Frequency Agile Pocket Tracker
Transmitter Configuration Instructions

Frequency Agile Option

The Pocket Tracker Frequency Agile (FA) option allows the user to set the Pocket Tracker's primary and alternate transmitting frequencies*, and to select the normal or low RF power output level. Advanced commands provide direct control of the Pocket Tracker's Phase Locked Loop (PLL) registers.

*The practical frequency range is 144 to 146 MHz. If the difference between the primary and alternate frequencies is too large it may be necessary to re-tune L3 per the illustrated Pocket Tracker Assembly Instructions when changing frequencies.

No special configuration software is required. A PC, Macintosh, PDA, etc. and a terminal emulation program such as HyperTerminal is all that is needed. No special cabling is required. The same cable used to configure the TinyTrak3 APRS operating parameters can be used to set the FA options.

Cabling

Pocket Trackers use a "sub-mini" 3/32" stereo jack for the Frequency Agile Serial Port (J14). Connect this port to a PC with a serial cable to check or set the Frequency Agile options, then disconnect the serial cable for normal operation.

Serial data is sent from the Pocket Tracker transmitter PIC (U6) to the PC during configuration on the "tip" contact. Data sent by the PC to the Pocket Tracker transmitter PIC is on the "ring" connection. The "sleeve" is grounded. Note that this is the same configuration that's used on the Pocket Tracker's GPS / PC Serial port (J8). The same cabling and / or adapters used to configure TinyTrak3 options can be used to check or change the Frequency Agile settings.

Activating the Frequency Agile User Interface

Accessing the Frequency Agile user interface is not difficult but the following instructions must be followed carefully:

1) It is very important that you verify your Pocket Tracker is working properly on the default frequency (set by the factory) before you try to access the Frequency Agile user interface. Changing frequency data before completing the initial alignment and test steps could make completion of the Pocket Tracker very difficult. See the illustrated Pocket Tracker Assembly Instructions for final alignment and testing details.

2) Disconnect the Pocket Tracker from its power source.

3) Move the "FS" jumper-shunt on the J11 pins to the TEST pins (J13) near the shield. This will insure the Pocket Tracker transmit circuits remain powered during transmitter PIC (U6) interrogation and configuration. **Note:** If the FS jumper is left installed on the "4" end of J11 the Serial Data Out line from the transmitter PIC (U6 pin 7) will be grounded and the Pocket Tracker transmitter PIC will not be able to communicate with the PC.

4) Connect a personal computer serial port to J14 using an appropriate cable (see **Cabling** above).

5) Activate a terminal emulator on the personal computer. Set communication parameters to 4800 baud, no parity, 8 bits, no handshake. These are the same communication settings used by the TinyTrak3 chip (U1) in the Pocket Tracker.

6) With the Pocket Tracker still powered off, start sending a continuous stream of carriage-return characters from the personal computer by holding down the "Enter" or "Return" key. Serial data must be present at J14 at the moment the Pocket Tracker is powered on to activate the PT-FA user interface.

7) Apply power to the Pocket Tracker while serial data is being transmitted. Stop sending serial data as soon as a screen similar to the one below is seen.

```
F14xxxx
P
S/I/G
R/N/Dxxxx
Cxx
Axxxx
esc

r=0640
n=70CE
c=C0
d=FFFD
p=01
Nc=70CB
a=FFF6

PT>
```

If no data is seen then disconnect power then reapply power while sending serial data. If you continue to see no data then verify the terminal emulator settings, verify:

- The FS jumper (J11) has been removed
- The TEST jumper (J13) is installed
- The personal computer's keyboard repeat rate is set to a fast repeat rate. The PT-FA firmware will bypass the configuration interface if no PC data is seen during the first 25 mS after power up. The keyboard auto-repeat rate for a PC is adjusted via the "Keyboard" option in the "Control Panel".

Using the Frequency Agile User Interface

The first seven user interface lines displayed above (starting with F14xxxx) are simply a reminder of the various user interface commands.

The next seven lines give current values for the various configuration options. Each command and option value is discussed below.

The next line, "PT >", is the Frequency Agile user interface command line prompt.

After the Pocket Tracker frequency options have been configured, disconnect the Pocket Tracker from its power source, move jumper from the TEST pins (J13) back to the desired end of J11, and disconnect the personal computer. The Pocket Tracker will now function as before but on the new frequencies and at the new power level (Normal or Low). (The factory default settings for the PT-FA will cause it to function just like a standard Pocket Tracker: Primary Frequency: 144.39 MHz, Alternate Frequency: 144.34 MHz.)

Important notes:

Hardware limitations prevent the Pocket Tracker from operating at full power across the entire two-meter amateur band. RF output will be attenuated if the frequency is set above 146 MHz or below 144 MHz.

Once aligned, the Pocket Tracker can change its operating frequency by approximately plus or minus 1 MHz. Trying to command the Pocket Tracker to a frequency beyond this will result in the transmitter's phase locked loop (PLL) not locking properly. If that happens the transmit frequency will not be stable. For best results the primary and alternate operating frequencies should not be more than 2 MHz apart.

