Transmitter Adjustment

Press the **AGC-F** button for fast AGC, and the **LSB** mode button for normal shift. The display shows suppressed carrier frequency, so bear in mind that your actual transmitted signal is offset below the display by the (audio) frequency of the AFSK tones generated by your TNC.

Before transmitting the first time, preset the **RF PWR** control to about 12 o'clock, and set the **METER** button to the **ALC** position. Key the transmitter from your keyboard, and adjust the **MIC** control (or TNC output level) for less than mid-scale indication.

Now you can set the **METER** button to the **PO** position, and set the **RF PWR** for the desired power output.

Frequency Display & Tuning

As mentioned above, the transceiver displays the suppressed carrier frequency, from which you must subtract the audio frequency of your TU's or TNC's AFSK tones to find the actual operating frequency. For example, if your TNC uses 1600- and 1800-Hz tones, you can subtract the difference (1700 Hz) from the display to find the actual center frequency of your transmitted signal. Also, you want to center your receiver audio passband at 1700 Hz, so you need to turn the **SHIFT** control counterclockwise to about the 11-o'clock position (the normal SSB passband is centered about 1500 Hz away from the carrier frequency).

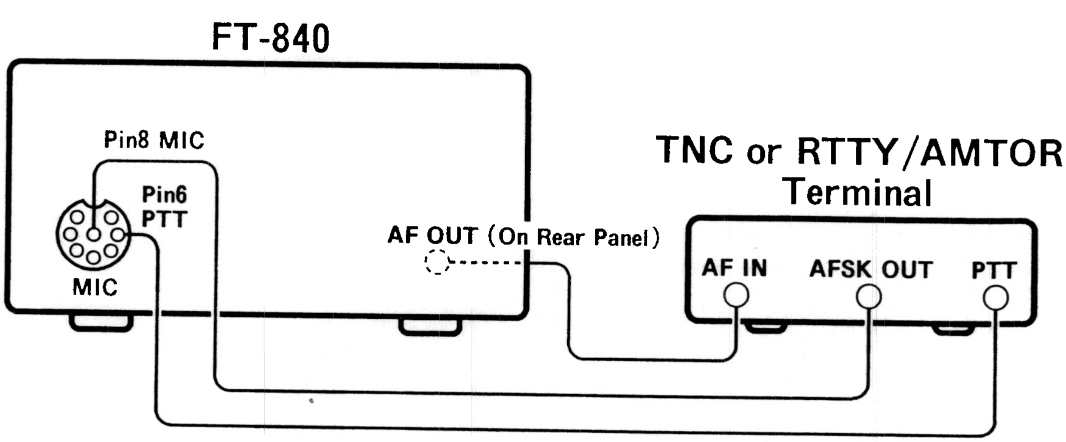
Of course, if your TNC or TU uses higher-frequency tones, you have to shift the passband further.

Example: You want to have a packet QSO with a station who has told you they will be on 14.1013 MHz (sometimes called the old "14.103" according to the 1700-Hz TAPR convention), and your TNC uses 2115-/2315-Hz tones (like the MFJs). What frequency should your display show?

Unlike RTTY and AMTOR, which imply the mark frequency when setting up skeds, packet frequencies refer to the center of the two tones. With your modem, the carrier offset is in the middle between 2315 and 2115 Hz, or 2215 Hz. So if you're using LSB mode, you need to add this offset to the specified QSO frequency to get your displayed frequency: 14.10130 + 0.002215 (MHz) = 14.103515, which displays as either 14.103.51 or 14.103.52. On the other hand, if you're using USB mode, you subtract the offset, and your display shows 14.099.08 or 14.099.09.

Since tuning is very critical for F1 packet, you should enable display of the 10-Hz digit, by holding the **UP** button while switching the transceiver on. Tune the transmitter and receiver within 10 Hz of a signal to minimize repeats.

> ### *Caution!*
>
> Some digital modes (such as RTTY) require continuous key-down transmission. While the internal fan is designed to protect your radio from excessive heat, full key-down output for long periods is not recommended. Especially during hot or humid weather, we recommend reducing power to preserve the life of the components. During long transmissions, place your hand at the rear exhaust occasionally to ensure that it's not getting too hot. The safest approach is to keep power output at 50 watts or less during long transmissions.



Packet TNC & RTTY/AMTOR Terminal Unit Interconnections

1200-Baud FM Packet

The equipment setup for 1200-baud FM packet (above 29 MHz) is the same as for 300-baud packet. There is no squelch output from the FT-840, however, so performance will be better on noisy channels if your TNC has PLL-type DCD. Tuning is much less critical in this mode, requiring no special adjustments.

