
OPERATING MANUAL FOR
THE LIL'DMXter

SOFTWARE VERSION 1.01

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INTRODUCTION

The Lil'DMXter is a portable test set for checking DMX512 transmission and reception. It is also a cable tester for DMX512 cables, testing both continuity and data transmission.

The unit is built into a water-resistant case. It's pretty rugged - but the display is glass so please use reasonable common sense care.

The Lil'DMXter is battery operated using rechargeable batteries. We ship it with a good charge, but you may want to plug it in overnight to top it off. Use the line cord provided to connect to a 120VAC outlet. Your Lil'DMXter will run while plugged in as well. Units may be ordered strapped for 230VAC operation.



IF THIS BOX IS CHECKED, THIS UNIT IS FACTORY STRAPPED FOR 230VAC OPERATION.

Your Lil'DMXter is a software based machine that uses a menu structure allowing you to step thru its features to get to the test you need to perform. Much of its operation is obvious. The purpose of this manual is to help you run it quickly, and to find the section you want easily.

SAFETY WARNING

Due to failure of either the dimmers or the console, or due to a short between the DMX512 line and power cables, it is possible that a DMX512 control cable may be connected to the AC mains. If connected to the AC mains, a DMX512 cable would be carrying hazardous voltages. If any conductor of a DMX512 cable is connected to the AC mains it is possible that the metal case of the connector is also connected to the AC line. Care should always be taken when testing an installed DMX512 cable that no hazardous potentials are present.

The user should note the following:

Testing of DMX512 lines that are shorted to the AC line is hazardous and should not be attempted.

The metal frame and metal front panel parts of the Lil'DMXter are grounded only when the Lil'DMXter is being used with its 3-wire line cord plugged into a properly grounded outlet. The DMX512 lines entering the Lil'DMXter are isolated from the metal frame. The frame should not become "hot" if there is AC leakage on the DMX512 lines. But do not rely on this for your safety - check that YOUR DMX512 lines are not "hot".

IT IS POSSIBLE THAT THE SHELL OF THE DMX512 CONNECTOR MAY BE HOT. IF THE SHELL OF THE CONNECTOR IS HOT, THEN THE METAL FRONT PANEL PARTS OF THE DMXter WILL BE HOT UNLESS THE DMXter IS GROUNDED.

If there is ANY likelihood that ANY of the DMX512 lines are "hot" to the AC line, the case of the Lil'DMXter should be grounded at all times. During battery operation this can be accomplished by using the AC cord and connecting a ground wire from the ground pin of the AC cord to a water pipe ground.

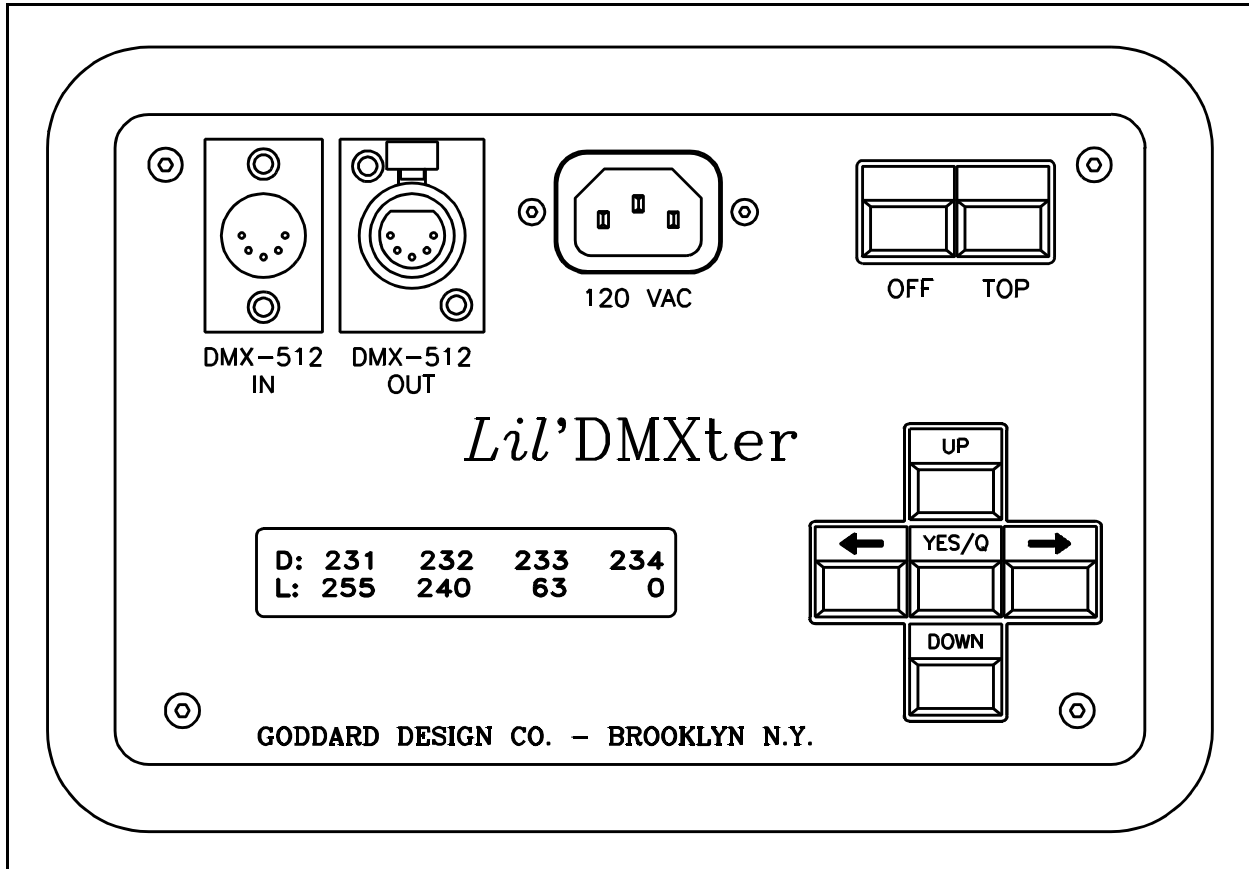
Further, The Lil'DMXter does NOT indicate the presence of hazardous voltages on the DMX512 lines.

GETTING STARTED - QUICKLY

So you want to play **NOW**? First read the **SAFETY WARNING** above. Then go right ahead. We feel that the operation of the Lil'DMXter is fairly straightforward. But we would suggest that you read the following sections before you start taking our name in vain:

- 1.0 - 1.3 CONVENTIONS (all of it)
- 2.0 TURNING ON
- 3.0 FUNCTION MENU
- 4.0 TRANSMIT DMX - The most commonly used functions in **TRANSMIT** are:
 - 4.1 ADJUSTING ONE DIMMER
 - 4.5 SEND/EDIT SNAPSHOT
- 5.0 RECEIVE DMX
- 5.1 VIEW LEVELS

1.0 CONVENTIONS



As with any software based device, we have set up some conventions.

1.1 KEY CONVENTIONS

The block of five keys on the right hand side of the unit is used for most of the operation of the unit.

<UP>, <DOWN>

<UP> and <DOWN> are used to step thru items of the menus. They also function as "no" to answer the queries of the menu. When setting dimmer levels or changing the value of a FLAVOR parameter the Lil'DMXter uses the <UP> and <DOWN> keys to raise and lower the numeric values.

<LEFT>, <RIGHT>

The right and left arrows are used in stepping thru dimmer numbers. While they are marked with arrows, for the remainder of this manual they will be referred to as <LEFT> and <RIGHT>.

There are two sets of commands that use the <RIGHT> and <LEFT> keys for a use other than stepping thru dimmer numbers. See the section on **EDIT FLAVOR** and the section on **VIEW START CODE** for a discussion of this.

<YES/Q>

The blue <YES/Q> key is the "yes" answer to queries and initiates the action that you have chosen in most cases.

When the Lil'DMXter is performing functions where a yes/no answer would be inappropriate, there will no longer be a "?" in the display. At this point the <YES/Q> key will quit the work you have been doing and generally put you back to the point in the menu at which you entered. There are some exceptions to this rule; quitting some functions will return you to different points in the menu. These will be pointed out later in the manual.

