Test Report:	**2W04767**
Applicant:	**VTECH ENGINEERING CANADA** 200-7671 Alderbridge Way Richmond, BC V6X 1Z9
Equipment Under Test: **(EUT)**	**VTECH 5831** Cordless Telephone Set
FCC ID:	
In Accordance With:	**FCC Part 15, Subpart C** Frequency Hopping Spread Spectrum Transmitters 2400 - 2483.5 MHz & 5725 – 5850 MHz
Tested By:	Nemko Canada Inc. 3325 River Road, R.R. 5 Ottawa, Ontario K1V 1H2
Authorized By:	J. Harrington, RF Group Manager
Date:	12 March 2002
Total Number of Pages:	70

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Section 1. Summary of Test Results

General

All measurements are traceable to national standards.

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted is accordance with ANSI C63.4-1992. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

TESTED BY: Glen Westwell, Wireless Technologist Date: Mar 12 2002

Summary Of Test Data

Name Of Test	Para. No.	Result
Powerline Conducted Emissions	15.207(a)	Complies
Channel Separation	15.247(a)(1)	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	Complies
Time of Occupancy	15.247(a)(1)(ii)	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	Complies
Peak Power Output	15.247(b)	Complies
Spurious Emissions (Radiated)	15.247(c)	Complies

Footnotes:

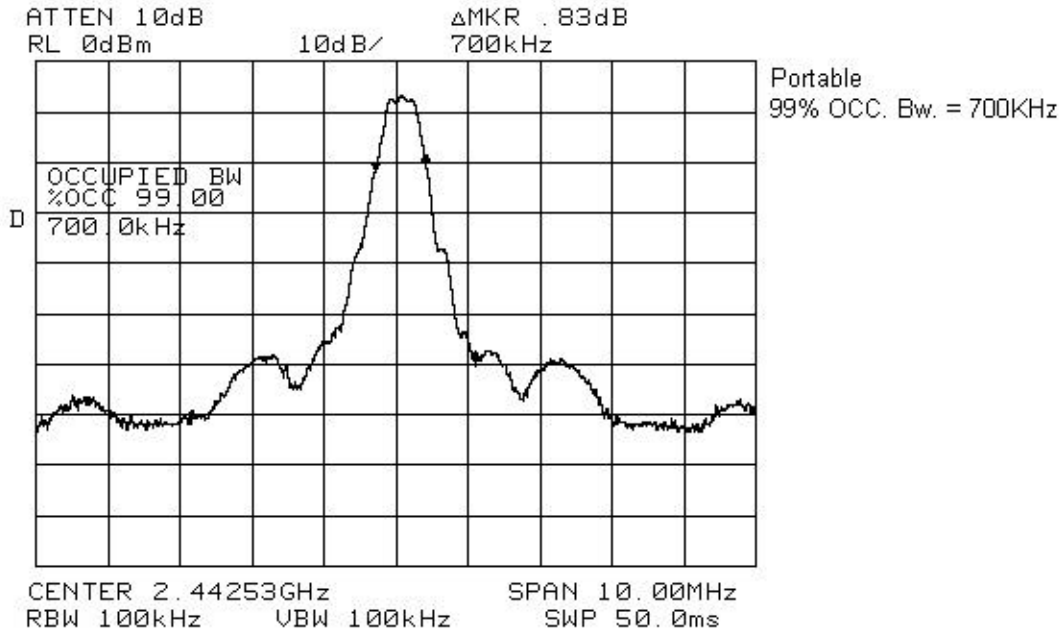
Test Conditions:

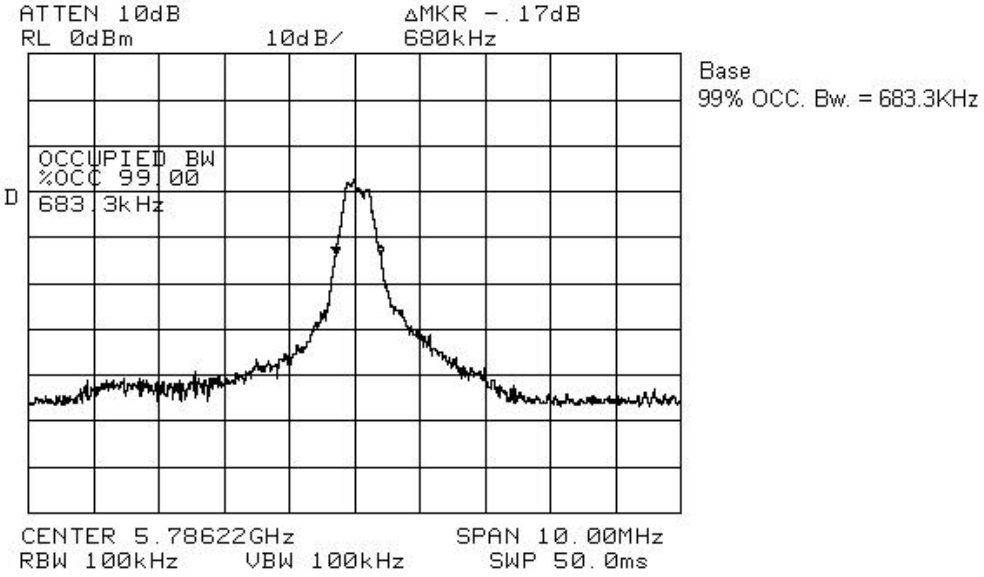
Indoor	Temperature:	22°C
	Humidity:	36%
Outdoor	Temperature:	-5°C
	Humidity:	42%

Section 2. General Equipment Specification

Manufacturer:	Vtech Engineering Canada
Model No.:	Vtech 5831
Serial No.:	Base: BS01 Portable: HS01
Date Received In Laboratory:	2 Feb. 2002
Nemko Identification No.:	#1&2

Frequency Range:	Base:	5744.736 – 5825.952 MHz
	Portable:	2401.056 – 2482.272 MHz
Number of Channels:	75	
Channel Spacing:	864KHz (typical)	
Rated Output Power (into antenna):	Base:	28.5dBm (typical)
	Portable:	23dBm (typical)
Antenna Gain:	2dBi	
Emission Designator:	700KF1D	


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR .83dB
700kHz
Portable
99% OCC. Bw. = 700KHz
OCCUPIED BW
%OCC 99.00
700.0kHz
D
CENTER 2.44253GHz
SPAN 10.00MHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -.17dB
680kHz
Base
99% OCC. Bw. = 683.3KHz
OCCUPIED BW
%OCC 99.00
D
683.3kHz
CENTER 5.78622GHz
SPAN 10.00MHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms

