

FM Translator Module (CHT-FMT) User Manual

AM/FM Receiver to FM MPX Translator Board for Crown Broadcast Transmitters

Relevant Board Revisions:

CHT-FMT

- 01 : Pre-Production Revision
- 02 : First Production Revision

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Translator Board System Overview

The FM Translator Module is designed to work within Crown Broadcast's FM Broadcast Transmitters. It receives FM or AM signals from an external antenna input and generates an FM composite multiplex (MPX) signal output to be used by the transmitter's internal FM modulator. The translator module interfaces directly with Crown's mainboard to provide user interface feedback via the transmitter's front panel display. Band and frequency selection is performed via circuit board mounted DIP switches on the translator module itself. The translator module may sometimes be referred to as a receiver module.

Receiver Functionality

The onboard AM/FM receiver utilizes a Digital Signal Processor (DSP) that incorporates advanced algorithms to provide world-class receiver performance. Tuner parameters have been optimized by experts in AM/FM reception to provide the best overall performance for this specific product, eliminating the need for broadcasters to make adjustments. The receiver is capable of tuning:

- 1) FM frequencies from 76.00 – 108.00 MHz in steps of 0.05 MHz (50 kHz).
- 2) AM frequencies from 520 – 1710 kHz in 10 kHz increments.
- 3) AM frequencies from 531 – 1629 kHz in 9 kHz increments.

Transmitter Front Panel

Relative Received Signal Strength Indicator (RSSI)

The translator board provides a relative Received Signal Strength Indicator (RSSI) to aid in aiming a directional reception antenna. Signal strengths are approximate and are only intended as a first-order signal strength approximation. The RSSI signal is output to the transmitter's front panel, and provides an approximate signal strength indication displaying on the "Wide Band" LED indicator. A low signal strength will display as the left-most LED dimly lit, corresponding to an approximate signal strength of less than about 5 dB μ V (assuming a 50 Ω load). Strong signal strength will display as the right-most LED lit, corresponding to approximate signal strength of greater than 65 dB μ V (assuming a 50 Ω load). If reading the signal strength with a voltmeter, 5 – 65 dB μ V strength levels will correspond to approximately 0.4 – 5.0 Volts, respectively.

L/R Audio Input Level

Two graphical LED displays are provided that show the approximate real-time monitor levels of the received Left and Right channels.

Stereo-Mono Switch

AM

The Stereo-Mono Switch position is ignored when the translator is configured to receive an AM station, and the translator will generate a "Mono" FM composite signal.

FM

When the translator is configured to receive an FM signal, the Stereo-Mono slide switch selects the AM/FM receiver's mono/stereo reception mode and the translator's transmission mode. When in the "Stereo" setting, the translator will dynamically adjust the Left/Right channel blend based upon real-time signal conditions, providing the best possible user experience. When the switch is in the "Stereo" position, the translator will always broadcast a Stereo Pilot, regardless of the received signal. In the case of weak signal reception, or when receiving a mono station, the broadcaster should select the "Mono" setting, which will disable the Stereo Pilot generation, thus optimizing the FM composite deviation output.

Receiver Configuration

If you have a transmitter equipped with the receiver/translator option, you will need to set the receiving or incoming band and frequency for your AM/FM receiver. For quick configuration, use the "Quick Start to Receiver Configuration." For more details and configuration examples, refer to the sections below for the appropriate receiver frequency band.

Quick Start to Receiver Configuration

- 1) With the top cover removed, locate the receiver module and the two DIP switches (labeled DIP0 and DIP1), and identify pins 1:8 of each DIP switch. Note that "On" or "1" is indicated by a DIP pin being in the "Up" position, and "Off" or "0" is indicated by a DIP pin being in the "Down" position.
- 2) Use the following tables to set DIP0 Pins 1:8 and DIP1 Pins 1:2 for the desired incoming frequency:
 - a. For FM Reception, use "Table 1 – DIP0 1:8 – FM Frequency Selection" and "Table 2 – DIP1 1:2 – FM Frequency Offsets."
 - i. The frequency chosen by setting DIP0's pins and the offset chosen by setting DIP1's pins 1:2 must sum to your desired frequency. (e.g. $98.00 + 0.10 = 98.10$)
 - b. For AM Reception, use "Table 3 – DIP0 1:8 and DIP1 1:2 – AM Frequency Selection."
- 3) Set the reserved pins, DIP1's pins 3:8, to "Off".
- 4) Press the Reset button to force the receiver to use the new configuration settings. Be careful when pressing the Reset button, as the resistor next to the button may be very hot; this is normal.
- 5) After setting the frequency, replace the top cover and screws.

