IFBT4 TRANSMITTER

TUNE-UP PROCEDURE

EQUIPMENT REQUIRED (or equivalent applies)

Audio signal generator capable of producing signals of -50 dBm to +10 dBm into 600 ohms at frequencies of 10 Hz to 50 kHz. Used in development: Tektronix SG-505.
RF spectrum analyzer with sensitivity of -100 dBm or better, a frequency range of 10 MHz to 3 GHz or wider, a terminating impedance of 50 ohms, and capability of handling an input level of + 25 dBm without overload or significant distortion. Used in development: Hewlett Packard E4405B.
Frequency counter covering 10 MHz to 806 MHz with an accuracy of +/- 100 Hz and readout to the nearest 100 Hz or better. This function may be resident on many higher end spectrum analyzers. Used in development: Tektronix CMC251.
Deviation meter capable of measuring frequency deviation from 0 to +/-100 kHz at 470 MHz to 806 MHz with an RF power level of +25 dBm or less in an FM system modulated by audio frequencies from 10 Hz to 50 kHz. The unit should also have a demodulated audio output. Used in development: Boonton Model 8200.
Digital multimeter capable of measuring current to at least 200 ma and voltage to 10 VDC with an accuracy of 3% or better. Used in development: Fluke Model 85.
Audio analyzer capable of measuring audio distortion to 0.05% or less over a frequency range of at least 10 Hz to 50 kHz. The unit should also have an output of residual distortion to an external measurement device. Used in development: Tektronix AA501A.
Oscilloscope with good audio response and sensitivity of at least 10 mv/cm with associated high impedance probe is also needed for evaluation of residual distortion. Used in development: Tektronix Model 224.
Power supply for bench top use capable of supplying 6 to 18 VDC at 250 ma (minimum) of current is needed. Both current and voltage should be metered. The supply should also have a variable current limit adjustment. Used in development: Leader Model LPS-152.
RF power meter or 50 ohm RF probe and associated meter capable of measuring RF power to 1 GHz at power levels to +25 dBm to an accuracy of 5% is also required. Many higher-end spectrum analyzers have this capability available as part of the cursor functions. Used in development: Hewlett Packard 8482H and Hewlett Packard E4418B.
AC RMS voltmeter with a range of at least +20 dBV to -60 dBV (10 Vrms to 1 mVrms) readable to within +/- 3% is needed. Used in development: Tektronix AA501A.
Note that DMMs may read inaccurately in RF fields. A 50-Ohm BNC to BNC coax cable (RG58) 2 to 3 feet long is necessary to connect the RF output of the IFBT1 to the spectrum analyzer and/or frequency counter. An accurate 20dB pad may be used at the RF output of the IFBT1 to reduce levels to the test equipment.

GENERAL NOTES
The tuning capacitors are small and have very small tuning slots. An alignment tool, which fits the tuning capacitors, is a must.

INITIAL POWERUP

Set the power supply output to +12Vdc and current limiting to 400 ma to protect the IFBT4 from shorts and over current due to misalignment. Connect the power supply to the IFBT4 power input jack with proper polarity. With the front panel power switch set to TUNE, the current drain should be 60 ma or less. When properly aligned this value should be nominally about 50 ma. If the unit has not been programmed there is no visible indication from the unit. If the unit has previously been programmed, the LCD display backlight will illuminate and the screen will have a display. All measurements are made using the unit ground pad at TP24.

VOLTAGE CHECK & CPU PROGRAMMING

With the power supply connected to the IFBT4 as above and the unit power switch set to TUNE position perform a voltage check or the unit voltage regulators. The voltages should be within ±5% of nominal. Check for +5Vdc at TP51, +3.3Vdc at TP52, +1.8Vdc at TP57, and –5Vdc at TP56. Check the +5Vdc TP51 with 6.0Vdc and with 18Vdc power input, then reset to 12Vdc input. If all voltages look good, switch the unit power to OFF. Connect programmer to J6, switch the unit power to TUNE, and program the CPU by installing the appropriate firmware. Disconnect the programmer cable from J6. Note: once programmed, the LCD backlight will illuminate.

LCD CONTRAST ADJUSTMENT

Adjust trimpot R50 to obtain -1.2Vdc at TP25. The LCD should now display numbers and icons of the main screen.

PRESET ADJUSTMENTS

If the unit has not been previously tuned, preset the three remaining trimpots to mid-position (R14, R40, and R47).

SET FREQUENCY BLOCK

Momentarily short TP20 to TP19 using a jumper to initiate factory test mode. Step the MENU button switch to the screen showing “BLOCK 20”. Step the UP select button once and pause until the next higher block number appears, then repeat until the proper frequency block is set for that specific unit. Switch the unit power to OFF until the LCD goes dark then switch the power back to TUNE. Take note during power up that the display momentarily shows the proper block number.

VOLTAGE CONTROLLED OSCILLATOR ALIGNMENT

Step the MENU button once to the Channel/Frequency screen. Using the UP or DOWN select buttons, scroll to the highest frequency channel FF. (Note: By holding in the UP or DOWN button, the unit will scroll and will wrap around from FF to 00 or 00 to FF. Connect an RF cable from the unit Local Osc output (TP2 hot, TP3 gnd) to the spectrum analyzer. Set the frequency display range of the spectrum analyzer to the approximate center of the unit frequency block and set the bandwidth to 40MHz. Set the analyzer bandwidth (typ 100kHz) and amplitude to display the LO signal. Adjust trimcap C64 (through the access hole in the RF shield) to move the free running oscillator toward the desired frequency. Once the oscillator is close enough to the frequency it will lock in.