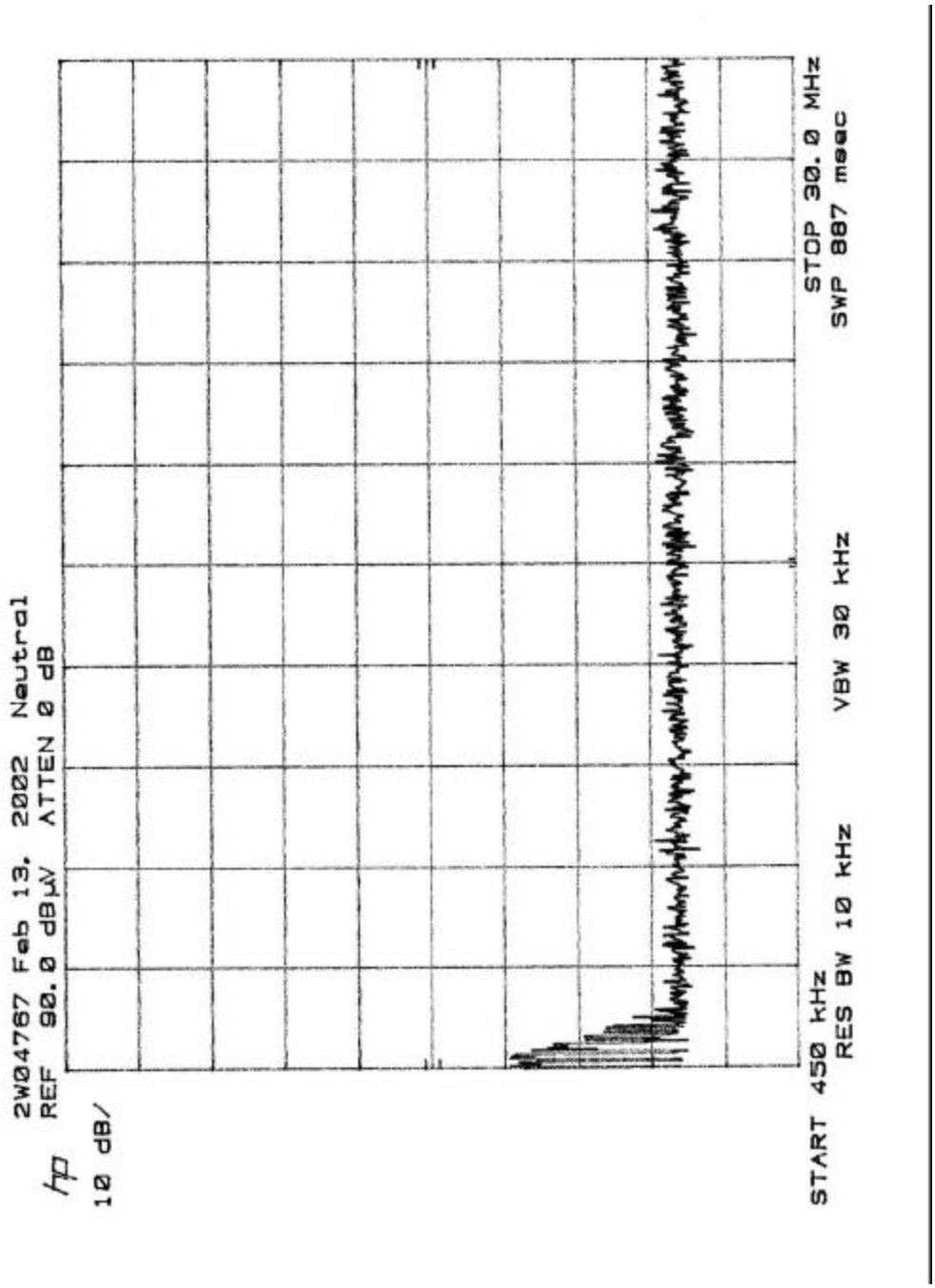
Section 3. Powerline Conducted Emissions

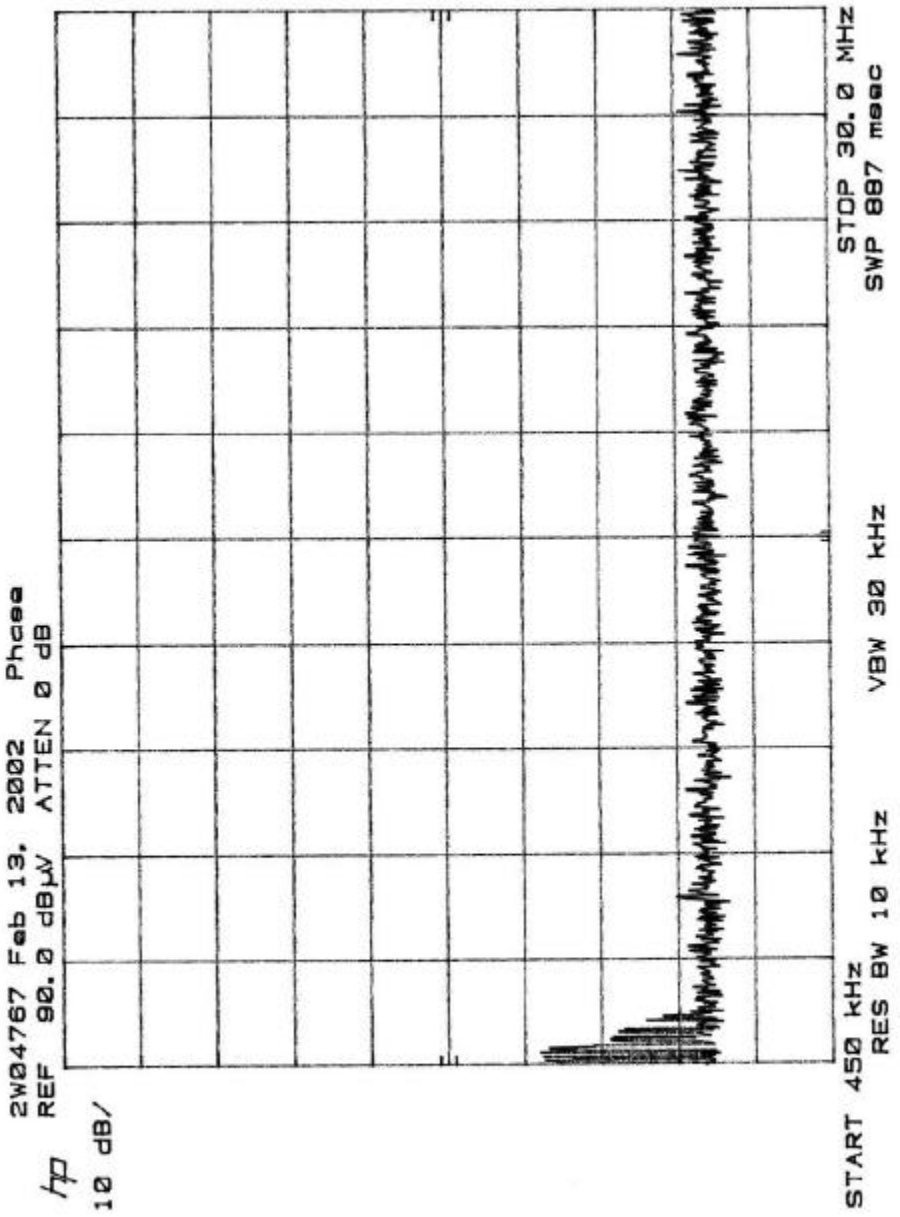
Para. No.: 15.207 (a)

Test Performed By: Glen Westwell	**Date of Test: 26 Feb. 2002**

Test Results: Complies.

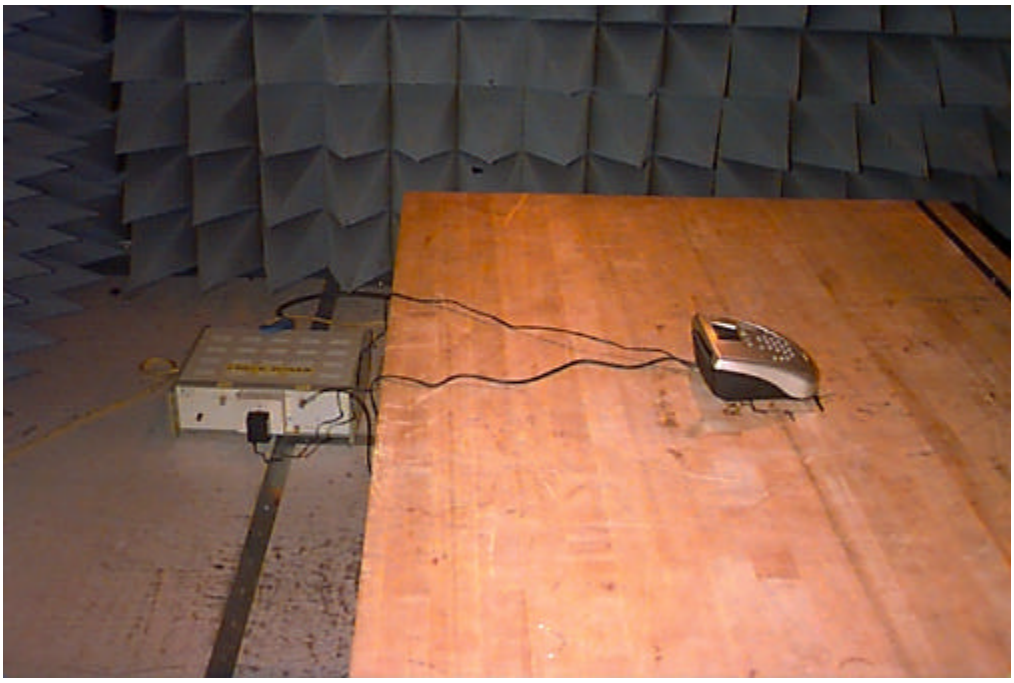
Measurement Data: See attached graph(s).


