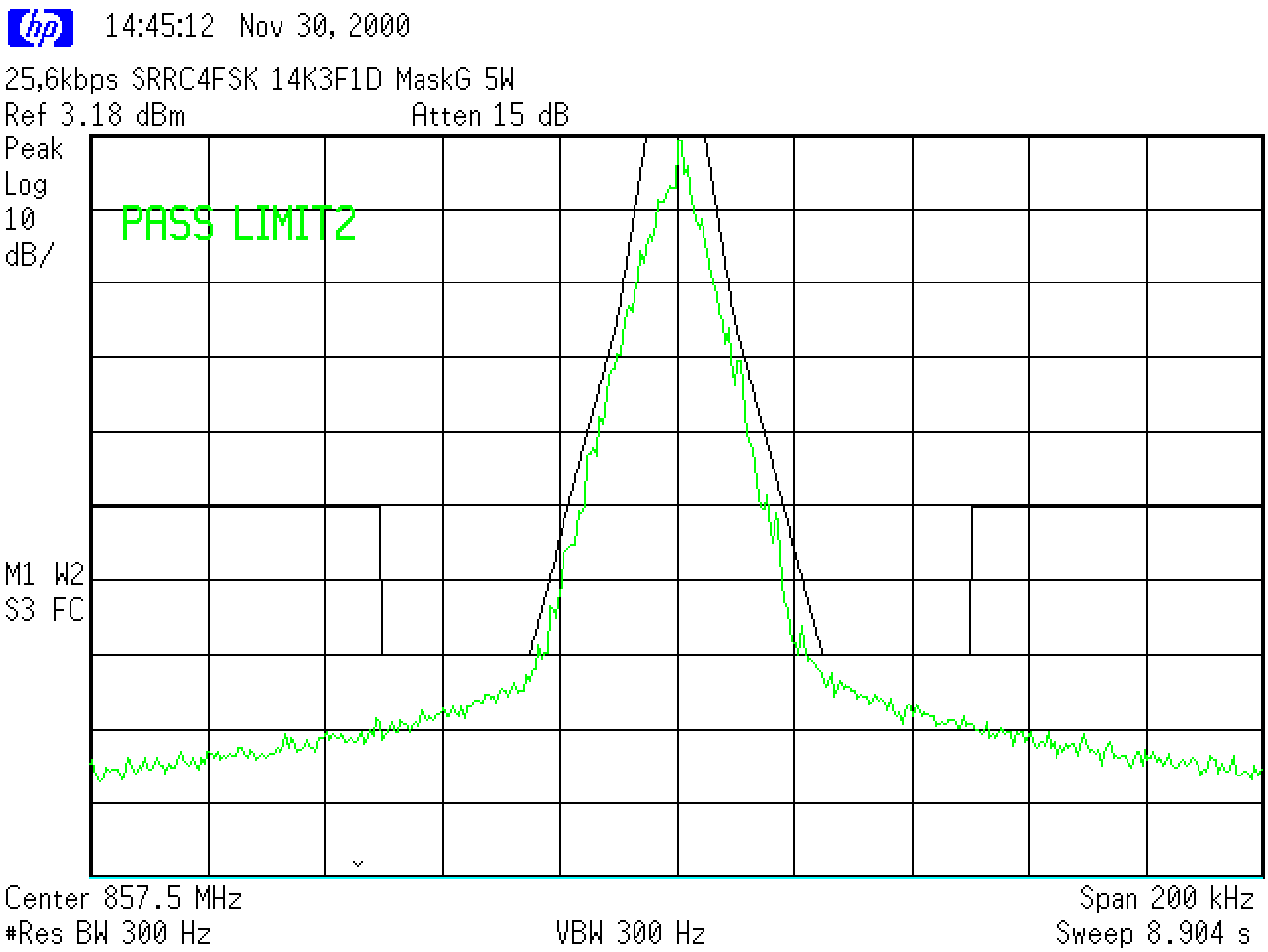
See Page 10 for emission designator determination.