1.1(1) QUITTING <TOP> vs <YES/Q>

When you are finished using a function and want to do something else there are two basic ways to "Quit". You can use either the <YES/Q> or the <TOP> keys, but the result will be somewhat different. The <YES/Q>, as mentioned above, generally puts you back to the point in the menu at which you entered. If you want to use another function within the same main menu group use <YES/Q>. Example: If you are in **VIEW LEVELS** and you next want to **VIEW PARAMETERS** press <YES/Q>, <DOWN>, <YES/Q>. But if you next want to **ADJUST ONE DIMMER**, first you will have to use <YES/Q> to quit and then move to the **TO FUNCTION MENU?** entry and then <YES/Q> to return to the **FUNCTION SELECT MENU**. The key strokes are <YES/Q>, <DOWN>, <DOWN>, <YES/Q>, <UP>, <YES/Q>, <YES/Q>. It would seem to be a lot easier to hit the <TOP> and roll down the **FUNCTION SELECT MENU**. There is a reason why this is not always the best practice. Hitting <TOP> does not clear the termination relay in the same way as <YES/Q>. A detailed description of termination relay setting can be found in section 10.1.

While using <TOP> alone is seldom a problem we suggest that you get into the habit of using the following key strokes to return quickly to the **FUNCTION SELECT MENU**: <YES/Q>, <TOP>.

1.2 DISPLAY CONVENTIONS

There are two different purposes of the display. One is to allow you to move around the menu structure to the area you need for the test you want to perform. Here the top line of the display will generally tell you where you are in the menu, and the second line will usually ask you a question or give you a choice of actions. These displays are always in the form of a question and will contain a "?".

The other purpose of the display is to give you information about the DMX512 system you are testing. This will be done either in 1 line or 2 line messages.

1.3 NUMBER CONVENTIONS

The Lil'DMXter can communicate information to you in two forms for certain functions; decimal or hexadecimal. Hexadecimal notation is available for dimmer levels and the start codes. Dimmer numbers and timing information is available in decimal notation only. If you wish to have hex readouts, you may set this option in the **SETUP USER OPTIONS** menu. Any readout displayed in hex will be two hex digits ending with a lower-case "h".

2.0 TURNING ON

Open the case by pressing on the front edge while undoing the latches. The display will be blank. When the unit is off, <TOP> functions as an "ON" key. Press the <TOP> button and you will see the opening message

```
Lil'DMXter V1.01
GODDARD DESIGN CO.
```

This message also includes the software version, which is important if you need to contact the factory with any questions. This manual is written for software Version V1.01.

Next the copyright notice will scroll across the display.

When the unit is on, pressing the <TOP> key clears any pending operation and returns you to the top of the main menu, skipping the power off timer and backlite queries.

The black <OFF> key is used to put the unit in "sleep" mode. Lil'DMXter is, however, never truly "off" because this switch doesn't interrupt power to the processor. (See the section on **BATTERY OPERATION** in Section 9 for details on battery operation and "Turning Off the Battery".) To turn off the battery, you must open the case. **IF YOU REALLY INSIST ON TRYING TO DO THIS BEFORE YOU READ THE SECTION, PUT DOWN THE ALLEN KEY. YOU WANT TO REMOVE THE SINGLE SCREW ON THE BOTTOM OF THE CASE - NOT THE FOUR SCREWS ON THE TOP OF THE FACE!!!**

2.1 IF THE UNIT WILL NOT TURN ON...

If the unit will not turn on, but instead displays

```
Lil'DMXter V1.01
MEAL PENALTY
```

this indicates that the battery is discharged to a point where it will not properly run the unit. Plug the unit into AC.

If instead of the **MEAL PENALTY** message the display remains blank there are three possibilities:

The battery is discharged to a point that the internal battery shutdown circuit has disabled the power supply.

The internal battery switch is turned off

The battery is totally discharged.

Plug the unit into AC. If the display comes on reading `LIL'DMXTER is sleeping...` then it is likely that the unit was in internal battery shutdown. You may run it on AC if you need it immediately; otherwise, allow it to charge.

WARNING: If the internal battery switch is off the Lil'DMXter will display "is sleeping" when the unit is plugged into the AC line and the unit will appear to operate, but it will cease to operate the moment you remove the AC line. With the battery switch off it will not operate correctly. (A good indication of this problem is that the display backlite pulses.) You may leave the unit plugged into the AC line for 10 minutes and then try again. If the unit fails to operate the moment the AC line is removed, you can assume that you must open the unit and turn on the internal battery switch. See Section 9.3.

If after plugging the unit into the AC line the display remains blank, the user should press `<TOP>`. If the display remains blank, the battery was probably totally discharged. After allowing the unit to charge for 10 minutes, try turning the unit on again. If the unit now operates correctly on AC, the battery was totally discharged and should be allowed to charge immediately for at least 6 hours. It may be used while charging.

2.2 BYPASSING THE INITIALIZATION MESSAGE

We're proud to tell you all the information about software version and copyright, but we also know you're going to get mighty tired of having to look at it every time you initialize the unit, so...

Hold down the `<OFF>` key while pressing the `<TOP>` key, release the `<TOP>` key while still holding down the `<OFF>` key. This will bypass the initialization routine and the message you see is

```
OK, OK, OK!  
I 'M AWAKE
```

2.3 DISABLING THE AUTO POWER OFF TIMER

The unit will turn off if it hasn't registered a keystroke after 10 minutes or so. This is intended to conserve battery life. We strongly suggest that you make a habit of leaving the **POWER OFF** timer on. But if you are using the Lil'DMXter in a situation where you have to frequently walk away from the unit, you may find it best to disable this timer. The first question the Lil'DMXter asks is

```
DISABLE THE AUTO  
POWER OFF TIMER?
```

Answer yes by pressing `<YES/Q>` or no by pressing `<UP>` or `<DOWN>`

2.4 TURNING OFF THE DISPLAY BACKLITE

While we think you will usually want to use the display backlite, we can see some cases when ambient light conditions would make it better if it were off. The next choice the unit gives you is

```
DO YOU WANT THE  
BACKLITE OFF?
```

Answer yes by pressing `<YES/Q>` or no by pressing `<UP>` or `<DOWN>`

The backlite has a timeout that will turn it off if no keystroke has been registered in about 1 minute. To turn it back on, press any key. Using the `<LEFT>` and `<RIGHT>` keys is appropriate here, as they will perform very few other functions but will turn the backlite on.

3.0 FUNCTION MENU

The Lil'DMXter works on a function menu. You can step thru the choices by pressing the **<UP>** or **<DOWN>** keys until you come to the function you wish to use. To select that function, press **<YES/Q>**. The functions you may choose from are:

TRANSMIT DMX512?	Section 4
RECEIVE DMX512?	Section 5
FLICKER FINDER?	Section 6
CABLE TESTER?	Section 7
SETUP USER OPTIONS?	Section 8

4.0 TRANSMIT DMX

TRANSMIT DMX is one of the primary diagnostic tools offered by the Lil'DMXter. The unit can transmit a DMX512 signal to allow you to check that the receive end of your transmission link is correctly receiving the signal.

DMX512 is a standard primarily intended to communicate level information to dimmers. It has provisions for non-level or non-dimmer communications by means of a "start code". For dimmer communication the start code has a value of 0, sometimes referred to as the "null start code". The default start code setting in the Lil'DMXter is therefore 0.

4.0(1) IF A NON-ZERO START CODE IS SET

If you previously changed the start code to a non-0 value, you will now be informed of this fact and given the chance to change the start code if you wish. The method is identical to that explained in Section 4.9.

4.0(2) IF A NON-STANDARD "FLAVOR" IS SET

The Lil'DMXter provides considerable control of the parameters of the transmitted DMX signal. This is required because DMX512 allows many parameters to vary over wide ranges. Our method of allowing you to select groups of preset parameters we call selecting the "flavor". See the discussion of flavors in Section 4.7 below. The Lil'DMXter's default "flavor" setting is DMX512/1990 8uS mark after break. With this setting the Lil'DMXter uses an 88uS break, an 8uS mark after break, transmits a level for all 512 dimmers, and refreshes the dimmers at approximately 40 times per second.

If you previously changed the "flavor" to one other than DMX512/1990 88uS break, 8uS MAB you will now be informed of this fact and given the chance to change the "flavor" if you wish. The method is identical to that explained in Section 4.7.

