GE Phoenix SX and PSX Programming Data Formats

This document was adapted from VO1CPU's excellent page on Phoenix radios. The original frequency conversion algorithm and documentation is credited to Jean-Marie Houle (VE2AEY). Tim (KE3HT) contributed the X2444 and general programming information. I took the liberty of compiling this information into a single comprehensive document with additions from original GE manuals to create a single resource of programming information for Phoenix radio enthusiasts.

I program the radio by removing the X2444p serial EEPROM from its socket on the top of the radio. Then I use a standard programmer to read/write the data. If you have a normal EPROM programmer it may have the ability and you can avoid the mess of the GE programming methods. I have plagiarized VO1CPU's document to reflect what I have added to support this type of GE Phoenix without the GE programmer. A special note, the bytes are listed with a number to the left that represents the GE programmer but NOT a normal EPROM programmer. The halves of the nibbles are reversed due to the way the 16 bit words are handled.

FREQUENCY CONVERSION ALGORITHM

First we compute N, A and R bit values. Note that A6 is always zero in the following examples:

Example 1: 146.52 receive

Add the IF frequency 146.52 + 45.0 = 191.52

Divide by the channel spacing 191.52 / .005 = 38304 (95A0h)

95A0h	1	0	0	1	0	1	0	1	1	0	1	0	0	0	0	0
Gives N & A	N9	N8	N7	N6	N5	N4	N3	N2	N1	N0	A5	A4	A3	A2	A1	A0

Example 2: 146.52 transmit

Divide by the channel spacing 146.52 / .005 = 29304 (7278h)

7278h	0	1	1	1	0	0	1	0	0	1	1	1	1	0	0	0
Gives N & A	N9	N8	N7	N6	N5	N4	N3	N2	N1	N0	A5	A4	A3	A2	A1	A0

Example 3: 462.70 receive

Add the IF frequency 462.70 + 45.0 = 507.70

Divide by the channel spacing 507.70 / .0125 = 40616 (9EA8h)

9EA8h	1	0	0	1	1	1	1	0	1	0	1	0	1	0	0	0
Gives N & A	N9	N8	N7	N6	N5	N4	N3	N2	N1	N0	A5	A4	A3	A2	A1	A0

Example 4: 462.70 transmit

Divide by the channel spacing 462.70 / .0125 = 37016 (9098h)

9098h	1	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0
Gives N & A	N9	N8	N7	N6	N5	N4	N3	N2	N1	N0	A5	A4	A3	A2	A1	A0

The reference divisor (0.005 MHz, 0.00625 MHz or 0.0125 MHz) listed below MUST be same for Transmit and Receive for any given channel. The reference divisor R2, R1 and R0 values are as follows:

R2	R1	R0		
0	0	1	Ref. oscilator 13.2 MHz	channel spacing .0041666 (.0125 UHF)
0	1	0	Ref. oscilator 13.2 MHz	channel spacing .005 (VHF & Most common)
0	1	1	Ref. oscilator 13.2 MHz	channel spacing .00625
1	0	1	Ref. oscilator 13.8 MHz	channel spacing .0041666 (.0125 UHF)
1	1	0	Ref. oscilator 13.8 MHz	channel spacing .005
1	1	1	Ref. oscilator 13.8 MHz	channel spacing .00625

PHOENIX SX (X2212 NVRAM) DATA STRUCTURE

The Phoenix SX radios used a 1024 bit (256 x 4 bit words) Xicor X2212 serial NVRAM storage chip. In these radios the N, R and A data are stored in eight bytes per frequency with the lower nibbles containing the channel data as follows:

RECEIVE:

Byte 0:	Channel Guard type	(See Table 2)
Byte 1:	N9, R2, R1, R0	
Byte 2:	N4, N3, N2, N1	
Byte 3:	N8, N7, N6, N5	
Byte 4:	A3, A2, A1, A0	
Byte 5:	N0, 0, A5, A4	(1111 if channel not used) A6 always 0
Byte 6:	CG code	(see Table 3 HEX CODE 6)
Byte 7:	CG code	(see Table 3 HEX CODE 7)

TRANSMIT:

