Waveform Processor Card Memory tests
Run file: **WPMEMTST** [ret]
So called; Waveform Processor MEMory TeST.
This document is current for WPMEMTST Rev 3.

The SEL command is the selection for global options; D, E and M

When D=0, which is its default value, no messages will be displayed but error messages may be displayed. D=1 means that messages to help you monitor the progress of the test will be displayed. For example messages will appear as RAM is being filled and checked.

When E=0 no error messages will be displayed but the diagnostics will continue testing. In other words errors are ignored. When E=1, which is the default value, the diagnostics will abort after finding and printing the first error. E=2 will print all errors and continue to test.

The option M is for displaying the 68k monitor functions as a 68k file is loaded into the Waveform Processor card. It need only be used (M=1) when you think a 68k file is not loading into the Waveform Processor card. M=0 is the default value.

To remind you of the SEL options the SELHLP command contains a **summary.**

Similarly the **HELP** command will summarize the rest of the commands in WPMEMTST.

Test Name: PRAM
No. of tests: 6
Purpose: To test the Waveform Processor private RAM.

PRAM tests the Waveform Processor card's private RAM between addresses $81000 and $C0000. Option N=1 zeros will be written and read to all locations in the range, N=2 $5555 and N=3 $AAAA similarly. For N=4 a random word will be written and read, while N=5 the address itself is written in and read out - so called *Walking Address Test.* For PRAM,N=6 bytes instead of words are written and read to make sure high- and low-order bytes may be accessed independently.

Test Name: P1RAM
No. of tests: 6
Purpose: To test the Waveform Processor's access to P1 memory.

P1RAM performs the first five tests as in PRAM but over P1 address space from $5000 to $5800. The waveform processor will see this address space from $55000 to $55800 and errors will have their addresses displayed as such.

Test Name: P2RAM
No. of tests: 6
Purpose: To test the Waveform Processor's access P2 memory.

P2RAM performs the first five tests as in PRAM but over P2 address space from $5800 to $6000. The waveform processor will see this address space from $45800 to $46000 and errors will have their addresses displayed as such.

Test Name: RAMREF
No. of tests: 1
Purpose: To test the refresh function on the Waveform Processor's memory.

Test Name: DMATST
No. of tests: 2
Purpose: To test the DMA mapping function on the Waveform Processor's access to P1 and P2 memory.

DMATST,N=1 tests the P1 DMA mapping.
DMATST,N=2 tests the P2 DMA mapping.

Waveform Processor Card Interrupt tests
Run file: **WPINTTST** [ret]
So called; Waveform Processor INTerrupt TeST.
This document is current for WPINTTST Rev 1.

Test Name: INTRPT
No. of tests: 7
Purpose: To test the CMI to Waveform Processor interrupts (7 of them).

CMI-39 Waveform RAM Card tests
Run file: **WVRAMTST** [ret]
So called; WaVeform RAM TeST.
This document is current for WVRAMTST Rev 5.

The SEL command is the selection for global options; D, E, B, R and M

When D=0, which is its default value, no messages will be displayed but error messages may be displayed. D=1 means that messages to help you monitor the progress of the test will be displayed. For example messages will appear as RAM is being filled and checked.

When E=0 no error messages will be displayed but the diagnostics will continue testing. In other words, errors are ignored. When E=1, which is the default value, the diagnostics will abort after finding and printing the first error. E=2 will print all errors and continue to test.

The option M is for displaying the 68k monitor functions as a 68k file is loaded into the Waveform Processor card. It need only be used (M=1) when you think a 68k file is not loading into the WP card. M=0 is the default value.

The R option in SEL is to select the combination of RAM cards you wish to test. R=1 will select the first waveform RAM card. This option defaults to all 7 RAM cards. If a card is not present errors will be detected for all data except 0000, so be sure to select the required number first. A command CARDS will give you an indication of what cards are present.

The B option in SEL enables to select a particular 512K block within each RAM card. B defaults to all four values from B=0 to 3.

To remind you of the SEL options the SELHLP command contains a summary.

Similarly the HELP command will summarize the rest of the commands in WVRAMTST.

Test Name: CARDS
No. of tests: 1
Purpose: To see which CMI-39 Waveform RAM Cards are present.

While one can simply look at how many of the seven waveform RAM cards are present there is the possibility that they maybe selected incorrectly or may not be working at all. CARDS is a simple test to give a quick indication of any problem

Test Name: WVRAM
No. of tests: 6
Purpose: To test the RAM on the CMI-39 Waveform RAM Cards.

