E-mu Systems, Inc.
applied magic for the arts

EMAX II

16 - BIT DIGITAL SOUND SYSTEM

DIAGNOSTICS AND TRIMS

DIAGNOSTICS & FUNCTION TESTS

1   OVERVIEW

A complete functional test should be the first step in diagnosing a problem on the Emax II. Many times a complete functional will reveal important clues to the problem, which might have otherwise overlooked. Try to isolate the problem as much as possible through the operational controls, and then go in with your instruments to nail it down. When dealing with a 16-bit audio system, a high quality amplifier and speaker system is a necessity in order to pick out subtle audio problems.

Although the microprocessor and output sections should not give you much trouble, certain sections of the Emax II may be more difficult to troubleshoot. Because of the difficulty associated with removing and re-soldering surface-mount IC's, problems involving these chips should be referred to the factory. If you have isolated the problem to a surface-mount chip, a board swap is in order. Simply call the E-mu Customer Service Department to arrange for a board swap.

The Emax II contains a number of on-board diagnostic tests. These can be accessed or read from the front panel without even opening the unit!

2   NOTICE

Because of the complexity of the custom LSI chips and surrounding circuitry in the Emax II, the schematic diagrams for these sections have been deliberately omitted. Complex timing diagrams and theory be yond the scope of this manual are necessary to troubleshoot these sections. 99% of all Emax II problems can be diagnosed and repaired without knowledge of these chips. In fact, we even use the "shotgun" method here at the factory (it's faster). If you are ever in doubt about a particular problem, please don't hesitate to call us for assistance. We'll be happy to help.

Call E-mu Customer Service at (408) 438-1921 between the hours of 8:30 am and 5:00 pm PST, Monday through Friday.

3   BOOTPROM DIAGNOSTICS

The bootprom diagnostic tests are invoked each time Emax II is powered up. On power-up, hardware in the Emax II turns on all LED's. Hence, a completely dead CPU will probably have all LED's lit. If all LED's don't light on power-up, something in hardware is seriously wrong. If a test fails, the associated LED is not extinguished, but the subsequent tests are performed and a boot is attempted.

The LED's are extinguished for the following reasons:

ENTER   -   Turned off as the CPU's first instruction.

SEQUENCER   -   Turned off if CPU RAM is basically functional. No use of the RAM is made until after this test is performed.

TRANSPOSE   -   Turned off if the analog jack port is detected. This will remain lit if the analog board is not plugged in.

DRIVE SELECT -   Turned off if LSI #2 can be written and read.

MASTER   -   Turned off only if LSI #1 can be written and read AND there is working memory installed. (On Turbo units, the memory expansion board must be installed for this test to pass.)

SAMPLE   -   Turned off if the 8254 timer works.

DIGITAL PROC.-   Turned off if the MIDI/RS422 UART works.

PRESET MAN -   Turned off if the scanner is present and initialized.

PRESET DEF. -   Turned off if the floppy controller can seek to track 00. This requires that both the floppy chip and the drive be connected.

DYNAMIC PROC. -   Turned off after a complete software boot.

(Emax II will boot with the output board disconnected.)

4   SPECIAL FUNCTION DIAGNOSTICS

These on-board tests are hidden from the user in the Special Functions menu. They may be accessed in the following manner:

1.   Activate MASTER, 9 (Special).
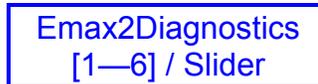   The following screen is displayed.

> Special
> [1—6] / Slider

2.   To enter the hidden diagnostics press 9 on the keypad.

      Remember: *1 number past the last choice.*

3.   The display now reads:

> Emax2Diagnostics
> Enter Code:

4.   The Secret Code is: 3 - *6* - 2- 9 *or* Emax spelled on the telephone dial. The display now says:

> Emax2Diagnostics
> [1—6] / Slider

5.   The test number may be selected either with the data slider or by entering the test number on the numeric keypad. If the slider is used, start the test by pressing the Enter switch.