2W04767 Fab 13, 2002 Neutral
REF 90.0 dBµV ATTEN 0 dB
10 dB/
START 450 kHz
RES BW 10 kHz
VBW 30 kHz
STOP 30.0 MHz
SWP 887 msec


2W04767 Fab 13, 2002 Phase
REF 90.0 dBµV ATTEN 0 dB
10 dB/
START 450 kHz
RES BW 10 kHz
VBW 30 kHz
STOP 30.0 MHz
SWP 887 msec

Front View

Side View



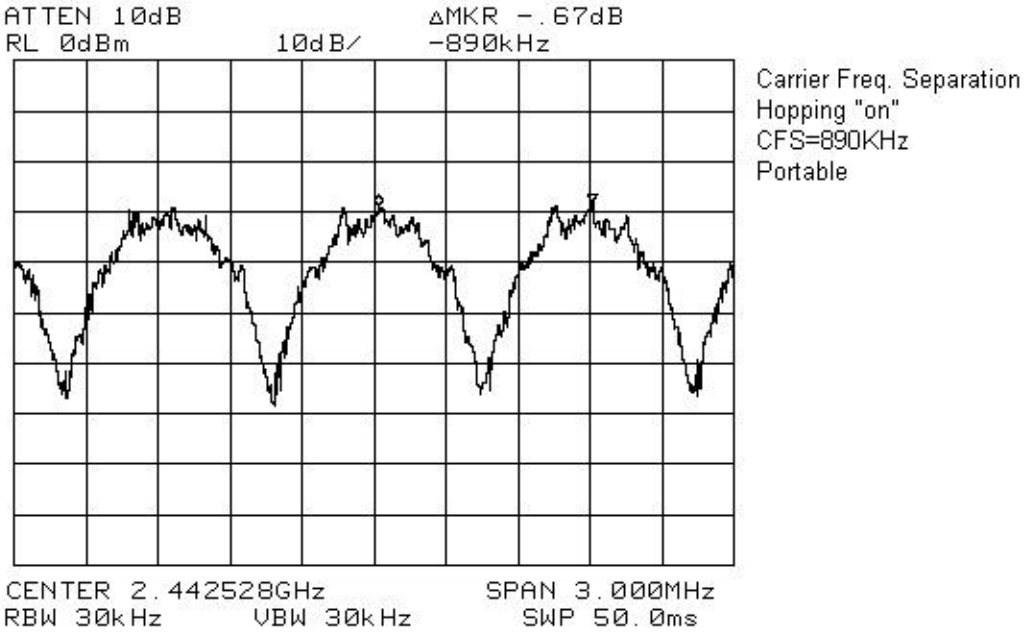
Section 4. Channel Separation

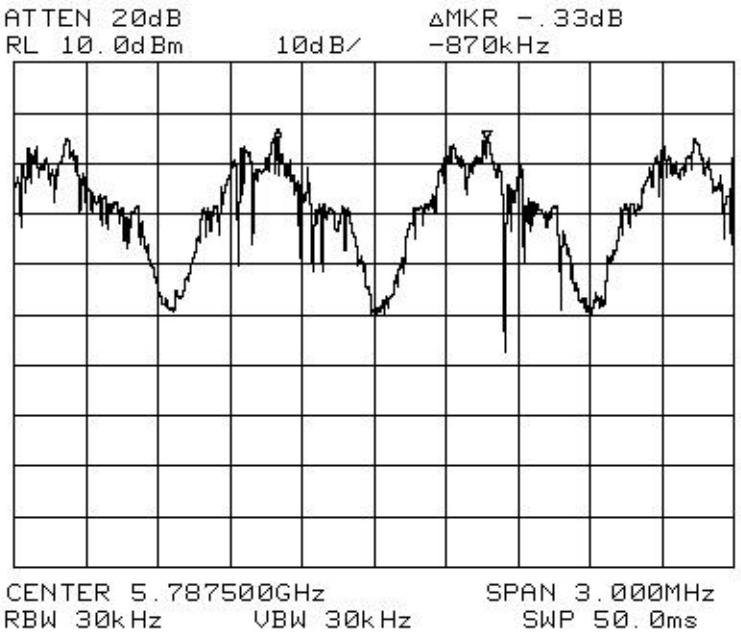
Para. No.: 15.247 (a)(1)

Test Performed By: Glen Westwell	**Date of Test: 26 Feb 2002**

Test Results: Complies.

Measurement Data: Measured 20 dB bandwidth: 667KHz
Channel Separation: 890KHz


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR -.67dB
-890kHz
Carrier Freq. Separation
Hopping "on"
CFS=890KHz
Portable
CENTER 2.442528GHz
SPAN 3.000MHz
RBW 30kHz
VBW 30kHz
SWP 50.0ms



Carrier Freq. Separation
Hopping "on"
CFS=870KHz
Base Station

Section 5. Pseudorandom Hopping Algorithm

Para. No.: 15.247 (a)(1)

Test Performed By: Manufacturer Data	**Date of Test: 26 Feb 2002**

Test Results:

Measurement Data: Number of Hopping Frequencies: 75

See attached customer supplied data.

4.1 Hopping Algorithm

As mentioned above, each wireless link or connection will utilize a TX-RX slot pair (4 slots apart) within the same 10mS frame. Each connection will employ an individual and unique hopping pattern that consists of 75 separate channels. Within the same frame, the same channel is used for both the TX and RX slot. A hopping pattern contains 75 different channels (i.e. no two channels are the same). The four possible traffic bearer hopping patterns are pseudo-randomly generated. The pseudo-random generated dummy bearer hopping pattern, that corresponds to slot pair 1-5, is derived from the Fixed Part's identity (FPID). The FPID is used as the seed for the pseudo-random pattern.

The FPID has a length of 40 bits and is randomly generated. It is used as the system security code. To register a new portable part to a fixed part, the system security code must be entered in the portable part.

If an active connection is required and there are currently no active connections present then the preferred slot pair is 4-8 while the dummy bearer remains on the same slot pair (1-5) all the time. However if a new connection is made immediately after the previous connection is dropped (within 1s), a new connection will be established temporarily on slots 3-7. Within the next second, the upper levels of the protocol will be informed that the old connection does not exist and a handover will be performed for this new connection. The connection will be moved from slot pair 3-7 to slot pair 4-8.

Each traffic bearer connection contains its own hopping engine [HE] connection state machine. Each HE connection state machine is independent of each other. In standard mode of operation, there is only one hopping pattern associated for each HE connection state machine. In each instance an evaluation is done of the used channels based on the number of uplink, downlink errors and RSSI levels. As a result of evaluation some channels can be marked as bad and would require replacing. The replacement channel is chosen from the pool of unused channels for that pattern. This replacement channel is inserted in place of bad channel in the hopping patterns on both sides of the link.

When a specific noise profile is discovered, the HE connection state machine initiates enhanced mode of operation. In this mode, the same data is transmitted on two separate slots which are spaced two slots apart. For example if the connection was present on slot pair 4-8 in standard mode then after the discovery of a specific noise profile the system will open an additional slot pair 2-6 with same data. The chosen channels for the hopping patterns for slot pairs 4-8 and 2-6 are independent, uncoordinated and the dynamic channel replacement for those slots are independent of each other. During the usage of enhanced mode, only two PPs can be used to place a call with one FP (uses all 4 available slot pairs). Also, in enhanced mode of operation there is a facility to limit the maximum number of channels that can be replaced in the hopping pattern that corresponds to slots 1-5 (used by dummy bearer). This helps other PPs to remains in synchronisation with FP.