These tests will check the RAM you have selected in SEL with the R option.
WVRAM,N=1 fills the RAM with $0000 and checks it.
WVRAM,N=2 fills the RAM with $5555 and checks it.
WVRAM,N=3 fills the RAM with $AAAA and checks it.
WVRAM,N=4 fills the RAM with random data and checks it.
WVRAM,N=5 fills the RAM with its own address and checks it (a so called *walking address test*).
WVRAM,N=6 fills the RAM and checks it in *byte mode.*
WVRAM,N=7 fills the Ram with $FFFF0000 then fills it with $0000FFFF before checking it. This test is designed to slam the data bus up and down to check for problems with bus termination.

Note: The waveform RAM should be tested with and without the channel cards running, as the channels running exercise the waveform RAM more heavily. Refer below to the CRUN and CSTOP commands.

Due to the bulk of RAM to be tested (up to 14Mb) several hours of continuous testing is necessary to be completely sure of correct operation. You should use the continuous-running option P=C on any of the tests required for long periods. Refer also to the CHAIN WAVERAM section 6.11.2. Over an extended testing period, ERRORS gives an accumulated error count for each card but be sure to clear the error counts first with the CLEAR command. See below.

Error Messages

If an error occurs a common error message routine is called which indicates where in memory the error occurred, the data which was expected, and the data which was actually read. It then reads the error location again. If on the second read the data is correct, the error is indicated as *SOFT*. If it is still wrong and the same as it was the first time, it is indicated as *HARD*. If the second read is wrong but different from the first read, the error is *RANDOM*.

Test Name: RAMREF
No. of tests: 1
Purpose: To test the refresh function on the Waveform RAM cards.

Be sure that the channel cards are **not** running during this test (type CSTOP if they are). This is because if channel cards are running the RAM will be refreshed so the test will be invalid.

Channel card running and stopping

To run all channels type the CRUN command. To select individual channels, use CRUN with the C option. C will select any of the 16 channels. There are eight channel cards numbered 1 to 8 and each card has two channels a and b. Hence the first channel is 1a and the last or 16th channel is 8b. The channels selected will continually loop over the area of memory being tested at the time.

To halt the channel cards use the CSTOP command and similarly use the C option (C=1-16)to stop selected channels.

Error Logging

This test has seven error counters for each of the Waveform RAM cards. These counters are not automatically cleared when starting any tests, so use the CLEAR command to clear them. To display the number of errors that may have occurred on each card, type ERRORS.

To run memory tests continuously over a long period and accumulate the error counts you will also have to use the SEL,E=0 option so that errors are not printed (as when E=2) or that the test does not abort after the first error (E=1).

CMI-28 General Interface Card Memory tests
Run file: SMMEMTST [ret]
So called; SMIDI MEMory TeST.
This document is current for SMMEMTST Rev 1.0.

The SEL command is the selection for global options; D, E and M When D=0, which is its default value, no messages will be displayed but error messages may be displayed. D=1 means that messages to help you monitor the progress of the test will be displayed. For example messages will appear as RAM is being filled and checked.

When E=0 no error messages will be displayed but the diagnostics will continue testing. In other words, errors are ignored. When E=1, which is the default value, the diagnostics will abort after finding and printing the first error. E=2 will print all errors and continue to test.

The option M is for displaying the 68k monitor functions as a 68k file is loaded into the SMIDI card. It need only be used (M=1) when you think a 68k file is not loading into the SMIDI card. M=0 is the default value.

To remind you of the SEL options the SELHLP command contains a summary.

Similarly the HELP command will summarize the rest of the commands in SMMEMTST.

Test Name: PRAM
No. of tests: 6
Purpose: To test the General Interface Card's private RAM.

The PRAM command tests the SMIDI card's private RAM from locations $81000 to $82000. Option N=1 zeros will be written and read to all locations in the range, N=2 $5555 and N=3 $AAAA similarly. For N=4 a random word will be written and read, while N=5 the address itself is written in and read out - so called *Walking Address Test*. For PRAM,N=6 bytes instead of words are written and read to make sure LDS and UDS signals are operating properly

Test Name: P1RAM
No. of tests: 6
Purpose: To test the SMIDI Processor's access P1 memory.