Tuning

For optimal performance the following tuning procedure is suggested:

1) Select the desired primary and alternate frequencies. Remember that frequencies below 144 MHz and above 146 MHz will be attenuated.

2) Use the “F” and “I” commands (see below) to set the Pocket Tracker’s operating frequency mid-way between the primary and alternate frequencies selected in step 1. Then re-align the Pocket Tracker according to the Alignment and Fine Tuning Procedures in the illustrated Pocket Tracker Assembly Instructions.

3) After tuning use the “F”, “I”, “S”, and “G” commands as noted below to set the desired operating frequencies.

Frequency Agile Command Descriptions

<Enter>

Typing a carriage return (pressing the “Return” or “Enter” key) will cause the Pocket Tracker to print the current configuration values to the screen. No internal values will be changed.

F - Frequency.

Use this command to set the Pocket Tracker's primary operating frequency. This is the frequency used if the “FS” jumper is NOT installed (or parked on the “9” end of J11). Note that this command will only update the internal variables used for this power cycle. The new frequency will be lost at the end of the current power cycle. The Pocket Tracker’s PLL will not be reinitialized until configuration mode is exited. Use the "I" command (see below) to immediately update the PLL and the "S" command to update EEPROM to make this frequency change permanent.

Example: F144390 <Enter> will calculate the data needed to operate the Pocket Tracker at 144.390 MHz. Note there is no decimal point in the frequency and there is no space between the F and the first number in the frequency.

A - Alternate Frequency.

Use this command to set the Pocket Tracker's alternate frequency. This is the frequency used if the “FS” jumper is installed so it connects the “4” pin (the pin closest to the corner of the board) to the grounded center pin of J11. Be sure to use the “S” command before exiting configuration mode to make the new value permanent.

The Pocket Tracker's default frequency step size is 5 kHz. The alternate frequency is specified as a 4 digit 2's complement hexadecimal number that represents the number frequency steps that should be added or subtracted from the primary frequency. Don't worry if you don't understand 2's complement hexadecimal numbers. Just use the table at the end of this document to look up the correct value.

It is important to understand that the alternate frequency is always an offset from the primary frequency. Changing the primary frequency using the "F" command will automatically change the alternate frequency.

For example, if an alternate frequency of 50 kHz below the primary is desired then the "A" parameter would be set to –10 because -10 * 5 kHz = -50 kHz. The number –10 expressed as a 2's complement 4-digit hexadecimal value is FFF6.

Example: AFFF6 <Enter> will set the secondary frequency to a value 50 kHz below the primary frequency.

P - Power Amp state.

0 => the power amp will not be enabled when a packet is transmitted.
1 => the power amp will be used when a packet is transmitted.

Leaving the power amp off allows the Pocket Tracker to be operated at very low power. This is useful for testing and for applications such as a low-power hidden transmitter. Note that this command will cause the power amp to be used / not used for this power cycle only. Use the "S" command (see below) to update the value of the "P" parameter stored in EEPROM. The power amp is always turned off while in FA User Interface mode.

Example: P1 <Enter> will instruct the Pocket Tracker to USE the power amp.

D - Delta F.

The FA transmitter PIC firmware assumes the Pocket Tracker's phase locked loop (PLL) reference oscillator crystal (X1) is exactly on frequency. However, stray capacitance and component tolerances rarely make this true. The D command allows the Pocket Tracker to trim the frequency with software.

The Pocket Tracker's default frequency step size is 5 kHz. The D value indicates how many steps should be added or subtracted from ideal frequency data values calculated with the "F" and "A"commands. Most Pocket Trackers use a value of -3 to -4. Once set, the "D" value should never have to be changed again. **IMPORTANT NOTE: The "D" parameter was set for your Pocket Tracker at the factory. Be sure to note its value if you decide to change it!**

Data is input as a 4 digit 2's complement hexadecimal number. Don't worry if you don't understand 2's complement hexadecimal numbers. Just use the table at the end of this document to look up the correct value.

Example: To input a Delta F value of -3 type the following: DFFFD <Enter>

I - Initialize the PLL.

This command will cause the Pocket Tracker to immediately reprogram the transmitter's PLL with the current transmitter PIC settings. Note that this command only updates the PLL for this power cycle. Use the "S" command to store the frequency data in EEPROM.

Example: I <Enter>

S - Save.

This command will store the current Pocket Tracker frequency data (which may or may not have been uploaded to the PLL) into the EEPROM storage area in the transmitter PIC (U6). This data will now be used each time the Pocket Tracker transmitter is energized.

Example: S <Enter>

G - Go.

This command will exit configuration mode and "go" to normal Pocket Tracker mode. The PLL will be updated and the PA turned on (if P = 01).

Example: G <Enter>

Advanced commands

The Frequency Agile option allows direct control over the PLL's data registers. Be careful here. If you don't understand how the PLL works it is probably best to avoid these commands.