Byte 0:	CCT	(See Table 4)
Byte 1:	N9, R2, R1, R0	
Byte 2:	N4, N3, N2, N1	
Byte 3:	N8, N7, N6, N5	
Byte 4:	A3, A2, A1, A0	
Byte 5:	N0, 0, A5, A4	(1111 if channel not used) A6 always 0
Byte 6:	CG code	(see Table 3 HEX CODE 6)
Byte 7:	CG code	(see Table 3 HEX CODE 7)

** Please note special codes for memory location 0F1h (number of channels in bank A),*
** 019h (number of channels in bank B) and 011h CCT time (see instructions).*

PHOENIX PSX (X2444 NVRAM) DATA STRUCTURE

The PSX-200 radios used a 256 bit (32 bytes) Xicor X2444 serial NVRAM storage chip. In these radios the N, R and A data are stored as packed bytes. The upper and lower nibbles of each byte contain the channel data. Each frequency requires 4 bytes (eight 4 bit nibbles) as follows:

RECEIVE:

Byte 00:	1	N9, R2, R1, R0	(left half of nibble)
	0	Channel Guard type	(See Table 2) (Right half of nibble)
Byte 01:	3	N8, N7, N6, N5	(Left half of nibble)
	2	N4, N3, N2, N1	(Right half of nibble)
Byte 02:	5	N0, 0, A5, A4	(1111 if channel not used) A6 always 0
	4	A3, A2, A1, A0	
Byte 03:	7	CG code	(see Table 3 HEX CODE 7)
	6	CG code	(see Table 3 HEX CODE 6)

So 145.09 would be input to a programmer as: `A0 29 02 00`
145.05 would be input to a programmer as: `A0 28 BA 00`
462.70 would be input to a programmer as: `90 3D 28 00`

TRANSMIT:

Byte 00:	1	N9, 0, 0, 0	
	0	CCT	(see Table 4)
Byte 01:	3	N8, N7, N6, N5	
	2	N4, N3, N2, N1	
Byte 02:	5	N0, 0, A5, A4	
	4	A3, A2, A1, A0	
Byte 03:	7	CG Code	(see Table 3 HEX CODE F)
	6	CG Code	(see Table 3 HEX CODE E)

So 145.09 would be input to a programmer as: `08 E2 9A 00` (CCT = 30 secs)
145.05 would be input to a programmer as: `08 E2 92 00` (CCT = 30 secs)
462.70 would be input to a programmer as: `88 21 18 00` (CCT = 30 secs)
467.70 would be input to a programmer as: `88 24 28 00` (CCT = 30 secs)

** Please note special codes for memory location 0F1h (number of channels in bank A),*
** 019h (number of channels in bank B) and 011h CCT time (see instructions).*

Once you have all this data written down you can then convert it to the format used by a normal serial EEPROM programmer. The ELNEC PREPROM-02aLV or the MCT MOD-EMP Universal programmers work well.

X2444P mode A/B chip has the memory layout of:

Mode A receive:	00h - 03h
Mode B receive:	04h - 07h
Mode A transmit:	08h - 0Bh
Mode B transmit:	0Ch - 0Fh

Example read from an X2444P chip with an EPROM programmer is:

```
00h:  A0 29 02 00       A0 27 B6 00       Receive
08h:  08 E2 9A 00       08 E1 8E 00       Transmit
      Mode A            Mode B
      Simplex           Simplex
      145.09            144.39
      CCT 30 secs       CCT 30 secs
```

Example write to an X2444P chip made by an EPROM programmer is:

```
00h:  A0 2B AE 00       A0 28 BA 00       Receive
08h:  0D E5 06 00       08 E2 92 00       Transmit
      Mode A            Mode B
      146.91x           145.05
      146.31r           Simplex
      CCT 3 mins        CCT 30 secs
```

The following shows a memory dump of the X2444P after programming a PSX-200 for GMRS use on simplex 462.700 and repeater 462.700(output) 467.700 (input) frequencies. No PL tones are currently programmed into the unit:

```
PG4U - universal program for Elnec programmers

From address: 000000  To address: 00010F   Date: 06/26/2001  Time: 9:26:39 AM

Address  +0 +1 +2 +3 +4 +5 +6 +7 +8 +9 +A +B +C +D +E +F  0123456789ABCDEF
-------------------------------------------------------------------------------
000000   90 3D 28 00 90 3D 28 00 88 21 18 00 88 24 28 00  •=(.•=(.^!..^$(.
000010   A9 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA  ©ªªªªªªªªªªªªªªª
000020   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000030   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000040   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000050   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000060   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000070   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000080   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
000090   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000A0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000B0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000C0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000D0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000E0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
0000F0   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ

000100   FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿ
```