P1RAM performs the first five tests as in PRAM but over P1 address space from $6000 to $6800. The waveform processor will see this address space from $56000 to $56800 and errors will have their addresses displayed as such.

Test Name: P2RAM
No. of tests: 6
Purpose: To test the SMIDI Processor's access P2 memory.

P2RAM performs the first five tests as in PRAM but over P2 address space from $6800 to $7000. The waveform processor will see this address space from $46800 to $47000 and errors will have their addresses displayed as such.

Test Name: DMATST
No. of tests: 2
Purpose: To test the DMA mapping function on the SMIDI Processor's access to P1 and P2 memory.

DMATST,N=1 tests the P1 DMA mapping.
DMATST,N=2 tests the P2 DMA mapping.

DMATST tests the DMA switching.

General Interface Card Peripheral tests

Run file: **SMPERTST** [ret]
So called; **SMIDI PER**ipheral **T**e**ST**.
This document is current for SMPERTST Rev 4.

Extra diagnostic tools needed: 11-LED monitor (plugs into 26-way socket), 7-LED monitor (has DIN plugs), 3 DIN to DIN leads, A DIN to 9-way connector and the XLR lead (3 plugs).

The SEL command is the selection for global options; D, E and M
When D=0, which is its default value, no messages will be displayed but error messages may be displayed. D=1 means that messages to help you monitor the progress of the test will be displayed. For example messages will appear as RAM is being filled and checked.

When E=0 no error messages will be displayed but the diagnostics will continue testing. In other words errors are ignored. When E=1, which is the default value, the diagnostics will abort after finding and printing the first error. E=2 will print all errors and continue to test.

The option M is for displaying the 68k monitor functions as a 68k file is loaded into the SMIDI card. It need only be used (M=1) when you think a 68k file is not loading into the SMIDI card. M=0 is the default value.

To remind you of the SEL options the SELHLP command contains a summary.

Similarly the HELP command will summarize the rest of the commands in SMPERTST.

The following two commands can be run on the SMIDI card without the need to use shorting plugs, LED monitors or other test equipmemnt.

Test Name: INTRPT
No. of tests: 2
Purpose: To test two CMI-SMIDI interrupts.

These interrupts are the 68k interrupts, levels 1 and 7. By refering to sheet 3 of the CMI-28 circuit, you'll see the two interrupts on the LS259 latch labelled $\overline{\text{INT1}}$ and $\overline{\text{INT7}}$.
INTRPT,N=1 will test level 1, and INTRPT,N=2 will test level 7.

Test Name: TIMERS
No. of tests: 4
Purpose: To test the two 68B40 timers on the board.
(Refer to sheet 6 of the circuit diagram of CMI-28.)

TIMERS,N=1,2 will test the latches of timer A (when N=1) and timer B (N=2) by writing a byte to the latch and reading it back.

TIMERS,N=3,4 tests the timers' interrupt to the 68k - level 2. Both timers are wire-ORed to this interrupt, hence the two tests. N=3 testing the ability of Timer A to interrupt the 68k and N=4 timer B's ability.

To run the next set of commands, a shorting plug or LED monitor is needed. If a shorting plug is placed in the 26-way socket tests ACIA,N=5 (ACIA looping) and SMPTE can be run only. An LED monitor (one with 11 LED's) can be plugged into the same socket and all of the following tests can be run.

Similarly all the tests can be run by connecting the SMIDI board up to the CMI-332 and -333 boards in the audio rack (just as it is in the Series III configuration) and by plugging in shorts from MIDI out A to MIDI in A; from MIDI out B to MIDI in B; from MIDI out C to MIDI in C; a special shorting lead from MIDI out D to the 9-way connector which has the keyboards' communications. Also a special shorting lead from SMPTE out to SMPTE in and CLICK in. Another LED monitor (one with 7 LED's) is plugged into the Sync and Drum-machine DIN sockets. With this arrangement the CMI-332 and most of the CMI-333 board can be tested quickly.

Test Name: ACIA
No. of tests: 5
Purpose: To test the 4 ACIA's and their interrupts to the 68k (level 3).

ACIA,N=1-4 will cause each ACIA in turn to transmit a byte over and over for a second or two. This can be monitored with the LED's or with a CRO placed on pin 6 of the ACIA's. The ACIA generates an interrupt on level 3 to the 68k each byte transmission. If an interrupt does not occur within a certain time limit the 68k assumes the interrupt is not working and will tell you so.