To transmit FM packet, just press the **PO** meter selector button and adjust the **RF PWR** control for the desired power output.

AMTOR & F1 Packet Operation with the YF-112C 500-Hz Filter option

Obtaining optimum AMTOR, RTTY and 300-baud packet operation under QRM conditions may prove difficult, because the optional 500-Hz narrow CW filter is not available for reception in the SSB modes needed for AFSK transmission. You can keep operation simple (and avoid the need for the 500-Hz CW filter option) by using the LSB mode with its 2.4-kHz bandwidth for both transmission and reception, but the broad receiver IF bandwidth is not optimum for receiving narrow-shift AFSK under QRM conditions. Alternatively, if you have the 500-Hz CW filter installed, you can try using it for reception in CW mode and transmitting in an SSB mode (split); but this requires offsetting your transmit and receive frequencies, along with a few other inconveniences.

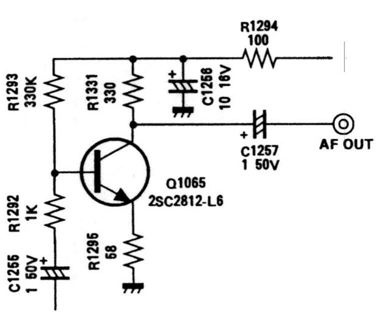
The following describes split-mode FSK operation, which you can try in order to obtain better performance from the FT-840 in this mode. *It will work with some TNCs/terminal units, but probably not all, depending on the AFSK tone frequencies used,* therefore, neither Yaesu nor its representatives claims as to the suitability of the FT-840 for this application.

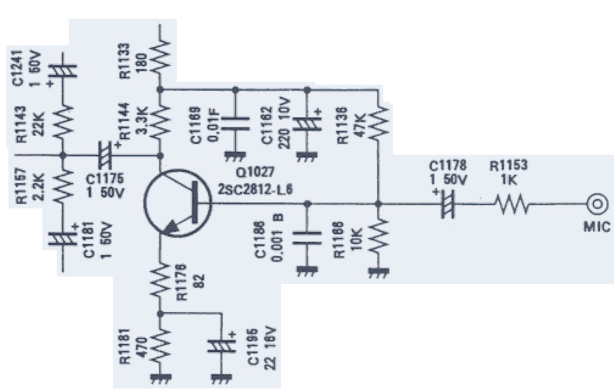
As described earlier, if you choose to receive in the LSB mode (standard for HF narrow-shift AFSK), you need to turn the **SHIFT** control counterclockwise according to your AFSK tone frequencies. If you use the USB mode instead, you need to turn it clockwise. Even so, the SSB IF filter passband (about 2.7 kHz) is much broader than 170-Hz shift RTTY, AMTOR and 200-Hz packet, and the extra noise will not give optimum performance under crowded QRM conditions. For 425- or 850-Hz wide-shift RTTY, however, the SSB filter is best.

After having some QSOs with the SSB filter as described previously, if you have the optional 500-Hz CW filter installed, you can try setting up split-mode operation. This involves setting up one VFO (or memory half) for receiving using the 500-Hz CW narrow filter. Unfortunately, if your TNC uses high AFSK tones (centered above 2 kHz), you may not be able to shift the IF quite enough. The initial setup is a little tricky, but the result can be nearly 5:1 improvement in signal-to-noise ratio on weak signals. The FT-840 has several features that keep the process from getting too complicated.

First you will want to disable the CW BFO offset from the display (as described on page 21) by holding the **BAND-DOWN** button while turning the transceiver on. Confirm that it is off by switching between CW and USB modes: the display should not change. In addition, activate the CW Reverse Sideband feature as described on page 21 (CW and LSB should sound and tune the same).

Store the offset of the center of your AFSK tones in the clarifier. This lets you keep the TX and RX VFOs (or memory halves) on the same frequency-which is important for tuning. To store the offset, tune to a 100 kHz multiple, like 14.100.0 MHz. Then add the center of your AFSK tones (for 170-Hz shift this is 2210 Hz for MFJ TNCs), to the displayed frequency (e.g.., 14.100.0 + 0.002.21 =





14.002.21). Then switch off the clarifier. Once it's set, be careful not to touch the **CLAR** knob! The setting must remain the same for all split-mode operation using these AFSK tones.

