DFD3

DFD3 has 10Hz resolution and digital filtering to eliminate flicker due to round off error.

DFD3 measures only the VFO. It has it's own band-switch which must be set to match the radios band-switch.

Installation requires only access to the VFO which is available on a rear panel connector of many radios.

DFD3 is user programmable for most any multi-band radio. First the user programs the number of bands the radio has. Then, for each band, programs an offset value. The offset can be any value up to 40MHz in 10Hz steps.

Each band can be accurately calibrated by tuning a known frequency in the band (i.e.: crystal calibrator) and adjusting the offset to cause DFD3 to display the exact frequency. This data is also stored in EEPROM so it's a once in a great while deal.

Here's the really neat thing. DFD3 will program itself for many popular radios. The user merely tunes the band switch until the model of their radio is displayed and presses a button.

If you have a bunch of single band QRP rigs, you can program DFD3 bands as one band per rig. You can then move DFD3 from rig to rig by simply setting the band-switch to match the rig it's connected to.

DFD3 is for multi-band radios usually consisting of a crystal controlled converter followed by a tunable (variable) IF. Each band is programmed for an offset which, when added to the measured VFO frequency, produces and displays the RF frequency.

DFD3 allows for 32 bands. There is no law that says these bands have to be on the same radio. You can store three 5 band radios, a 10 band radio, a 3 band radio and 4 single band radios all at the same time (or any other combination). All you have to do is remember which bands go with which radio.

The offset frequency is determined by:

If RF increases as VFO increases then OFFSET = (LBL-VFOlow)

If RF increases as VFO decreases then OFFSET= -(UBL+VFOlow)

where LBL is the Lower Band Limit, UBL is the Upper Band Limit, and VFOlow is the Lower tuning limit of the VFO.

Suppose the band being tuned is 7-8MHz and the VFO tunes 3-4Mhz and that it tunes forward (RF increases as VFO increases) then

OFFSET=(7-3) = 4 MHz display will read 4.000.00 MHz>XX where XX is the band number and > indicates positive.

Had the VFO tuned backwards (RF increases as VFO decreases) then

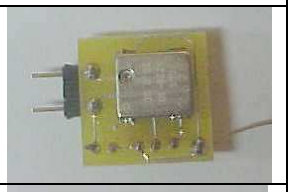
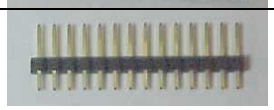
OFFSET= -(8+3) = -11 MHz display will read 11.000.00 MHz<XX where XX is the band number and < indicates negative.

A calibrate function allows you to tweak the offset for each band to get up to 10Hz accuracy. The offsets are stored in EEPROM so the calibrated values are saved until you reprogram or recalibrate a band.