ACIA,N=5 is the ACIA looping test and will only work if the transmit signal from each ACIA is looped to its receive input. The 11-LED monitor has these loops implemented. The test cycles through all 4 ACIA's transmitting a byte then receiving the same. If you get receiving first, check the short or loop before suspecting the ACIA. If the test works with the 11-LED monitor plugged into the 26-way socket but does not work with the DIN plug loops then there is a fault on the CMI-332 board - either the open collector buffers are not transmitting or the opto-couplers are faulty. A CROw would be the best way to check this, but they tend to squawk and make an awful noise not to mention the mess they can leave on the bench or carpet.

INTIME and EXTIME are two timer tests, best monitored using the LED's (either the 11- or 7-LED monitors)

INTIME simply puts the timers into an internally clocked mode - the Sync out 1 and 2 flash fairly fast, Sync out 3 and 4 flash 8 times slower and the SMPTE LED (on 11-LED monitor) flashes somewhere between these rates.

The EXTIME command tests the cascading connections between the timers (Refer to Sheet 6 of the circuit). In order for this to work with the CMI-332 and -333 boards connected make sure you have the SMPTE shorting lead in and that it is plugged into the Click In socket, too.

For EXTIME,N=1 the Syncsw signal is low which means that Sync Out 4 = Click In, hence with the 11-LED monitor you will see the SMPTE LED and Sync Out 4 LED flash in time (very fast). Sync Out 1,2 and 3 will appear to count in binary.

For EXTIME,N=2 the Syncsw signal is high which means that Sync Out 4 will be a division of Click In. In this case the SMPTE LED will still flash at a very fast rate, Sync Out 4 at a slower rate, and Sync Out 1,2 and 3 will count at a very slow rate.

The DRUM command simply flashes the two Drum LED's on either the 11- or 7-LED monitors.

The SMPTE command displays the actual SMPTE code on the screen. This appears in the form of hours, minutes, seconds and frames each digit being separated by a 0, e.g. 15 seconds becomes 0105 seconds. Both the SMPTE generated and SMPTE read are displayed in the following form Hours Generated, Hours Read, Minutes Generated,... etc. Without the shorting lead or 11-LED monitor, in only SMPTE generated code will appear. SMPTE read will be all zeros.

If you have simply typed SMPTE with no option then about one minute of code will be displayed. By including the T-option (T=1 to 10) you can display up to ten minutes of code. By choosing T=0 it will display SMPTE code forever (until you press ESC).

This test exercises interrupt levels 4, 5 and 6. Level 4 for SMPTE generate and level 5 and 6 for SMPTE reading of zero and one, respectively. If the SMPTE generated code is grossly out of time with the minute timer then suspect the 3.84MHz crystal oscillator and associated circuitry. Small differences from the minute timer or between the SMPTE generated code and code read can be ignored.

Channel Card Memory Tests
Run file **CHMEMTST** [ret]
So called; **CH**annel Card **MEM**ory **T**e**ST**.
This document is current for CHMEMTST Rev 2.

Firstly select the number of channels you wish to test by choosing the C option in the SEL command. For instance to select the first channel card type SEL,C=1.

Test Name: CHRAM
No. of tests: 7
Purpose: To test the Channel Cards' memory externally (ie from P2)

The command CHRAM will run memory diagnostics on the channel card(s) from P2 (i.e. without the channel card processor being used).
CHRAM,N=1 fills RAM with $00 and checks it.
CHRAM,N=2 fills RAM with $55 and checks it.
CHRAM,N=3 fills RAM with $AA and checks it.
CHRAM,N=4 fills RAM with a random number and checks it.
CHRAM,N=5 fills RAM with $A5 waits then checks it (refresh test).
CHRAM,N=6 fills RAM with a word consisting of the page number (MSB) and the address within the page (LSB) then checks it (similar to walking address test).
CHRAM,N=7 tests for uniqueness in addressing any of the channel cards.

Test Name: LDRAM
No. of tests: 4
Purpose: To test the Channel Cards' memory internally.

The command LDRAM will load a program into the channel card(s) and the channel card will now run its own memory tests.
LDRAM,N=1 fills the available RAM with $00 and checks it.
LDRAM,N=1 fills the available RAM with $55 and checks it.
LDRAM,N=1 fills the available RAM with $AA and checks it.
LDRAM,N=1 fills the available RAM with a random number and checks it.