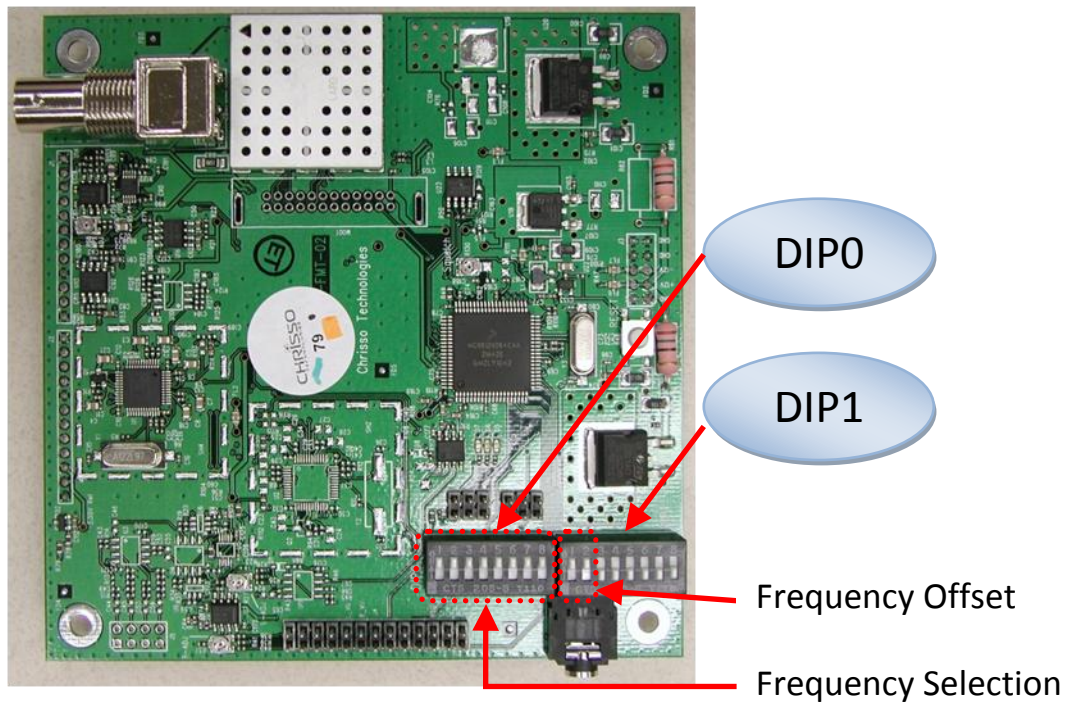


Figure 1 – Frequency Selection DIP Switches

FM Band Frequency Selection

The translator's receiver can tune FM frequencies from 76.00 – 108.00 MHz in steps of 0.05 MHz (50 kHz); this allows for tuning of all typical FM broadcast frequencies in the US, European, and Japanese Bands. To tune:

- 1) Use "Table 1 – DIP0 1:8 – FM Frequency Selection", below, to correctly set DIP0's pins 1:8 values to match the closest frequency less than or equal to your desired frequency.
- 2) Use "Table 2 – DIP1 1:2 – FM Frequency Offsets", below, to add the additional frequency offset needed to obtain your desired frequency.
- 3) Press the Reset button to force the receiver to tune using the new configuration settings. Be careful when pressing the Reset button, as the resistor next to the button may be very hot; this is normal.

For example: If 98.10 MHz is desired, set DIP0 to the value corresponding to 98.00 MHz (01101110), and set DIP1 pins 1:2 to the value corresponding to 0.10 MHz (10). $98.00 \text{ MHz} + 0.10 \text{ MHz} = 98.10 \text{ MHz}$, the desired frequency. See Figure 2, below, for a picture of the correct DIP positions for tuning 98.10 MHz.