Now press the **CW/N** button, twice if necessary, so that "NAR" appears, and turn the **SHIFT** control counterclockwise from center. If your TNC has a tuning indicator, set the **SHIFT** so that the indicator is centered while receiving only background noise. Depending on the AFSK tone frequencies of your TNC, and on internal component tolerances in the FT-840, you may not be able to center the tuning indicator, even with the **SHIFT** control fully counterclockwise. If this appear to be the case, try it set fully counterclockwise anyway to see if reception is better than with the wide filter.

With the shift and clarifier set up, and the 500-Hz CW filter selected, you are ready to tune in a signal. Press **CLAR** to activate the clarifier before tuning (but don't touch the clarifier knob!). Start by tuning in a strong signal, and once your screen shows the signal being decoded, adjust the **SHIFT** control slightly for best copy.

The first time you transmit split-mode, we suggest you try responding to a CQ or calling a BBS, rather than initiating a CQ. First press the **SPLIT** button ("SPLIT" appears). With the station tuned for best copy, set up the alternate VFO (or memory half) to transmit in LSB with the appropriate frequency offset from your receiving (CW) frequency, like this: press **CLAR** to deactivate the clarifier, and **LSB** to change to the transmit mode. Then press **A=B** to copy the displayed frequency and mode to the hidden (TX) VFO or memory half. That sets up the transmitter. Finally, press **CLAR** and **CW/N** twice to return to the receive frequency/mode. Now you can transmit.

Again, the magic key sequence to set up the transmitter after tuning to a new frequency is: **CLAR - LSB - A=B - CLAR - CW/N - CW/N.** You need to do this every time you tune to a new frequency, so you might want to make a note of it.

Try to establish a connection with a moderately strong signal on a clear channel. If the connection is very poor (many repeats), move the **SHIFT** control very slightly to the right or left and see if the repeats decline. Continue in this manner until you find a "sweet spot" (with minimal repeats) for the **SHIFT** control, and make note of it. You will use this setting for all future LSB narrow-shift AFSK operation.

Final Note: Computer-Generated RFI

When using a TNC connected to your transceiver, or even having a PC located in the shack, the possibility exists that you may experience computer-generated RFI (Radio Frequency Interference).

The CPU in a personal computer operates with a crystal-controlled oscillator (clock) and timing circuits. Common clock frequencies include 8, 12, 16, 20 and 25 MHz. In addition, high-speed digital data switching uses square waves, which produce odd-order harmonic frequencies.

Computer-generated RFI may appear at seemingly random frequencies (usually right where a rare DX station is calling CQ!) throughout the range of your transceiver, and may sound like constant ticking or buzzing that may change as you type or work within a program. Severe RFI may have S-meter indications as strong as S-9 ~+10db over, making copy of voice signals difficult and data signals virtually impossible.

Computer-generated RFI is usually a result of inadequate shielding of the PC's cabinet or I/O and peripheral connections. While computer equipment may comply with RF emission approval standards, this does not ensure that sensitive amateur radio receivers will not experience RFI from the device.

There are a few steps you can take to reduce or eliminate computer-generated RFI. The first step is to ensure that only shielded cables are used for TNC-to-transceiver connections, carefully check RF ground connections and re-orient your station equipment in relation to the computer. Try moving your PC and peripherals slightly and see if it has any affect on the RFI, in some cases, this alone may be enough to correct the problem.

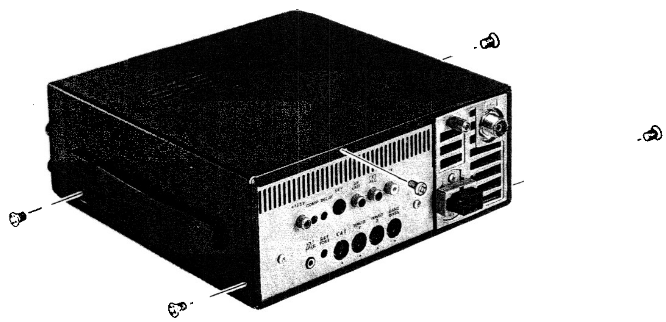
If not, several additional steps to try include installing AC line filters on the power cord(s) of the suspected equipment and inserting decoupling ferrite toroidal chokes on interconnecting patch/data cables and smaller ferrite beads on single wires.

As a last resort, you can try installing additional shielding within the PC case, using appropriate conductive mesh/screening or conductive tape. Especially check RF "holes" where plastic is used for cabinet front panels. For further information, consult amateur radio reference guides and publications relating to RFI suppression techniques.