Channel Card Interrupt Tests
Run file **CHINTTST** [ret]
So called; **CH**annel Card **INT**errupt **T**e**ST**.
This document is current for CHINTTST Rev 2.

Test Name: CHINT
No. of tests: 4
Purpose: To test the end of loop, CMI to Channel Card interrupts and FIRQ's (from the timer on the Channel Support Card).
Firstly select the number of channels you wish to test by choosing the C option in the SEL command. For instance to select the first channel on the first card (Channel 1a) type SEL,C=1.

CHINT,N=1 will test the interrupts from the main CPU's to the channel cards.
CHINT,N=2 will test the fast interrupts (FIRQ's) on the channel cards driven by the timer on the channel support card.
CHINT,N=3 tests the end-of-loop interrupts on the channel cards. It sets a loop going and if the interrupt has not occurred when the loop is expected to finish then an error message is displayed. Beware if you have a problem with pitch generation the error may also occur. If this is suspected try running the pitch register tests with the file CHPITTST.

Run file **CHSUPTST** [ret]
So called; **CH**annel **SUP**port Card **T**e**ST**.
This document is current for CHSUPTST Rev 1.

Test Name: TIMER
No. of tests: 1
Purpose: To test the 6840 timer on the Channel Support Card by writing to and reading each of the three timer latches.

Test Name: PIA
No. of tests: 1
Purpose: To test the 6821 PIA on the Channel Support Card by writing to and reading each of the two PIA latches.

Test Name: UNIQ
No. of tests: 2
Purpose: To test the uniquenss of addressing each of the channel cards from P1-MASK1 and from P2-MASK2. It necessary to have all channel present to run this test fully.

Channel Card Pitch Register Tests

Run file **CHPITTST** [ret]
So called; **CH**annel Card **PIT**ch Register **T**e**ST**.
This document is current for CHPITTST Rev 1.
The test name SET was only used to help set up the software for this test and not necessary for the testing procedure. A four digit hex number is entered and the loop played, it then outputs eight values of the software timing of the loop. Use a frequency greater than $7FFF to exit this procedure.

Test Name: PIT
No. of tests: 12
Purpose: To test the 12 bits of the pitch register.

The channel runs a single loop for a particular pitch register value (predetermined pitch) and is software timed. If the end-of-loop interrupt occurs outside of a tolerance on the software timing an error message will appear.

Test Name: OCT
No. of tests: 8
Purpose: To test the 8 settings of the octave register.

The channel runs a single loop for a particular octave register value (predetermined pitch) and is software timed. If the end-of-loop interrupt occurs outside of a tolerance on the software timing an error message will appear.

Channel Card Filter Tests
Run file **CHFILTST** [ret]
So called; **CH**annel Card **FIL**ter **T**e**ST**.
This document is current for CHFILTST Rev 1.

Test Name: 2TONE
No. of tests: 10
Purpose: To test the filter settings and all the bits in the filter DAC register.

The first test 2TONE,N=1 will simply generate a sinewave at 1kHz with a filter setting of $FF. Use an oscilloscope to monitor the signal, take note of the amplitude. Press the space bar for the next test and each successive test.
The next 9 tests (2TONE,N=2-10) will create a two tone signal, the lower frequency being at the -6dB point for a particular filter setting and the higher frequency being at a 0dB level for the same filter setting. Note that the signal level oscillates between the 0dB signal level (as measured with the 1kHz signal) and a level half of that amplitude. For tests 2TONE,N=3,4,5 and 6 the least significant 4 bits of the filter DAC are tested by pulsing each one on and off slowly during the display of the two tones. By looking very carefully at the display during the attenuated signal a tiny flicker can be perceived if the DAC is working properly.

Test Name: FILT
No. of tests: 10
Purpose: To test the filter settings for -6dB points.

The first test FILT,N=1 will simply generate a sinewave at 1kHz with a filter setting of $FF. Use a distortion meter to monitor the signal level, set it to 0dB. Press the space bar for the next test and each successive test.

Each test will generate a signal at the given frequency and filter DAC value. Adjust the appropriate pots on the Audio Module for a -6dB setting. But note that if the Audio Module has been adjusted according to the setup procedure in AUDIOCAL, this FILT test should really be used to exhibit the linearity of the filter. I.e. for each successive test in FILT the attenuated signals should be at approximately the same level for each.

