



# *CSM800FH*

## *User Manual*

Revision	Modified		Checked		Module Name
	Date	By	Date	By	
					<b>CSM800FH</b>
					<b>Description</b>
					800/900 MHz RF Module with Frequency Hopping
					<b>Remarks</b>
					Uses CSM800 Hardware, Item #66990008
					<b>Item Number</b>
					669900xx

TABLE OF CONTENTS

1. TABLE OF CONTENTS..... 2  
2. FUNCTIONAL DESCRIPTION..... 3  
3. FCC COMPLIANCE NOTIFICATIONS..... 4  
4. SETUP AND ADJUSTMENT PROCEDURE..... 5  
5. APPROVED ANTENNA LIST.....5  
6. LABEL PLACEMENT..... 5  
7. TECHNICAL SPECIFICATIONS ..... 6  
8. MICROCONTROLLER INTERFACE ..... 7  
9. HOP SEQUENCES ..... 8

TABLE OF FIGURES

Figure 1: Label placement ..... 5  
Figure 2: CSM FH Pin Layout..... 7

 <b>HETRONIC</b> Research and Development Technical Documentation Form Rev. A	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	2 of 10

## 2. FUNCTIONAL DESCRIPTION

**CSM800FH FCC ID: LW9-CSM800FH**

**Canada ID: 2119B-CSM800FH**

Operates as a Frequency Hopping Spread Spectrum radio within the 902 to 928 MHz band. A guard band of 175 kHz is applied at each side of the band to limit out-of-band emissions. The first possible operating channel is centered at 902.175 MHz. Due to rounding, the last used operating channel is 927.7224 MHz.

Due to the large available operating bandwidth, the band is divided into 250 equally spaced operating channels, with a 102.6 kHz channel spacing. Of the 250 operating channels, 5 groups of 50 equally spaced, non-overlapping, channels are utilized under normal operation. Channel spacing within a group is 513 kHz. The channel group (0-4) is determined by a configurable Network ID which must be transmitted to the CSM800FH via serial interface before normal operation can begin. The channel group is given by the equation:

$$\text{ChannelGroup} = \text{NetworkID} \% 5$$

The dwell time for each of the 50 operating channels is 20 milliseconds within a 1 second period. Each of the 50 channels is occupied only once during each 1 second period.


The hopping sequence (channel index order) is determined by a pseudo-random algorithm which takes the Network ID as input and which guarantees each channel is used only once within the sequence of 50 channels. When all 50 channels have been used, the hopping sequence repeats. Each non-overlapping channel group utilizes the same hopping sequences, thus the number of unique hopping sequences is  $250 / 5 = 50$ . The hop sequence number (0-49) is given by the following equation.

$$\text{HopSequence} = \frac{\text{NetworkID}}{5}$$

Note that with a possible Network ID value of 255, 2 additional Hop Sequence indexes can be obtained (50 and 51), but these yield the same channel sequence as Hop Sequence 0 and 1.

<b>CSM800FH FHSS Operating Parameters – North America</b>	
Operating Band	902-928 MHz
First Channel	902.175 MHz
Last Channel	927.7224 MHz
Total Number of Channels	250
Channel Spacing	102.6 kHz
Number of Channel Groups with Non-Overlapping Channels	5
Number of Channels per Group (Hops)	50
Group Channel Spacing	513 kHz
Dwell Time (within 1 second period)	20 ms

**Table 1 - CSM800FH FHSS Operating Parameters - North America**

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	3 of 10

### 3. FCC COMPLIANCE NOTIFICATIONS

#### FCC Part 15 Notice

“This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.”

#### ISED RSS-Gen Notice

“This device complies with Industry Canada’s licence-exempt RSSs. Operation is subject to the following two conditions:

- (1) This device may not cause interference; and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.”

“Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes :

- 1) l’appareil ne doit pas produire de brouillage;
- 2) l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.”