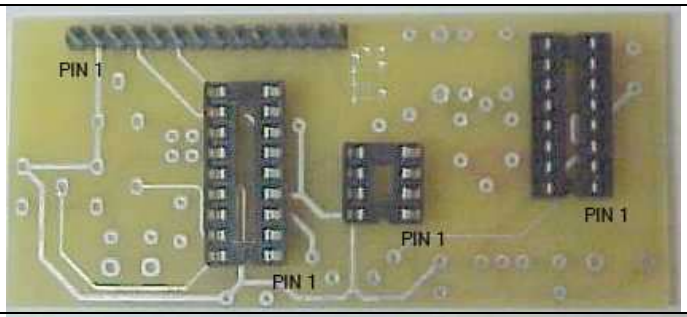
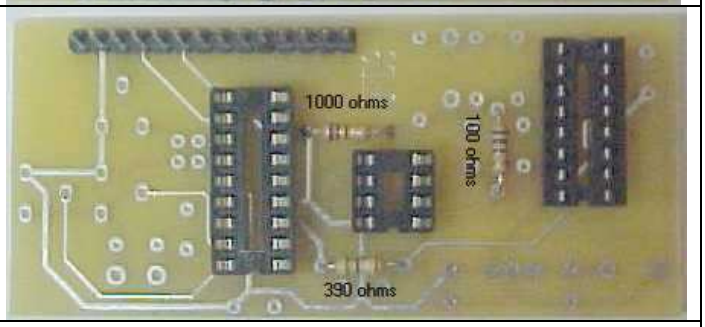
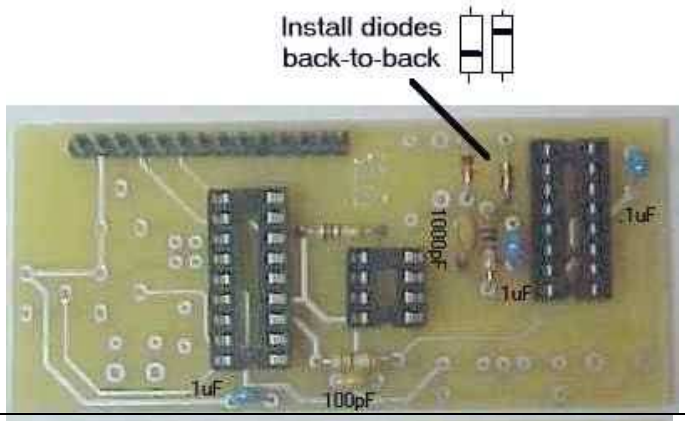
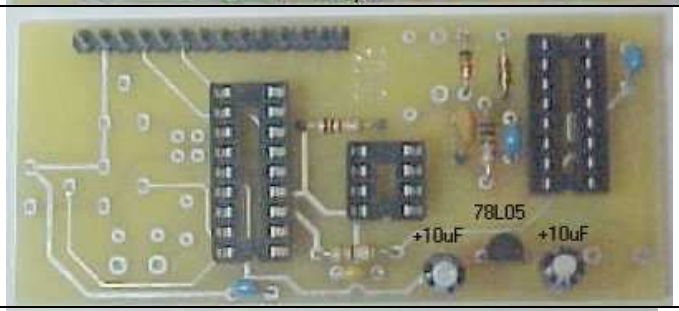
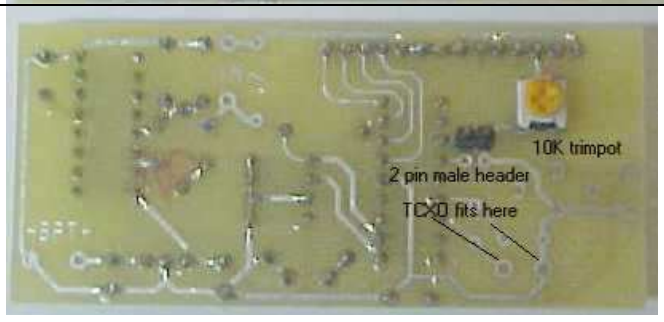
DFD3 also stores CW, LSB and USB BFO offsets. These values are added to the RF frequency when the MODE selector in the CW, LSB or USB positions. These values can also be calibrated. These offsets are zero for radios without crystal controlled BFOs but can be calibrated to match the BFO settings you use for each of these modes.