The corresponding emission designator prefix for necessary bandwidth
15K9F1D for 9600 baud rate , 4.7 kHz deviation
14K3F1D for 12800 baud rate, 4.15 kHz deviation

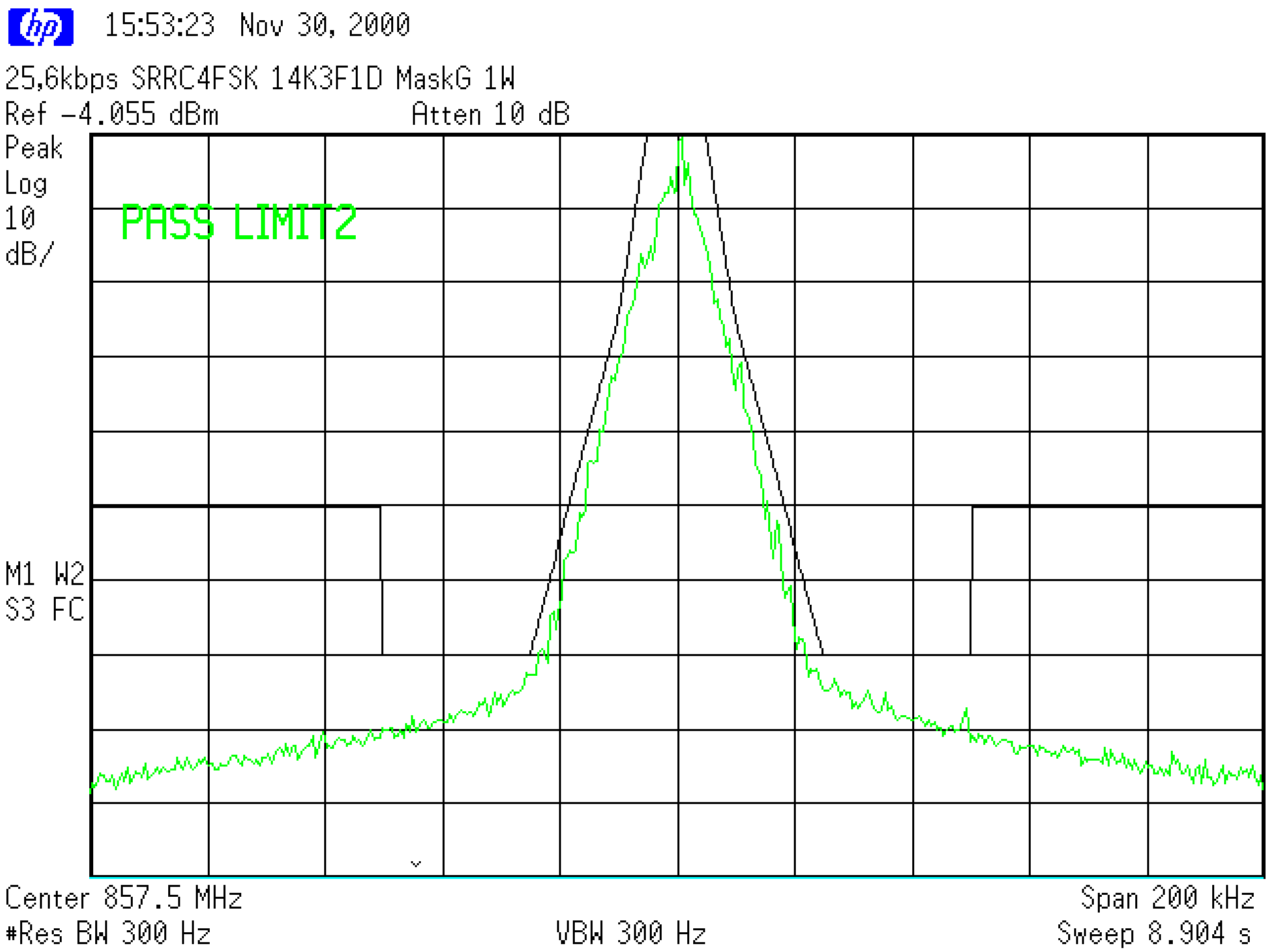
TEST DATA: Refer to the following graphs:

MASK: G, 14K3F1D

SPECTRUM FOR EMISSION **14K3F1D**
OUTPUT POWER: 5 Watts
12800 bauds, 4 level FSK
PEAK DEVIATION = 4150 Hz
SPAN = 200 kHz