Installing Internal Accessories

This chapter describes installation of the internal options available for the FT-840. The YF-112A and YF-112C crystal filters can be installed by removing only the top cover, while installing the TCXO-4 master oscillator requires first removing the bottom cover and then the top cover. This chapter describes the cover removal procedures first, followed by the individual procedures for each option. Proper performance with these options depends on proper installation. If you are unsure of the procedures after reading the following, feel free to ask your Yaesu dealer for help.

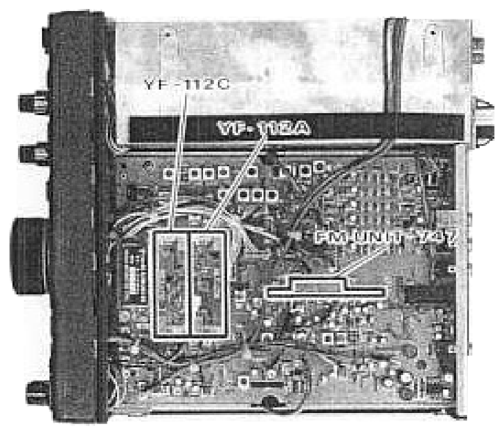
Figure 1: Top Cover Removal



Top Cover Removal

- ❒ Turn the transceiver off, and disconnect all cables.
- ❒ Place the set on the work surface with the rear facing you, and remove the five screws affixing the top cover (Figure 1). Note the single rear screw is a different type than the rest (remember this when replacing the screws). Pry the top cover open and disconnect the speaker cable plug from its connector leading to the transceiver. Then lift the top cover off.

Figure 2: Filter & FM Unit Location

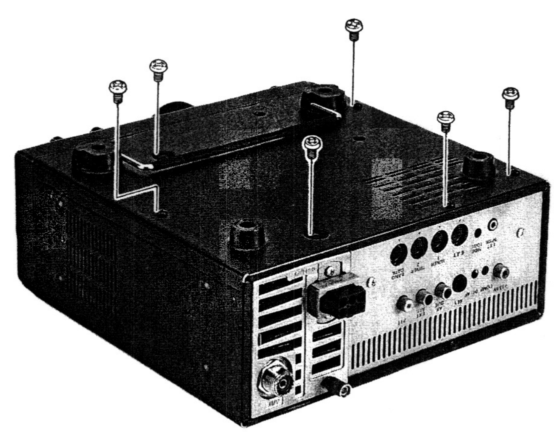


Filter & FM-Unit Installation

The 500-Hz YF-112C and 6.0-kHz YF-112A crystal filters may be installed for improved CW and AM receiver selectivity. The filter units have diodes installed which indicate their installation and enable selection from the front-panel. Installation of the FM Unit -747 permits narrow-band reception and transmission.

- ❒ Referring to the photo at the right, determine the correct location of the unit(s) you are installing. Filters and the FM-Unit are installed by plugging them into position as labeled on the circuit board and shown in the photo (Figure 2).
- ❒ If installing the TCXO-4, continue with the following steps; otherwise re-connect the speaker cable and replace the top cover.

Figure 3: Bottom Cover Removal



TCXO-4 Enhanced-Stability Oscillator

The ±2-ppm TXCO-4 option can be installed as a replacement for the standard ±10-ppm crystal oscillator.

- ❒ Remove the top cover as described above.
- ❒ Now flip the transceiver on its top side and remove the six screws affixing the bottom cover.

English

Fig. 4: TCXO-4 Installation

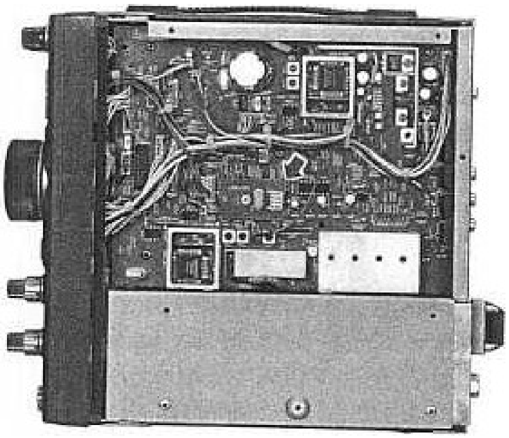
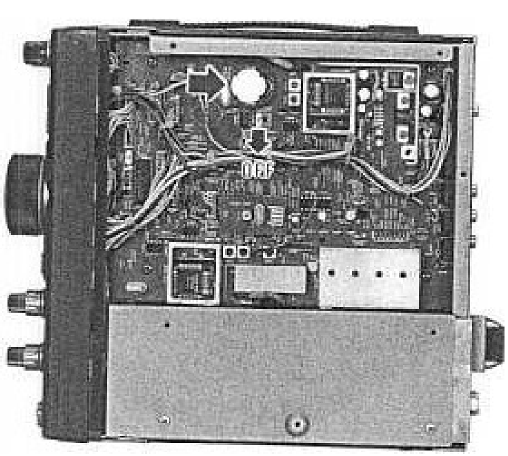