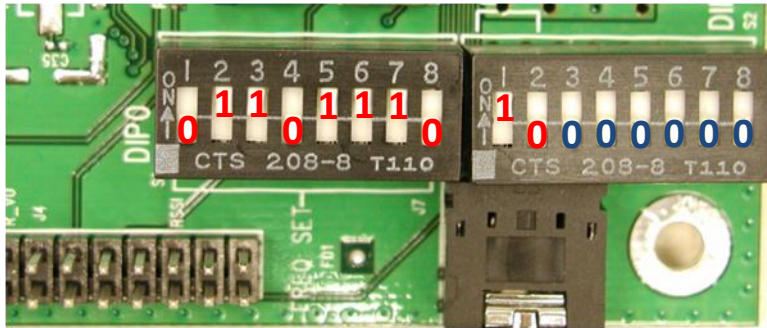


Figure 2 – FM Frequency 98.10 MHz DIP Settings

Table 1 – DIP0 1:8 – FM Frequency Selection

Frequency	DIP0		Frequency	DIP0		Frequency	DIP0	
(MHz)	1:4	5:8	(MHz)	1:4	5:8	(MHz)	1:4	5:8
76.00	0000	0000	87.00	0011	0111	98.00	0110	1110
76.20	0000	0001	87.20	0011	1000	98.20	0110	1111
76.40	0000	0010	87.40	0011	1001	98.40	0111	0000
76.60	0000	0011	87.60	0011	1010	98.60	0111	0001
76.80	0000	0100	87.80	0011	1011	98.80	0111	0010
77.00	0000	0101	88.00	0011	1100	99.00	0111	0011
77.20	0000	0110	88.20	0011	1101	99.20	0111	0100
77.40	0000	0111	88.40	0011	1110	99.40	0111	0101
77.60	0000	1000	88.60	0011	1111	99.60	0111	0110
77.80	0000	1001	88.80	0100	0000	99.80	0111	0111
78.00	0000	1010	89.00	0100	0001	100.00	0111	1000
78.20	0000	1011	89.20	0100	0010	100.20	0111	1001
78.40	0000	1100	89.40	0100	0011	100.40	0111	1010
78.60	0000	1101	89.60	0100	0100	100.60	0111	1011
78.80	0000	1110	89.80	0100	0101	100.80	0111	1100
79.00	0000	1111	90.00	0100	0110	101.00	0111	1101
79.20	0001	0000	90.20	0100	0111	101.20	0111	1110
79.40	0001	0001	90.40	0100	1000	101.40	0111	1111
79.60	0001	0010	90.60	0100	1001	101.60	1000	0000
79.80	0001	0011	90.80	0100	1010	101.80	1000	0001
80.00	0001	0100	91.00	0100	1011	102.00	1000	0010
80.20	0001	0101	91.20	0100	1100	102.20	1000	0011
80.40	0001	0110	91.40	0100	1101	102.40	1000	0100
80.60	0001	0111	91.60	0100	1110	102.60	1000	0101
80.80	0001	1000	91.80	0100	1111	102.80	1000	0110
81.00	0001	1001	92.00	0101	0000	103.00	1000	0111
81.20	0001	1010	92.20	0101	0001	103.20	1000	1000

Frequency	DIP0	
(MHz)	1:4	5:8
81.40	0001	1011
81.60	0001	1100
81.80	0001	1101
82.00	0001	1110
82.20	0001	1111
82.40	0010	0000
82.60	0010	0001
82.80	0010	0010
83.00	0010	0011
83.20	0010	0100
83.40	0010	0101
83.60	0010	0110
83.80	0010	0111
84.00	0010	1000
84.20	0010	1001
84.40	0010	1010
84.60	0010	1011
84.80	0010	1100
85.00	0010	1101
85.20	0010	1110
85.40	0010	1111
85.60	0011	0000
85.80	0011	0001
86.00	0011	0010
86.20	0011	0011
86.40	0011	0100
86.60	0011	0101
86.80	0011	0110

Frequency	DIP0	
(MHz)	1:4	5:8
92.40	0101	0010
92.60	0101	0011
92.80	0101	0100
93.00	0101	0101
93.20	0101	0110
93.40	0101	0111
93.60	0101	1000
93.80	0101	1001
94.00	0101	1010
94.20	0101	1011
94.40	0101	1100
94.60	0101	1101
94.80	0101	1110
95.00	0101	1111
95.20	0110	0000
95.40	0110	0001
95.60	0110	0010
95.80	0110	0011
96.00	0110	0100
96.20	0110	0101
96.40	0110	0110
96.60	0110	0111
96.80	0110	1000
97.00	0110	1001
97.20	0110	1010
97.40	0110	1011
97.60	0110	1100
97.80	0110	1101

Frequency	DIP0	
(MHz)	1:4	5:8
103.40	1000	1001
103.60	1000	1010
103.80	1000	1011
104.00	1000	1100
104.20	1000	1101
104.40	1000	1110
104.60	1000	1111
104.80	1001	0000
105.00	1001	0001
105.20	1001	0010
105.40	1001	0011
105.60	1001	0100
105.80	1001	0101
106.00	1001	0110
106.20	1001	0111
106.40	1001	1000
106.60	1001	1001
106.80	1001	1010
107.00	1001	1011
107.20	1001	1100
107.40	1001	1101
107.60	1001	1110
107.80	1001	1111
108.00	1010	0000

