

FT-757GX FTPLUS OPERATION SUPPLEMENT

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Designed, manufactured and programmed in England**

Guide v1.2

FTPLUS REPLACEMENT CPU SYSTEM FOR THE FT-757GX



GENERAL DESCRIPTION

This is a replacement microprocessor package for the Yaesu FT-757GX mobile transceiver. This has been created because the original CPU for this radio has been out of production for many years.

This has been built upon many months of work and testing and it continues to be actively developed.

Using VK2TRP's project as a start point, it has been slowly improving and evolving until it has reached its current level.

It is hoped that this item DOES NOT replace a working original CPU. Working originals ensure the originality of your radio and avoids the potential to cause damage by incorrect or inexperienced installation.

The package involves two parts. The firmware which this document is outlining – and the main PCB itself.

The part is based on a DIP-40 PIC 18F452 IC. These are low cost, easy to program and easy to incorporate into a design like this.

The firmware attempts to faithfully recreate the functions of the original CPU, while providing some useful functional upgrades.

These features are outlined below, which will be covered in greater depth throughout this manual. It is hoped that operators will take an interest in how things were created and this document will do its best to outline this.

<u>Original CPU</u>	<u>FTPLUS</u>
8 Memory Channels	14 Memory Channels
Memory programming	Memory Programming
Yaesu CAT one-way control	Yaesu CAT one-way control
Split transmit	Split transmit
Clarifier function	Clarifier function
Single Speed Dial	Single Speed Dial
Standard limited PMS system	Improved PMS system
	Accelerated Fuzzy Logic Dial
	CB Transceiver Mode
	Fine Tuning
	Kenwood Duplex CAT control
	Frequency Correction
	Multiple baud speed options
	Open-source and upgradeable!

THIS DOES NOT REPLACE THE ORIGINAL YAESU INSTRUCTION MANUALS. IT IS INTENDED TO SUPPLIMENT THAT DOCUMENT.

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MEMORY PROGRAMMING

To save a tuned frequency to the onboard memory bank, we follow the same procedure as the original CPU.

In VFO mode (VFO A or B), tune to your desired frequency and press VFO>M.

The current memory channel location will flash and beep TWICE in the display.

In addition, you can save from a third VFO frequency, when MR mode is active.

Channels are numbered from 0 to E, so when you reach 9, any further increases will be in letters, so one after 9 is 'A'.

In CB mode, saving of CB frequencies directly to the memory bank isn't implemented, as one can just save these frequencies from VFO mode if desired

HINT!

In VFO mode:

You can change memory channel WITHOUT entering MR mode. Just hold BAND UP or BAND DOWN for 1.5 seconds to increase or decrease the current channel. There will be two flashes and beeps, showing the new channel.

In MR mode:

You can tune up and down the entire frequency range, without disturbing your VFO A or B contents, making a "third" VFO. Frequencies tuned using this feature, are NOT saved at all, unless the VFO>MR button is pressed.

You can also move up and down the bands, by pressing and holding BAND UP/DOWN for 1.5s. A short press on BAND UP/DOWN moves the current memory up or down by one.

To move a saved frequency to VFO A or B, press M>VFO to move, or M<>VFO to swap.

This works regardless of VFO or MR mode. When the chosen button is pressed, the display will flash and beep, before the frequencies are swapped or moved.

Ensure you have your desired MR and VFO selected before pressing this button, to avoid any mistakes.

VFO / MR / CB Transceiver Mode*

Three modes exist within FTPLUS. All modes are accessed by pressing MR/VFO.

To toggle between VFO and MR modes, a single short press on MR/VFO will change modes.

Wideband Mode Only

To enter CB Transceiver mode, hold down MR/VFO for approximately 3 seconds

VFO A/B – VFO tuning

Tune the whole frequency range. VFO A or VFO B will be shown in the display.

When in this mode, press BAND UP / DOWN to move from one frequency band to the next.

Press and hold BAND UP / DOWN to increase or decrease memory channel (hidden in VFO mode of course) – this is handy for saving frequencies to memory without entering MR mode first.

MR – Memory Recall

Tune the whole frequency range. MR will be shown in the display, along with the current channel.

To change channel, a short press on BAND UP/ DOWN will change selected channel up or down.

Press and hold BAND UP/ DOWN to increase or decrease CHOSEN BAND. This is a convenience feature, allowing you to change bands in preparation for saving, using the extra VFO we use within MR mode.

When in MR mode, you can tune the radio as you wish, WITHOUT affecting VFO A or B.