#### For Canadian User

CAN ICES-3 (B)/NMB-3(B)”

**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:


- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

“Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment”

**WARNING:** The OEM must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Hetricon FCC identifier for this product below.

**“Contains FCC ID: LW9-CSM800FH”**

**“Contains IC: 2119B-CSM800FH”**

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	4 of 10

**RF Exposure**

The Hetronic CSM800FH equipment has been approved for mobile applications where the equipment should be used at distances greater than 20cm from the human body. Operation at distances of less than 20cm is prohibited and requires additional SAR evaluation.

L'équipement Hetronic CSM800FH a été approuvé pour les applications mobiles où l'équipement doit être utilisé à des distances supérieures à 20 cm du corps humain. Le fonctionnement à des distances inférieures à 20 cm est interdit et nécessite une évaluation SAR supplémentaire.

**NOTE:** FCC/IC warnings are to be incorporated into the manuals as provided to the end user.

 <b>HETRONIC</b> Research and Development Technical Documentation Form Rev. A	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	5 of 10

#### 4. Setup and Adjustment Procedure

The CSM800FH is factory tested and setup during the approved end control process. Any settings and adjustments are performed by factory trained personnel. No final adjustments are required by the end user.

#### 5. Approved Antenna List

Item	Part Number	Mgf.	Type	Gain (dB)
1	66504100	Hetronic	Omnidirectional	Unity
2	EXC902	Laird	Omnidirectional	Unity
3	M202020R10007	Ventev	Omnidirectional	2 bBi

Table 2 – Approved Antenna List

#### 6. Label Placement

The actual labeled and assembled unit will look similar to the one pictured below:



Figure 1

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	6 of 10

## 7. TECHNICAL SPECIFICATION

Electrical Specifications <sup>1,2</sup>					
Parameter	Min.	Typ.	Max.	Unit	Notes
Supply Voltage (V <sub>CC</sub> )	2.9	3.3	5.5	V DC	
Transmit Mode Supply Current		42		mA	V <sub>CC</sub> = 4V, 10 dBm output, 50 ohm load.
Receive Mode Supply Current		34		mA	V <sub>CC</sub> = 4V.
Input Voltage on I/O pins			5	V DC	
RF Specifications <sup>1,2</sup>					
Parameter	Min.	Typ.	Max.	Unit	Notes
RF Output Power <sup>3</sup>	9	9.5	10	dBm	For 10 dBm operating region. After factory calibration.
RF Input / Output Impedance	50			Ohms	
RF Load VSWR			10:1		
Receiver Sensitivity (BER < 10 E-3)		-112		dBm	4.8 kbps, 2.7 kHz, FSK.
Frequency Accuracy		1	1.5	ppm	Over operating temp. range.
Receiver Input RF level			10	dBm	
Modulation Format	2FSK				
Additional Notes					
<sup>1</sup> All tests performed at V <sub>CC</sub> = 4V and T <sub>OP</sub> = +25°C unless otherwise noted. <sup>2</sup> Test results for CSM800 operating as CSM800TR <sup>3</sup> Maximum output power varies according to operating region requirements.					

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	7 of 10

## 8. Microcontroller Interface

### Pin Layout

CSM FH uses a pin layout compatible with legacy Hetronic radio modules. This layout allows the CSM FH to be used in devices that accept direct installation of the legacy module. Please note, however, that the pins are not utilized the same way as the legacy radios, and software modification of devices is required to make use of the CSM FH radio module.