4.2 WDCT Random pattern generation

The hopping sequence is randomly generated by using a pseudo random number generator. The random number generator is based on primitive polynomial modulo 2.

$$x^8 + x^4 + x^3 + x^2 + 0$$

Only generated numbers that are in the range of allowed channels will be included in the hopping sequence. If a generated random number is out of this range, the calculation is repetitively performed until number in range is generated.

It is not permitted to use the same channel more than once in a hopping sequence. Because of that there is a second check. If in the hopping sequence there is already a channel equal to a generated random number, then the random number calculation is repeated until a valid number is generated. That valid random number is then included in the hopping sequence.

The first 75 channels in a generated hopping sequence are used for hopping. The remaining channels in the hopping pattern array are used as spares for channel replacement. Those channels are also randomly generated.

Appendix A shows the C code for generating the pattern.

4.3 RF Channel Plan

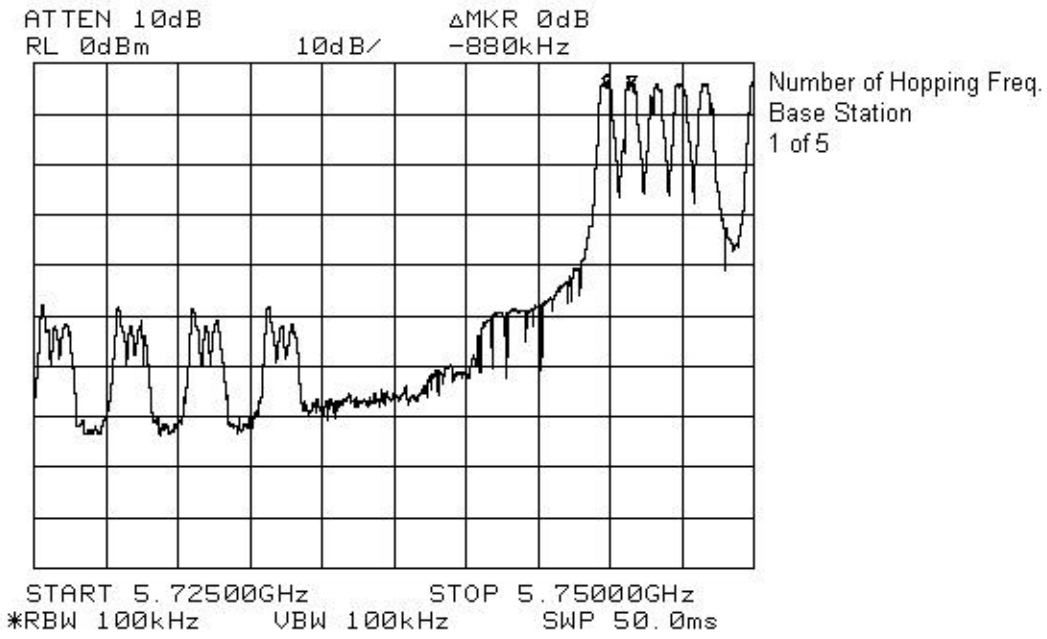
Each slot pair will use a set of 75 channels out of the main list of 94 channels. For the fixed part transmit, the minimum channel frequency used is 57xxMHz and the highest channel frequency is 58xxMHz. For the portable part transmit, the minimum channel frequency used is 2401.056MHz and the highest channel frequency is 2481.408MHz.

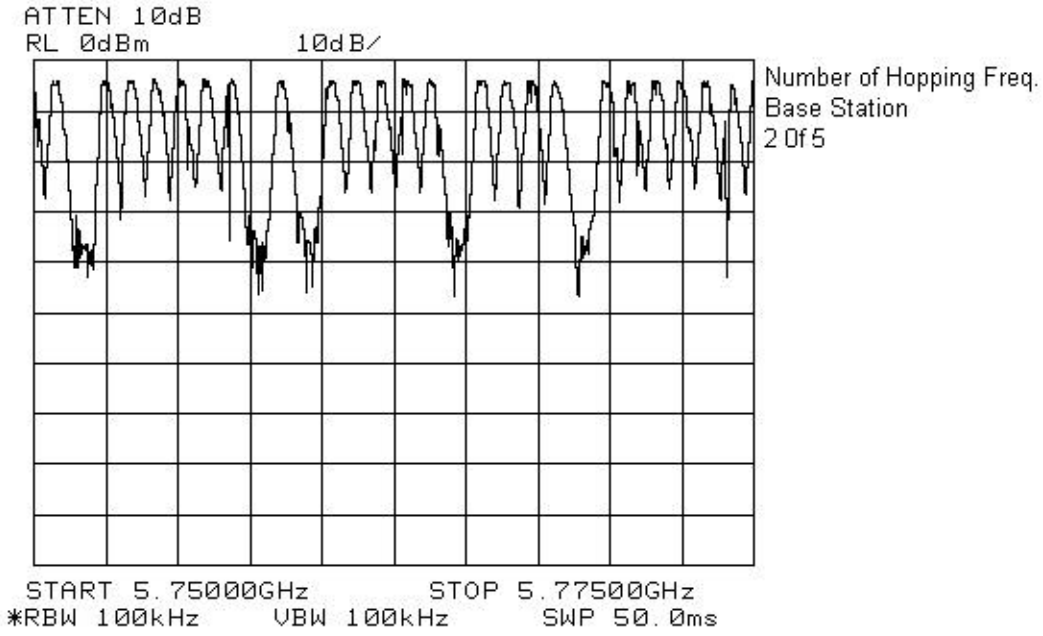
Appendix B shows the RF channel plan for the telephone. The table displays the channel number and the transmit frequencies for both fixed and portable parts.