4.1 ADJUSTING ONE DIMMER

If you want to look at the output of one dimmer, or if you want to use the Lil'DMXter as a focusing remote, you want to use the first choice in the **TRANSMIT DMX512** submenu.

```
TRANSMIT DMX512
ADJUST ONE DIMMER?
```

If you choose **<YES/Q>**, you will get a new display reading

```
SENDING DIMMER    1
                TO LEVEL    0
```

Change the dimmer number by using the **<RIGHT>** and **<LEFT>** keys; you may choose dimmers from 1 to 512 with the default "flavor" setting. Use the **<UP>** and **<DOWN>** keys to set the level from 0 to 255.

The level information may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, the display will show two hex digits followed by a lower-case "h".

4.2 QUICK STEPPING THRU DIMMER AND LEVEL

Press the **<RIGHT>** or **<LEFT>** keys to increment or decrement the dimmer numbers by one.

Hold down the **<RIGHT>** or **<LEFT>** keys to auto-increment or auto-decrement the dimmer numbers by one.

Hold down the **<YES/Q>** key and press the **<RIGHT>** or **<LEFT>** key to increment or decrement the dimmer number by 10.

Hold down **<YES/Q>** and then press and hold the **<RIGHT>** or **<LEFT>** keys to auto-increment or auto-decrement by 10.

If you hold down the **<UP>** key, the dimmer levels will auto-increment towards full. If you hold down the **<DOWN>** key, the dimmer levels will auto-decrement towards zero.

Hold the **<YES/Q>** button down while you press the **<UP>** key to jump to 255 (full). Hold the **<YES/Q>** button down while you press the **<DOWN>** key to jump to 0.

4.3 CLEARING SNAPSHOT

The Lil'DMXter can "take a snapshot" of information transmitted down the line, assuming you have plugged the input of the Lil'DMXter into the line coming from a working console. This is a useful function that we will discuss more later. You may also build a snapshot dimmer by dimmer, using the Lil'DMXter's keys. Before doing either you may wish to clear the old snapshot.

The Lil'DMXter will ask you

```
TRANSMIT DMX512  
CLEAR SNAPSHOT?
```

you should press **<YES/Q>** to answer yes. The unit will next ask

```
CLEAR SNAPSHOT?  
ARE YOU SURE?
```

This gives you a second chance if you didn't really mean to clear it. If you did, press **<YES/Q>** again and the unit will momentarily read

```
ZZAAPP!!  
SNAPSHOT IS HISTORY!
```

The Lil'DMXter will drop thru to the next menu entry.

4.4 TAKING NEW SNAPSHOT

The Lil'DMXter can take the information it receives from the digital line and hold it in memory for later use. Taking a snapshot overwrites any old snapshot - most of the time. If your old snapshot contained 125 dimmers and the new one has 96, the new snapshot will not overwrite dimmers 97 thru 125. This is why you may wish to clear an old snapshot before taking a new one.

When you press **<YES/Q>** the top line of the display will briefly read

```
TAKING SNAPSHOT
```

Assuming that there is data to be recorded, the bottom line will read briefly

```
SNAPSHOT RECORDED
```

After a brief pause, the Lil'DMXter will drop thru to the next menu entry and the display will read

```
SEND/EDIT SNAPSHOT?
```

The snapshot function is start code sensitive. If your DMXter is still reading

```
TAKING SNAPSHOT
```

for more than three seconds, and the bottom line remains blank, this means that your DMXter is receiving data with a different start code than the one it is currently set to receive.

After 3 seconds, if no digital input is received, or if the input is not a digital form that the Lil'DMXter can recognize, you will see

```
NO DIGITAL INPUT
```

When you see this message on the display, first check to see that you have a cable plugged into the Lil'DMXter input connector and into the output connector of a working console.

Neither executing **<TOP>** nor **<OFF>** erases a snapshot. Many menu items erase a snapshot.

The following events will overwrite a snapshot with a new snapshot:

- 1 - Taking a new snapshot
- 2 - In cable test mode, using **SINGLE ENDED** cable test
- 3 - Using the **FLICKER FINDER** mode
- 4 - Using **VIEW LEVEL**. Whatever levels are in the table at the time one exits **VIEW LEVELS** will be preserved and may be used as a snapshot.

The following events will erase a snapshot and leave the table clear:

- 1 - **ADJUST ONE DIMMER**
- 2 - **ADJUST ALL DIMMERS**
- 3 - Using **CLEAR SNAPSHOT**
- 4 - Shutting down due to low battery (showing you **MEAL PENALTY**)
- 5 - If the battery is turned off by the internal battery switch

4.5 SEND/EDIT SNAPSHOT

Pressing the **<YES/Q>** key will start sending the entire snapshot to the dimmers and display levels of four dimmers at a time. You can edit this as you need: use the **<RIGHT>** and **<LEFT>** keys for changing the dimmer numbers. Use the **<UP>** and **<DOWN>** keys for changing the level of the dimmer displayed in the left-most position on the display.

The level information may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, all levels will be displayed as two hex digits followed by a lower-case "h".

Press the **<RIGHT>** or **<LEFT>** keys to increment or decrement the dimmer numbers by one.

Hold down the **<RIGHT>** or **<LEFT>** keys to auto-increment or auto-decrement the dimmer numbers by one.

Hold down the **<YES/Q>** key and press the **<RIGHT>** or **<LEFT>** key to increment or decrement the dimmer number by 10.

Hold down **<YES/Q>** and then press and hold the **<RIGHT>** or **<LEFT>** keys to auto-increment or auto-decrement by 10.

If you hold down the **<UP>** key, the dimmer levels will auto-increment towards full. If you hold down the **<DOWN>** key, the dimmer levels will auto-decrement towards zero.

Hold the **<YES/Q>** button down while you press the **<UP>** key to jump to 255 (full). Hold the **<YES/Q>** button down while you press the **<DOWN>** key to jump to 0.

4.6 ADJUST ALL DIMMERS

This function allows you to set all the dimmers to the same level at once. Use the **<UP>** and **<DOWN>** keys. If you hold down the **<UP>** key, the dimmer levels will auto-increment towards full. If you hold down the **<DOWN>** key, the dimmer levels will auto-decrement towards zero.

The level information may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, the display will show two hex digits followed by a lower-case "h".

Note that the Lil'DMXter will not allow you to bring all the dimmers to full at once. Many installations lack the power service to handle everything at full at once, and we don't own a piece of any fuse or circuit breaker manufacturer.

4.7 SEND FLAVOR

Although they are "standards", there are many parameters of DMX512/1986 and DMX512/1990 that are permitted to vary over a wide range. These parameters may vary from product to product or even from moment to moment at the output of the same product. The Standard defines the acceptable range within which a number of parameters of the transmitted signal are permitted to vary. The Lil'DMXter allows you to vary 5 important parameters of DMX512. Three of these parameters may be adjusted to values that fall outside those permitted by the Standards. We provide

these out-of-Standard test signals to allow sophisticated testing of DMX receivers. It should be understood that one piece of equipment's ability to operate outside the Standard does not make it inherently a "better" piece of gear than one that does not!

While these parameters are individually variable, to simplify matters, we have provided for presets of those parameters and we have taken to referring to those presets as "flavors". Therefore to choose a flavor refers to choosing a preset of parameters for the transmitted signal. The concept of flavors applies only to a transmitted signal generated by the Lil'DMXter and not to reception.

There are 8 possible choices of "flavor":

	BREAK	MAB	DIMMERS	IBT	IPT
DMX512/1990 8uS MAB	88uS	8uS	512	0	0
24 DIMMERS 8uS MAB	88uS	8uS	24	0	0
DMX512/1990 4uS MAB	88uS	4uS	512	0	0
24 DIMMERS 4uS MAB	88uS	4uS	24	0	0
70uS BK 4uS MAB 20 D	70uS	4uS	20	0	0
USER A (default values)	160uS	20uS	128	1	1,542
USER B (default values)	160uS	20uS	512	1	40
USER C (default values)	88uS	8uS	512	0	0

BREAK = BREAK TIME

MAB = MARK AFTER BREAK

DIMMERS = NUMBER OF DIMMERS

IBT = INTERBYTE TIME (in units, each unit = 22uS)

IPT = INTERPACKET TIME (in units, each unit = 22uS)

Getting into the **SEND FLAVOR** submenu will put you at the last flavor that was set. You may step thru the choices from there. Use the **<YES/Q>** key to select your flavor and return to the **TRANSMIT** submenu. You will find yourself at the **ADJUST ONE DIMMER** choice. This is an exception to the general rule that **<YES/Q>** returns you the point from which you entered the menu.