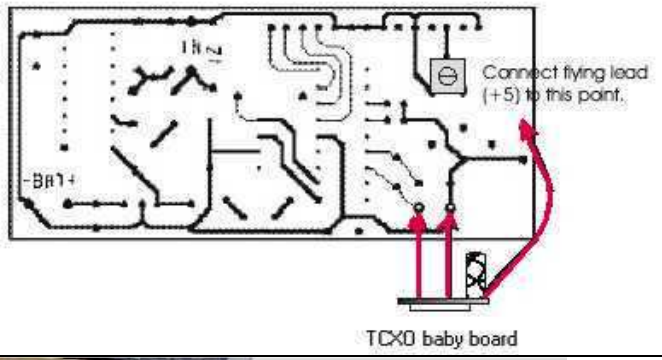
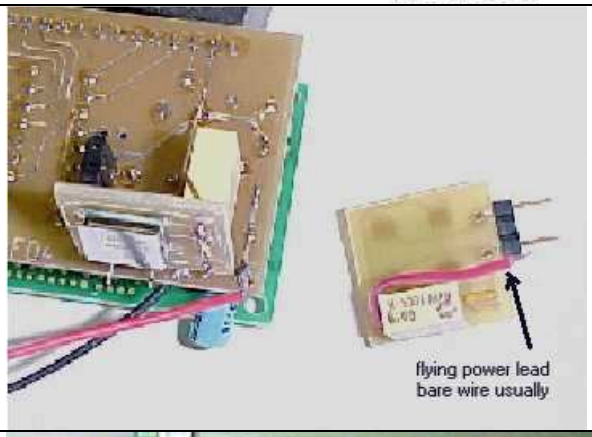
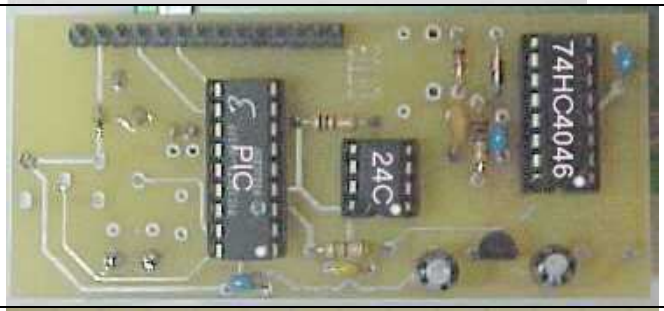
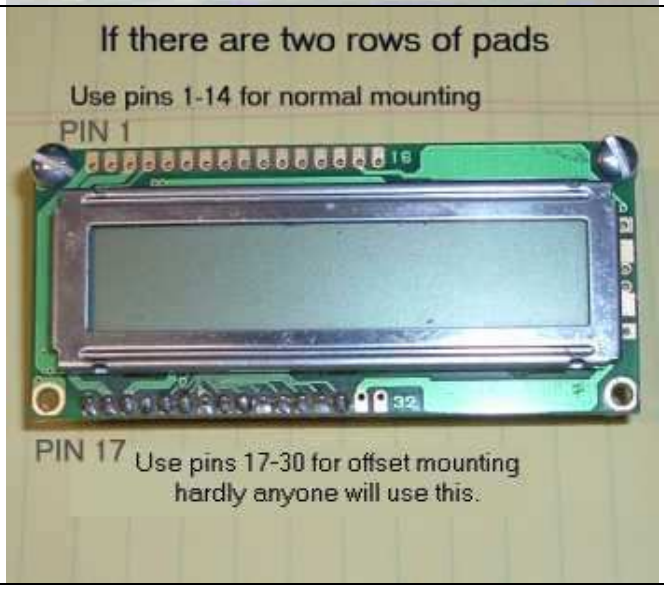
As a result, DFD3 will accurately display the carrier frequency of the receive or transmit signal in any mode.

PARTS LIST

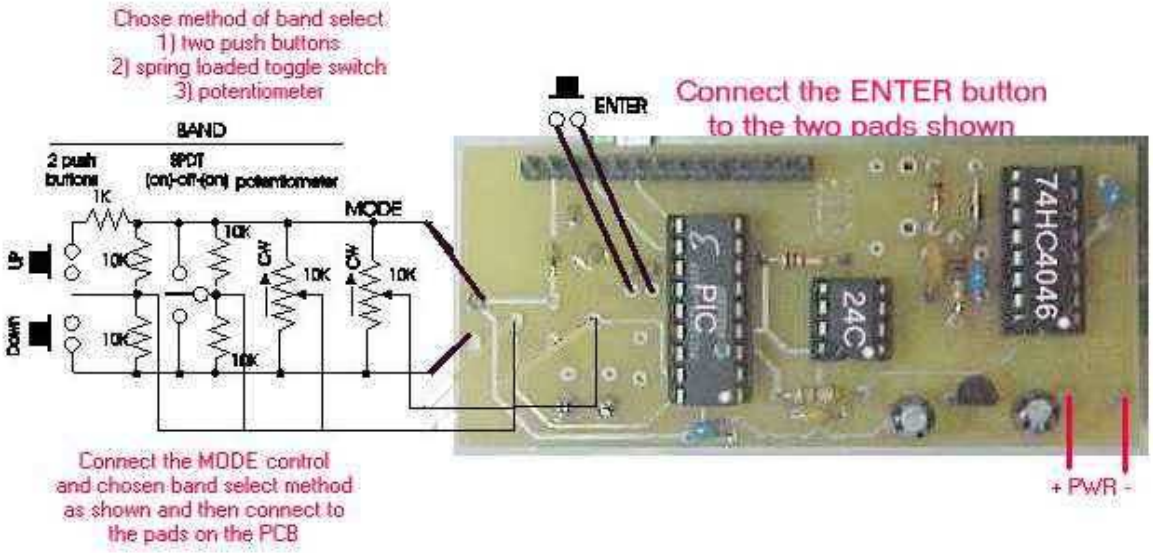
D1, D2	1N4148		U1	74HC4046	
R1	100ohms Brown-black-brown		U2	PIC16C71	
R2	390 ohms Orange-white-brown		U3	24Cxx Various models	
R3	10K trimpot		U4	78L05 Voltage regulator	
R4	1K ohms Brown-black-red		TCXO	Oscillator module	
C1	.001uF		H1	2 pin header 2 Pin jumper	
C2,C3,C5	.1uF		J1	Female connector	
C4	100 pF		P1	Male connector	
C7,C8	10uF				