PSX200.DOC – converted and updated by KG4LNE. Original document source was taken from psx200.txt tpe 6/23/00 ke3ht@lmrgroup.com

TABLE 1

Channel Address Mode A or B		
Channel	**RX Address**	**TX Address**
1	2	3
2	4	5
3	6	7
4	8	9
5	A	B
6	C	D
7	E	F
8	0	1

TABLE 2

Channel Guard Type		
Function	**W/O STE Hex Code**	**With STE Hex Code**
NO CG or TONE CG ONLY	0	2
RX & TX DCG	E	C
RX DCG & TX TONE CG or NO TX CG/DCG	A	8
TX DCG & RX TONE CG or NO RX CG/DCG	6	4

STE = Squelch Tail Elimination.

CHANNEL GUARD

Channel Guard may be selected on a channel-by-channel basis in several possible configurations, such as:

- No Channel Guard.
- Tone CG only.
- Digital Code CG – RX & TX
- RX DCG & TX Tone CG or no TX CG
- TX DCG & RX Tone CG or no RX CG

See Table 2 for Hex codes for the type of Channel Guard selection. The Hex codes for CG tones and digital code are found in Table 3.

NOTE:

1) On wideband radios using DCG, an inverted digital code must be used (TX &RX). Refer to table 3-C.
2) Phoenix-SX UHF Mobile radios using the 19D901205G1-G3 Synthesizer/Interconnect Board must use INVERTED DCG (hex codes from Table 3-C). Check the 19D901205 board and verify that jumper W701 is removed and the jumper between HL65 and HL66 is installed.
3) On narrowband, VHF, hi-split radios (combination number digit 4 and 6 = K and 5) with DCG. The inverted digital code MUST be used for the RECEIVE CG ONLY. The TX DCG is NOT inverted

DISABLE TRANSMITTER

"Open" transmit or receive channels may be programmed. When a receive channel is blank, the receiver will stay muted. When a transmit channel is blank, the transmitter is disabled. To program an open channel the data address (under the 'Mode-A' function 5 or 'Mode-B' function D) is set to F. The remaining four data addresses no longer have any effect.

NUMBER OF CHANNELS

[NOT SURE ABOUT THIS SECTION!]

Program the number of channels in the radio to limit EEPROM search. If six channels or less, use the HEX Codes in Table 5. If there are more than six channels in Mode A or seven in Mode B, use the following procedure.

- ✍ From Table 7-C select the Hex code for 466-300 MHz. (Hex = 83283). The first transmit function code is the 8.
- ✍ From Table 5 select the Hex code for 8 channels. (Hex = 7).
- ✍ Find the sum of the two and convert back to Hex (i.e. 1st function code for TX FREQ = 8, plus Code for 8 channels = 7 gives 15 or 0Fh).

CCT TIMEOUT

The CCT timeout may be enabled or disabled on a per channel basis. The timeout delay that is selected will be the same for all channels. The CCT enable/disable bit in Table 4-A is used to enable or disable CCT timeout on a particular channel.

CCT BIT DELAY CODE

[NOT SURE ABOUT THIS SECTION!]

The CCT delay code must be programmed in the Channel 8 (*) position from Table 4-B. If channel 8 is used, the must be summed as in the following example.

- ✍ From Table 7-C select the Hex code for 466-425 MHz (Hex = 83228). The first Transmit function code is the 8.
- ✍ From Table 4-B select the Hex code for 3:00 minutes. (Hex = 5).
- ✍ Find the sum of the two and convert back to Hex (i.e. 1st function code for TX FREQ = 8, plus Code for 8 channels = 7 gives 15 or 0Fh).