Table 2 – DIP1 1:2 – FM Frequency Offsets

Offset	DIP1
(MHz)	1:2
0.00	00
0.05	01
0.10	10
0.15	11

AM Band Frequency Selection

The translator's receiver can tune AM frequencies from 520 – 1710 kHz in 10kHz increments for the US, and from 531 – 1629 kHz in 9 kHz increments for Europe and Japan; this allows for tuning of all typical AM broadcast frequencies in the US, European, and Japanese Bands. To tune:

- 1) Use "Table 3 – DIP0 1:8 and DIP1 1:2 – AM Frequency Selection", below, to correctly set DIP0's pins 1:8 and DIP1's pins 1:2 to match your desired band and frequency.
- 2) Press the Reset button to force the receiver to tune using the new configuration settings. Be careful when pressing the Reset button, as the resistor next to the button may be very hot; this is normal.

For example: If 990 kHz is desired, in the US, set DIP0's pins 1:8 to 11001011 and DIP1's pins 1:2 to 11, or in Europe/Japan, set DIP0's pins 1:8 to 11101100 and DIP1's pins 1:2 to 11.

Table 3 – DIP0 1:8 and DIP1 1:2 – AM Frequency Selection

US AM Band				Europe/Japan AM Band			
Frequency	DIP0		DIP1	Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2
520	1100	0000	00	531	1110	0000	00
530	1100	0000	01	540	1110	0000	01
540	1100	0000	10	549	1110	0000	10
550	1100	0000	11	558	1110	0000	11
560	1100	0001	00	567	1110	0001	00
570	1100	0001	01	576	1110	0001	01
580	1100	0001	10	585	1110	0001	10
590	1100	0001	11	594	1110	0001	11
600	1100	0010	00	603	1110	0010	00
610	1100	0010	01	612	1110	0010	01
620	1100	0010	10	621	1110	0010	10
630	1100	0010	11	630	1110	0010	11
640	1100	0011	00	639	1110	0011	00
650	1100	0011	01	648	1110	0011	01
660	1100	0011	10	657	1110	0011	10
670	1100	0011	11	666	1110	0011	11
680	1100	0100	00	675	1110	0100	00
690	1100	0100	01	684	1110	0100	01
700	1100	0100	10	693	1110	0100	10
710	1100	0100	11	702	1110	0100	11
720	1100	0101	00	711	1110	0101	00
730	1100	0101	01	720	1110	0101	01
740	1100	0101	10	729	1110	0101	10
750	1100	0101	11	738	1110	0101	11

US AM Band			
Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2
760	1100	0110	00
770	1100	0110	01
780	1100	0110	10
790	1100	0110	11
800	1100	0111	00
810	1100	0111	01
820	1100	0111	10
830	1100	0111	11
840	1100	1000	00
850	1100	1000	01
860	1100	1000	10
870	1100	1000	11
880	1100	1001	00
890	1100	1001	01
900	1100	1001	10
910	1100	1001	11
920	1100	1010	00
930	1100	1010	01
940	1100	1010	10
950	1100	1010	11
960	1100	1011	00
970	1100	1011	01
980	1100	1011	10
990	1100	1011	11
1000	1100	1100	00
1010	1100	1100	01
1020	1100	1100	10
1030	1100	1100	11
1040	1100	1101	00
1050	1100	1101	01
1060	1100	1101	10
1070	1100	1101	11
1080	1100	1110	00
1090	1100	1110	01
1100	1100	1110	10
1110	1100	1110	11
1120	1100	1111	00
1130	1100	1111	01

Europe/Japan AM Band			
Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2
747	1110	0110	00
756	1110	0110	01
765	1110	0110	10
774	1110	0110	11
783	1110	0111	00
792	1110	0111	01
801	1110	0111	10
810	1110	0111	11
819	1110	1000	00
828	1110	1000	01
837	1110	1000	10
846	1110	1000	11
855	1110	1001	00
864	1110	1001	01
873	1110	1001	10
882	1110	1001	11
891	1110	1010	00
900	1110	1010	01
909	1110	1010	10
918	1110	1010	11
927	1110	1011	00
936	1110	1011	01
945	1110	1011	10
954	1110	1011	11
963	1110	1100	00
972	1110	1100	01
981	1110	1100	10
990	1110	1100	11
999	1110	1101	00
1008	1110	1101	01
1017	1110	1101	10
1026	1110	1101	11
1035	1110	1110	00
1044	1110	1110	01
1053	1110	1110	10
1062	1110	1110	11
1071	1110	1111	00
1080	1110	1111	01