CB Transceiver Mode

This is a handy mode, to directly access the CEPT/FCC and UK 27/81 CB bands.

When in this mode, use either the VFO wheel or BAND UP / DOWN to go up and down channels.

The default band is CEPT / FCC, upon a new install.

To change bands, when in CB mode, press SPLIT quickly.

Depending on your display CPU, you may see ‘CE’ or ‘b’ in the display for a second. This signals your current band.

To view your chosen frequency, press CLAR and the frequency will be shown for a second.

To change to 80ch mode

There also exists an 80 channel mode. Channels are arranged as follows:

1 – 40 CEPT CB
41 – 80 UK CB

To change to 80 channel mode, hold SPLIT for approximately 3 seconds.

Depending on your display CPU, the words ‘ALL CB’ will be displayed.

To exit 80 channel mode, hold SPLIT once again.

To exit CB mode, press MR/VFO

HINT!

Memories can be saved quickly over the CAT interface, if an app supports it. See the CAT section for more details

To copy a CB frequency to VFO A or B, press M>VFO when in CB mode.

*** CB Mode is only available when radio is in WIDEBAND condition, either permanently with the switch on the front panel, or temporary wideband over serial.**

TUNING DIAL TYPE SELECTION

Within FTPLUS, there are two VFO dial MODES

To change dial type, ensure you are in VFO or MR mode and HOLD M>VFO for approximately 3 seconds.

DIAL 0 – STANDARD DIAL

This is the standard Yaesu-specification dial. One revolution is equal to approximately 10khz.

DIAL 1 – ACCELERATED DIAL

This dial will move up and down faster, the more “effort” is put in to spinning the tuning wheel. Spinning quickly will increase the frequency counting speed faster or slower.

There are 4 different “speeds”.

Speed 1 = 10khz per revolution
Speed 2 = 50khz per revolution
Speed 3 = 100khz per revolution
Speed 4 = 250khz per revolution

Speeds are handled seamlessly and automatically.

HINT!

Speeds can be changed over CAT serial! See CAT section for more information

FINE TUNING MODE

In VFO or MR mode, fine tuning can be activated.

To activate or deactivate Fine Tuning, hold down D-LOCK until a beep is heard

When this mode is active, small turns on the VFO tuning wheel will make the display move one digit to the LEFT, allowing the missing digit to be displayed

For example, when tuned to 7.000.0 mhz, turning the dial will make the frequency display move one digit left while tuning, so the display would display 70.000.1, 70.000.2 etc. The display will hide the extra digit when tuning stops.

This gives approximately 5khz increase / decrease in frequency per revolution.

This mode also works when tuning using the MIC buttons.

FREQUENCY CORRECTION AND ALIGNMENT

FTPLUS has an alignment feature, which allows you to set, for example a ZERO POINT if your radio is not quite aligned correctly

Example:

You tune to 27.555 and all stations sound high-pitched. This is because your radio is slightly off-frequency.

The procedure is outlined here:

Tune to a desired frequency, using fine-tune if necessary to get to true ZERO.

Activate the alignment mode and slowly turn the tuning dial clockwise or anticlockwise, until the stations sound correct. The difference between your displayed frequency and the true frequency is called an OFFSET.

An offset can either be +/-.

The number doesn't really matter, but when the stations are sounding correct, you press the SAVE button to store the offset. This will then be applied wherever you tune.

There are even two modes for this.

Default mode is one single offset for the whole tuning range.

You can also activate "per-band" offsets, so you can set different offsets per band.

Handy if you need one offset for 40 meters LSB and a different one for 20 meters USB!

To proceed, please continue reading.

1) CHOOSE AN OFFSET MODE

If your radio is out of tune by approximately the same amount across the whole tuning range, single offset mode is sufficient

If it varies from band to band, activate multiple offset mode.

To toggle offset modes, hold down VFO<>M. You will hear either two or three beeps.

Two beeps is SINGLE OFFSET MODE

Three beeps is PER-BAND OFFSET MODE

2) TUNE TO A KNOWN ON-FREQUENCY SIGNAL. IGNORE HOW IT SOUNDS OFF FREQUENCY! TUNE TO WHAT WOULD BE ITS CORRECT FREQUENCY.

Ensure you get it as close as possible to 0 in the hz digit of the display. It will sound incorrect, or off-frequency as we have not yet aligned it.

Activating Fine Tune can help and make things even more accurate. Being on ZERO, means you have found ZERO POINT. The display is on Zero point, but the radio tuning circuits are not. We correct this now.