4.7(1) CHANGING THE USER FLAVORS

The Lil'DMXter gives you three choices of "send flavor" for you to define using your own parameters. When the display reads

```
SEND FLAVOR?
EDIT USER FLAVORS?
```

and you press **<YES/Q>**, the display next reads

```
USER FLAVOR EDITOR
USER A USER B USER C
```

which is displayed only briefly.

4.7(2) CHANGE BREAK LENGTH

The top line of the next display reads

```
BREAK LENGTH IN Us
```

On the second line there will be three numeric entries representing the user A, B, and C break lengths. If you wish to change values for break lengths, press the **<RIGHT>** or **<LEFT>** keys. You will see a cursor entering from the right or left side of the display. The arrow keys move the cursor along this line; when you are at the location where you wish to enter information, the **<UP>** and **<DOWN>** keys will count up and down. When you are done making changes, pressing the **<YES/Q>** key enters the numbers and clears the cursor. You may now use the **<UP>** and **<DOWN>** keys to step thru the next parameter submenu. If you do not wish to change break lengths, press the **<UP>** or **<DOWN>** keys to step thru the parameter submenu.

The DMX512 Standard requires that breaks be at least 88uS and allows for breaks as long as 1 second. The Lil'DMXter can transmit breaks as short as 50uS and as long as 49,144uS if the mark after break is set at 8uS. The total of the mark after break and the break can equal no more than 49,152uS, and the Lil'DMXter will not allow you to exceed this total.

4.7(3) CHANGE MARK AFTER BREAK LENGTH

The next user defined parameter is mark after break length (MAB). Just as above for break length, use the **<RIGHT>** and **<LEFT>** keys to move the cursor across the display, and the **<UP>** and **<DOWN>** keys to

increment and decrement the information. When you are done making changes, pressing the **<YES/Q>** key enters the numbers and clears the cursor.

DMX512/1986 defined the MAB as 4uS. DMX512/1990 defined the MAB as no shorter than 8uS and less than 1 second. The Lil'DMXter can transmit a mark after break as short as 3uS and as long as 49,064uS if the break is set at 88uS. The total of the break and the mark after break can equal no more than 49,152uS and the Lil'DMXter will not allow you to exceed this total.

4.7(4) NUMBER OF DIMMERS

The next user defined parameter is number of dimmers for which bytes are transmitted. As before, use the **<RIGHT>** and **<LEFT>** keys to move the cursor across the display and the **<UP>** and **<DOWN>** keys to increment and decrement dimmer number. Press the **<YES/Q>** key to enter the information. Press the **<DOWN>** key to go on.

The Lil'DMXter is settable to transmit any number of dimmers from 1 to 999.

DMX512 sets a maximum number of dimmers at 512. No dimmer system should be expected to work correctly when transmitted more than 512 dimmers. We provide the ability to transmit more than 512 dimmers as a test feature. While DMX512 does not set a minimum number of dimmers, setting the Lil'DMXter to transmit fewer than 22 dimmers will violate the minimum break to break spacing requirements of DMX512/1990 unless you properly set the interbyte time or the interpacket time (see below).

4.7(5) INTERBYTE TIME

DMX512 transmits dimmers grouped in "packets". A packet starts with a break and mark after break sequence. Next the start code is sent, followed by the dimmers. Each dimmer is transmitted as a byte. The bytes are sent sequentially. The packet is considered to continue until the start of the next break. The Standard does not require there to be any time between bytes. Many DMX512 transmitters do insert a small pause between bytes. The Lil'DMXter does insert a very small pause between bytes. This pause is approximately 4uS long. The Lil'DMXter takes 48uS to transmit a byte when the minimum possible time would be 44uS.

To help simulate consoles that insert pauses and to allow testing of some early dimmer designs that may require pauses between dimmer bytes, the Lil'DMXter allows you to insert an additional pause between each dimmer byte. The interbyte interval may be adjusted between 0 and 15 units. Each unit represents an additional pause of 22uS (equal to 1/2 a byte time) added to 4uS noted above.

4.7(6) INTERPACKET TIME

The next user defined parameter is interpacket time or interpacket pause. Some early dimmers may require such a pause. The Lil'DMXter allows the user to insert up to an additional 65,535 units of interpacket time, each unit equal to a 22uS pause. DMX512/1990 requires that a dimmer function properly with no pause between packets.

The Lil'DMXter inserts a very short pause of about 4uS at the end of each packet. We will consider this to be a zero unit interpacket time.

As before, use the **<RIGHT>** and **<LEFT>** keys to move the cursor across the display and the **<UP>** and **<DOWN>** keys to increment and decrement the value for interpacket time. Press the **<YES/Q>** key to enter the information. Press the **<DOWN>** key to go on.

One use of the interpacket time is to allow the Lil'DMXter to send DMX packets with fewer than 22 dimmers without violating the Standard. DMX512/1990 requires the break-to-break time not be less than 1196uS. With packets of fewer than 22 dimmers this requirement will not be met by the Lil'DMXter unless interpacket time is added to maintain the minimum break-to-break time requirement. Should you wish to send packets of less than 22 dimmers that conform to the Standard, you should add at least 2 interpacket units for each dimmer less than 24 that you have selected. (Yes, we mean 24. When figuring out how many units of interpacket time to use, calculate with 24 instead of 22 dimmers.)

4.8 RETURN TO FUNCTION MENU

This does exactly what you might think it does!

4.9 CHANGING THE START CODE

DMX512 is a standard primarily intended to communicate level information to dimmers. It has provisions for non-level or non-dimmer communications by means of a "start code". For dimmer communication the start code has a value of 0, sometimes referred to as the "null start code". The default start code setting in the Lil'DMXter is therefore 0. Some of this equipment uses non-0 start codes. The Lil'DMXter provides you with the ability to set the start code you need for the type of equipment you are testing.

The display will read

```
START CODE IS 0
CHANGE IT?
```

If you press **<YES/Q>** the display will read

```
START CODE IS 0
CHANGE START CODE
```

Press the **<UP>** and **<DOWN>** keys to change the start code to your desired setting. Your choices are 0 to 255. When the desired value is displayed, press the **<YES/Q>** key to save this value. The DMXter will use this value as its start code for both **TRANSMIT** and **RECEIVE** until it is changed again by the user. The only exceptions are when a DMXter has had its battery turned off or when the power supply safety circuit has shut down the power supply. Then it reinitializes the start code to 0. See **MEAL PENALTY**, Section 9.2(1).

The start code may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, the display will show two hex digits followed by a lower-case "h".

Exiting **CHANGE START CODE** jumps you to **ADJUST ONE DIMMER**.

This is an exception to the general rule that **<YES/Q>** returns you the point from which you entered the menu.

4.9(1) MAB ACCURACY VS. START CODE

If the start code is set to 0 and the break length is less than 16mS, the mark after break should be essentially jitter-free. When you set a non-0 start code or when the break time is longer than 16mS, regardless of start code, we change the method of generating the mark after break. This alternate method has a maximum jitter of about 4uS. To guarantee that the generated mark after break is never less than that set by the current flavor, we offset the average value. The result is that if you set the mark after break to 8uS with a non-0 start code, the minimum value will be 8uS; the maximum value will be about 12uS. Most of the time, the average value will be close to 12uS. Very few packets with a mark after break as short as 8uS will be sent.

4.10 THE SCOPE TRIGGER

The Lil'DMXter can provide an oscilloscope triggering signal synchronized to the break in the DMX512 data stream. Most users will not have any interest in this function - feel free to skip the rest of this section. For this reason, the default for this function is off.

The scope trigger menu display reads

```
SCOPE TRIGGER IS OFF
ENABLE TRIGGER?
```

Use the **<YES/Q>** key to enable it. The scope trigger will turn on and the display will read

```
SCOPE TRIGGER IS ON
DISABLE TRIGGER?
```

Each time you press the **<YES/Q>** key the display will toggle. Leave this function by using the **<UP>** or **<DOWN>** keys.