ASSEMBLY

Install the IC sockets And male Display connector	
Install the resistors	
Install the .1uF 100pF and 1000pF capacitors Install the two diodes Back-to –Back.	
Install the 10uF electrolytics and 78L05	
Install the 10K contrast control and adjust it fully CCW. trim pot and the 2 pin male header **Header jumper** **ON = 100Hz resolution** **OFF = 10Hz resolution**	

Solder the TCXO and Power lead As shown	
It will look like This Trimpot may be Mounted flat. **Do not adjust the Trimpot .** Flying lead is Usually bare wire	
Insert the ICs	
Solder the Female header On the display Module pins 1-14. If the display Has two rows Of connections Use the top row For normal mounting or Bottom row, Pins 17-30 for Offset mounting	

Hardly anyone Will use Offset mounting	

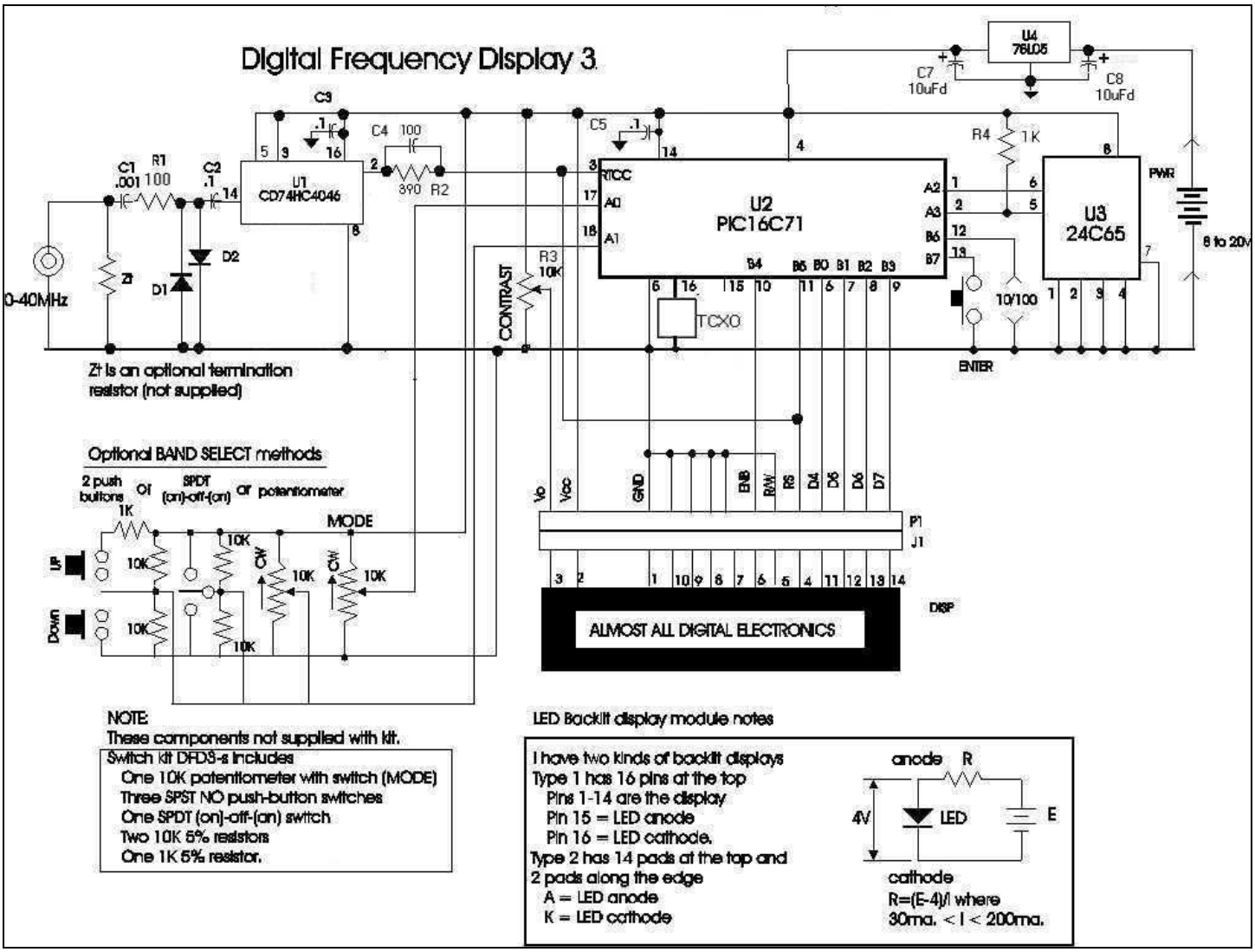


Connecting the front panel controls (ENTER usually mounts on back of cabinet)

All 3 band selection methods are shown,

1) **2 push buttons**
2) **SPDT (on)-off-(on)**
3) **Potentiometer (not recommended)**

Use only one.



Operating DFD3

DFD3 has only three operating controls, a BAND selector, a MODE selector and an ENTER button.

The BAND selector is a potentiometer, toggle switch (SPDT with spring return to center) or two pushbuttons as described in the assembly instructions. It's function is to change the band that DFD3 is operating on to match the band your radio is operating on. It increments or decrements the band number and during calibration it increments or decrements the frequency.