      These are the test options:

1	Bank RAM Test
2	GRAM Test
3	RS422 Test
4	Write/Verify FI Test
5	Verify Floppy Test
6	Panel Test
7	Adjust Features
8	HD Diagnostics
9	Serial Number

1   Bank RAM Test

This tests the bank portion of the Emax II's main processor (32CG16) RAM. This is the same RAM that the diagnostics are running from, so this RAM probably has to be working in order for the test to run in the first place!
When this test is selected, the display will say:

> Testing BANK RAM

When this test passes, the display says:

> BANK RAM Passed

2   G-RAM Test

This tests the Emax II's Sound RAM. The test makes two passes of writing, then reading from RAM. If an error is found, the display shows:

> is:HHHH sb:HHHH
> IC#??addr: HHHHH

The top line of the display shows what the data is and what is should be. The address of the error is shown on the bottom line.

The IC# display is a great idea in theory, but unfortunately, it does not work. E-mu Systems never got it to work. Oh, well! Since there are not that many memory chips in the Emax II, the bad IC can be found quickly by first determining which bit is bad (convert Hex-to-binary) and then swapping around the chips corresponding to that bit.

This is a very thorough memory test, which should be able to find any type of memory error.

MEMORY TROUBLESHOOTING CHART

Main Board 256k byte RAM's

Bits	0 - 3	4 - 7	8 - 11	12 - 15
	46	47	48	49
IC#	50	51	52	53
	56	57	58	59
	60	61	62	63

Main Board 64K RAM's

Bits	0 - 3	4 - 7	8 - 11	12 - 15
	64	65	66	67
	68	69	70	71
	73	74	75	76
IC #	77	78	79	80
	82	83	84	85
	86	87	88	89
	92	93	94	95
	96	97	98	99

Memory Expansion Board

Bits	0 - 3	4 - 7	8 - 11	12 - 15
	4	3	2	1
	8	7	6	5
	12	11	10	9
	16	15	14	13
	20	19	18	17
IC#	24	23	22	21
	28	27	26	25
	32	31	30	29
	36	35	34	33
	40	39	38	37
	44	43	42	41
	48	47	46	45

3   **RS422 Test**
This test writes and reads an AA and then a 55 to the RS422 port. The test waits a reasonable length of time for each response. If there is no response, it records a timeout error. In order for the test to work, a jumper plug must be inserted into the RS422 jack on the back panel. The LED's show that the 500KHz clock is running. If you do not wish to make the test plug, simply connect pins 4 and 8, and pins 5 and 9 together with clip leads. To test the 500KHz dock, monitor pin 7 with your oscilloscope. This test also checks most of the MIDI circuitry as well as RS422 since they both share the same UART. See the functional test procedure for a dedicated MIDI test.

Construction of the RS422 Test Plug:
This will come in handy if you plan to repair many Emax's. It allows you to test the UART and Clock in one operation. To build the test plug, you will need: A 9 pin D-type female RS422 connector, 2 LED's, and 2 small pieces of wire. Wire the test plug as shown in the diagram below.

BACK   FRONT   FRONT
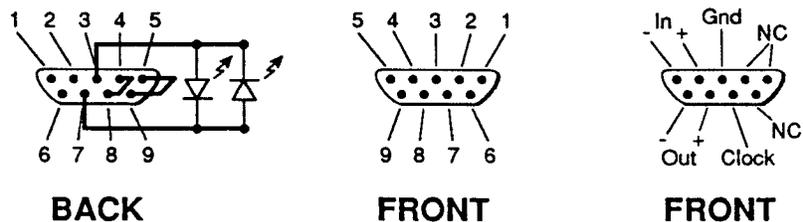
**RS-422 Test
Plug**

4   **Floppy Write/Verify Test**
This test writes and reads worst-case data patterns in a butterfly seek pattern. It starts at the OD (outside diameter) of the disk, jumps to the ID (inside diameter), and then back to 1 track in from the OD, 1 track in from the ID, etc. etc. The display shows the number of passes, hard and soft errors. Use a blank formatted Emax II disk, as this test is destructive to disk data. A reminder prompt is given upon entry to this test. The test runs until the disk is removed.

5 **Floppy Verify Test**
This test requires a disk that has been run through at least one pass of the Write/Verify test (test #4). It runs a butterfly pattern while verifying the data as in the previous test.

ERRORS →	Pass = Test Passes Hard = 2 Passes Failed Soft = 1 Pass Failed, 1 Pass Good

6 **Panel Test**
All the panel buttons will either toggle the corresponding LED or display their value on the screen if there is no LED. Pressing ENTER twice in succession, exits the test.

7 **Adjust Features**
This function allows a technician in the field to restore software dependent features (such as memory size and stereo sampling) in cases where the EEPROM has been erased or damaged. If you have an Emax II that has forgotten what options it has, call the factory for instructions.