Continue to adjust C23 until the voltage on TP11 is 3.9 Vdc. Press the UP button to change to frequency channel 00. The voltage at TP11 now should be between 0.7Vdc and 1.5Vdc for proper tracking.

TRANSMITTER RF OUTPUT

CAUTION: A properly operating transmitter puts out nominally 250 mW (+24 dBm). Keep the input attenuator and, therefore, the reference level of the spectrum analyzer at a point where the analyzer will not suffer damage or produce significant distortion itself (seen especially in harmonic energy). A safe condition can be generally established by using an accurate 20 dB pad.

Set the frequency display range of the spectrum analyzer to the approximate center of the unit frequency block and set the bandwidth to 40MHz. This ensures that the fundamental and all required multiples of the oscillator frequency are simultaneously displayed on the screen. Set the REFERENCE LEVEL to +30 dBm and other functions to AUTO. Turn the transmitter on by moving the front panel power switch to XMIT. Measure the output power of the transmitter. This may be most easily accomplished by using the cursor peak function if the analyzer has it. Otherwise use a power meter.
(Note: In XMIT mode the frequency cannot be changed. To change to another frequency, the front panel power switch must be set to the TUNE position then returned to the XMIT position. Likewise, the unit will not transmit in TUNE mode)

Check the RF output power level at frequency channels 00, 10, 20, 30, 40, 50, 60, 70, 80, 90, A0, B0, C0, D0, E0, F0 and FF across the block and note the frequency with the highest RF output.
(Note: for quick tuning, hold in MENU button and momentarily press UP or DOWN to scroll 16 frequencies per step)

Return to the frequency having the highest RF output. Adjust trimpot R40 to obtain 23.5 to 24.0 dBm RF output. Recheck the RF output at the other frequency channels listed above and verify the RF level is no greater than +24dBm and no less than -22.5dBm across the block (+23.5 dBm, +0.5dB to -1 dB). Don't forget to account for cable losses. Expand the spectrum analyzer bandwidth suitable to check for spurious emission levels from zero to at least 3GHz to verify that ALL other signals are at least 43 dB below the main RF output level (-43 dBc assures a 6 dB margin to the FCC specifications).

FREQUENCY ADJUSTMENT

Set the transmitter frequency to the center of the block , CH 80. Connect the output of the RF through a 20dB pad to a frequency and set the frequency counter to display the carrier frequency to 100Hz resolution. Momentarily short TP20 to TP19 to obtain the factory test mode and step MENU to the FINETUNE screen. Using the UP and DOWN buttons, set to the frequency within 1.6MHz of nominal center. (Note: each adjustment steps 3.1MHz) Once set, step MENU to the main screen.

AUDIO ADJUSTMENT

Note: The IFBT4 has an internal audio calibration feature in the factory test mode to simplify audio adjustment. The DSP generates internal audio signals at proper levels and frequencies to properly calibrate the modulator settings.

Connect the IFBT4 RF output to the modulation analyzer through a 20dB pad. Setup the modulation analyzer for proper levels and settings. On the IFBT4, step the MENU to the screen showing DEV CH80 100KC. Adjust DEVIATION Trimpot R47 to obtain 98.5 to 101kHz FM deviation (100kHz nominal). Step MENU once to DEV CH 00 screen and use the UP or DOWN buttons to set the FM deviation as close as possible to 100kHz. The number will display between -10 and +10 and is only for reference. Step MENU to the next screen and repeat to obtain as close as possible to 100kHz deviation. Step MENU to the next screen to calibrate the limiter or go to the main screen.

LIMITER ADJUSTMENT

Set the audio signal generator to 1kHz at 0.775 mV rms (0dBu) balanced output and connect to the IFBT1 XLR input connector using the audio cable. The balanced input to the XLR connector pins should be Audio+ to pin 2, Audio- to pin 3, and Audio common to pin 3. Set the IFBT4 rear panel input DIP switches 1 thru 4 to LINE (up, up, down, down).

With the IFBT4 in the factory test mode, step MENU to the LIMITREF SET TO 0 screen. Measure the audio level at TP5 (Test Point 5) with the RMS voltmeter set to dBu or dBm mode and note the audio level for reference setting or set to 0dB in ratio mode. Step the MENU to the next screen showing LIMITCAL and a number. Step the UP or DOWN buttons to obtain a setting as close to 5 db below the reference setting. Step MENU to the main screen.

AUDIO DISTORTION ADJUSTMENT

With the IFBT4 still set in factory test mode, step the MENU to SETUP then step the UP button to the COMPAT screen, step MENU once then step UP or DOWN to find the 200 mode. Step MENU to the PASSTHRU OFF screen, step UP to set to PASSTHRU ON. This bypasses all audio processing. Set the audio input level from the oscillator to -10dBu to the IFBT4 XLR input so that the unit is below limiting. From the recovered audio output of the modulation analyzer, measure the distortion and adjust BIAS trimpot R14 on the IFBT4 main board for the lowest distortion possible. It should be less than 0.2%. Set the IFBT4 DOWN button to PASSTHRU OFF.

PILOT TONE CHECK

With the unit connected to the modulation analyzer and the audio input to the IFBT4 XLR set OFF, check the pilot tone deviation and frequency. Make sure there are no filters or roll off that will affect the measurement. The deviation should be between 4.5 kHz and 6.5kHz. The pilot tone frequency will be 32.765 kHz for the UM200 mode of operation. If this is correct then all the other modes will also be correct. The other modes can be checked if needed by going to SETUP and COMPAT. The Pilot frequency for the 400 mode will be between 25 kHz and 32 kHz (a different frequency for each switch setting), and 29.995kHz for IFB mode. Step MENU to main screen.