The MODE selector must be a potentiometer. It's function is to change the mode that DFD3 is operating in to match the mode your radio is operating in (AM, CW, LSB or USB). It's intent is to display the carrier frequency of the signal regardless of its type modulation. It's use is optional. You can chose to operate in the AM mode at all times where DFD3 displays the band number, however, it will not necessarily be displaying the carrier frequency.

During programming the MODE selector positions a cursor under the digit being programmed.

PROGRAMMING DFD3

To enter the programming mode turn DFD3 off. Press and hold the ENTER button while turning power on. Continue to hold the ENTER button.

When the MODE selector is to the left of center DFD3 is in manual programming mode. When it is to the right of center DFD3 is in auto-programming mode.

Manual programming mode.

DFD3 displays "**#BANDS=XX**"

When the BAND selector is decremented the band number decreases. When it is incremented it increases.

Toggle the BAND selector to adjust XX until it equals the number of bands your radio has (32 maximum). Release the ENTER button. The unit is now in calibrate mode.

Go to Calibrate mode (below) to complete the manual programming.

Automatic Programming mode.

DFD3 displays the manufacturer Followed by the radio model. I.e.: **Collins 75S-1**

Turn the BAND selector to step through the available radio models. When your model of radio is displayed release the ENTER button. The unit will auto-program itself for your radio. DFD3 is now in the calibrate mode. Go to the calibrate mode to accurately calibrate each band.

Radio Models List

If your interest is in a single model of radio shown in BLUE then you should order DFD1A, DFD2 or the plug-n-play unit for your radio instead.
If you want a universal display for several models then order DFD3 anyway.