Technical details: the scope trigger is output on Pins 4 and 5 of the female connector. The signal is balanced RS485. Pin 5 goes high approximately 2uS before the falling edge of break and remains high until approximately 3.2uS after the falling edge of mark after break.

5.0 RECEIVE DMX512

When the Lil'DMXter is in the **RECEIVE** mode, the first question the user needs to answer is

```
RECEIVE DMX512
AT END OF LINE?
```

DMX512 systems may be wired as a "daisy chain" with multiple receivers (dimmer racks) connected in series by a cable going from the console to receiver 1, another cable going from receiver 1 to receiver 2, and then on from there until all the receivers are connected in a chain. The last receiver in the chain is required to terminate the line. For more information on termination, please see Section 10.1.

The Lil'DMXter may be inserted at any point in the daisy chain. If it is inserted at the end of the daisy chain, it must terminate the DMX line. If it is inserted in the middle of the daisy chain it should be transparent passing signals from its input connector to its output connector. Your answer to the `END OF LINE?` question will control whether the DMXter terminates the line or not. Answering `<YES/Q>` will terminate the line.

5.0(1) IF A NON-ZERO START CODE IS SET

If you previously changed the start code to a non-0 value, you will be informed of this fact and given the chance to change the start code if you wish. The method is identical to that explained in Section 5.4.

5.1 VIEW LEVELS

Pressing the `<YES/Q>` key will display 4 dimmer numbers on the top line and their levels below. If within 3 seconds the Lil'DMXter does not receive DMX512 data, the display will change to

```
NO DIGITAL INPUT
OR INPUT NOT DMX512
```

This is a latched display. After correcting the problem, you must restart the **VIEW LEVELS** section. To do this, use the `<UP>` or `<DOWN>` keys, or exit **VIEW LEVELS** and re-enter.

The unit allows you to step thru the levels for all of the dimmers displaying 4 at one time.

Regardless of how many dimmers are being transmitted, there will always be 512 entries in the dimmer table. The level value for dimmers that are not being transmitted will be displayed as 0. If you wish to know how many dimmers are being transmitted, see **VIEW PARAMETERS** below.

The level information may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, the levels will be displayed as two hex digits followed by a lower-case "h".

The behaviors of the `<LEFT>` and `<RIGHT>` keys and the `<YES/Q>` key are the same as in **SEND EDIT**: Press the `<RIGHT>` or `<LEFT>` keys to increment or decrement the dimmer numbers by one.

Hold down the `<RIGHT>` or `<LEFT>` keys to auto-increment or auto-decrement the dimmer numbers by one.

Hold down the `<YES/Q>` key and press the `<RIGHT>` or `<LEFT>` key to increment or decrement the dimmer number by 10.

Hold down `<YES/Q>` and then press and hold the `<RIGHT>` or `<LEFT>` keys to auto-increment or auto-decrement by 10.

5.1(1) DATA ERROR WHILE VIEWING LEVELS

If a significant data transmission error is detected, the first three characters will read `ERR` instead of `LEV`. If no digital data is detected within 3 seconds, or if the data is unreadable the display will change to say `NO DIGITAL INPUT`. These displays are latched, and after correcting the problem you must restart the **VIEW LEVELS** section. This is done by using the `<UP>` or `<DOWN>` keys, or by exiting **VIEW LEVELS** and re-entering. If you get an `ERR` flag, you may view the error by pressing and holding `<YES/Q>` while pressing `<UP>`. The display will be the same as the first display in **VIEW PARAMETERS**.

5.2 VIEW PARAMETERS

Whenever the Lil'DMXter is receiving DMX512 it checks for the following problems:

PE = PARITY ERROR
FE = FRAMING ERROR
BK = BREAK TOO SHORT (less than 88uS)
MK = MARK AFTER BREAK TOO SHORT (less than 8uS)
DMX512/1986 called for a 4uS mark. DMX512/1990 requires a mark of 8uS or longer. We flag marks of less than 8uS as a warning of possible compatibility problems.
OVFL = OVERFLOW (meaning that you have attempted to receive more than 512 dimmers)
BNW = BROKEN WIRE (The probable cause is Pin 2 or 3 of your cable is open. If this reads as B?W it means that this feature is disabled. Turn it on again thru the **USER SETUP OPTION**).

If there is an error in any portion of this test, the unit will indicate so. An error is indicated by * shown on the display under the its code. If there is no problem, the bottom line will read

NO ERRORS DETECTED

Technical Note: We report a **PARITY ERROR** for any byte that does not have its first stop bit. DMX512 is a no-parity system and the 9th bit should always be high. To prevent false trips on the **BREAK TOO SHORT** and **MARK AFTER BREAK TOO SHORT** measurements, the trip point for these measurements is set as follows: a break must be measured as 87.5uS or less. A mark after break must be measured as 7.5uS or less.

The Lil'DMXter allows the user to look at certain parameters of the transmission in detail. Pressing the <UP> and <DOWN> keys will scroll the user thru the choices. Pressing <DOWN> will bring you to:

5.2(1) BREAK LENGTH

BREAK LENGTH reads out a minimum value, a maximum value and an average of the last 32 packets, all expressed in uS (or if appropriate, in milliseconds). The average value will take a few seconds to appear on the display. The Lil'DMXter can measure the minimum, maximum and average break length for breaks longer than 65uS. If it receives a minimum break time of less than 65uS, the minimum and maximum values will be replaced with the words TOO SHORT. This is to warn you that you have exceeded the measurement capability of the DMXter. The average value will still be shown but its validity should not be counted on. Break length is not start code sensitive; the break length of all packets is measured regardless of the start code that the packet is transmitted with.

5.2(2) MARK LENGTH

MARK LENGTH reads out a minimum value, a maximum value and an average value for break length expressed in uS (or if appropriate, in milliseconds). The average value will take a few seconds to appear on the display. If it receives a minimum mark time of less than 3uS, the minimum and maximum values will be replaced with the words TOO SHORT. This is to warn you that you have exceeded the measurement capability of the DMXter. The average value will still be shown but its validity should not be counted on. Mark length is not start code sensitive; the mark length of all packets is measured regardless of the start code that the packet is transmitted with.

5.2(3) START CODES

The Lil'DMXter shows you which start codes are being sent. It also reminds you which start code it is currently set to read levels from. The top line of the display will read

START CODES SET= X (where X=the current start code)

The bottom line will read out the start codes that have been received since the test was started. They will be sorted in numerical order with the lowest number to the left. If more than 4 start codes are being received, you will see

< 0 4 58 200 > (or something similar)

The brackets indicate that you may scroll right or left thru all the start codes being received.

The start codes may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, all start codes will be displayed as two hex digits followed by a lower-case "h".

5.2(4) # OF BYTES PER PACKET

This screen reads out the minimum and maximum values. We call this **BYTES PER PACKET**; we mean number of dimmer levels bytes per packet. The start code is not included in this count.

Warning: while the Standard does not require that the number of bytes be fixed for all transmissions, if the minimum and maximum number of bytes are different, you should suspect a problem. Also you should never receive more than

512 bytes. This test is start code sensitive; this test reports the byte count of only those packets transmitted with the currently selected start code.

5.2(5) BREAK-TO-BREAK TIME

This screen reads out the minimum value, the maximum value and an average value. The Lil'DMXter can measure the minimum, maximum and average break-to-break length of a DMX512 signal where this time is 900uS or longer. If it receives a break-to-break time of less than 900uS, all three values will be removed from the display and be replaced by the words `TIME LESS THAN 900uS`. Break-to-break time is not start code sensitive; the break-to-break time of all packets is measured regardless of the start code that a packet is transmitted with.

The method of measuring break-to-break length on the Lil'DMXter causes there to be a statistical uncertainty of +/- 8uS on any measured value. If the DMXter is receiving a DMX512 signal from a console whose break-to-break lengths do not vary, eventually the minimum value will settle to a value 8uS shorter than the average while the maximum will settle to a value 8uS greater than the average. For consoles whose break-to-break length varies but does so in a repeatable manner, the minimum value is likely to be 8uS less than the true minimum while the maximum value will be 8uS greater than the true maximum value. For consoles that erratically produce variable break-to-break lengths it is impossible to say exactly what the results will be other than the minimum and maximum values will be within +/- 8uS of the ideal value. Added to this uncertainty is any inaccuracy caused by the finite accuracy of the Lil'DMXter's time base. The time base should be accurate to +/-150 parts per million.