Fig. 5 Lithium Battery

Fig. 6 Backup Switch



❐ Referring to Figure 4, locate the standard OSC UNIT at approximately the center of the board . Squeeze the tip of the nylon stand-off with a pair of pointed pliers, and pry up that side of the OSC UNIT slightly. With your thumb and two fingers, gently pry up the opposite side of the board, then lift the entire unit from the board.

❐ The TCXO-4 is installed in the same manner. Align the 4 pins extending from the board with the connector on the unit, then press it firmly in place (until the tip of the nylon stand-off protrudes through the mounting hole).

❐ Replace the bottom cover (six screws), turn the set over and then replace the top cover (bail towards the front) and its five screws.

Lithium Battery Replacement & Memory Back-Up Switch

A 3-volt Lithium Battery (P/N BT2001) is located on the bottom circuit board of the transceiver (see Fig. 6). This maintains the memorized data in your radio. Normal battery life is usually greater than five years, however, should replacement be needed, perform the following steps.

❐ With the top and bottom covers removed, note the location of the battery. Using your finger, slide the battery inward(you will feel slight pressure by the mounting spring), then slightly pry it up and outward so that it ejects freely through the slots in the battery holder (Fig. 5).

❐ Carefully note battery polarity with the positive (+) side facing upward, and battery-type information. Install the replacement battery in the reverse manner.

Back-Up Switch

Located next to the lithium battery is the memory **BACK UP** switch(Fig. 6). This is normally kept in the ON position to ensure your memorized data is maintained (by a small amount of power from the lithium battery) when the radio is off, or the DC power source is removed.

❐ If you do not plan to operate your radio for extended periods of time, slide this switch to the OFF position to conserve battery life.

❐ Ensure the radio is powered on when sliding the switch back to the ON position, as this reduces the initial current demand on the battery by the radio's circuits from an un-powered state.

Note: memorized settings will be lost and the radio will return to factory default settings when turning off the backup battery. This has the same effect as performing the power-on sequence described on page 13.

CAT System Computer Control

The CAT (Computer Aided Transceiver) System in the FT-840 provides control of frequency, mode, VFO, memory and other settings by the operator's external personal computer. This allows multiple control operations to be fully automated as single mouse click or keystroke operations on the computer keyboard.

Serial data is passed at TTL levels (0 and +5V) via SO (serial output) and SI (serial input) pins 2 and 3 of the CAT jack on the rear panel of the transceiver, at 4800 bits/s. CAT jack pinout is shown on page 10. Each byte sent consists of one start bit, 8 data bits, no parity and two stop bits:

Start Bit	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	2 Stop Bits

One byte, sent left-to-right

All commands sent *to* the transceiver must consist of *blocks* of five bytes each, with up to 200 ms between each byte. The last byte sent in each block is the *instruction opcode*, while the first four bytes of each block are arguments: either parameters for that instruction, or dummy values (to pad the block out to five bytes):

4th Arg Byte	3rd Arg Byte	2nd Arg Byte	1st Arg Byte	Opcode

5-Byte Command Block, send left-to-right

There are twenty-four instruction opcodes for the FT-840, listed in the table on the next page. Notice that several instructions require no specific parameters, but every command block sent to the transceiver *must* consist of five bytes.

The CAT control program in the computer must construct the 5-byte block by selecting the appropriate instruction opcode, organizing the parameters, if any, and providing unused (dummy) argument bytes for padding (dummy bytes may have any value). The resulting five bytes are then sent, *opcode last*, to the SI serial input pin of the CAT jack on the transceiver.

Example: Tune to 14.25000 MHz;

- ❒ First determine the opcode for the desired instruction (see the CAT Commands table, next page). These opcodes should be stored in the program so they can be looked up when the user requests the corresponding command. In this case the instruction is "Set Op Freq", so the opcode is 0Ah. Small "h"s following each byte value indicate hexadecimal (base 16) values.
- ❒ Build the four argument byte values from the desired frequency by breaking it into 2-digit blocks (BCD "packed decimal" format). Note that a leading zero is always required in the hundred's-of-MHz place (and another in the ten's-of-MHz if below 10 MHz).
- ❒ The resulting 5-byte block should look like this (again, in hexadecimal format):

Byte Value		01h	42h	50h	00h
Content of this byte	Set Op Freq. opcode	100's & 10's of MHz	1's of MHz & 100's of kHz	10's & 1's of kHz	100's & 10's of Hz

- ❒ Send these five bytes to the transceiver, in *reverse order* from that shown above—from right-to-left (see the examples on page 38).