US AM Band			
Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2
1140	1100	1111	10
1150	1100	1111	11
1160	1101	0000	00
1170	1101	0000	01
1180	1101	0000	10
1190	1101	0000	11
1200	1101	0001	00
1210	1101	0001	01
1220	1101	0001	10
1230	1101	0001	11
1240	1101	0010	00
1250	1101	0010	01
1260	1101	0010	10
1270	1101	0010	11
1280	1101	0011	00
1290	1101	0011	01
1300	1101	0011	10
1310	1101	0011	11
1320	1101	0100	00
1330	1101	0100	01
1340	1101	0100	10
1350	1101	0100	11
1360	1101	0101	00
1370	1101	0101	01
1380	1101	0101	10
1390	1101	0101	11
1400	1101	0110	00
1410	1101	0110	01
1420	1101	0110	10
1430	1101	0110	11
1440	1101	0111	00
1450	1101	0111	01
1460	1101	0111	10
1470	1101	0111	11
1480	1101	1000	00
1490	1101	1000	01
1500	1101	1000	10
1510	1101	1000	11

Europe/Japan AM Band			
Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2
1089	1110	1111	10
1098	1110	1111	11
1107	1111	0000	00
1116	1111	0000	01
1125	1111	0000	10
1134	1111	0000	11
1143	1111	0001	00
1152	1111	0001	01
1161	1111	0001	10
1170	1111	0001	11
1179	1111	0010	00
1188	1111	0010	01
1197	1111	0010	10
1206	1111	0010	11
1215	1111	0011	00
1224	1111	0011	01
1233	1111	0011	10
1242	1111	0011	11
1251	1111	0100	00
1260	1111	0100	01
1269	1111	0100	10
1278	1111	0100	11
1287	1111	0101	00
1296	1111	0101	01
1305	1111	0101	10
1314	1111	0101	11
1323	1111	0110	00
1332	1111	0110	01
1341	1111	0110	10
1350	1111	0110	11
1359	1111	0111	00
1368	1111	0111	01
1377	1111	0111	10
1386	1111	0111	11
1395	1111	1000	00
1404	1111	1000	01
1413	1111	1000	10
1422	1111	1000	11

US AM Band				Europe/Japan AM Band			
Frequency	DIP0		DIP1	Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2
1520	1101	1001	00	1431	1111	1001	00
1530	1101	1001	01	1440	1111	1001	01
1540	1101	1001	10	1449	1111	1001	10
1550	1101	1001	11	1458	1111	1001	11
1560	1101	1010	00	1467	1111	1010	00
1570	1101	1010	01	1476	1111	1010	01
1580	1101	1010	10	1485	1111	1010	10
1590	1101	1010	11	1494	1111	1010	11
1600	1101	1011	00	1503	1111	1011	00
1610	1101	1011	01	1512	1111	1011	01
1620	1101	1011	10	1521	1111	1011	10
1630	1101	1011	11	1530	1111	1011	11
1640	1101	1100	00	1539	1111	1100	00
1650	1101	1100	01	1548	1111	1100	01
1660	1101	1100	10	1557	1111	1100	10
1670	1101	1100	11	1566	1111	1100	11
1680	1101	1101	00	1575	1111	1101	00
1690	1101	1101	01	1584	1111	1101	01
1700	1101	1101	10	1593	1111	1101	10
1710	1101	1101	11	1602	1111	1101	11
				1611	1111	1110	00
				1620	1111	1110	01
				1629	1111	1110	10

Squelch Control Level Adjustment

Potentiometer R130 (labeled Squelch) adjusts signal detection level for the automatic squelch control. If the received RSSI level ever drops below the currently set squelch control level, the MPX output of the FM receiver will mute, keeping the transmitter from broadcasting “dead air.” The translator will automatically unmute the MPX output when the input RSSI level is more than 6dB above the currently set squelch control level.

Rotating the potentiometer ranges the squelch level sensing from approximately 5 dBμV in the most counter-clockwise position to approximately 65 dBμV in the most clockwise position, with the exceptions that the full counter-clockwise position forces a “never squelch” state, and the full clockwise position forces an “always squelch” state. Unless squelch control is needed, it is highly recommended to leave the squelch potentiometer in the full counter-clockwise position.