TABLE 3-A

Tone Freq	Hex Code	
(A) (B)	6 E	7 F
NO CG	0	0
67.0	1	0
71.9	2	0
74.4	3	0
77.0	4	0
79.7	5	0
82.5	6	0
85.4	7	0
88.5	8	0
91.5	9	0
94.8	A	0
97.4	1	2
100.0	B	0
103.5	C	0
107.2	D	0
110.9	E	0
114.8	F	0
118.8	0	1
123.0	1	1
127.3	2	1
131.8	3	1
136.5	4	1
141.3	5	1
146.2	6	1
151.4	7	1
156.7	8	1
162.2	9	1
167.9	A	1
173.8	B	1
179.9	C	1
186.2	D	1
192.8	E	1
203.5	F	1
210.7	0	2

TABLE 3-B

Digital CG Data																	
DCG (A) (B)	HEX 67 EF		DCG (A) (B)	HEX (67) (EF)		DCG (A) (B)	HEX 67 EF		DCG (A) (B)	HEX 67 EF		DCG (A) (B)	HEX 67 EF		DCG (A) (B)	HEX 67 EF
023	31		261	79		654	37		023	72		261	47		654	AC
025	51		263	B8		662	3F		025	E7		263	D5		662	46
026	61		265	97		664	4E		026	F9		265	E6		664	9C
031	91		271	9B		703	B6		031	F1		271	53		703	7C
032	A1		305	76		712	E5		032	92		305	93		712	C4
043	32		311	9C		723	D9		043	29		311	4E		723	2B
047	72		315	DC		731	40		047	31		315	C9		731	D6
051	92		331	9D		732	47		051	A1		331	E2		732	79
054	C2		343	4D		734	63		054	B5		343	17		734	F8
065	53		346	6E		743	AC		065	9B		346	CA		743	37
071	93		351	9E		754	E3		071	76		351	3A		754	03
072	A3		364	85		036*	E1		072	5A		364	95		036*	A7
073	B3		365	74		053*	B2		073	49		365	55		053*	50
074	C3		371	F8		122*	25		074	26		371	63		122*	59
114	C4		411	F4		145*	56		114	65		411	44		145*	CB
115	D4		412	75					115	A6		412	35			
116	03		413	B5		212*	AB		116	E3		413	C2		212*	EE
125	55		423	C9		225*	59		125	74		423	DC		225*	25
131	95		431	2B		246*	6A		131	85		431	D9		246*	90
132	A5		432	EB		252*	AA		132	FC		432	73		252*	B0
134	C5		445	29		255*	DA		134	39		445	32		255*	30
143	36		464	F9		266*	6B		143	75		464	61		266*	60
152	A6		465	E2		274*	CB		152	D4		465	9D		274*	56
155	D6		466	46		325*	5D		155	40		466	3F		325*	A0
156	E6		503	F6		332*	AD		156	97		503	27		332*	70
162	27		506	49		356*	EE		162	F6		506	B3		356*	A8
165	57		516	37		446*	30		165	E9		516	EB		446*	DA
172	A7		532	17		452*	50		172	E1		532	4D		452*	B2
174	26		546	FC		454*	60		174	C3		546	A5		454*	6B
205	D5		565	7C		455*	70		205	BB		565	86		455*	AD
223	39		606	B6		462*	80		223	C5		606	99		462*	AA
226	44		612	CA		523*	90		226	F4		612	6E		523*	6A
243	3A		624	D3		526*	A0		243	9E		624	35		526*	5D
244	E7		627	F1					244	51		627	91			
245	5A		631	99					245	A3		631	B6			
251	E9		632	35					251	57		632	D3			

* *Exclusive GE codes.*

The Digital CG table is used with Phoenix-S/SX as follows:

1. VHF, Narrow band, TX
2. VHF, Narrow band RX, 150-162 MHz
3. UHF, Narrow band, TX & RX

The Inverted Digital CG table is used with Phoenix-S/SX as follows:

1. VHF, Narrow band, RX 162-174 MHz
2. VHF & UHF, Wideband, TX & RX.

TABLE 4-A

Carrier Controlled Timer	Hex Code
CCT Enabled	8
CCT Disabled	0

TABLE 4-B

Carrier Controlled Timer (Minutes:Seconds)	Hex Code
0:30	0
1:00	1
1:30	2
2:00	3
2:30	4
3:00	5
3:30	6
4:00	7

TABLE 5

Number of Channels	Hex Code
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7