5.2(6) UPDATES PER SECOND

This screen reads out the minimum, maximum and average number of DMX512 packets per second. The minimum and the maximum values are refreshed once per second. Thirty-five seconds is required for the average to appear initially. Following that, it is refreshed once per second. To leave this display, press either `<UP>` or `<DOWN>` or `<YES/Q>` and hold them for approximately 1 second. You will know that you have held the key long enough when the numbers on the bottom line of the display have been erased. This test is not start code sensitive.

5.3 RETURN TO FUNCTION MENU

This does exactly what you might think!

5.4 START CODE

DMX512 is a standard primarily intended to communicate level information to dimmers. It has provisions for non-level or non-dimmer communications by means of a "start code". For dimmer communication the start code has a value of 0, sometimes referred to as the "null start code". The default start code setting in the Lil'DMXter is therefore 0. Some equipment uses non-0 start codes. The Lil'DMXter provides you with the ability to set the start code you need for the type of equipment you are testing.

The display will read

```
START CODE IS  0
CHANGE IT?
```

If you press `<YES/Q>` the display will read

```
START CODE IS  0
CHANGE START CODE
```

Press the `<UP>` and `<DOWN>` keys to change the start code to your desired setting. Your choices are 0 to 255. When the desired value is displayed, press the `<YES/Q>` key to save this value. The DMXter will use this value as its start code for both transmit and receive until it is changed again by the user. The only exceptions are when a DMXter has had its battery turned off or when the power supply safety circuit has shut down the power supply. Then it reinitializes the start code to 0. See **MEAL PENALTY**, Section 9.2(1).

The start code may be displayed in hex. The setting of the hex **USER SETUP OPTION** determines whether this information is shown in hex or decimal. If hex is used, the display will show two hex digits followed by a lower-case "h".

5.5 DMX512 PARAMETERS NOT CHECKED

BAUD RATE - The Lil'DMXter does not measure the baud rate of the received signal. Neither does it measure bit jitter. If the baud rate of the console is within the allowed range, the Lil'DMXter should properly receive the signal, but no measurements are made or reported.

SIGNAL VOLTAGE LEVELS - The Lil'DMXter does not measure the voltages provided on the RS485 line, specifically neither differential nor common mode voltages are evaluated to see if they fall within the RS485 specification. If the Lil'DMXter is reliably receiving data, it is probable that the differential signal level is adequate. Testing of common mode signals is beyond the scope of the Lil'DMXter and this manual. Both common mode and differential mode signals can be tested by a qualified technician using standard laboratory equipment.

INTERBYTE TIME - Current software does not check Interbyte time.

INTERPACKET TIME - Current software does not check Interpacket time.

6.0 FLICKER FINDER

The Lil'DMXter will let you look at changing DMX512 levels in your lighting system. Running a cue causes DMX512 levels to change, of course. When your console is sitting there not running cues, the levels should be constant. Sometimes they aren't and that's not an easy problem to diagnose and troubleshoot - until now. Most of the time the flickering lamp is not caused by the console; it's the lamp, or the socket, or the dimmers. Once in a while it is the console or the DMX512 transmission line. Since all of us automatically suspect the piece of equipment we understand the least, the Lil'DMXter allows you to do a quick diagnosis of your console and the transmission line - and lets you get out the ladder with a heavy heart, but a clear conscience.

To use **FLICKER FINDER** you will use the DMXter to take a snapshot of the console's output and compare it to what the console is outputting a short time later. You can do this at the console end only, checking the console only. Or, if you have any reason to suspect the DMX512 cable, you can do it either at the console first, moving down to the dimmer end, or you can do the whole test at the dimmer end on the principle that a funky cable will not give you repeatable results. If you suspect a bad cable, we advise that you run **SINGLE ENDED CABLE TEST** first, as this will test certain cable parameters that **FLICKER FINDER** is not designed to test.

Be certain that the Lil'DMXter is connected to the console's output, either at the console or at the dimmer end of the control cable. Set the console to output a stable cue (important-not a chase!) Set a real cue with real levels, not every channel at 00. If you suspect one mode is "flickering" set the console in that mode.

Upon entering the **FLICKER FINDER** submenu, the first message is

```
TAKE SNAPSHOT OF
CONSOLE'S OUTPUT?
```

Pressing **<YES/Q>** causes it to record the snapshot. If the DMXter did not see a digital input, it will tell you so. After correcting the problem, press the **<DOWN>** key to try again. After the snapshot is recorded, the next display will be

```
COMPARE LIMIT IS    4
CHANGE IT?
```

The compare limit is the number of steps of change either plus or minus that are allowed before the DMXter considers that a channel is changing or flickering. Note that one step is one part in 256; not one part in 100. The default compare limit is 4, but the user may set it from 0 to 64. The Lil'DMXter will remember the last limit you set and only returns to the default upon hard power up, i.e. battery switch on/off or **MEAL PENALTY**. If the hex setup option has been selected, compare limits will be displayed in hexadecimal. If the previously set compare limit is satisfactory, you may bypass changing it by pressing the **<DOWN>** key. Pressing **<YES/Q>** allows you to change the compare limit in a manner similar to changing start code.

When you have set the compare limit (or bypassed setting it) you will see the following message

```
COMPARING INCOMING
DATA TO REFERENCE
```

As long as no errors are detected and the battery has sufficient charge, you will continue to see this message.

When an error is detected, the message will change to

```
ERRORS DETECTED
PRESS YES/Q TO VIEW
```

The test continues to operate with no further indication of other errors, if any. So let the test continue to run for whatever period of time you want; 15 minutes, 1 hour etc.

Pressing <YES/Q> will show you a summary screen of the errors found. It will show you the number of dimmers with errors (1-512). On the second line of the display you will see FIRST and a number representing the lowest dimmer number with errors and LAST and a number representing the highest dimmer number with errors. To see details of the dimmers, press <DOWN>. You will now see a display

```
DIM: XXX ERRS: XXXXX
L: XXX H: XXX R: XXX
```

This screen means: the number following DIM is the lowest dimmer number with errors. The number following ERRS is how many errors accumulated for this dimmer; it may range from 1-65,535. The number following L is the lowest level outside the reference window that the dimmer went to. The number following H will equal the highest level outside the reference window. The number following R equals the reference value for this dimmer recorded when the snapshot was taken. It is possible for the L value to be higher than the R value if all the incoming levels are higher than the R value. Similarly it is possible for the H value to be lower than the R value if all the incoming levels are lower than the R value.

At this point pressing the <RIGHT> key will take you to an identical screen for the next dimmer with errors. Using the <LEFT> key will take you to the previous dimmer with errors. (If you are at the first dimmer with errors, the <LEFT> key will take you to the highest dimmer with errors.) Both the <LEFT> and <RIGHT> keys have auto-repeat functions. Holding the <YES/Q> key while pressing either the <RIGHT> or <LEFT> key will jump you to the last dimmer with errors or the first dimmer with errors, respectively. At any time while viewing the detailed error screens, holding the <YES/Q> and <UP> will temporarily redisplay the error summary screen. When viewing either the summary or detailed error screens you may quit by pressing <YES/Q>. This will return you to

```
FLICKER FINDER
TO FUNCTION MENU?
```

6.1 RE-ENTERING FLICKER FINDER

If you hit <YES/Q> accidentally, do not despair! You may reenter **FLICKER FINDER** at three separate points. Pressing the <DOWN> key will offer you the chance to take a new snapshot. Pressing the <DOWN> key again offers you the chance to reuse the existing snapshot. Pressing the <DOWN> key a third time offers you the chance to view previous errors. Isn't that reassuring?

If the last time flicker finder was run, no errors were detected, or if flicker finder has not been run since the unit was powered up after either the battery switch was turned off or the unit went into a **MEAL PENALTY** attempting to view previous errors will produce the following

```
NO ERRORS RECORDED
```

If during the data comparison section of the test you press <YES/Q> before any errors are detected you will get the following message

```
TEST SUSPENDED
TO FUNCTION MENU?
```

If you wish to continue the test, press <DOWN> or <UP>. Pressing <YES/Q> will return you to the function menu. Once errors are detected, the error comparison section of the test cannot be re-entered. Once stopped, restarting the comparison clears the error tables.