HOLD DOWN CLAR for approximately 3 seconds. The display will show a single 0.

With the station broadcasting in the background, adjust the tuning dial until the most "correct" sound is heard.

When happy, hold down CLAR for 3 seconds until you hear a beep. The tuned frequency should now match your displayed frequency.

HINT!

To reset to zero, press D-Lock when in alignment mode.

For a reminder of your chosen display frequency, press CLAR once quickly.

CAT INTERFACE AND MODES
INTRODUCTION

FTPLUS supports two methods of CAT communication.

1) Original Yaesu FT-757GX mode

RS232: **Receive from PC only**
Baud Rate: **4800 Baud**
Stop Bits: **2**

No other cables are required. Use the original CAT port on the back of the FT-757GX

Some extra commands have been added, which could be turned into a custom command in FLRIG

See Page 10.

2) Advanced Kenwood CAT emulation

RS232: **Bidirectional Half-Duplex**
Baud Rate: **1200, 2400, 4800, 9600,**
19200, 38400, 57600,
115200

Stop Bits: **2**
This requires a “serial TX” transmit line to your RS232 USB device.

On FTPLUS boards, this extra TX connection is provided on the circuit board itself.

This transmit line is provided on the PCB of FTPLUS. labelled RS232 TX. This is also connected to MIC DOWN button on the front panel, (PIN 3 MIC socket). It is for the operator to decide the best way of attaching the TX line.

Examples:

Use the CAT port on the back of transceiver as normal and piggyback a wire to MIC DOWN on the front panel, for serial transmit.

Disconnect the AGC wire from J11 Pin 5 and reattach this to TX pin on FTPLUS.

Feed 3 x DuPont or similar cables to the RS232 port on FTPLUS and fit these between the casing of the radio, for RX, GND and TX serial.

See Page 11.

CAT INTERFACE AND MODES

YAESU MODE

Please see the original FT-757GX manual for information regarding CAT commands and formatting.

Some NEW COMMANDS have also been added for your convenience. Commands are assembled and sent in exactly the same way as the Stock Yaesu system

F1 = 100 & 10 Hz

F2 = 10Khz & 1 Khz

F3 = 100Khz & 1Mhz

F4 = 10Mhz & 100Mhz (100Mhz = not used)

CM = Command

XX = Value not important, is ignored

Eg F1 F2 F3 F4 CM would be sent as F1F2F3F4CM

Command: E0, E1, E2, E3, E4, E5, E6, E7, E8, E9, EA, EB, EC, ED, EE

Requires (F1 F2 F3 F4 E0) – (F1 F2 F3 F4 EE)

This is for fast memory saving. E0 – EE are the channel numbers (0 – 14).

Command: 0A (for reference)

Requires (F1 F2 F3 F4 0A)

Setting of frequency for current VFO

Command: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1A, 1B, 1C, 1D, 1E

Requires (F4 F3 F2 F1 10) – (F4 F3 F2 F1 1E)

Fast memory saving, in human-readable format. 10 – 1E are the channel numbers (0 – 14).

EG 7.000mhz to channel 3 = 0700000013

EG 10.100Mhz to channel 10 = 101000001A

Command: 0F (for reference)

Requires (F4 F3 F2 F1 0F)

Setting of frequency for current VFO in human-readable format

OTHER COMMANDS

S1 – Speed 1 (Slowest)

S2 – Speed 2 (Slow)

S3.– Speed 3 (Fast)

S4 – Speed 4 (Fastest)

XX = Value not important, is ignored

Eg S1 S2 S3 S4 CM would be sent as S1S2S3S4CM

Command: FB

Requires (S1 S2 S3 S4 FB)

Dial speeds setting (in accelerated dial mode)

Speeds are in *10 Hz, written in HEX format.

Eg an S1 of 05 = 50Hz, 09 = 90Hz, 10 = 160Hz, FF = 255Hz

Example 050A1932FB would be:

Speed1 = 05, Speed2 = 0A(10), Speed3 = 19(25),

Speed4 = 32(50)

Giving Speed1 50hz, Speed2 100hz, Speed3 250hz, Speed4 500hz.

Command: FC

Requires (XX XX XX XX FC)

Temporary wideband, until next reboot.

If activated when transceiver is widebanded via the internal switch, will emulate non-widebanded condition until reboot. This is useful for testing perhaps.