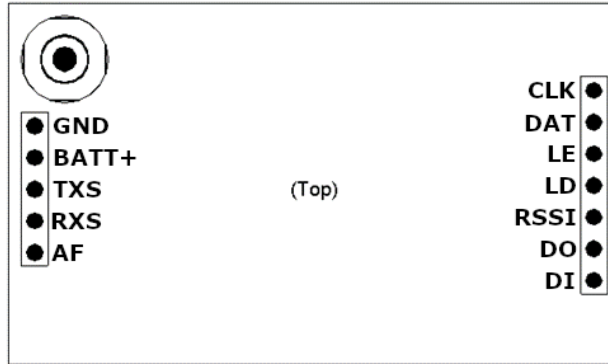


Figure 2 - CSM FH Pin Layout

### Pin Description

Pin Label	Type	FH Pin Description
GND	S	Negative Supply Input, 0 V DC (Ground)
BATT+	S	Positive Supply Input, 2.9-5.5 V DC
TXS	IPU	Not Used <sup>1</sup>
RXS	IPU	Not Used <sup>1</sup>
AF	O	Not Used <sup>3</sup>
CLK	IPU	Not Used <sup>1</sup>
DAT	I	Not Used <sup>1</sup>
LE	I	Not Used <sup>1</sup>
LD	O	Not Used <sup>2</sup>
RSSI	O	Not Used <sup>3</sup>
DO	O	UART command data out (CSM -> Host)
DI	IPU	UART command data in (Host -> CSM)

(S = Supply, I = Input, O = Output, B = Bi-Directional, PU = Pullup, PD = Pulldown)

Table 2 - CSM FH Pin Descriptions

Notes:

- 1 – These unused pins are pulled to BATT+ internally.
- 2 – The LD pin is driven LOW under CSM FH operation.
- 3 – The RSSI and AF pins are used for diagnostic output for the FHSS sub-system.

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	8 of 10



## 9. HOP SEQUENCES

The tables below provide the unique hop sequences generated based on the Network ID. The channel numbers in the table below correspond to a channel index within the Channel Group table. For example, if the Hop Sequence # is 0, the first hop is at group channel 28 (found below in Table 3). For Group 0, channel 28 is centered at 916.539 MHz (found above in Table 2).