Data Returned From FT-840

The *Status Update*, *Read Flags* and *Read Meter* commands cause the FT-840 to report various operational and internally stored settings on the SO (serial output) line:

Status Update causes the FT-840 to return all or portions of its RAM table (up to 1941 bytes).

Read Flags obtains only the first 3 bytes (the Status Flags) from the RAM table, plus 2 extra "filler" bytes (08h and 41h),

Read Meter returns the meter deflection (0 — 0FFh) repeated in four bytes, followed by one "filler" byte (0F7h).

Each returned byte may be delayed by an interval determined by the *Pacing* command (0 to 255 ms in 1-ms steps). This delay is initially zero until the *Pacing* command is sent. This allows returned data to be read and processed by even very slow computers. However, you should set it as short as your computer will allow, to minimize the inconvenience of the delay. In the worst case, when the radio is to return all1941 bytes of internal data, about 1.4 seconds is required with "0"-length delay selected, but almost 3 *minutes* if the maximum delay is selected!

Status Update Data Organization

The 1941 bytes of *Update* data is organized as shown at the top of the page after next. Aside from the *Read Flags* command, different portions of this data can be returned in blocks of 1, 18, 19 or 1941 bytes, depending on the parameters of the *Update* command sent by the computer. The details of these commands follow the descriptions of the data.

English

CAT Commands

Legend:

Send all commands in REVERSE order from that shown! Commands that duplicate a front panel button are named with all caps. Parameter variables are named to reflect their format: eg., "CH" indicates a memory number, from 1 to 64h (1 to 100 decimal).

"—" indicates a padding byte. Value is unimportant, but it must be present to pad the block out to exactly five bytes.

Opcodes are listed in both hex and decimal format for convenience - only one opcode byte can be actually sent.

Command	Opcode		Parameter Bytes				Parameter Description
	hex	(dec)	1	2	3	4	
SPLIT	01	1	T	-	-	-	Switch Split tx/rx operation ON (T=1) and OFF(T=0)
Recall Memory	02	2	CH	-	-	-	Recalls memory number CH: 1 to 64h corresponding to memories 1 through P0
VFO ► M	03	3	CH	P2	-	-	Code display to memory CH (P2=0), Hide CH (P2=1) or Unhide CH (P2=2)
LOCK	04	4	P	-	-	-	Tuning knob or panel lock/unlock(P=1/ 0)
A/B	05	5	V	-	-	-	Select operation on VFO A (V=0) or VFO B (V=1)
M ► VFO	06	6	CH	-	-	-	Copy memory CH (1 to 64h) to last-used VFO
UP	07	7	00h	S	-	-	Step current display up 100 kHz (S=0) or 1 MHz (S=1)
DOWN	08	8	00h	S	-	-	same as UP, but steps down
CLAR	09	9	C	-	-	-	Clarifier on/off (C=1/ 0)
Set Op Freq.	0Ah	10	F1	F2	F3	F4	New operating frequency in F1 - F4, in BCD format: see text for example
MODE	0Ch	12	M	-	-	-	M values: LSB=0, USB=1, CW-wide=2, CW-nar=3, AM-wide=4, AM-nar=5, FM= 6 or 7
HAM/GEN	0Dh	13	HG	-	-	-	Select HAM/GEN stepping functions (H/G=0/1)
Pacing	0Eh	14	N	-	-	-	Add N-millisecs (0-0FFh) delay between bytes of all data returned from radio
PTT	0Fh	15	T	-	-	-	Transmitter on (T=1) or off (T=0)
Status Update	10h	16	U	-	-	CH	Instructs the radio to return 1, 18, 19 or 1941 bytes of Status Update data. CH is significant only when U1=4. See text
TUNER	81h	129	T	-	-	-	Switch antenna tuner on (T=1) or off (T=0)
START	82h	130	-	-	-	-	Start antenna tuner
RPT/T	84h	132	R	-	-	-	Select simplex (R=0), -shift (R=1), or +shift (R=2)
A=B	85h	133	-	-	-	-	Copy displayed VFO(A or B) data to other VFO (B or A, resp.)
Memory Scan Skip	8Dh	141	CH	T	-	-	For memory CH (1 - 64h), skip (T=1) or include (T=0) in scanning
Step Op Freq.	8Eh	142	D	-	-	-	Step operating freq up (D=0) or down (D=1) minimal step (10- or 100- Hz)
Read Meter	0F7h	247	-	-	-	-	Instructs radio to return digitized meter indication (4 repeated bytes, and 0F7h)
Rptr Offset	0F9h	249	00h	S2	S3	S4	Set offset for RPT shifts, valid values are 0 - 500,000Hz (BCD format, in S2 - S4). Parameter 1 must be zero, S2 must be 0, 1 or 2. S3 is 1's & 10's of kHz, S4 is 10's & 100's of Hz.
Read flags	0FAh	250	-	-	-	-	Instructs radio to return the 24 1-bit Stats Flags (5 bytes, see following pages)