Command: FD

Requires (XX XX XX XX FD)

CB Mode on/off (only in widebanded mode, either temporary or permanent wideband)

Command: FE

Requires (XX XX XX XX FE)

Full EEPROM reset

ADVANCED KENWOOD CAT EMULATION

Ensure the serial transmit TX pin is connected as outlined in the previous section

To change radio to “KENWOOD MODE”

Power off the radio

Hold down VFO A / B

Power on the radio

A single number ‘1’ should appear in the display for a second.

If you do this and a ‘0’ appears, retry.

If you do this and nothing appears, ensure you are pressing the correct key.

The radio is now in Kenwood mode. Yaesu mode is now disabled.

To change back to Yaesu mode, repeat the procedure, but ensure ‘0’ is in the display.

In summary:

0 – Yaesu

1 – Kenwood

BAUD RATE ADJUST (KENWOOD MODE ONLY)

When in Kenwood mode, power off the radio.

Hold down SPLIT and power on the radio. A baud rate should be displayed, probably the default 4800.

Keep pressing split using SHORT PRESSES to cycle through desired baud rates

1200 – 115200 baud rates are available.

When happy, hold SPLIT until 3 beeps are heard.

Baud adjustment is complete.

KENWOOD COMMANDS CURRENTLY SUPPORTED.

See other publications regarding Kenwood commands. Here is a brief summary:

AI0; / AI1 - Auto information

UP; DN; - Up / Down buttons

FA FB - Read / Set VFO A/B frequency

FN - VFO A/B/ MR Mode

FR FT - Current VFO in use

IF - Information

LK - Dial lock

MC - Set Memory Channel

MD – Mode (Set as dummy value, due to physical switch. Dummy value and physical switch positions should match)

MR - Memory Read

MW – Memory Write

RC, RD, RU, RT – RIT mode (Clarifier)

RX – Receive mode

TX – Transmit mode (See CAT PTT section)

SC – Scan (PMS)

SP – Split mode

ID – Identifier (ID006 = Kenwood 140s)

CAT PTT

CAT PTT is supported in FTPLUS. A slight modification to the radio is required to take advantage of this. Soldering is required.

NEW PMS SYSTEM

The PMS system is a scanning system, designed to scan through frequencies quickly and stop when a signal is received.

The original PMS system was rather limited in its scope.

So a new system has been designed.

There are two PMS controls.

The PMS switch itself.
The 500K button.

The PMS switch turns the feature on or off
The 500K button changes how the PMS scan is performed.

The different PMS modes are outlined on this page.

VFO MODE – Press PMS to begin and to end scanning

500k button pushed OUT:

Scanning will begin from the start of the current YAESU programmed bands, to the start of the NEXT BAND.

Example: You are tuned to 7.165 mhz. Scanning will begin from 7.000 mhz and carry on until the start of the NEXT BAND, which in this case, is 10,100mhz

500k button pushed IN:

Scanning will begin from the start of the current CEPT/FCC band, until the end of the band.

Example: You are tuned to 7.165mhz. Scanning will begin from 7.000mhz and carry on until the end of the 40 meter band, which is 7.200 mhz

Most, if not all CEPT/FCC bands are programmed. Just tune to anywhere within your chosen band and PMS will do the rest

MR MODE – Press PMS to begin and end scanning

500k button pushed OUT:

Scanning will begin from frequency stored at current memory channel, to the frequency stored at the NEXT channel.

Example:
You have 14.150 stored to channel 2
You have 7.165mhz stored to channel 3
You have 10.150mhz stored to channel 4.

If you are currently tuned to channel 3, pressing PMS will scan from between channel 3 to channel 4. So the scanning range will be from 7.165 to 10.150, going UP. Once 10.150 is reached, the cycle begins again from 7.165.

If you are currently tuned to channel 2, pressing PMS will scan from between channel 2 and channel 3. So the scanning range will be from 14.150 to 7.165mhz, going DOWN. Once 7.165 is reached, the cycle will restart from channel 2 (14.150).

If the SAME FREQUENCY is stored, eg 7.000 is stored as default in channel 0 and channel 1, you will hear an error beep because scanning isn't possible, as the start and end frequencies are the same.

500k button pushed IN: ***

All channels are scanned individually, beginning at Channel 0 and ending at Channel E, then starting again.

***** This can cause rapid relay clicking and it isn't recommended to use**

NEW PMS SYSTEM

CB MODE – Press PMS to begin and end scanning

500k BUTTON HAS NO EFFECT IN CB MODE DURING PMS SCANNING

All frequencies of the CURRENT CB BAND are scanned, in channel form.

Pressing PMS will begin scanning from Channel 1 until the last channel of the current band.