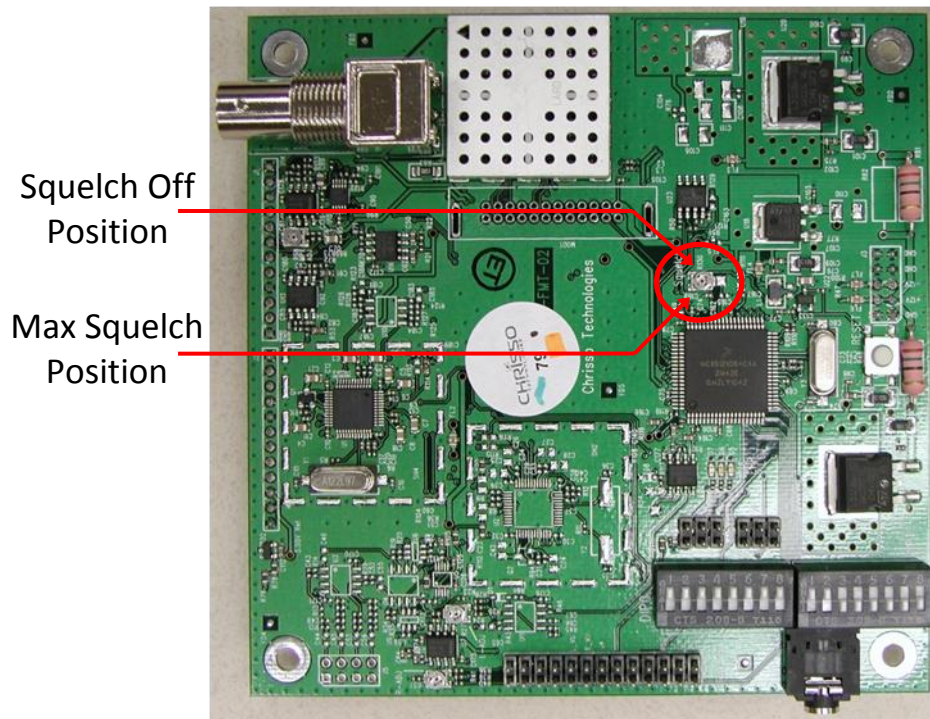


Figure 3 – Squelch Control Level Adjustment Potentiometer

Reserved Pins

DIP1's pins 3:8 are reserved for future use. All of these pins should be in the "Off" position, as to not interfere with the intended operation of this translator board version. Unintended results could occur if any of these pins are in the "On" position.

De/Pre-Emphasis

No configuration of De/Pre-Emphasis is necessary for the CHT-FMT. The Pre-Emphasis of the translator will be the same as the Pre-Emphasis of the source station.

Audio Output Level Adjustment

Potentiometer R41 (labeled R-ADJ) and potentiometer R27 (labeled L-ADJ) are used to adjust the Right and Left audio output levels, respectively, for monitoring purposes only. These levels are factory set to 1.9Vrms to maximize the range on the front panel input audio LEDs. Adjusting these levels affects the front panel input audio LEDs, the audio level out of the monitor stereo jack on the receiver board, and the audio level out of the Left and Right Monitor RCA jacks on the rear of the transmitter case.

Adjusting counter-clockwise increases the audio level, whereas adjusting clockwise decreases the audio level. Adjusting these potentiometers has no effect on the Composite MPX signal that feeds the FM Modulator.

Composite Output Level Adjustment

Potentiometer R68 (labeled MPX ADJ) is used to adjust the level of the Composite MPX signal that feeds the FM Modulator. Adjusting this potentiometer will increase or decrease the modulation percentage

as indicated on the front panel “Modulation” LEDs. This potentiometer is factory calibrated to achieve 100% modulation.