8 **HD Diagnostics**

> HD Diagnostics
> [1 - 6] / Slider

1 **HD Select Drive**
Allows you to select any currently mounted drive.

2 **HD Read Only - Non-Destructive**
Exercises (reads) the entire HD media for data read errors. Runs continuously. Press and hold ENTER to quit. Exiting the drive in this manner sets the drive error correction to ON.

3 **HD Read/Reassign - Potentially Destructive.**
Same as Read Only, but first turns error correction OFF and re-assigns bad blocks using the drive block assignment.

4 **HD Write/Read/Reass**
DESTROYS ALL DATA! Exercises the entire HD media by writing a test pattern, reading it back, and comparing. Runs continuously. Drive must be reformatted after this test with the Emax II format disk utility. This installs the file system to allow the Emax II to recognize the drive. Press and hold ENTER to quit.

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5   HD Error Correct
Allows investigation and change of the drive error correction state. Should be set to ON after the diagnostics are completed.

6   HD Result
SCSI Sense Key and Sense Code, Sector Number and Status of the last HD operation.

7   HD Media Defect
Displays the HD's defect list in Hex.

8   Exit HD Diagns
Returns you to the Diagnostics submodule.

9   Serial Number
This feature was originally intended to discourage theft by entering the unit's serial number into the EEPROM. The feature was not implemented.

5   FUNCTIONAL TEST

This section describes part of the functional tests that are performed on every Emax II before it leaves the factory. A functional test can be performed to verify that a problem exists or as a final test to verify that the unit is working perfectly before you return it to the customer.

> ### *Equipment Needed:*
> Amp and Headphones
> 2 mono audio cables (w/phone plugs)
> MIDI Cable
> Sample source (radio, generator, mic.)
> Sync source
> RS422 test plug
> Foot pedal simulator
> Audio return plug (2)
> Footswitch
> Emax II Test Disk
> Scratch diskette

FOOTPEDAL SIMULATOR AND AUDIO RETURN PLUG

To test and calibrate the foot pedal input, either an Emax foot pedal or a foot pedal simulator is required. The audio return plug is useful for testing the submix outputs. Construction of the both devices is diagrammed below.

Footpedal Simulator — 10K Pot, 1/4" Phone Plug

Audio Return Plug — Short the Ring and Tip of a Stereo Plug
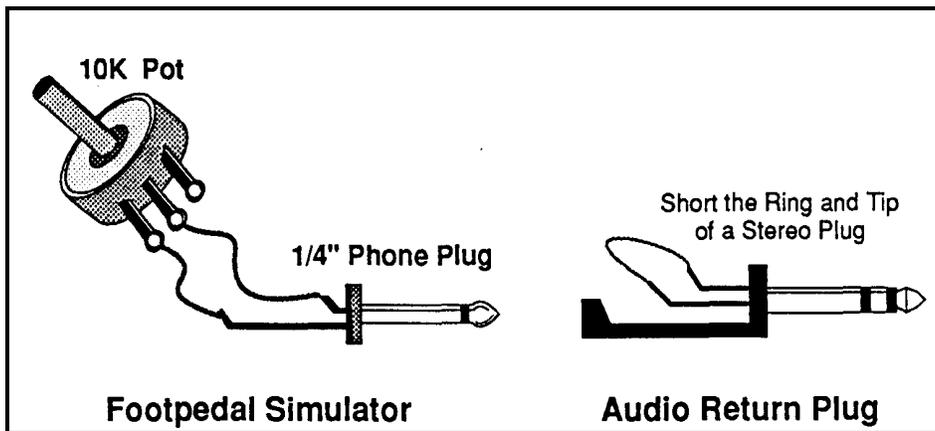
1. DIAGNOSTIC TESTS

Perform Diagnostic Tests 1 - 4.

- The Bank RAM Test
- The GRAM Test
- The RS422 Test (insert the RS422 test plug)
- Test the Front Panel by pressing down on panel area of keyboard units to test for flex related LCD problems.
- Plug in the footswitch and check both footswitch jack inputs.
- Check the Memory Size. Clear memory - MASTER, 4. Check memory remaining - MASTER, 2.