1 – 40 CEPT
1 – 40 GB
1 – 80 80 Channel mode

To scan a different band, ensure PMS is stopped. Change transceiver to desired band and press PMS to start scanning.

NOTES ABOUT SCANNING – ALL MODES

Current frequency or channel can be skipped, by rotating the VFO tuning dial. Scanning will recommence once the squelch level drops to your chosen level.

IF PMS IS STOPPED WHILE NO SIGNAL IS RECEIVED, IE THE FREQUENCIES AND CHANNELS ARE CHANGING, THE PREVIOUS FREQUENCY / CHANNEL WILL BE RETUNED, JUST AS THOUGH NO PMS HAS TAKEN PLACE.

IF PMS IS STOPPED WHILE LISTENING TO A TRANSMISSION, THE TRANSCEIVER WILL STAY ON THAT FREQUENCY OR CHANNEL

EEPROM RESET

To reset the EEPROM back to defaults, with the radio switched on, press and hold VFO A/B until beeps are heard.

Radio will reboot.

WIDEBAND INFORMATION

The radio can be widebanded using the switch behind the front panel, as usual.

If transceiver is NOT widebanded, CB mode is disabled.

If out-of-band transmit is attempted when transceiver is NOT widebanded, 3 beeps will be heard and TX will be prevented until transceiver is retuned to a valid frequency.

TEMPORARY WIDEBAND

There is a temporary wideband facility, which is a command sent over Yaesu mode serial. See CAT section for more information.

This wideband will only persist until next power cycle reboot.

BUTTON ACTION QUICK REFERENCE

BUTTON	MODE	SHORT PRESS	LONG PRESS
VFO A/B	BOOT-UP ONLY(HOLD)	CHANGE CAT MODE	CHANGE CAT MODE
	VFO MODE	VFO A/B	EEPROM RESET
SPLIT	BOOT-UP KENWOOD MODE (HOLD)	BAUD RATE	BAUD RATE SAVE
	CB MODE	CHANGE CB BAND	CB 80 CH MODE
MR/VFO	VFO / MR	VFO / MR	CB MODE ON/OFF
VFO<>M	VFO / MR	VFO<>M	OFFSET MODE SWITCH
M>VFO	ALL	M>VFO	DIAL TYPE 0/1
CLAR	ALL	CLAR	ZERO BIT SET
	ZERO BIT MODE	SHOW FREQ	SAVE ZERO BIT OFFSET
	CB MODE	SHOW FREQ	ZERO BIT SET
D LOCK	VFO / MR	D-LOCK	FINE TUNE ON/OFF
	CB MODE	D-LOCK	NONE
BAND UP/DOWN	VFO	BAND+/-	M CHANNEL+/-
	MR	M CHANNEL+/-	BAND+/-
	CB MODE	CB CHANNEL +/-	M CHANNEL +/-

PROGRAM DESCRIPTION – Rough notes

- Global #bit (int 1) variables, band data, CB channel data are in Consts
- EEPROM values loaded or set with a checkbyte. If set, EEPROM already programmed.
- Main variables set.
- CAT interrupt set

Main loop:

- Read BCD counter, store to global res1
- Action any CAT interrupts if dial is still
- Scan buttons. Res = +20 for long press
- Action buttons. If so, trigger “force refresh”
- Check dial against Res1. If moved, return “moved” - begin timer. Dial clock pulse(counter = 10) misses pulses, so compare directly to counter for accuracy. Dial is directly connected to counter, so 100hz (and 10 hz) can be sent with NO CPU INPUT, unless we preload counter preset

Update Display

- Split int32 freq to int8
- Set and send nibbles. Allow 410uS for display interrupt, waiting for PB2, which is running approx 50-60hz from TMS chip

Tune PLL

- Load any offset and apply to global int32 frequency, making “offset freq”
- Split offset freq to int8
- Calculate band data, strobe to counter “preset enable” lines
- Calculate userspace “band data” – its different to Yaesus internal
- Calculate N-codes for PLL1. 500Khz limit + 560 = Ncode. Every 500khz, Ncode is dropped to 560, going to 1059
-
- Calc N-codes for PLL2. Formula is:
- Low mode (start – 15mhz) = Band freq (mhz + 100khz) = ((Band freq / 5) + 12)
- High mode (15 – 30mhz) = ((Band freq / 5) + 12) – 30
-
- Strobe PLL1, PLL2
- Strobe 10hz to up/down counter
- Send 100hz straight to mixer without strobing
-
- Save frequency to cache EEPROM if different from previous