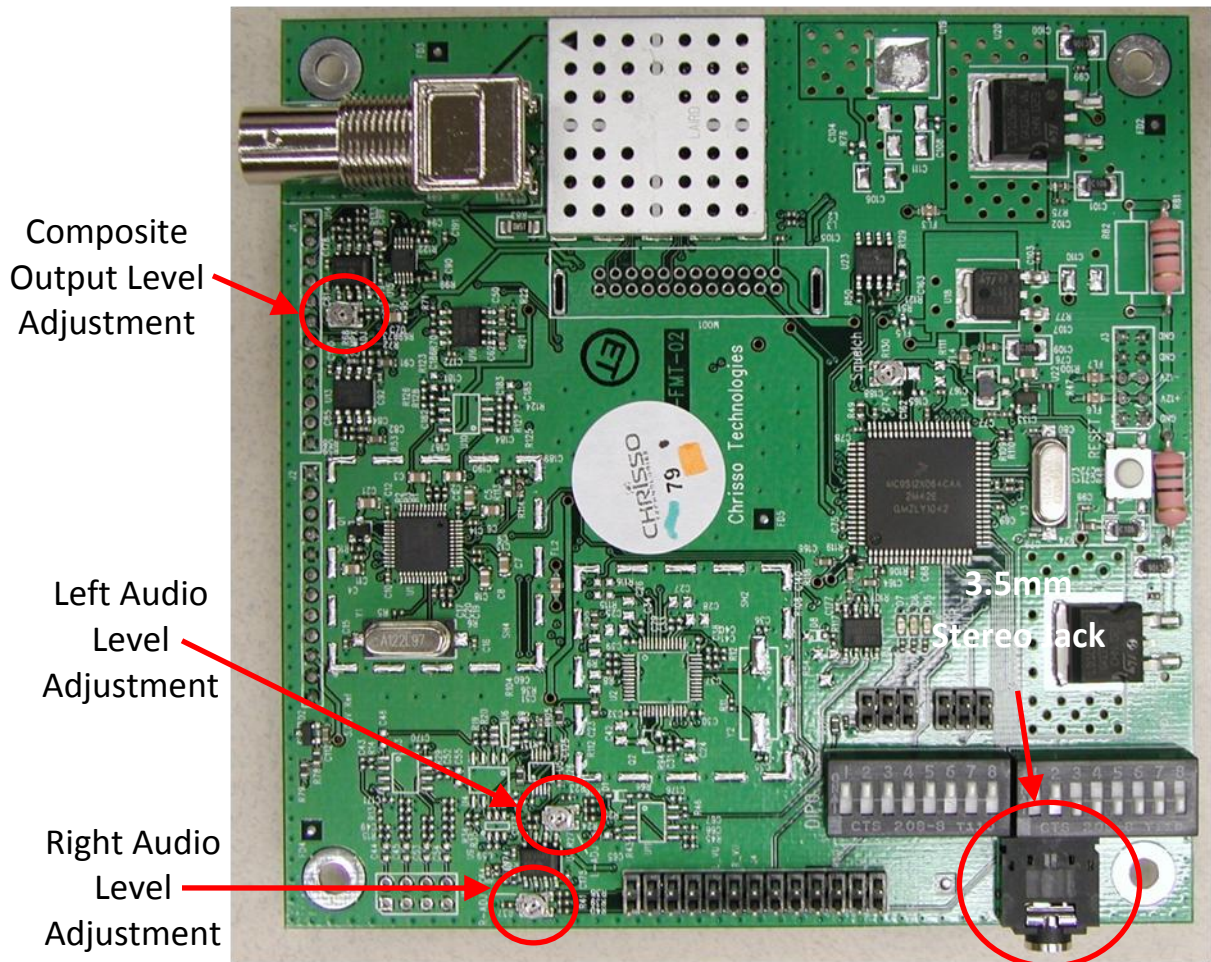


Figure 4 – Level Adjustments and Audio Monitoring Jack

Error Handling

The translator board is designed for prolonged use in a broadcast environment, and should never require rebooting in standard operation. While thorough testing has been performed on the receiver’s hardware and software, in the extremely unlikely event that a software lockup would occur, an extra software recovery loop has been implemented to allow the translator to automatically reboot and recover from faults in less than 30 seconds of a detected lockup.

Light Emitting Diodes (LEDs)

The translator board has three onboard status indicator LEDs.

PILOT LED

When the front-panel Stereo-Mono Switch is set to “Stereo” and the receiver board is set to receive an FM signal, the translator PILOT LED indicates the presence of a stereo pilot in the received signal. When the Stereo-Mono Switch is set to “Mono” or the receiver board is set to receive an AM signal, the PILOT LED will be off. If the PILOT LED is not consistently lit, it is recommended to force the receiver to mono reception by moving the front-panel Stereo-Mono Switch to the “Mono” position.

I2C_ACTIVE LED

The “I2C_ACTIVE” LED indicates digital bus communications between various digital components of the translator. This LED will light frequently and for various lengths of time. If this LED is lighted solid, it may indicate an I²C communication error. This error will trigger the translator’s auto-recovery feature, and the translator will self reboot.

ERROR_CODES LED

The “ERROR_CODES” LED indicates that an error has occurred within the translator. If this LED lights, the translator will reboot itself within 30 seconds. If this LED lights or flashes for more than 30 seconds, power cycle the translator by pressing the Reset button. If resetting the translator does not solve the issue, this indicates an unrecoverable hardware error, and will require the translator module to be serviced. This LED flashes at different rates depending upon the error. The following are for diagnostics purposes only, and are not to be treated as an exhaustive error-code list.