Hop Sequences (Indexes to Frequency/ Channel Tables)																										
Hop Index	Hop Sequence # (Network ID / 5) [0-25]																									
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
0	28	30	49	2	24	33	41	6	12	1	40	14	10	47	0	39	25	11	22	29	9	15	42	21	31	27
1	13	8	35	10	43	0	3	44	48	29	25	47	2	14	33	17	40	21	7	1	15	9	31	11	42	20
2	8	45	0	17	18	29	13	27	35	4	26	12	39	48	1	19	36	22	31	23	16	5	32	7	38	3
3	44	27	18	5	22	47	34	10	43	12	4	38	16	32	14	25	23	28	8	48	33	0	45	13	37	39
4	2	39	31	1	8	32	26	16	7	43	35	21	29	11	38	23	49	44	20	24	47	14	3	6	41	25
5	35	0	6	42	26	20	48	18	19	3	11	39	31	17	27	38	21	4	9	41	8	30	5	23	16	14
6	30	37	33	39	46	1	28	20	49	23	36	48	17	12	29	34	26	7	42	4	5	16	38	22	32	41
7	25	26	11	49	3	7	5	4	37	31	14	8	35	30	22	33	47	39	19	42	43	24	6	17	44	9
8	21	22	4	6	12	15	45	28	29	16	39	33	44	0	9	20	17	38	43	5	36	26	18	32	46	8
9	33	1	27	32	10	41	49	14	44	28	22	19	38	34	3	43	7	9	16	13	37	45	40	15	25	12
10	10	17	42	29	30	38	36	5	22	24	49	11	1	21	32	4	35	6	27	43	14	47	41	44	3	40
11	41	28	12	26	38	49	27	19	47	33	16	46	36	18	35	2	5	37	21	0	23	4	22	45	7	44
12	45	21	29	19	47	4	8	41	0	15	2	49	34	35	23	6	10	42	32	9	40	25	43	31	24	13
13	11	7	23	44	48	9	37	13	1	5	17	0	6	33	15	27	39	32	24	16	26	36	46	38	18	30
14	22	42	15	20	49	16	21	30	4	40	34	1	27	29	5	3	19	24	18	25	10	2	47	43	14	45
15	31	32	5	41	0	25	7	45	9	26	6	4	3	23	40	28	44	18	14	36	39	17	48	46	12	11
16	38	24	40	13	1	36	42	11	16	10	27	9	28	15	26	8	20	14	12	2	19	34	49	47	35	22
17	43	18	26	30	4	2	32	22	25	39	3	16	8	5	10	37	41	12	35	17	44	6	0	48	33	31
18	48	35	19	22	25	6	14	43	17	20	37	2	7	10	44	42	45	29	23	27	13	28	9	1	15	46
19	9	5	30	47	6	37	23	0	28	11	24	3	14	41	45	12	43	26	10	21	31	42	17	36	39	1
20	6	20	46	16	7	14	19	2	24	48	23	32	5	38	47	40	4	13	30	12	0	33	37	28	45	17
21	32	43	25	28	29	26	31	21	5	2	20	15	13	9	36	30	27	47	48	10	34	19	35	14	49	7
22	40	36	21	35	41	22	16	23	45	42	47	30	49	8	7	0	14	17	34	31	24	43	44	39	6	15
23	46	14	10	45	9	17	24	31	36	19	28	25	37	40	39	21	13	35	33	34	20	27	1	49	29	38
24	27	41	47	25	42	12	44	17	18	49	15	24	40	43	48	26	9	30	45	35	1	29	21	8	11	34
25	15	16	8	14	44	45	4	33	13	21	43	41	47	3	37	48	24	36	2	11	42	31	39	26	17	29
26	0	29	20	38	2	3	35	47	6	13	7	34	32	19	41	24	22	15	5	28	45	37	25	9	40	48
27	18	47	2	37	15	39	43	42	26	34	13	40	45	25	17	11	28	49	0	19	27	20	29	35	1	32
28	47	12	39	11	16	34	18	38	2	44	8	36	21	26	19	7	30	33	29	6	41	3	4	0	23	43
29	14	48	17	21	5	19	46	32	10	6	30	26	11	36	34	22	8	0	1	44	3	41	23	33	4	24
30	4	15	13	46	34	8	29	49	3	45	32	27	18	20	30	14	38	40	26	37	22	7	2	25	10	0
31	26	2	7	33	13	31	25	15	11	32	48	45	0	37	42	1	12	34	6	38	18	46	20	19	27	5
32	37	11	1	34	14	23	30	3	33	9	10	35	19	49	4	44	2	31	38	15	25	40	24	42	43	28
33	1	23	41	43	17	28	33	48	27	30	42	6	24	44	13	18	31	5	40	8	11	21	36	16	26	49
34	20	3	14	40	31	48	6	39	46	35	9	43	25	24	12	36	15	8	37	49	29	1	11	30	21	19
35	29	4	3	24	39	13	0	12	20	8	31	44	43	6	28	46	42	16	25	30	21	11	26	5	36	35
36	42	38	16	3	33	40	22	37	15	36	44	23	41	4	25	13	6	46	47	26	17	39	12	18	48	21
37	3	13	48	36	32	35	20	34	14	0	5	18	26	46	49	10	16	45	11	33	4	23	7	37	22	6
38	17	19	38	4	37	24	10	25	42	46	33	7	23	22	43	15	0	20	41	18	48	12	28	27	13	36
39	36	10	22	0	28	42	40	9	21	38	12	37	33	45	31	29	48	19	44	32	46	18	27	34	20	16
40	5	25	37	12	20	11	9	29	30	7	46	13	48	28	21	49	18	2	17	22	32	38	19	10	34	23
41	23	9	28	18	19	30	1	35	41	37	38	20	46	27	8	47	32	25	36	45	7	22	10	40	2	33
42	12	49	34	7	40	44	47	24	39	27	45	10	22	2	6	31	37	1	4	20	28	13	15	29	9	18
43	7	31	9	27	35	5	11	8	23	25	19	29	20	1	16	41	34	43	46	40	2	10	14	24	47	37
44	34	44	43	9	21	18	39	36	32	47	29	42	15	31	46	5	1	41	13	14	49	35	8	3	30	2
45	49	33	44	31	36	27	12	46	34	41	21	17	42	39	20	32	11	23	15	3	30	8	16	4	5	47
46	19	6	24	15	11	46	17	26	38	14	1	31	9	42	18	16	29	3	28	47	35	49	30	41	8	10
47	24	46	36	8	23	10	38	7	40	17	41	5	30	16	2	45	3	48	49	39	6	44	33	12	0	42
48	16	40	45	48	27	21	15	1	8	22	18	28	12	13	11	35	46	10	39	7	38	32	34	2	19	4
49	39	34	32	23	45	43	2	40	31	18	0	22	4	7	24	9	33	27	3	46	12	48	13	20	28	26