All 1941 Bytes of Status Update Data (Sent L-to-R)

Flags	M	Operating Data Record	VFO-A Data	VFO-B Data
3	1	19 bytes	9 bytes	9 bytes
(A)	(B)	(C)	(D)	(E)

(A) Flag Bytes

The first 3 bytes are treated as 24 1-bit flag fields: a function is enabled (on) if a bit is set (1), and disabled (off) if reset (0). Most of the functions represented by these flags correspond to the radio display.

First Flag Byte

Bit 0: LOCK is active (= display)
Bit 1: GEN operation (= display)
Bit 2: SPLIT operation (= display)
Bit 3: Memory checking (M CK) in progress
Bit 4: Memory tuning (M TUNE) activated
Bit 5: MEM operation (= display)
Bit 6: VFO B in use for transmit or receive
Bit 7: VFO A or B operation (= display)

Second Flag Byte

Bit 0: PTT line closed by CAT command
Bit 1: Memory scanning is paused
Bit 2: Scanning in progress (paused or not)
Bit 3: Not used
Bit 4: Not used
Bit 5: Antenna Tuner tuning (WAIT)
Bit 6: HIgh SWR (= display)
Bit 7: FAST tuning/scanning rate is activated

(B) Fourth Byte: Memory Number

The 4th byte of Update data contains a binary value between 0 and 63h (99 decimal), indicating the current memory number *–1* (or the last-selected memory, if operating on a VFO). note: P1=54h, p0=63h.

(C) 19-Byte Data Records

The Memory Number is followed by a 19-byte record defining current operating conditions. That is, the two VFOs if operation is on a VFO, or the front and rear halves of the current memory if

19-Byte Data Record Format

1 byte	9 bytes	9 bytes
Mem Flag	VFO-A or Memory Front	VFO-B or Memory Rear

Memory Status Flags (1 Byte)

This byte is at the head of every 19-byte Data Record. Bits 0 through 5 are not used. Bit 6 is set if the SPLIT function is active on the memory, and Bit 7 is set if the memory is blanked.

VFO/Memory Data Record (9 Bytes)

The structure of a 9-byte VFO/Memory Data record is detailed in the table below. Each byte in the table is identified by its offset from the start (base address) of the record, since the same 9-byte record format is also used elsewhere.

9-Byte VFO/Memory Data Record Format

Offset	Contents & Format of Byte Field
0	BPF selection: 0 to 09h binary
1 – 3	Bytes 1 — 3: Base frequency in 10's of Hz (w/o clar/rpt offset). Binary value in range 10000 – 3000000. Byte 1 is MSB.
4 – 5	not used
6	Mode: 0=LSB, 1=USB, 2=CW, 3=AM, 4=FM
7	not used
8	VFO/Memory Operating Flags (see below)

VFO/Memory Operating Flags

Each bit in this field signifies a state unique to one VFO or half-memory.

Bit 0: frequency not 100 Hz multiple (AM or FM operation)
Bit 1: SSB mode (0: LSB, 1:USB)
Bit 2: Memory set to SKIP when scanning
Bit 3: – Repeater Shift (for FM only)
Bit 4: + Repeater Shift (for FM only)
Bit 5: not used

Bit 6: Current mode is AM NARrow
Bit 7: Current mode is CW NARrow

(D) & (E) VFO-A and VFO-B Data (9 bytes x 2)

After the 19-byte Data Record for current operation is sent, two 9-byte VFO/Memory Data Records are sent; one for each VFO. The format of each of these records is the same as described above, and in fact, when operating on a VFO, the values in these records are identical to the two 9-byte records included in the 19-byte Data Record for current operation.