6.2 TECHNICAL NOTES ON FLICKER FINDER

Flicker finder disables the power off timer while it is comparing incoming data regardless of the user setup. The backlite is turned off and left off as well; terminating the test by using <YES/Q> turns it back on. During the comparison test, the only keys on the DMXter that are operational are <YES/Q> and <TOP>. The <OFF> key will not turn the unit off while the test is running.

If during the data comparison section of the test any dimmer records 65,535 errors the test will be suspended.

7.0 CABLE TESTER

The Lil'DMXter includes a cable test feature. While DMX512 cables may be tested by a conventional cable tester for continuity, testing them for ability to pass high speed digital data is a little more complicated. DC cable testers may pass as "good" cables that will provide unreliable operation of DMX512.

We provide two modes of cable testing - double ended and single ended. Double ended is used when you have both ends of the cable at hand; what you are doing with a standard cable tester. Single ended mode is used when you are testing an installed cable, where you don't have access to both ends at one time. This mode works by allowing you to take and store a sample of the signal being sent to the console end of the cable you wish to test. It allows you to move the Lil'DMXter to the dimmer end of the cable and take a new sample. If the samples are the same, the cable is assumed to be good.

7.1 DOUBLE ENDED CABLE TEST

Upon entering the cable test menu, your first choice is whether you wish to do double ended cable test

```
CABLE TESTER
DOUBLE ENDED?
```

Selecting **<YES/Q>** will bring you to the next question

```
CABLE TESTER
TEST PINS 4 AND 5?
```

Yes, we know, DMX512 doesn't use pins 4 and 5 - except that some manufacturers use them for non-DMX signalling. This is how some manufacturers signal overtemperature on the dimmer racks. So we give you the option of testing these pins. Our tests of pins 4 and 5 are for continuity only, and do not attempt to send digital data on these pins.

Answering **<YES/Q>** will cause the test to start in a mode that tests all 5 wires. Pressing the **<DOWN>** key will cause the test to start testing only pins 1,2 and 3.

Once you begin the cable test, and assuming that your cable is good, the unit will step thru its procedure. After the DMXter has completed one test sequence the top line of the display will change to read **CABLE GOOD!** Each time the asterisk moves, the unit has completed one complete cable test and the cable has passed. A cable test consists first of checking for ground continuity, then checking for continuity and lack of shorts on Pins 2 and 3, then optionally continuity on Pins 4 and 5. Then a packet of DMX512-like data is transmitted and checked that it is received intact. If all of the above tests are successful, we consider the cable good. We move the asterisk one place in the display and start doing the test all over again.

Testing multiple cables: If you intend to test more than 1 cable at a time, after testing the first cable simply unplug it from the DMXter without pressing any keys on the DMXter. One of the error messages will appear, telling you that the "cable" has failed. Plug the next cable to be tested into the DMXter and restart the test by pressing either the **<UP>** or **<DOWN>** keys. In this manner you may rapidly test multiple cables.

So it failed... If a cable fails the continuity test, the top line of the display will read

```
CABLE TEST FAILED
```

The text on the second line will tell you which pin(s) should be checked.

P1:* means that Pin 1 (shield) is open. If Pin 1 fails, the test terminates so you will have no way of knowing if there are problems with other pins of that cable. We suggest that in repairing the cable, you check all the pins for problems.

**SOME DMX512 USERS DO NOT WIRE PIN 1 ON BOTH ENDS OF THE CABLE.
THIS CABLE TESTER WILL NOT TEST CABLES THAT DO NOT HAVE PIN 1 CONNECTED ON BOTH ENDS.**

P2:* means Pin 2 open or that Pin 2 is shorted to Pin 1.

P3:* means Pin 3 is open or that Pin 3 is shorted to Pin 1.

PINS 2&3 REVERSED! obvious, huh?

P2:*P3:* means that either Pins 2 and 3 are both open or that they are shorted to each other.

If either Pin 2 or Pin 3 is open or shorted to ground or the other pin, the test will stop before testing Pins 4 and 5.

P4:* means Pin 4 is open or that Pin 4 is shorted to Pin 1.

P5:* means Pin 5 is open or that Pin 5 is shorted to Pin 1.

PINS 4&5 REVERSED! obvious, huh?

Px:*Px:* means that either both Pins are open or that the pins are shorted together.

P2:* P3:* P4:* P5:* means that either the pairs Pin 2/Pin 3 and Pin 4/Pin 5 are reversed or that Pin 2 is shorted to either Pin 4 or Pin 5, and that Pin 3 is shorted to Pin 4 or Pin 5. Pin 2 is not shorted to Pin 3 or the test would have stopped already.

If the data test part of the test fails, the display will read

```
CABLE TEST FAILED
WON'T PASS DATA
```

This means that you have a fatal problem with your cable. It may pass DC but massive errors were encountered when high speed digital data was sent. This error stops the test. If you wish to try again, press the <UP> or the <DOWN> keys. If, on the other hand, occasional data errors are found which might be caused by an intermittent solder joint or a cable that is borderline for transmitting data, the top line of the display will read

```
DATA ERROR
```

Once you've found a data error, the top line will continue to read DATA ERROR. The test will continue to run and the bottom line of the display will flash a black bar for about a second each time you encounter a data error.

7.1(1) ENDING CABLE TEST

To end cable test, press and hold the <YES/Q> key. Release the key and you will see the following message

```
TEST SUSPENDED
```

You may now use the <UP> or <DOWN> keys to restart the test. Pressing <YES/Q> will return you to

```
CABLE TESTER
DOUBLE ENDED?
```

As in many places in the Lil'DMXter, the quickest way to terminate a test is by pressing <YES/Q> <TOP>...

7.2 SINGLE ENDED CABLE TEST

When you are trying to test installed DMX512 cables, you will usually be able to get to one end of the cable at a time. This is the time for SINGLE ENDED CABLE TEST.

First, go to the console end, unplug the DMX512 cable to be tested, and use a short jumper to connect between the DMX512-IN connector on the DMXter's front panel and the DMX512-OUT connector on the console. You will now use the Lil'DMXter to take a sample of the console's output. NOTE: The Console must be set to output a stable cue, no fades running, no chases etc. Plug the DMX512 cable under test back in and take the DMXter to the other end of the cable, where you will take another sample and compare the two samples. If they are the same, then your cable is good.

The first message is:

```
TAKE SNAPSHOT OF
CONSOLE'S OUTPUT?
```

Answer <YES/Q> and the next message reads:

```
TAKING SNAPSHOT
```

If there is digital data available, you will see almost immediately

```
SNAPSHOT RECORDED
```

After a pause of about 2 seconds, you will see

```
UNPLUG DMXter, PLUG
CABLE IN CONSOLE
```

Do as it says and unplug the jumper cable. Replug the cable under test into the console. After a short time, the message will change to

```
INSERT OTHER END OF  
CABLE UNDER TEST
```

Take the DMXter to the other end of the cable under test and plug it into the other end of the cable under test, using the DMX512-IN connector on the unit. Hopefully you see the message

```
CABLE GOOD!  
THE TEST CONTINUES..
```

If not, well, that's why we have test equipment ... But do not despair - all the pins may not have connected at the same time. Pressing either the <UP> or the <DOWN> key will cause the unit to retest the cable. If the cable fails for any reason you can always retest using this method.

If you attempt to retest and instead of getting a "good" or "bad" message you get

```
RETESTING CABLE  
LOOKING FOR DATA
```

this means that DMXter has seen no signal, good or bad. Either you have totally open cable, or no cable at all.

7.2(1) RESTARTING THE TEST USING AN OLD SNAPSHOT

If you press <YES/Q> during a cable test you will exit back to the **SINGLE ENDED** menu item. To restart the test without taking a new snapshot do the following. Answering <YES/Q>, the display will now read:

```
TAKE SNAPSHOT OF  
CONSOLE'S OUTPUT?
```

Answer <DOWN> and the next message reads:

```
USE EXISTING  
SNAPSHOT?
```

Answering <YES/Q> will restart the test at the point where the

```
RETESTING CABLE  
LOOKING FOR DATA
```

message is displayed.