Table 3 - CSM800FH Hop Sequences (0-25) - North America

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	9 of 10

Hop Sequences (Indexes to Frequency/ Channel Tables)																										
Hop Index	Hop Sequence # (Network ID / 5) [26-51]																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
0	23	20	32	8	4	46	3	16	44	35	38	48	7	36	34	37	18	45	26	19	43	5	17	13	28	30
1	4	27	38	30	23	18	41	5	6	49	32	12	22	26	19	45	46	37	36	34	24	16	39	28	13	8
2	15	41	24	37	9	47	28	25	20	33	43	49	42	2	6	21	14	11	10	44	46	40	34	30	8	45
3	49	17	11	20	35	42	19	29	2	46	21	24	30	15	26	41	31	3	9	36	7	1	40	6	44	27
4	18	40	28	17	46	45	36	48	5	42	13	22	27	0	9	34	37	19	33	15	30	12	4	10	2	39
5	13	47	40	33	28	2	12	37	46	44	25	34	15	7	24	29	10	1	22	43	36	45	32	49	35	0
6	9	3	43	45	15	14	13	40	27	0	24	35	31	10	44	11	47	21	2	6	18	25	19	8	30	37
7	32	15	27	36	38	13	16	46	23	21	20	45	34	48	1	2	28	10	12	29	41	18	0	40	25	26
8	40	30	14	7	25	49	37	2	13	23	47	1	24	34	3	42	35	31	19	41	48	10	27	11	21	22
9	30	48	26	29	8	17	35	21	47	20	36	6	5	42	18	23	39	4	31	46	2	11	24	0	33	1
10	46	25	13	39	18	37	26	12	16	31	28	7	20	33	15	19	45	34	0	9	8	48	23	2	10	17
11	1	6	31	13	29	24	20	15	34	48	42	14	11	40	39	30	43	8	25	17	32	9	10	3	41	28
12	16	28	46	11	5	12	30	26	3	1	18	33	38	39	20	22	48	7	17	27	14	36	44	37	45	21
13	25	8	47	22	40	35	45	10	28	4	14	29	43	19	41	31	49	42	34	3	12	2	20	21	11	7
14	36	37	48	31	26	33	11	39	8	9	12	23	46	44	13	38	0	32	6	28	35	17	41	7	22	42
15	2	21	49	38	10	29	22	19	37	16	35	15	47	20	30	43	1	24	27	8	33	34	13	42	31	32
16	17	7	0	43	39	23	31	44	21	25	33	5	48	41	45	46	4	18	3	37	29	6	30	32	38	24
17	34	42	1	46	19	15	38	20	7	36	29	40	49	13	11	47	9	14	28	21	23	27	45	24	43	18
18	3	18	16	49	41	26	47	30	24	34	5	39	4	11	38	0	36	33	21	32	40	8	31	12	48	35
19	7	29	34	16	22	20	4	38	33	8	19	13	2	46	49	25	27	40	18	35	44	32	48	15	9	5
20	35	39	21	27	49	31	34	1	10	18	11	43	8	9	36	3	42	41	15	26	22	29	25	44	6	20
21	39	22	33	24	17	4	42	6	11	40	0	16	12	3	37	18	23	46	41	45	1	44	8	38	32	43
22	38	9	20	26	32	28	5	18	4	11	27	37	19	12	29	10	13	2	48	1	3	46	33	25	40	36
23	6	32	4	47	44	5	43	41	42	2	23	26	0	30	22	48	16	12	8	7	15	3	11	18	46	14