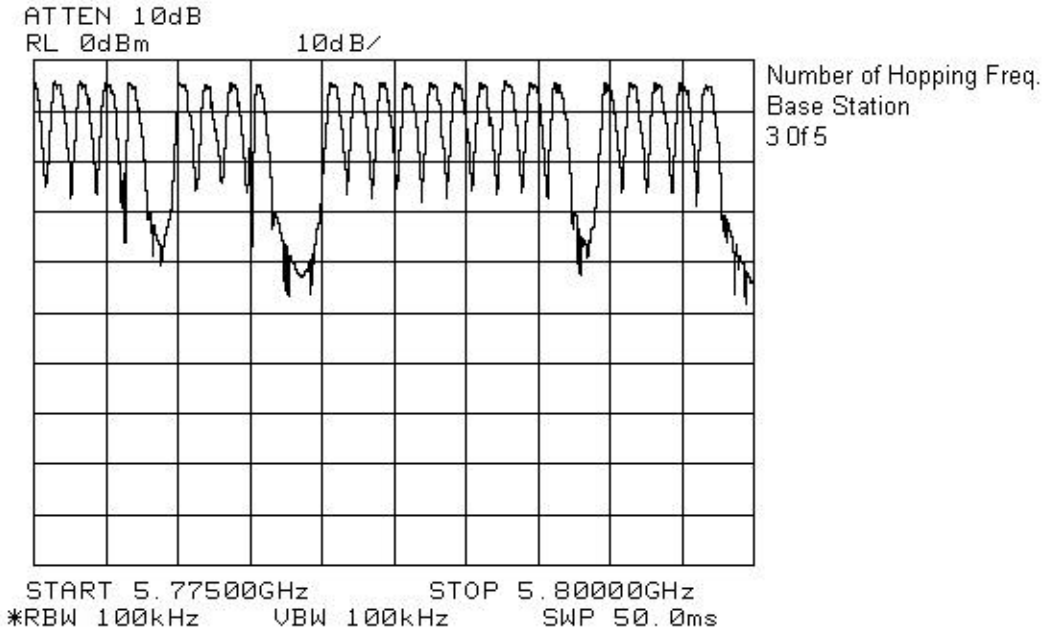
APENDIX A – Pattern Generator C Code

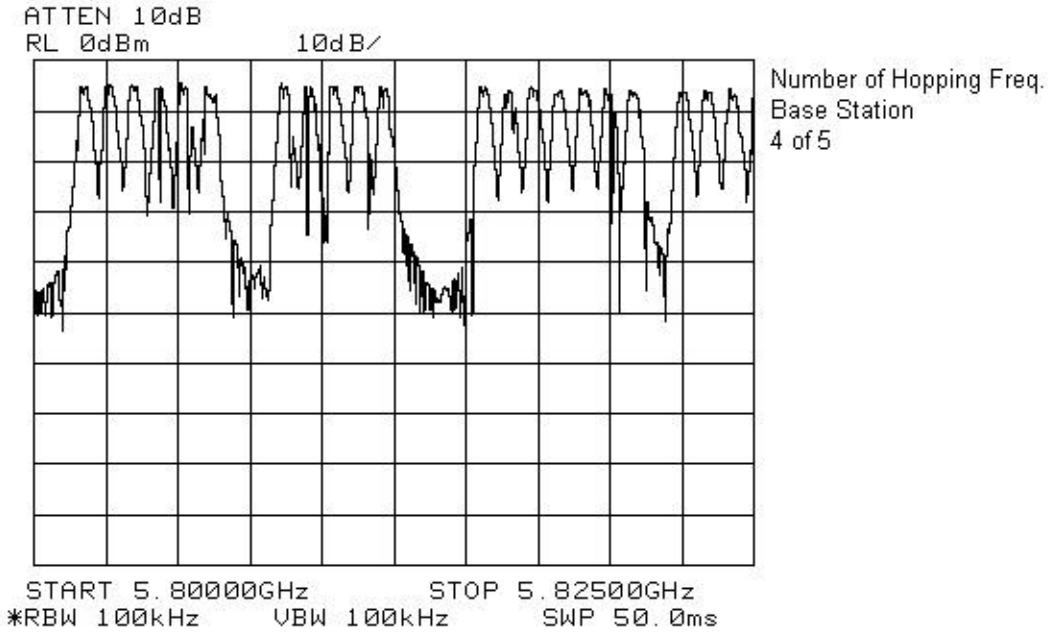
```
// C code for pattern generation.
// ------------------------------------------------
// Definition of used primitive polynomial modulo 2
// for random number generation
//        x^8 + x^4 + x^3 + x^2 + 0
// ------------------------------------------------
#define MASK              IB2+IB3+IB4
#define MSB_IN_POLYNOMIAL  IB8

// Bit masks
#define IB8 128
#define IB7 64
#define IB6 32
#define IB5 16
#define IB4 8
#define IB3 4
#define IB2 2
#define IB1 1

// ------------------------------------------------
// Private defines
//  Allowed band is from channel Nr.27-121 inclusive => 95 channels in total
// ------------------------------------------------
#define MAX_CHANNEL_NR          121
#define MIN_CHANNEL_NR          27
#define NR_OF_CHANNELS_IN_PATTERN ( MAX_CHANNEL_NR - MIN_CHANNEL_NR + 1 )
#define MAX_RANDOM_NR           ( NR_OF_CHANNELS_IN_PATTERN - 1 )
#define MIN_RANDOM_NR           0
#define RANDOM_NR_OFFSET        MIN_CHANNEL_NR

// Some variable declarations
unsigned char seed;
unsigned char random_number;
unsigned char i, j;
unsigned char channel[NR_OF_CHANNELS_IN_PATTERN];


 // First random number will be directly derived from seed.
 random_number = seed;


 // ------------------------------------------------
 // Fill the pattern channel[0..NR_OF_CHANNELS_IN_PATTERN-1]
 // with different random numbers.
 // ------------------------------------------------
 for (i=0; i<NR_OF_CHANNELS_IN_PATTERN; i++)
 {

CALCULATE_RANDOM_NUMBER:
   // ------------------------------------------------
   // One random number generation is in range 0-MAX_RANDOM_NR
   //  Random number calculation is done when valid random number
   //  in range 0-MAX_RANDOM_NR is generated.
   // ------------------------------------------------
   do
   {
    if (random_number & MSB_IN_POLYNOMIAL)
    {
```

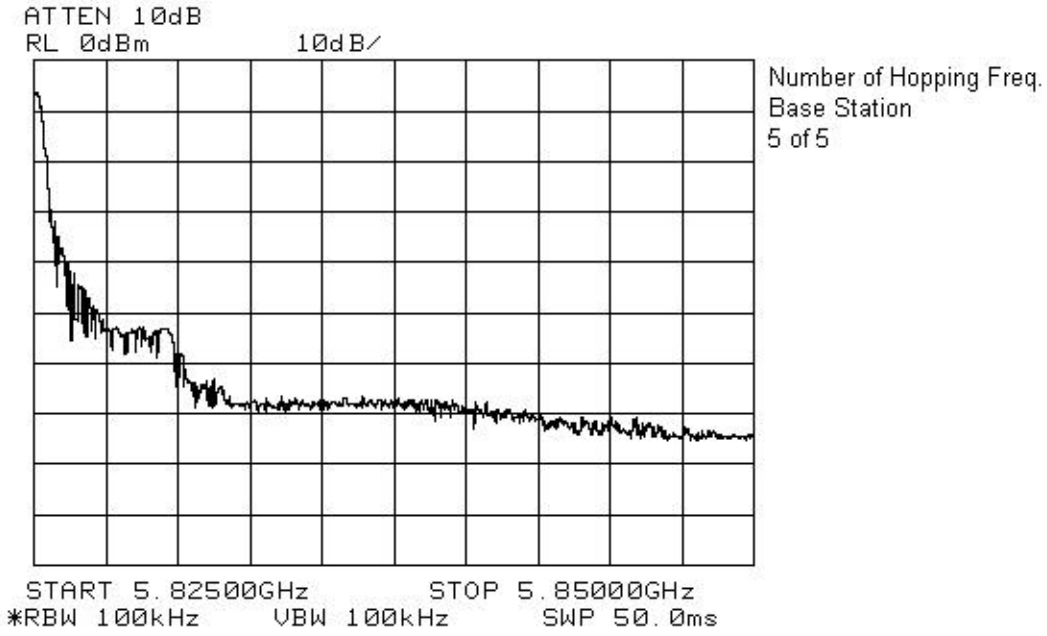
```
  random_number = ((random_number ^ MASK) << 1) | IB1;
 }
 else
 {
  random_number <<= 1;
 }
}
while (random_number >= MAX_RANDOM_NR);


// ---------------------------------------------
// Check to see if in pattern is already included channel
// that is equal with generated number.  Channel duplication
// in pattern is not allowed!
// ---------------------------------------------
for (j=0; j=<i; j++)
{
 if (channel[j] == (random_number + RANDOM_NR_OFFSET))
 {
  goto CALCULATE_RANDOM_NUMBER; // Random number will be again calculated
  break;
 }
}

// ---------------------------------------------
// Generated random number is valid and copied in the pattern.
// ---------------------------------------------
channel[i] = random_number + RANDOM_NR_OFFSET;
}
```

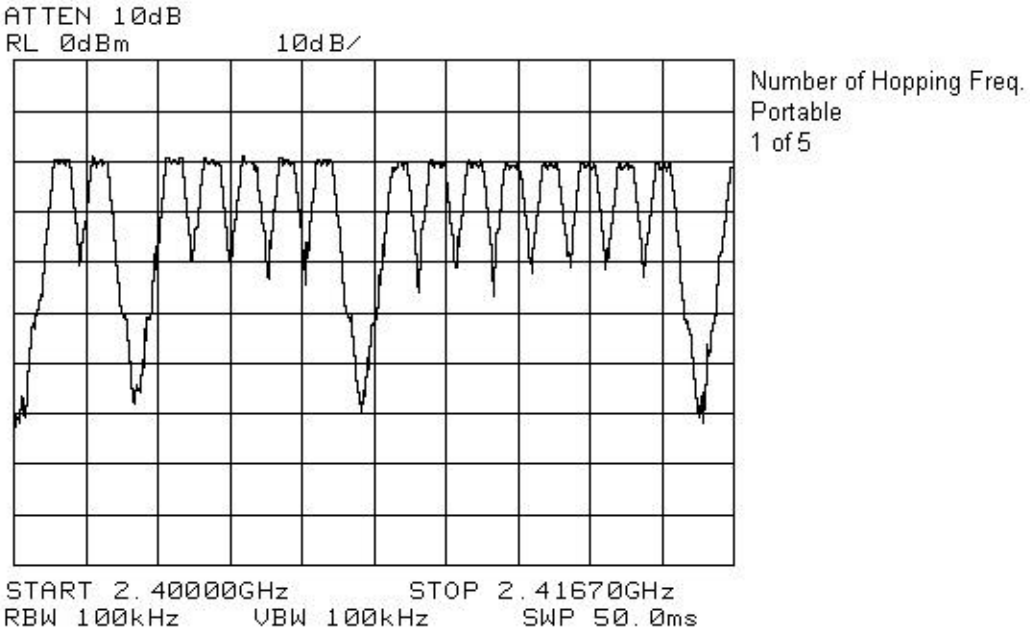

ATTEN 10dB
RL 0dBm
10dB/
ΔMKR 0dB
-880kHz
Number of Hopping Freq.
Base Station
1 of 5
START 5.72500GHz
STOP 5.75000GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