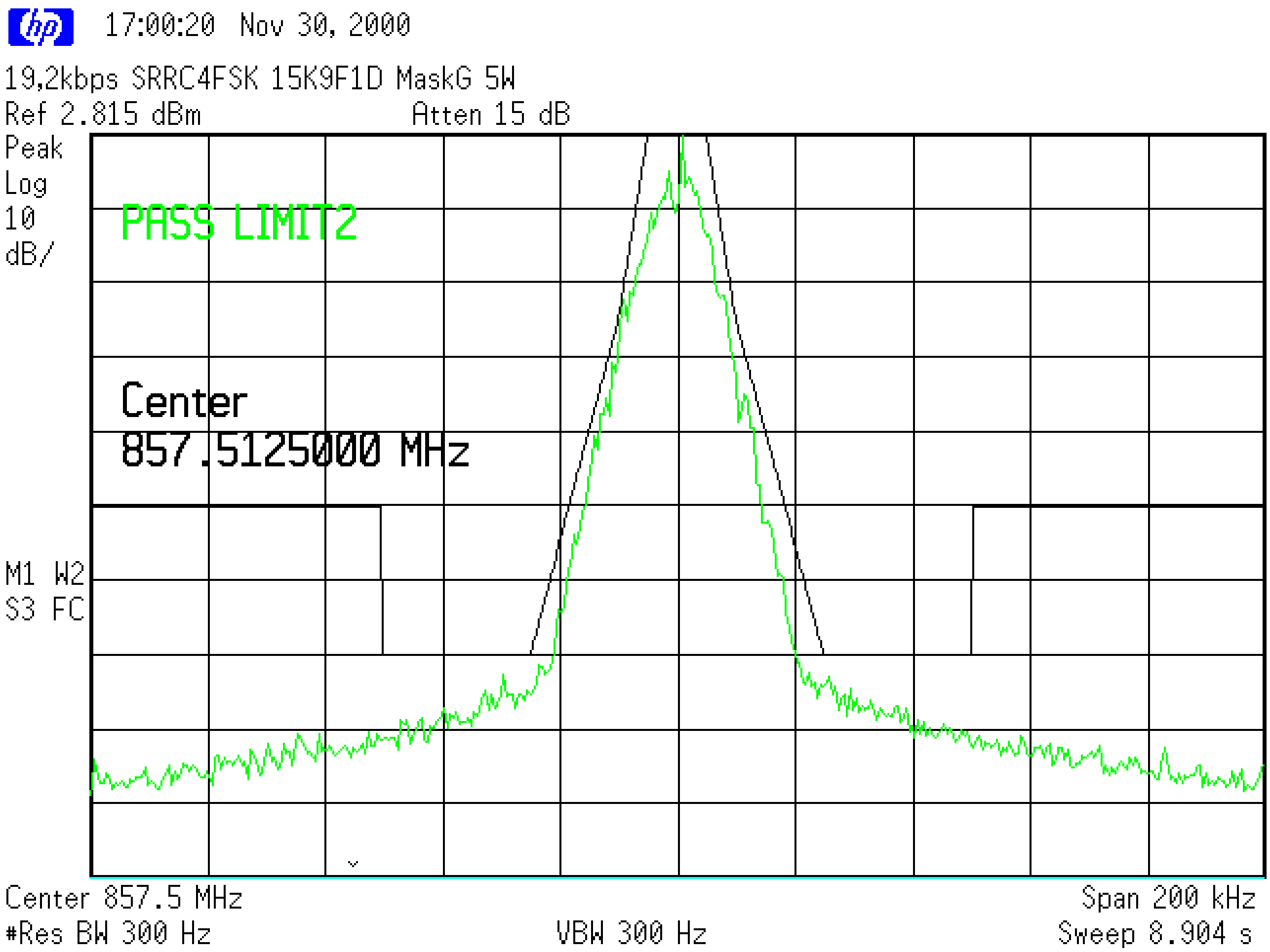


SPECTRUM FOR EMISSION **14K3F1D**
OUTPUT POWER: 5 Watts
12800 bauds, 4 level FSK
PEAK DEVIATION = 4150 Hz
SPAN = 200 kHz



MASK: G , 15K9F1D

SPECTRUM FOR EMISSION **15K9F1D**
OUTPUT POWER: 5 Watts
9600 bauds, 4 level FSK
PEAK DEVIATION = 4700 Hz
SPAN = 200 kHz



SPECTRUM FOR EMISSION **15K9F1D**
OUTPUT POWER: 1 Watt
9600 bauds, 4 level FSK
PEAK DEVIATION = 4700 Hz
SPAN = 200 kHz