(F) Memory Data Records

After the two 9-byte records for the VFOs, 100 19-byte Data Records are sent: one for each memory, beginning with memory 01. Each memory data record is constructed as described above for the 19-byte Data Records.

Status Update Data Selection

The 1st and 4th parameters of the Status Update command allow selection of different portions of the Status Data to be returned, as follows ("U" is the 1st parameter, "CH" is the 4th):

Parameters	Data Returned	Reference (see previous page)
U=0	All 1941 bytes	A
U=1	Memory Number	B
U=2	19-Byte Operating Data Record	C
U=3	18-Byte VFO-A & VFO-B Data	D & E
U=4, CH=1 ~ 64h	19-Byte Mem Data Record for mem CH	F

Note that, in most cases, you will only need to read the 19-byte Operating Data Record (with the first parameter = 2), since *all other CAT commands affect only this data* (except **VFO > M** and **Memory Scan Skip**).

Read Flags Data

The *Read Flags* command retrieves the (first) 3 Flag Bytes of the Status Data. The transceiver responds to the *Read Flags* command by returning the Flag Bytes described on the preceding page, plus two bytes with the constant values of 08h and 41h (in that order), as shown here:

1st Flag Byte	2nd Flag Byte	3rd Flag Byte	Dummy (08h)	Dummy (41h)

Read Meter Data

Sending the *Read Meter* command causes the transceiver to return a digitized meter deflection indication, between 0 and 0FFh (in practice, the highest value returned will be around 0F0h). Four copies of this value are returned, along with one constant byte (0F7h), as follows:

Meter Byte	Meter Byte	Meter Byte	Meter Byte	0F7h

During reception, the signal strength deflection is returned. During transmission, the power output level deflection is returned.

Coding Examples

Although Yaesu Musen Company cannot offer to provide complete CAT control programs (owing to the variety of incompatible computers used by our customers), following are a few examples of critical CAT i/o functions, in BASIC. Note that all variations of BASIC may not support some of the commands, in which case alternate algorithms may need to be developed to duplicate the functions of those shown.

Sending a Command

After "opening" the computer's serial port for 4800-baud, 8 data bits and 2 stop bits with no parity, as i/o device #2, any CAT command may be sent. However, if you determine that your computer may need extra time to process data returned from the transceiver, you should send the *Pacing* command first. Here is an example of the *Pacing* command setting a 2-ms delay:

```
PRINT #2,
CHR$(0);CHR$(0);CHR$(0);CHR$(2);CHR$(&HE);
```

Notice that the instruction opcode is sent last, with the first (MSB) parameter sent just before it, and the LSB parameter (or dummies) sent first. The parameters are sent in the reverse order from that in which they appear in the CAT Commands table. Also note that in this and the following examples, we are sending zeros as dummy bytes; although this is not necessary. If you decide to send commands through a 5-byte array, the values of the dummy parameters need not be cleared.

Using the same example as on page 31, the following command could be used to set the frequency of the display to 14.25000 MHz:

```
PRINT #2, CHR$(&H00); CHR$(&H50);
          CHR$(&H42); CHR$(&H01); CHR$(&HA);
```

Notice here that the BCD values can be sent just by preceding the decimal digits with "&H" in this example. However, in an actual program you may prefer to convert the decimal frequency variable in prefer to convert the decimal frequency variable in the program to an ASCII string, and then to convert the string to characters through a lookup table.

If you send a parameter that is out of range for the intended function, or not among the specified legal values for that function, the FT-840 should do nothing. Therefore, you may wish to alternate your sending regular commands or command groups with a *Read Flags* or an *Update* command, allowing the transceiver to let the computer know if everything sent so far has been accepted and acted upon as expected.

Bear in mind that some commands specify "binary," as opposed to BCD-formatted parameters. You can send binary parameters without going through the character/hex string conversion process. For example, the CH parameter in the Command table is binary. You could have the FT-840 recall memory 29 (decimal) by the following:

```
PRINT #2, CHR$(0);CHR$(0);CHR$(0);CHR$(29);CHR$(2);
```

Reading Returned Data

The reading process is easily done through a loop, storing incoming data into an array, which can then be processed after all expected bytes have been read into the array. To read the meter:

```
FOR I=1 TO 5
   MDATA(I) = ASC(INPUT$(1,#2))
NEXT I
```

Recall from above that the meter data consists of four identical bytes, followed by a filler byte, so we really only need to see one byte to get all of the information this command offers. Nevertheless, we must read all five bytes (or 1, 18, 19 or 1941, in the case of the Update data). After reading all of the data, we can select the bytes of interest to us from the array (MDATA, in the above example).

English

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