CMI-333 METRONOME & AUDIO MIXER DIAGNOSTICS

Run file **METMXTST** [ret]
So called; METronome and MiXer TeST.
This document is current for METMXTST Rev 2.

Test Name: MET
No. of tests: 2
Purpose: Tests the metronome circuitry.

Connect an amplifier to the metronome output to hear the result. MET,N=1 will produce 8 short clicks from the metronome output, while MET,N=2 produces 8 emphasised clicks from the output.

Test Name: MIXER
No. of tests: 1
Purpose: Tests the mixer on the audio rack.

It does this by switching each mixing port on in turn until all are on then switches them off in the reverse sequence. On the latest mixer cards (CMI-334 Rev.3) there are LEDs to monitor the test. Older cards (Rev.2) will need to be monitored with an oscilloscope or logic probe. Refer to page CMI-334-03 of the service manual (Mixer Control Circuitry); place the probe on the outputs of the 4099 IC's labelled C1 to C16 (note they should have +7v outputs).

Q777 SCSI INTERFACE ADAPER DIAGNOSTICS

Run file: **SCSITST**[ret]
So called; **SCSI** TeST.
This document is current for SCSITST Rev 1.0

The SCSI diagnostic runs a series of tests to check various sections of a Q777 board (not connected to any peripherals). An error message is printed if an abnormal result is obtained. The error message will specify the function of the test and an IC location as a guide to trouble shooting. The SCSI test must be terminated by **ESC**.

Test Name: SCSI
No. tests: 1
Purpose: To test the Q777 SCSI Interface adapter.

General System Diagnostic Chain Test

To run the general test program for the whole CMI,
type **CHAIN TEST** [ret]

This document is current for TEST.CF Rev 2.

This will test the following cards in sequence;

1. The Q-133 Debug Card (without shorting plugs)
   - with shorting plugs simply type **CHAIN TEST;PL** [ret]
2. The Q-209 Graphics Card
3. The Q-256 Memory Cards.
   - you should have two cards but if only one type **CHAIN TEST;-MM** [ret]
4. The CMI-33 Waveform Processor Card
   - type **CHAIN TEST;-WP** [ret] if you wish to omit this test
5. The CMI-39 Waveform RAM Cards (7 of them)
   - if you wish to test less than 7 cards (or any combination) then use the R option and type, for instance;
     CHAIN TEST;R%1-4% [ret] (tests cards 1 to 4).
   - type **CHAIN TEST;-WM** [ret] if you wish to omit this test.
6. The CMI-28 General Interface Test
   - type **CHAIN TEST;-MP** [ret] if you wish to omit this test
7. The CMI-31 Channel Card Tests (for all 8 Channel Cards)
   - type **CHAIN TEST;-CH** [ret] if you wish to omit this test
8. You can test the two floppy disc drives by selecting the option DD
   - i.e. type **CHAIN TEST;DD** [ret]
9. You can test the interrupts of the system by selecting the option I
   - i.e. type **CHAIN TEST;I** [ret]
10. To have the chain repeat itself continuously use the R option;
    - i.e. type **CHAIN TEST;R** [ret]

Waveform RAM Chain Test

The chain file WAVERAM.CF automatically tests Waveform RAM only, both with and without channels running. Use the following chain test for a full 7 RAM cards;

```
CHAIN WAVERAM [ret]
```

This document is current for WAVERAM.CF Rev 1.0

If some other number of RAM cards are required to be tested use the R option (R=1-7) as follows;

```
CHAIN WAVERAM;R%1,3-5% [ret]
```

In this instant RAM cards 1, 3, 4 and 5 will be tested.

During the test, Channel Cards are set running to further exercise the RAM. By default, all channels are used. Otherwise, include the C option (C=1-16) as follows;

```
CHAIN WAVERAM;C%1,2,3% [ret]
```

In this instance Channel card 1, side A and B, and channel card 2 side A (1a, 1b and 2a) will be tested.

The test first does one pass of the WVRAM tests and one REFRESH test without channels running. Then channels are started and the WVRAM test is run continuously. To stop the test, hit the ESC key. The last command in the chain generates an error report (errors counters are cleared at the beginning of the chain).

This is the procedure to calibrate the CMI-331 Rev.1 audio modules with the diagnostics titled AUDIOCAL.

You will need a CRO, distortion and noise meter, DVOM and an (audio rack) extender card. The mixer card is also required for the mixer tests.