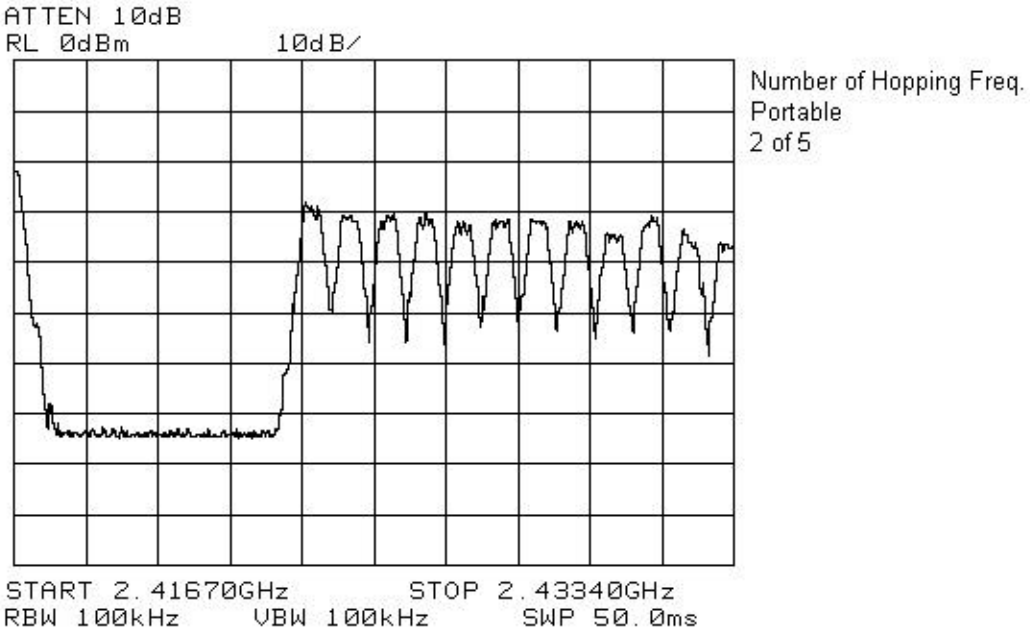

ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Base Station
2 Of 5
START 5.75000GHz
STOP 5.77500GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

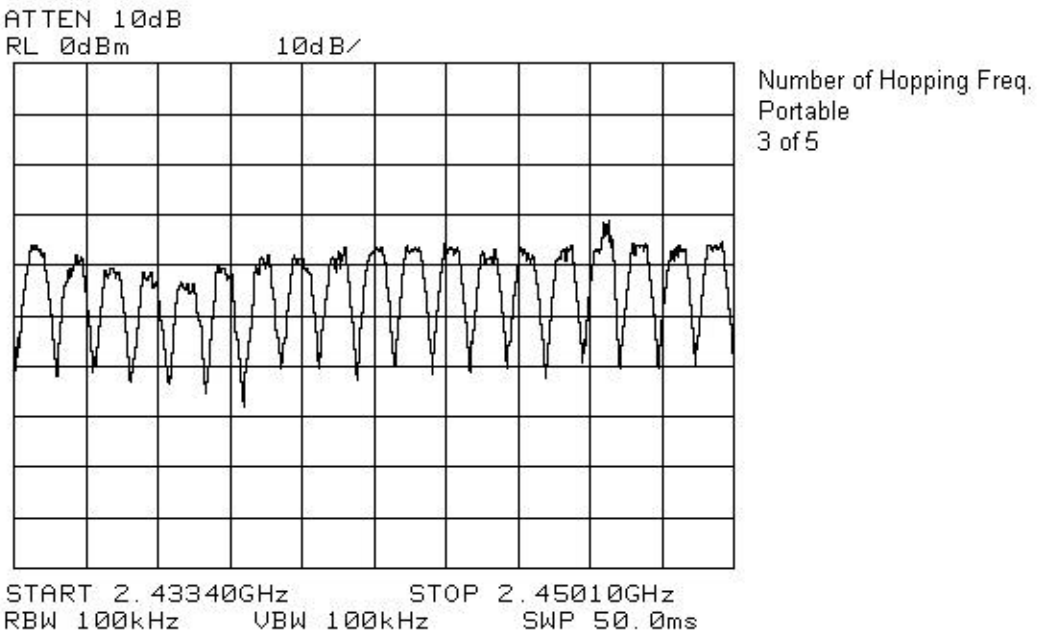

ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Base Station
3 Of 5
START 5.77500GHz
STOP 5.80000GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

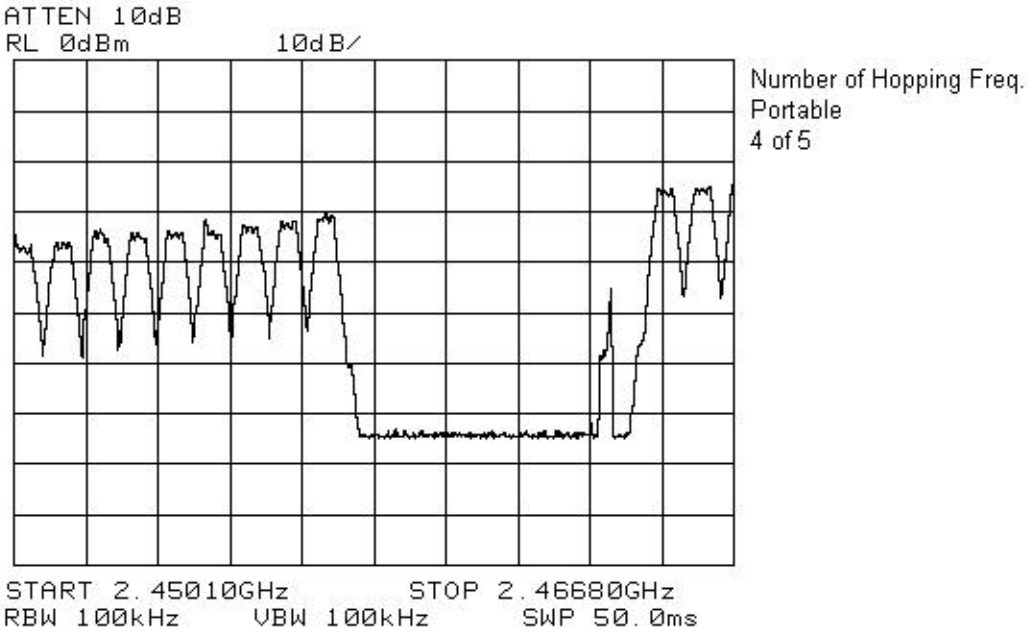

ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Base Station
4 of 5
START 5.80000GHz
STOP 5.82500GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