	Sample	Preset
1 Megabyte:	0524244	0028021
2 Megabyte:	1048488	0028021
3 Megabyte:	1572820	0028021
4 Megabyte:	2097108	0028021
5 Megabyte:	2621396	0028021
6 Megabyte:	3145684	0028021
7 Megabyte:	3669972	0028021
8 Megabyte:	4194260	0028021

Note: Pressure is not implemented, but pretend that it is. Also, leave a little dead space at the minimum and maximum positions on all settings.

Patch the Main Outputs of the Emax II into your stereo amplifier in preparation for the next few tests.

2. CALIBRATIONS

- Calibrate pitch wheel, mod wheel, data slider, volume slider and pedal. (MASTER,9,3). Use the foot pedal simulator to check the A/D Pedal input.

- RECALIBRATE: Master 9,3,1.
  Move left wheel for minimum post value in display. Enter. Rotate left wheel for maximum value. Enter. Return wheel to center position. Enter. Yes. Enter.

  Position the right wheel for minimum value. Enter. Rotate right wheel for maximum value. Enter. Yes. Enter. Press key hard and hold. Enter. Press key softly. Enter. Release key. Yes. Enter. Plug in foot pedal simulator. Move simulator to minimum value. Enter. Move to maximum value. Enter, Yes. Enter. Move data slider to minimum position. Enter.

  Move data slider to maximum position. Enter. Yes. Enter. Move volume slider to minimum position. Enter. Move volume slider to maximum position. Yes. Master.

3. FUNCTION CHECK (Keyboard Units)
- Use Test Disk Preset 00.
- Play keyboard and check volume fader.
- Move left wheel and verify pitch change.
- Press Preset Definition, 9. Play G3 repeatedly while pushing 1,0 and 1,1. Listen and verify no pitch change. Verify no vibrato with right wheel all the way down.

4. OUTPUT CHECK
- (Test Disk Preset 02). Play keyboard and check headphone and mono outputs.
- (Test Disk Preset 13). Play G2 and verify sound moving left and right through main outputs. Play at least 16 notes.
- (Test Disk Preset 14). Insert two audio return plugs into the Sub A outputs. Play the keyboard and listen for left/right panning.
- (Test Disk Preset 15). Insert two audio return plugs into Sub B outputs. Play the keyboard and listen for left/right panning.
- (Test Disk Preset 16). Insert two audio return plugs into Sub C outputs. Play the keyboard and listen for left/right panning.

Note: If there are no plugs inserted into the Submix Outputs, Emax II will sense this and the sound will be directed to the Main Outs.

5. MIDI CHECK
- Use Test Disk Preset 07
- Connect a MIDI cable between the MIDI In and MIDI Out jacks of the Emax II.
- Play G2 and hold it down.
- Unplug one end of the MIDI cable and release G2. Verify that the note sustains.
- Re-insert the MIDI cable and play G2 to verify that the note stops.

6. SYNC CHECK
- Press sequencer Play. Verify that the sequence plays.
- Turn amp volume down. Briefly insert one audio cable into Clock Out jack and listen for buzzing sound. Press Stop twice.
- Press Sequencer Manage, 2. Move slider up to select Click 24. Press sequencer Play. (Emax II is waiting for external sync.)
- Connect clock out from Drum Box or Signal generator (approx. 50Hz) to Clock In on Emax II. The sequence should start playing.

- Vary the external clock tempo and verify that Emax II follows the tempo changes perfectly.

- Unplug the sync input and verify that sequence stops. Press Stop twice.

Using the optimum sampling levels as shown will produce samples will the lowest possible amounts of noise and harmonic distortion.

7. SAMPLE CHECK
- Press Master, 4, Yes, to erase memory.
- Press Sample, 3 and set the sample rate to 39KHz.
- Press 4. Select maximum sampling time.
- Connect sample source (synth. signal generator, radio, mic.) to sample input jack. If the Emax II is stereo, use a stereo plug and select stereo sampling Sample, 2.
- Press Sample, 1. Use the data slider to adjust the gain for optimum level.

OPTIMUM SAMPLING LEVELS

Mono Emax II

Pri 01 G1 +00dB

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Stereo Emax II

Stereo G1   +00dB
||||||||||||||||||||||||
||||||||||||||||||||||||

- Press 7 to sample. Play sample for the entire duration and listen for distortion and noise. The original key is shown in display.

8. FINAL CHECK
- Play the unit for a few minutes as a reward for your hard efforts.
- Reassemble. Shake unit and verify no loose parts.