This document is current for AUDIOCAL Rev 1.01

Step 1.

To test the first card, firstly put it on the extender card and boot the diagnostics disc. Type **AUDIOCAL** [ret]. Now select which particular channel(s) you wish to calibrate by typing **SEL,C=1,2,5** [ret], for instance. This will select the first channel card both sides A and B and Channel 3 side A. You can make any combination of the C option from C=1 to C=16.

Step 2. VCF Cutoff Calibration

Start with a sine wave of 1kHz.

Type **TRIM1** [ret].

This will generate a sine wave of 1kHz on all channel selected with the VCA at a maximum, the filter cut-off a maximum and the filter resonance a minimum.

Step 3.

a) Take the DVOM, place the +ve probe on pin 7 of IC J1,2 and the -ve probe on pin 1 of the same IC. Set the pot on top of J1,2 to read 25 millivolts.

b) Repeat with the +ve probe on pin 7 of IC D3,4 and the -ve probe to pin 1 of IC D5. Set the pot on top of D3,4 to read 25mV.

c) Place the +ve probe on pin 1 of IC J1,2 and the -ve probe to ground (use pin 1 of one of the XLR connectors for a ground). Set the pot on top of IC F1 to read 72mV.

d). Place the +ve probe on pin 1 of IC D5 and the -ve probe to ground. Set the pot on top of IC D5 to read 72mV.

e) Re-check the following voltage measurements with respect to ground and re-adjust if necessary.
97mV on pin 7 of IC J1,2 (adjust pot J1,2).
72mV on pin 1 of IC J1,2 (adjust pot F1).
97mV on pin 7 of IC D3,4. (adjust pot D3,4).
72mV on pin 1 of IC D5. (adjust pot D5).

f) Set pots RV1, RV2, RV3, RV4, RV5, RV6, RV7 and RV8 to midway.

Step 4.
a) adjust pot RV13 to give +4dBm at XLR-S03 (Channel A).
b) adjust pot RV14 to give +4dBm at XLR-S04 (Channel B).
This step simply sets the output level for the next test.

Step 5
Press the space bar again (TRIM1,N=2). A sinewave of 15kHz is generated and the VCF is set to $F5. Adjust pot on F1 (for Chan. A) for -3dB (or +1dBm) and adjust pot on D5 similarly for Chan. B.

Step 6. Test of Overall Bandwidth (VCF open)
Now to test the module with a range of frequencies.

Type **TRIM2** [ret].

This will generate a sine wave of 20Hz on all channels selected. Monitor output S03 (Channel A) first. Check that the output level is between +1dBm and +4dBm.
Now push the Space Bar and this will call the next test frequency; 100Hz (TRIM2,N=2). Continue with frequencies 200Hz, 500Hz, 1kHz, 2kHz, 5kHz, 10kHz, and 12kHz (use the Space Bar to step to each frequency) and check that their output reading is +4dBm±0.5.

At 15kHz we would expect a 1.5dB rolloff to +2.5dBm±0.5.
At 16kHz we would expect a 2.0dB rolloff to +2.0dBm±0.5.
At 17kHz we would expect a 2.25dB rolloff to +1.75dBm±0.5.
At 18kHz we would expect a 2.7dB rolloff to +1.3dBm±0.5.
At 19kHz we would expect a 3.2dB rolloff to +0.8dBm±0.5.
At 19.5kHz we would expect a 3.6dB rolloff to +0.4dBm±0.5.
At 20kHz we would expect a 4.0dB rolloff to 0dBm±3.

Repeat the test on Channel B via output S04.

Now if all of this is o.k. proceed to step 8 otherwise continue with step 7.

Step 7.
Type **R** [ret]

This will repeat the test **TRIM2**. Re-check all the voltages in step 6 above and note carefully the problem.

Case 1: The output level has rolled-off earlier than 16-17kHz. Adjust pot on IC F1 (for Channel A) or pot on IC D5 (for Channel B) as in step 3c or step 3d but adjust the voltage to slightly less than 72mV.

Case 2: The output level drops to about +1dBm at 19.5kHz but has rolled-off much earlier (say at 12kHz) or is still high (say +4dBm or more) at 19kHz. Adjust the pot on top of IC J1,2 (for Channel A) or the pot on top of D3,4 (for Channel B) until the optimum response is obtained. You may need to re-adjust the pot on top of IC F1 (for Channel A) or of IC D5 (for Channel B).