24	33	19	7	3	0	38	6	4	39	14	22	46	37	16	2	28	32	13	5	10	31	23	36	20	27	41
25	22	1	19	5	7	27	23	32	0	30	34	28	10	18	35	40	20	25	46	49	6	38	12	9	15	16
26	8	12	36	1	30	39	49	11	14	27	26	44	16	31	46	4	17	23	42	18	10	21	43	33	0	29
27	44	38	23	14	6	16	24	3	31	10	4	36	33	8	7	12	5	48	30	22	9	41	21	46	18	47
28	27	24	9	48	20	40	46	13	32	17	15	10	1	45	31	49	25	35	37	42	5	28	22	14	47	12
29	20	43	15	12	27	25	18	28	38	39	9	2	29	37	42	35	40	49	45	31	16	13	7	47	14	48
30	21	33	17	9	11	44	1	31	35	28	39	41	36	43	48	16	6	5	24	12	19	42	47	23	4	15
31	43	16	41	10	24	8	40	14	9	22	3	21	44	35	23	39	30	17	49	4	28	47	29	36	26	2
32	5	13	18	21	16	48	8	36	41	29	46	0	32	17	27	7	12	22	39	20	47	26	6	45	37	11
33	37	35	2	4	45	19	0	22	12	3	10	20	25	38	47	9	34	15	32	14	39	7	46	29	1	23
34	0	34	22	41	33	32	44	23	17	47	7	18	45	5	10	13	38	28	16	2	42	4	26	27	20	3
35	45	49	10	23	37	34	33	7	48	41	2	27	40	32	14	15	19	9	38	47	17	22	18	1	29	4
36	10	11	35	32	2	1	7	34	45	5	49	9	14	27	8	24	29	43	20	30	0	19	28	31	42	38
37	29	44	42	28	1	43	27	9	19	12	31	47	21	25	17	8	24	30	40	39	38	15	2	41	3	13
38	14	26	8	34	47	11	2	49	40	32	30	31	3	1	16	6	21	44	29	5	45	35	9	39	17	19
39	24	5	3	2	43	30	25	47	15	7	41	11	6	49	4	17	8	39	35	23	13	14	1	26	36	10
40	31	4	44	40	42	3	15	24	1	45	6	8	39	14	33	26	41	36	47	0	27	43	35	16	5	25
41	11	0	39	15	21	6	29	42	49	13	17	3	26	24	12	5	44	16	43	48	34	31	14	4	23	9
42	41	46	5	35	3	36	14	8	43	19	16	17	23	21	32	33	26	0	11	38	25	30	42	48	12	49
43	26	45	12	42	36	0	21	17	30	15	48	4	18	6	28	32	33	38	44	13	49	39	3	22	7	31
44	12	10	37	6	48	22	17	0	26	24	45	38	28	4	25	27	7	20	23	40	11	33	16	19	34	44
45	28	14	25	0	13	10	48	45	18	6	40	19	9	22	43	1	2	29	7	24	26	37	38	35	49	33
46	48	2	45	44	12	7	39	33	36	43	37	32	13	23	40	20	22	27	4	25	21	0	5	34	19	6
47	19	31	29	18	34	9	32	27	22	26	1	25	35	28	21	14	15	47	13	11	4	20	37	43	24	46
48	42	23	6	25	31	41	9	43	29	37	44	30	17	47	0	36	3	26	14	33	20	24	49	5	16	40
49	47	36	30	19	14	21	10	35	25	38	8	42	41	29	5	44	11	6	1	16	37	49	15	17	39	34

Repeated

Table 4 - CSM800FH Hop Sequences (26-51) - North America

	Revision	Project:		Page
		Description:	800/900 MHz RF Module with Frequency Hopping	10 of 10