LED Invert Time	Error
50 ms	I ² C Bus Error
100 ms	Generic Port Error
200 ms	Tuner Lockup Detected

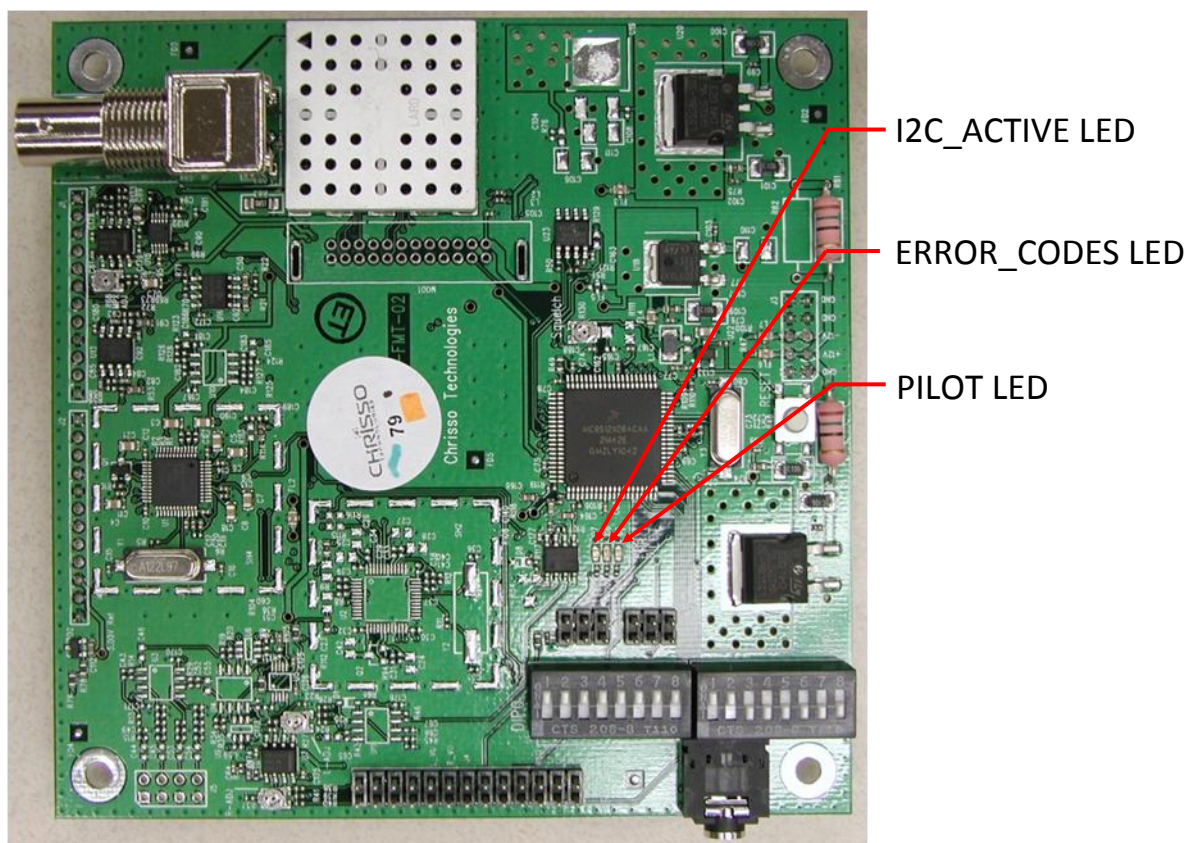


Figure 5 – Onboard LED Indicators

Model**CT-01****Features**

FM Stereo	Yes
AM	Yes
Headphone monitor	Yes
Factory Calibration	Yes
DSP enhanced MPX output	Yes
Receiver Type	DSP

FM Receiver Performance

Usable Sensitivity (mono)	12.0 dBf
50-dB quieting sensitivity (mono)	11.2 dBf
60-dB quieting sensitivity (mono)	17.0 dBf
THD, 1 kHz (mono)	0.03%
Stereo separation, 1 kHz	54 dB
S/N, 65 dBf (mono)	79.5 dB
Adjacent-channel selectivity	82 dB (noise limited)
RF intermod (97.7 + 98.5 -> 96.9)	107.0 dB
RF spur (96.24 -> 96.9)	> 114 dB
RF image (118.3 -> 96.9)	n/a - lowIF

AM Receiver Performance

Usable Sensitivity (mono)	10 dBuV
THD, 1 kHz (mono)	0.05%
Signal/Noise Ratio	77.5 dB

User Adjustments :

Composite level Left audio
(headphone only)
Right audio (headphone only)
Squelch level