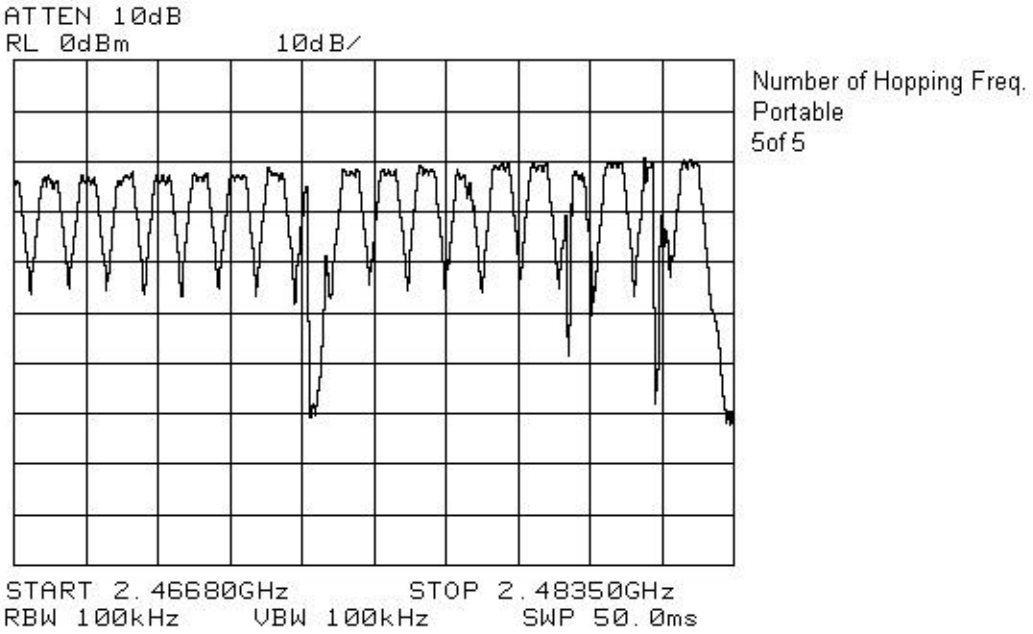

ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Base Station
5 of 5
START 5.82500GHz
STOP 5.85000GHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Portable
1 of 5
START 2.40000GHz
STOP 2.41670GHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Portable
2 of 5
START 2.41670GHz
STOP 2.43340GHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Portable
3 of 5
START 2.43340GHz
STOP 2.45010GHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Portable
4 of 5
START 2.45010GHz
STOP 2.46680GHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
Number of Hopping Freq.
Portable
5of5
START 2.46680GHz
STOP 2.48350GHz
RBW 100kHz
VBW 100kHz
SWP 50.0ms

Section 6. Time of Occupancy

Para. No.: 15.247 (a)(1)

Test Performed By: Glen Westwell	**Date of Test: 27 Feb 2002**

Test Results: Complies.

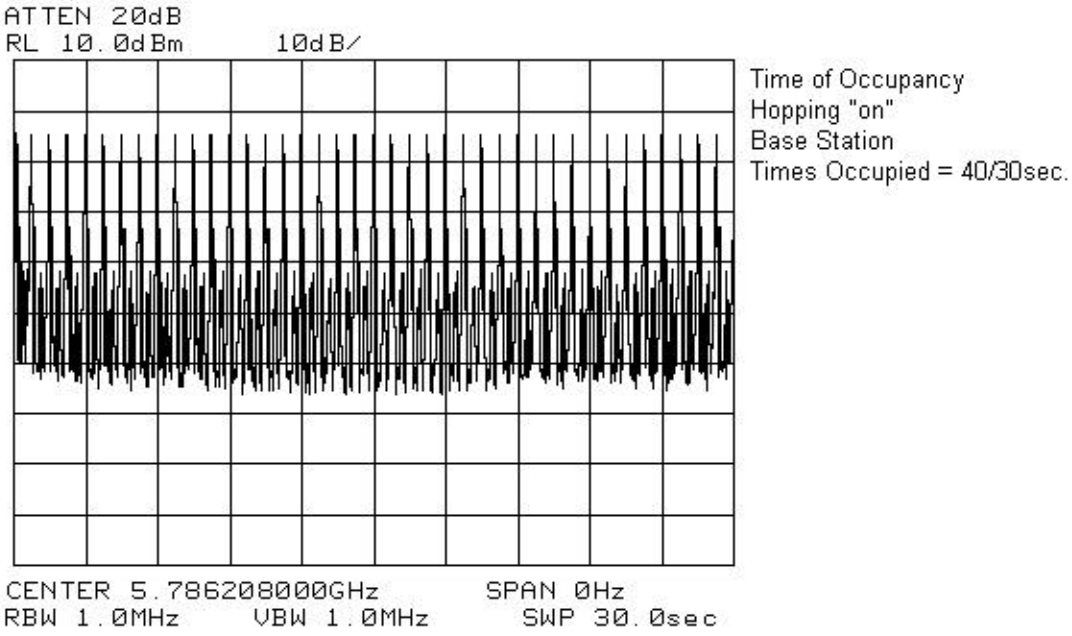
Measurement Data: Maximum Dwell Time On Any Channel:

Base:

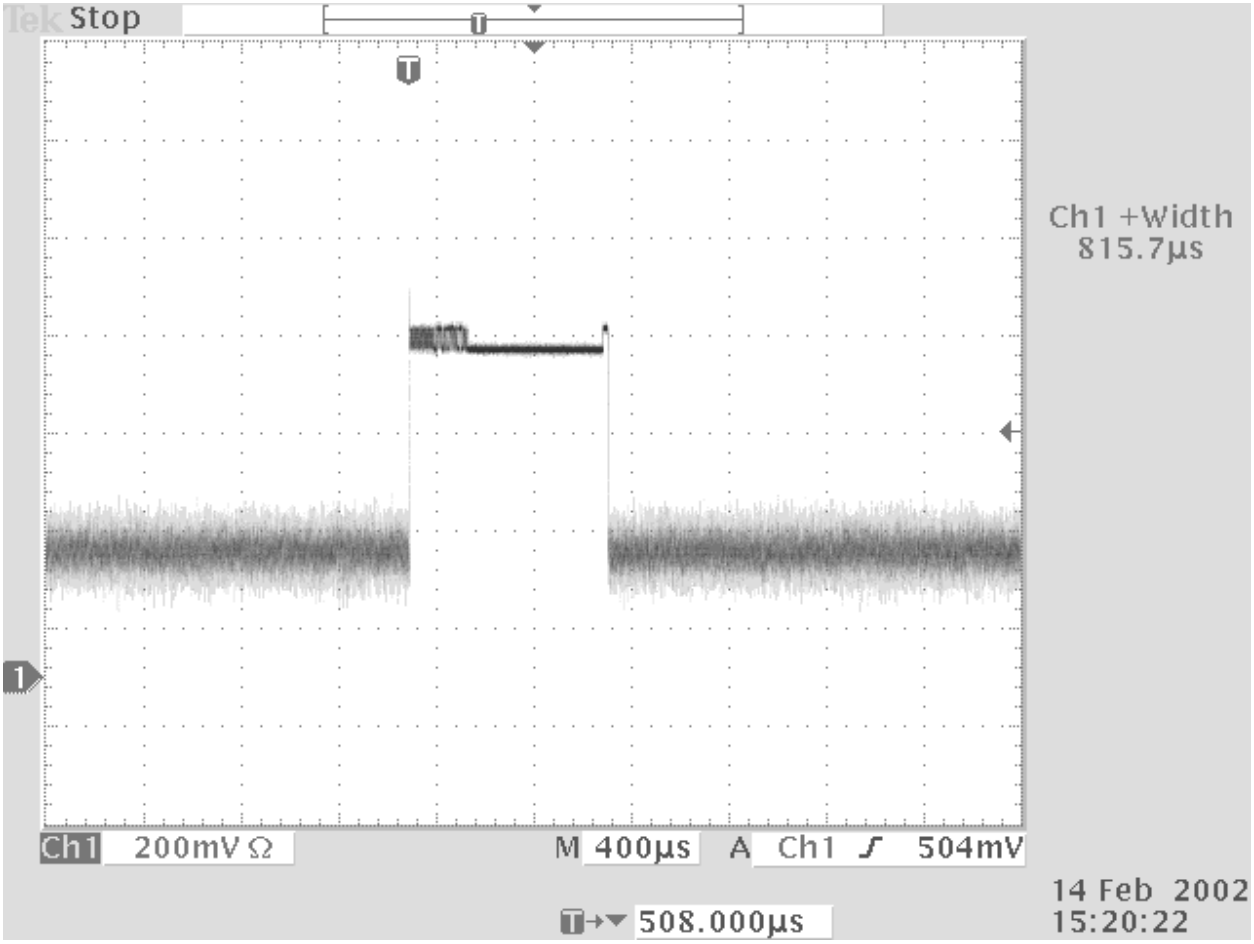
40 times occupied in 30sec period @ 815.7ìS = 32.6mS