Frequency Counter	Zero offset, **for use as test equipment**
Allied	A2515, A2517
Collins	32S-1, 32S-2, 32S-3, 51J-1, 51J-2, 51J-3, 51J-4, 51S-1, 75A-1, 75A-2, 75A-3, 75A-4, 75S-1, 75S-2, 75S-3, 75S-3A, 75S-3B, 75S-3C,(bands 13-28 are not programmed)* **If your only interest is an S line radio you should use custom DFD2 for the S line instead,** **or C-75 for plug-n-play.** KWS-1 , KWM-1, KWM-2 (bands 13,14 are not programmed.)* R-388, R-390, R-390A, R-392
Davco	DR-30

Drake

R1-A,(band 6 not programmed.)*
R2-A, R2-B,(bands 6-12 are not programmed.)*
R2-C,(band 6 not programmed.)*
R-4, R-4A, R-4B, R-4C, (bands 6-15 are not programmed.)*

If your only interest is an R4 or TR4 radio you should use DFD1-DRAKE instead,
or C-Drake for plug-n-play.

SPR-4 bands programmed as follows

BAND		low	high	xtal
Bands supplied with radio				
0		.15	0.5	0.00
1		.5	1	11.59
2		1	1.5	12.09
3		6	6.5	17.09
4		7	7.5	18.09
5		9.5	10	20.59
6		11.5	12	22.59
7		15	15.5	26.09
8		17.5	18	28.59
9		21.5	22	32.59
Ham Bands	meters			
10	160	1.5	2	12.59
11	80	3.5	4	14.59
12	40	7	7.5	18.09
13	30	10	10.5	21.09
14	20	14	14.5	25.09
15	17	18	18.5	29.09
16	15	21	21.5	32.09
17	12	24	24.5	35.09
18	10	28	28.5	39.09
19	10	28.5	29	39.59
20	10	29	29.5	40.09
21	10	29.5	30	40.59
22	not programmed			
23	not programmed			

Galaxy

GT-550

Hallicrafters

HT-44, S-20R, S-22R, S-38, S-40, S-41, S-47, S-51, S-52, S-53A, S-76, S-85, S-107, S-108, S-118, S-119, S-120, S-125, S-129, S-200, S-210, S-240
SR-150, SR-160, SR-400, SR-400A, SR-500, SR-750, SR-2000,
SX-25, SX-28, SX-42, SX-43, SX-62, SX-96, SX-99, SX-100, SX-110, SX-111, SX-115, SX-117

Hammarlund

HQ-100, HQ-105, HQ-110, HQ-120, HQ-129, HQ-140, HQ-145, HQ-150, HQ-160, HQ-170, HQ-180, HQ-200, HQ-215,(bands 20-24 not programmed)*
SP-400, SP-600

If your only interest is a HAMMARLUND radio you should use DFD1-HAMM instead,
or C-Hamm for plug-n-play.

Heathkit

HW-100, HW-101, SB-100, SB-101, SB-102, SB-300, SB-301, SB-303,
SB-310, SB-313, SB-400, SB-401, HR-1680

Henry	TEMPO-1
Kenwood	TS-520, TS-511, TS-900 **If your only interest is a TS-520S/SE radio you should use custom DFD2 for the TS-520S instead,** **or C-520 for plug-n-play.**
MacKay	3010B, 3010C
National	HRO-50, HRO-60, HRO-7, NC-2-40, NC-33, NC-46, NC-57, NC-60, NC-88, NC-98, NC-105, NC-109, NC-155, NC-173, NC-183, NC-188, NC-190, NC-270, NC-300, NC-303, NC-400, SW-54
SBE	SB-33
Squires	SS-1BS,(band 12 not programmed)* SS-1R, SS-1T(band 11 not programmed)*
Swan	260, 270, 270B, 300B, 350, 350C, 400, 500, 500CX, 700CX, 700S, 750CW **If your only interest is a SWAN radio you should use DFD1-SWAN instead,** **or C-Swan for plug-n-play.**
Yeasu	FT-101, FT-101B, FT-101E,Bands for the FT-101 are programmed in the same order as the YC-601 digital display. FRG-7, FTDX400, FRDX400, FLDX400, FTDX560

*Bands that are not programmed are auxiliary bands for which crystals were not supplied as standard. They can be manually programmed for whatever crystals you may have installed as follows: Turn DFD3 off, press and hold ENTER, turn unit back on to enter programming mode. Rotate MODE control left of center. DFD3 displays the number of bands this radio has. You can reduce this number to blank out any unused bands using the BAND selector or increase this number to add bands. Release the ENTER button. Turn BAND selector to unused band. The offset will be zero. DFD3 displays zero if not connected to your VFO or your VFO frequency if connected. Go to the calibrate mode described below.