NOTES

CAT PTT Modification PAGE 1

Parts required:

Approx 4 inches (100mm) of wire, eg DuPont

NPN transistor, at least 100mA (for example KSP2222, BC547 etc)

1000 Ohm resistor (1K)

Instructions:

Radio turned OFF

Remove radio top cover

Remove FTPLUS for easier access if needed

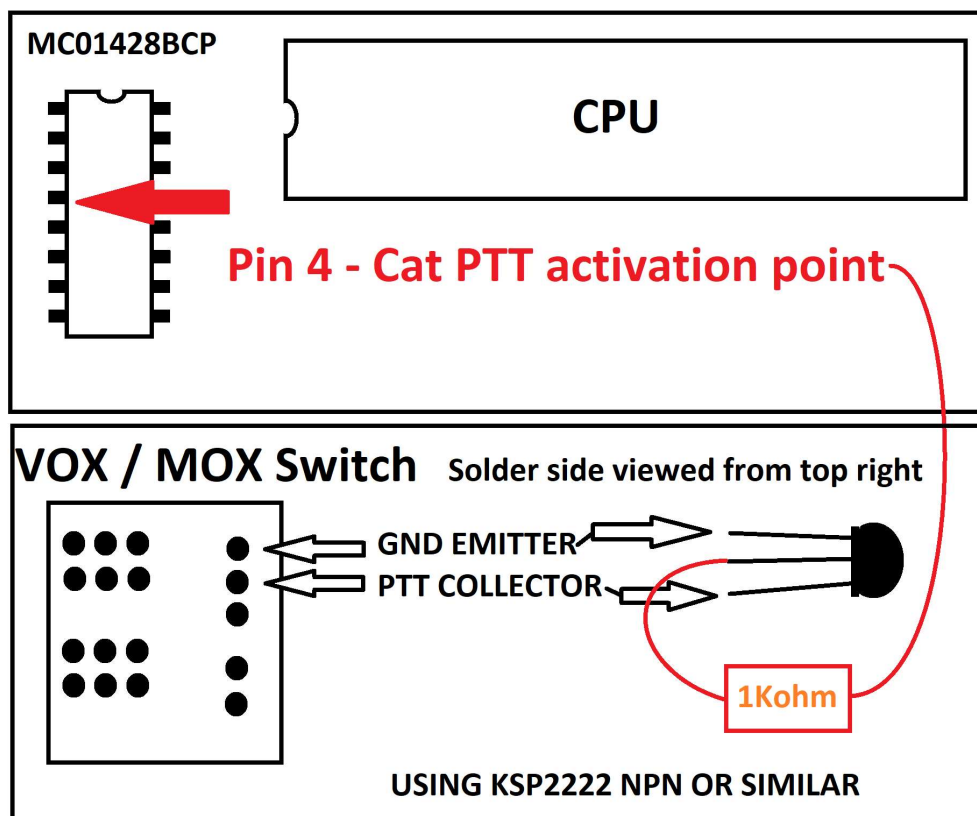
Locate IC marked MC14028BCP to the left of the processor

Locate Pin 4 (going from top left). Solder length of wire to Pin 4.

Solder 1K resistor to other end of wire

Solder BASE of transistor to other end of resistor

Locate MOX / VOX switch board (in front panel, directly under the left hand screw hole for the top lid), attach emitter and collector as shown



CAT PTT Modification PAGE 2

ATTENTION!

This modification is NOT COMPULSORY. Other methods of activating PTT exist, eg VOX, RTS, DTR lines etc

CAT PTT mode will only be active when FTPLUS is in KENWOOD mode.

If updating FTPLUS with the latest firmware, press LINEAR on the back of the radio to prevent PTT becoming active during programming. To disable PTT completely, a switch can be fitted between the activation point and the resistor if required.

The 10mS “ON-AIR” light upon power-up is normal. Nothing is transmitted.

FIRMWARE UPDATE

FT PLUS uses standard Pickit 3 pinout to reprogram. The programming pins are on the left hand side of the PCB. These may be marked:

M = MCLR

+ = 5V

- = GND

D = PGD

C = PGC

Reprogram, using PICKIT 3 application if required.

Credits:

Daniel Keogh VK2TRP for PLL information and initial schematics

Siegmund Souza for testing and being a guinea pig and highlighting mistakes

Matthew Bostock M0WCA for programming and new board design and features

Thanks also for all the encouragement during developing this. I just hope it brings some old radios back from the dead.