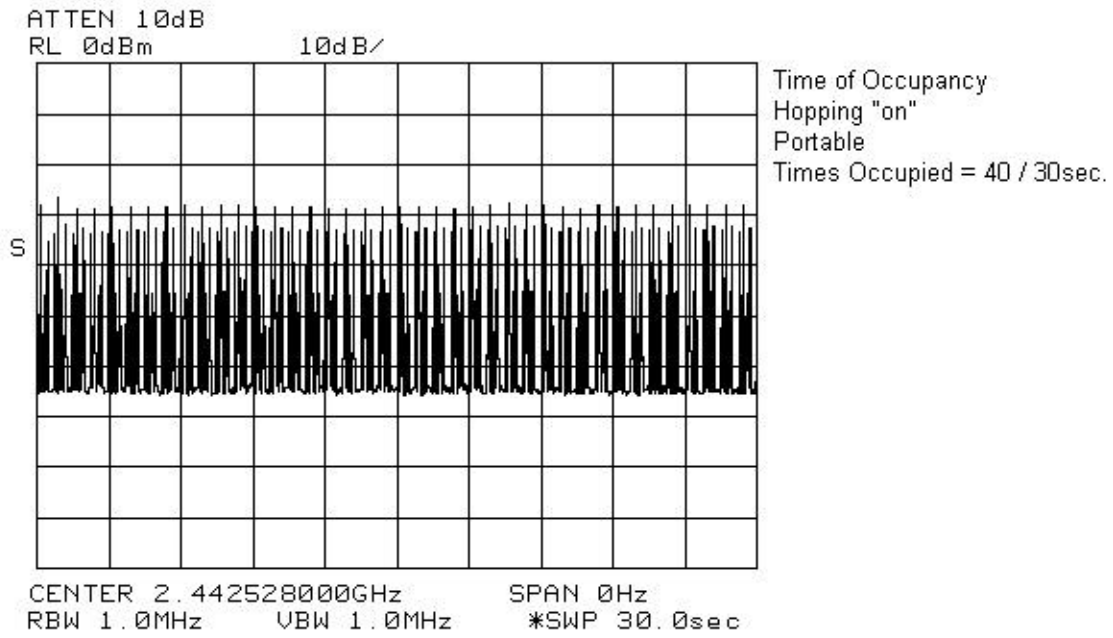
Portable:

40 times occupied in 30sec period @ 809.5ìS = 32.4mS

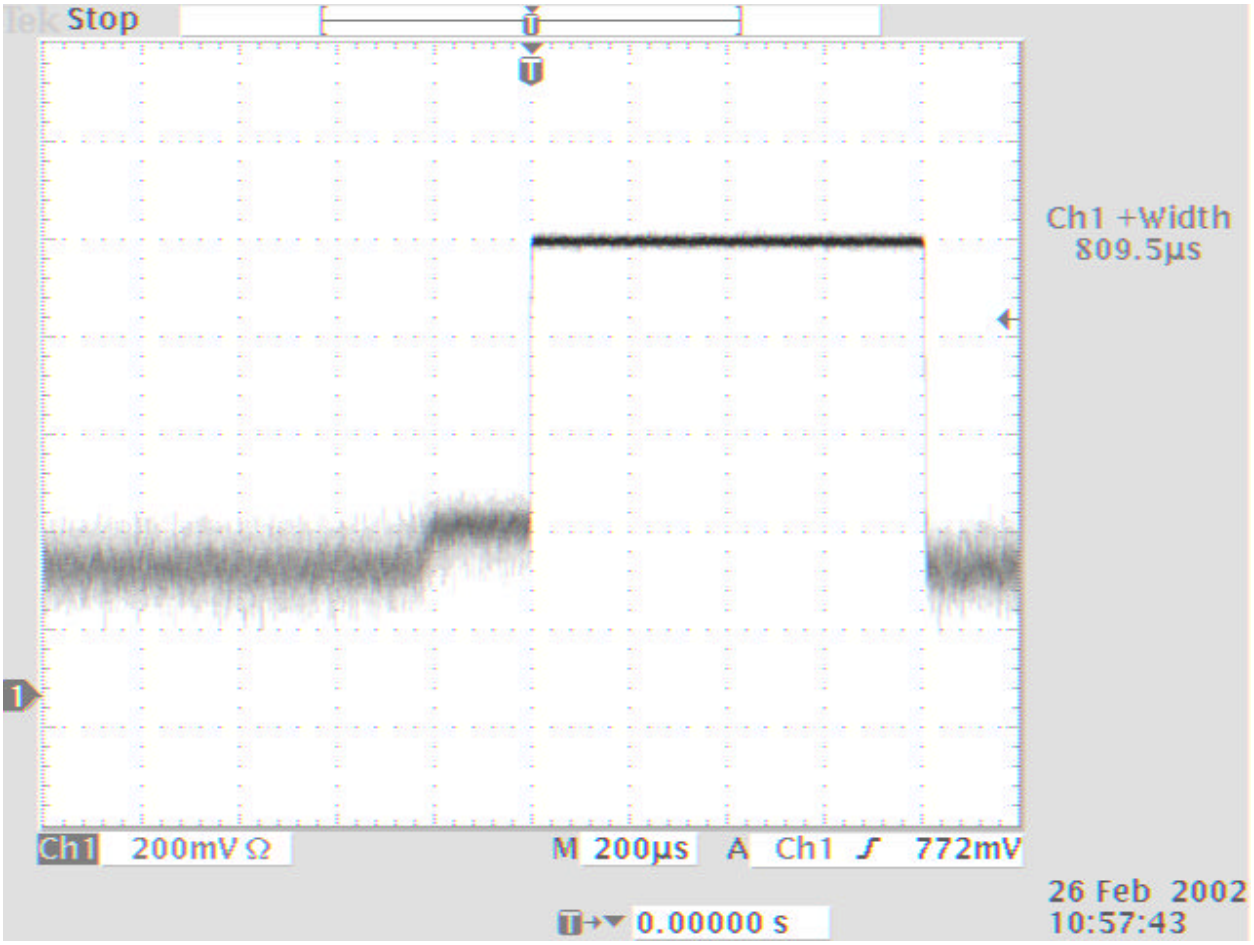

ATTEN 20dB
RL 10.0dBm
10dB/
Time of Occupancy
Hopping "on"
Base Station
Times Occupied = 40/30sec.
CENTER 5.786208000GHz
SPAN 0Hz
RBW 1.0MHz
VBW 1.0MHz
SWP 30.0sec

BASE


Stop
Ch1 +Width
815.7µs
Ch1 200mV Ω
M 400µs A Ch1 504mV
508.000µs
14 Feb 2002
15:20:22


ATTEN 10dB
RL 0dBm
10dB/
S
Time of Occupancy
Hopping "on"
Portable
Times Occupied = 40 / 30sec.
CENTER 2.442528000GHz
SPAN 0Hz
RBW 1.0MHz
VBW 1.0MHz
*SWP 30.0sec

Portable


Stop
Ch1 +Width
809.5µs
Ch1 200mV Ω
M 200µs A Ch1 772mV
0.00000 s
26 Feb 2002
10:57:43

Section 7. Occupied Bandwidth

Para. No.: 15.247 (a)(1)(i)

Test Performed By: Glen Westwell	**Date of Test: 27 Feb 2002**

Test Results: Complies.

Measurement Data: 667KHz.
See Attached Plots.