R - Update the PLL's R register.

Data is input in hex (4 digits). The R register sets the PLL's step size. The default value (640 hex) sets the step size to 5 kHz*. Other settings will cause undesired operation. All the values referenced in this document and the included tables assume a 5 kHz step size. The active filter hardware in the Pocket Tracker transmitter was designed for a 5 kHz step size. Other step sizes are not recommended.

*640 hex is 1600 in decimal. The reference oscillator operates at 8 MHz. 8 MHz divided by 1600 is 5 kHz.

Example: R0640 <Enter>

N - Update the PLL's N register.

Data is input in hex (4 digits). The N register sets the Pocket Tracker's operating frequency. You will see the N value change when you change frequency with the F command. The Pocket Tracker's operating frequency will be the N register + the D parameter (Nc) times the R register.

Example: If N = 70CE hex (28,878 decimal) and D = 0 then Nc = N + D = 70CE + 0 = 70CE. If R = 640 hex (5 kHz) then the Pocket Tracker's operating frequency is Nc * R = 28,878 * 5 kHz = 144.390 MHz.

Example: N70CE <Enter>

This table shows the relationship between the various PLL registers and FA parameters:

144.39 MHz Offset = -3 PA is on	144.39 MHz Offset = -4 PA is off	144.99 MHz Offset = -3 PA is on
r = 0640	r = 0640	r = 0640
n = 70CE	n = 70CE	n = 7146
c = C0	c = C0	c = C0
d = FFFD	d = FFFC	d = FFFD
p = 01	p = 00	p = 01
Nc = 70CB	Nc = 70CA	Nc = 7143

PLL Register and Parameter Relationship Table

C - Update the PLL's C (Control) register

Data is input in hex (2 digits). This register sets various operating modes inside the PLL. Best not to mess with this. Data is input in hex.

Example: CC0 <Enter>

Decimal to 2's complement hexadecimal conversion

Decimal	Hex	A value	Decimal	Hex	A value
0	0000	0kHz	0	0000	0kHz
1	0001	5 kHz	-1	FFFF	-5 kHz
2	0002	10 kHz	-2	FFFE	-10 kHz
3	0003	15 kHz	-3	FFFD	-15 kHz
4	0004	20 kHz	-4	FFFC	-20 kHz
5	0005	25 kHz	-5	FFFB	-25 kHz
6	0006	30 kHz	-6	FFFA	-30 kHz
7	0007	35 kHz	-7	FFF9	-35 kHz
8	0008	40 kHz	-8	FFF8	-40 kHz
9	0009	45 kHz	-9	FFF7	-45 kHz
10	000A	50 kHz	-10	FFF6	-50 kHz
11	000B	55 kHz	-11	FFF5	-55 kHz
12	000C	60 kHz	-12	FFF4	-60 kHz
13	000D	65 kHz	-13	FFF3	-65 kHz
14	000E	70 kHz	-14	FFF2	-70 kHz
15	000F	75 kHz	-15	FFF1	-75 kHz
16	0010	80 kHz	-16	FFF0	-80 kHz
17	0011	85 kHz	-17	FFEF	-85 kHz
18	0012	90 kHz	-18	FFEE	-90 kHz
19	0013	95 kHz	-19	FFED	-95 kHz
20	0014	100 kHz	-20	FFEC	-100 kHz
21	0015	105 kHz	-21	FFEB	-105 kHz
22	0016	110 kHz	-22	FFEA	-110 kHz
23	0017	115 kHz	-23	FFE9	-115 kHz
24	0018	120 kHz	-24	FFE8	-120 kHz
25	0019	125 kHz	-25	FFE7	-125 kHz
26	001A	130 kHz	-26	FFE6	-130 kHz
27	001B	135 kHz	-27	FFE5	-135 kHz
28	001C	140 kHz	-28	FFE4	-140 kHz
29	001D	145 kHz	-29	FFE3	-145 kHz
30	001E	150 kHz	-30	FFE2	-150 kHz
31	001F	155 kHz	-31	FFE1	-155 kHz
32	0020	160 kHz	-32	FFE0	-160 kHz
33	0021	165 kHz	-33	FFDF	-165 kHz
34	0022	170 kHz	-34	FFDE	-170 kHz
35	0023	175 kHz	-35	FFDD	-175 kHz
36	0024	180 kHz	-36	FFDC	-180 kHz
37	0025	185 kHz	-37	FFDB	-185 kHz
38	0026	190 kHz	-38	FFDA	-190 kHz
39	0027	195 kHz	-39	FFD9	-195 kHz
40	0028	200 kHz	-40	FFD8	-200 kHz

Note: You may also use the Microsoft Windows calculator to convert decimal numbers to hexadecimal. Place the calculator in "Scientific" mode (under View). Configure the calculator to "Dec" mode, enter the decimal number you wish to convert, then place the calculator in "Hex" mode. Use the right most four digits. If fewer than four digits are displayed then add enough zeros on the left to form a 4 digit number.