Obviously I don't have all of these radios to test DFD3 with. Auto-program data was taken from data for each radio. In the event of a problem with a model or particular band call, e-mail, or write me about it and I will supply an updated chip and correct the error for future production.

Mount the 14 pin female header on the display module soldering only one pin.
Then verify the connector is at a right angle to the module, remelting the soldered pin and adjusting the connector if necessary.
Then solder the remaining pins.
Plug the module into the DFD2 PCB.

At this point you can plug the counter board into the module and power them with a 9 volt battery.
You should see something displayed.
What you see at this point is not important as some inputs are still floating until final assembly in your enclosure. **Set the IF offset by adjusting the 15 turn trimpots. Then install the 74HC4046 chips.**
If only 8 black squares appear, either the TCXO has not been soldered on all 4 points or there is a solder problem on the circuits between the 18 pin chip and the display connector, or on the display module connector.

Calibrate mode.

To calibrate the frequency set the MODE control to AM (displays band number to far right of display). To calibrate the CW, LSB or USB offsets turn the MODE control until the desired mode is displayed at the far right of display.

To enter the Calibrate mode press and hold the ENTER button after power has been applied and the MODE control has been set. Calibrating can be done either with the unit connected to your radios VFO or not. If it is connected then you are adjusting for the correct RF frequency to be displayed. If not you are adjusting for the correct OFFSET to be displayed. If your VFO tunes forward on this band (RF increases as VFO increases) there should be a ">" to the right of the "MHz" on the display. If it tunes backward (RF increases as VFO decreases) there should be a "<" to the right of "MHz".

The best procedure is to tune your radio to a known frequency near the center of each band. This can be supplied by the crystal calibrator built in your radio. Connect DFD3 to your VFO. Allow your radio to warm up to stabilize the VFO.

Turn the BAND selector (and your radio) to the band to program or calibrate. Tune to the known frequency. Press and hold the ENTER button. Rotate the MODE control to position the cursor under the digit to be incremented/decremented. A ">" indicates the offset is positive for forward tuning VFO and "<" indicates the offset is negative for reverse tuning VFO. Move the BAND selector in the direction of the arrow to increment the frequency and opposite the arrow to decrement it. You are actually adding or subtracting the number of Hz represented by that digit to the total frequency. For example, if the cursor is under the KHz digit you are adding or subtracting 1 KHz per step.

At the instant the displayed frequency is correct, release the ENTER button. If you miss it by a little simply repeat the process.

Repeat this procedure for each band. When all bands are programmed, turn DFD3 off and back on. This takes it out of the program mode

The purpose of the calibration mode is to correct for any errors in your high-frequency crystals. A good crystal might be 50 parts/million accuracy. At 30 MHz this could be up to 1500Hz error. The resolution of the frequency offset is 10 Hz so you should be able to get within 10Hz of the known frequency.

To calibrate the CW, LSB or USB offsets, turn the MODE control (and your radio) to the desired mode. Zero beat to the known frequency. Press and hold the ENTER button. The process is similar to calibration/programming except the cursor is forced under the 10Hz digit. At the instant it equals the known frequency release the ENTER button. Repeat this for each of the three modes. Do this on only one band, the mode offset applies to all bands. It is correcting for any errors in your SSB BFO crystals and setting the

displayed frequency to the carrier frequency of the known signal. The resolution of the mode offset is 20 Hz so you should be able to get within 20 Hz of the known frequency.

This all sounds a bit complex and it may take a while. You will quickly get used to the operation of DFD3. Remember, it only needs to be done once. The manual programming or calibration will be lost if you reprogram the unit for a different radio. You can reprogram it or re-calibrate it a minimum of 10,000,000 times. **Remember, you cannot make a mistake that cannot be undone.** A jumper on the PCB allows you to select either 100Hz resolution (jumper ON) or 10 Hz resolution (jumper OFF).

Additional information is available at
http://www.aade.com/applications2/app2.html