Now go to step 4 again,first typing

TRIM1 [ret]

Step 8. VCA Distortion
Now measure distortion on both channels by typing the command
TRIM3 [ret].

This will generate a 1kHz sine wave again. On your distortion meter: adjust the meter to 0 on the calibration range then switch to the read setting. Adjust pot RV12 for Channel A and RV11 for Channel B until a level of approx -71dB is obtained. For Rev.1 cards only a figure better than -68dB is considered acceptable.

Distortion is introduced mainly by the DAC and careful selection of the DAC's can improve figures by several dB. Also the VCA contributes to distortion so substitution of the dBX chip can improve the results.

Step 9. VCF Distortion
Press the Space Bar for the next test (TRIM3,N=2). The Channel Card will now play audio zero. Feed in a 15kHz 14Vpp signal from a low distortion oscillator to pin 2 of IC G12,13 (LF347) for Channel A or to pin 13 of the same IC for Channel B. (There is a special clip that can be used to do this - see Note (i) below).
For Channel A adjust pots RV5, RV6, RV7 and RV8 for minimum distortion at 15kHz. This should be -65dB but a figure better than -61dB is considered acceptable. Adjust pots RV1, RV2, RV3 and RV4 similarly for Channel B. Remove the oscillator.

Step 10. VCA Control Range
Press the Space Bar again (TRIM3,N=3). The Channel card will generate a sine wave of 1kHz with the VCA control DAC's set at $FFF, i.e. maximum attenuation (no sound). Now set the distortion meter to dBm range and set the VCA attenuation controls, pot RV9 (for Channel A) or RV10 (for Channel B), for maximum attenuation. Ideally the level should be around -91dBm however the linearity of the dBx2150 may cause this to be as high as -85dBm.

Step 11. Overall Signal/Noise Measurement.
A final check on the noise performance of the channels. Press the Space Bar again (TRIM3,N=4), a 1kHz signal will again be generated. Check again for the +4dBm level then press the Space Bar again (TRIM3,N=5) this leaves the audio channel playing a sound of zeros (i.e. nothing) with the VCA and VCF set to their maximums, hence

measurement of the relative noise performance of the DAC and audio output circuitry can be made.

The absolute noise level should be approx -88dBm however a level of -85dBm is considered a pass/fail point. This is equivalent to a relative signal to noise ratio of approx 90dB.

Step 12. Total filter cut-off
Type the command **TRIM4**[ret]. TRIM4,N=1 will generate a sinewave at 1kHz with the filter open at $FF. After pushing the space bar (TRIM4,N=2) the filter will be cut completely to $00 and the signal level should drop to about -45dB.

Step 13. Resonance Control Test
Pressing the space bar again (TRIM4,N=3) will generate a 19.5kHz signal with the resonance on full (at $FF). The signal should be at about +19dBm. On the next step (TRIM4,N=4) the resonance is returned to its miniumum value of $00.

Step 14. Audio Module Mixer Test
Be sure to have the CMI-334 mixer card connected for this test.
Select both sides of the channel card under test and monitor both on separate channels of a Dual Trace Oscilloscope.

a) TRIM4,N=5 sets a 1kHz sinewave going on both A and B sides of a channel card with the mixer turned off. The VCA on Channel A is fully open (maximum volume) while the VCA on Channel B is closed (zero volume). Observe the signal on one trace and zero on the other. Press the space bar.

b) TRIM4,N=6 : same as before, but with the mixer turned on.
Observe the signal on both traces. Press the space bar.

c) TRIM4,N=7 sets a 1kHz sinewave going on both A and B sides of a channel card with the mixer turned off. The VCA on Channel A is closed (zero volume) while the VCA on Channel B is fully open (maximum volume). Observe zero on one trace and the signal on the other. Press the space bar.

d) TRIM4,N=8 : same as before, but with the mixer turned on.
Observe the signal on both traces. Press the space bar.

e) TRIM4,N=9 : both VCAs are set at the maximum volume and hence the signals will mix (as the mixer is still on) producing a sinewave at a level of about 10dBm.

f) TRIM4,N=10 : pressing the space bar again will turn the mixer off, reducing the levels to about 4dBm.

Note (i)
The special test plug can be made from an IC test clip. Solder a 4K7 resistor to pin 2 and feed the signal in on the other end of the resistor for channel A. A second resistor soldered to pin 13 is used for channel B.