7.2(2) ERROR MESSAGES IN SINGLE ENDED CABLE TEST

Error messages:

```
CABLE BAD OR MISSING  
PRESS <DOWN> TO TEST
```

This message will be seen only if you press <YES/Q> key before plugging in the second end of the cable under test. Plug in the cable under test and press <DOWN>. Pressing the <YES/Q> key a second time will cause the DMXter to return to the **SINGLE ENDED** menu entry.

```
CABLE TEST FAILED  
DATA ERRORS
```

See item 1) below

```
DATA ERRORS  
PINS 2/3 REVERSED
```

See item 2) below

```
DATA ERRORS  
PINS 2/3 MAY BE OPEN
```

See item 3) below

What errors cause **SINGLE ENDED CABLE TEST** to fail?

1) If the received level of any channel changes more than +4/-3 points from the value in the snapshot the test will fail.

2) A gross data format error such that the DMXter can't receive the DMX512 packet will cause the test to fail. We attempt to identify reversal of pins 2 and 3, but this error message should be taken as an advisory.

3) If we detect that either pin 2 or 3 is open the test fails. Why do we separately worry about an open pin when it would seem that an open pin would cause a data comparison failure? RS485, which is the electrical standard on which DMX512 is built, has an "interesting feature". Under certain unpredictable circumstances it will receive data with only shield and one of the two data lines connected. This makes checking cables harder. The cable test software uses special circuitry to specifically check to see if one of the two data lines is open.

IF YOU HAVE DISABLED THE "OPEN LINE DETECTOR" IN THE USER SETUP MENU, YOU WILL NOT SEE THIS MESSAGE.

7.3 RETURN TO FUNCTION MENU

This does exactly what you might think...!

8.0 SETUP USER OPTIONS

The Lil'DMXter is intended to be as helpful as possible in the maximum number of circumstances. So we provide the option of allowing the user to set certain parameters that make his life a little easier.

The entry point on the main user menu is

```
FUNCTION SELECT MENU
SETUP USER OPTIONS?
```

If you press **<YES/Q>** the first choice you are given is

```
DISABLE THE AUTO
POWER OFF TIMER?
```

Press **<YES/Q>** to turn it off either until you turn it back on thru this process, or until you turn the Lil'DMXter off and back on again with the **<OFF>** switch. (Remember that the auto power off timer kicks in after about 10 minutes if enabled.) This will also step you to the next menu item. Press **<DOWN>** for no, and to move on to the next menu item. Press **<UP>** to go back one menu item.

The next menu item is

```
DO YOU WANT THE
BACKLITE OFF?
```

Answer either **<YES/Q>** or **<UP>/<DOWN>** as you choose. The display will step you to the next (or in the case of **<UP>** the previous) menu item.

The next menu item is

```
DATA IS IN DECIMAL   OR   DATA IS IN HEX
DISPLAY IN HEX?     DISPLAY IN DECIMAL?
```

This choice is the hex/decimal switch. Each time you press **<YES/Q>** the display will step to the next menu item, and the unit will be switched to the other choice, either hex or decimal. As earlier, pressing **<UP>** steps you back to the previous menu item, and pressing **<DOWN>** steps you to the next menu item. Neither of these choices will affect the hex/decimal mode.

The next choice is

```
OPEN LINE ENABLED   OR   OPEN LINE DISABLED
DISABLE DETECTOR?   ENABLE DETECTOR?
```

First, what does this mean? And why should you care? The "Open Line Detector" is a proprietary Goddard Design Co. feature to help overcome a potential problem with the parent standard of DMX512, RS485. In RS485 it is possible to receive good data on a cable that is, in fact, bad; one that does not have connection of all of its pins. Needless to say, this can be irritating, and can throw you off when trying to track down problems. Since the chance of passing data intermittently on a cable where only shield and either pin 2 or 3 are connected exists, the Lil'DMXter incorporates some special circuitry that weeds out seemingly good data when all the pins are not connected. We call this the "open line detector".

There are some manufacturers and suppliers in the theatrical lighting field that have DMX512 cables that deliberately do not have pin 1 connected thru. This is a practice that Goddard Design Co. does not endorse, following upon majority interpretation of the DMX512 Standard. However, if the Lil'DMXter is used on these cables, the "open line" feature will provide spurious "bad cable" results, and so we provide the option to disable it.

The following functions use the "open line detector":

VIEW LEVELS - it is the feature we call "BNW" for broken wire

VIEW PARAMETERS - error summary screen where it is also called "BNW"

SINGLE ENDED CABLE TEST - the following message indicates that the error was caused by the open line detector

```
DATA ERRORS
PINS 2/3 MAYBE OPEN
```

DOUBLE ENDED CABLE TEST - it is inherent to this test and cannot be turned off. This test will not test cables where Pin 1 is not connected thru.

The last menu item is

```
SETUP USER OPTIONS
TO FUNCTION MENU?
```

Pressing <YES/Q> takes you back to the function menu. Pressing <UP> takes you back to the previous item in the user options menu. Pressing <DOWN> takes you to the beginning of the user options menu.

8.1 QUICK ACCESS TO BACKLITE AND TIMER

After the initial turn-on of the unit, pressing <TOP> again will not place you at the power off timer and backlite queries. These functions may be quickly accessed by the following sequence:

<TOP> <UP> <YES/Q>

You should now be sitting at the auto power off query in the user options menu.

9.0 CARE AND FEEDING OF THE BATTERY

The Lil'DMXter may be powered either from the AC line or from its own internal rechargeable battery. When the DMXter is plugged into an AC line, it will both draw its operating power from the AC line and recharge its internal battery.

We expect that many users are going to find battery operation to be most convenient when troubleshooting equipment in the theater, and will prefer line operation in the shop.

9.1 CHARGING

The Lil'DMXter is shipped charged. We recommend that you charge the unit for an additional 12 hours soon after receipt. Most of the charging occurs during the first few hours of being plugged in. For example, after about 6 hours, the unit is about 70% charged. Within about 12 hours the unit is 90% charged, but it will take in excess of 24 hours total to fully recharge the batteries. If you need to use a DMXter that is fully discharged, it is acceptable to give it 2-3 hours of charge, enough to make it usable. But make a general rule of charging the unit fully, at least for 12 hours. We also recommend that the unit be given a monthly "equalizing charge" lasting 24 to 36 hours.

The problem with a lot of battery powered equipment is that to get good battery life one has to follow a complicated regimen, which usually has little to do with how you wish to use the equipment. We have tried to design the DMXter to be "understanding" of your needs. You can short cycle the batteries in the DMXter when you need to; that is, run it partway down and charge it back up fully. You may leave it plugged into AC for several days at a time without injury; however, if you plan to use the unit in a shop or other setting where it would be more convenient to keep it plugged in, see below for the recommended modifications to facilitate this.

9.2 THE BATTERY TALKS/POWER MANAGEMENT

Surprise! The Lil'DMXter (like most battery-powered equipment) has a low battery warning. When it needs a charge, but before it's truly critical, it will give you the following message every 30 seconds

```
LOW BATTERY WARNING!
PLEASE FEED ME!
```

This message lasts for about 5 seconds. Note that while this message is displayed, the Lil'DMXter discontinues other operation. The amount of time/charge left in the battery is dependent on the function you are performing. **CABLE TEST** and **TRANSMIT** consume the most power. While you can continue to operate off batteries for 10, 20, maybe 30 more minutes, you should start thinking about the nearest AC outlet. As soon as you have plugged the unit in, you can continue your work on AC operation. The unit will also start to charge.

9.2(1) MEAL PENALTY

If you have been seeing the **LOW BATTERY WARNING** message for some time, the unit will at some point shut down. When the battery voltage drops low enough, the power supply is disconnected from the computer. This function is necessary to protect the battery. The display will go blank. Usually after a pause the battery voltage will recover enough that the power supply shut down circuit will turn the battery back on. The Lil'DMXter will display the message

```
Lil'DMXter V1.01  
MEAL PENALTY
```

This display will last for about 30 seconds. It means that the Lil'DMXter power supply had shut down and that while it is now on there is not enough charge to operate the Lil'DMXter. Attempts to turn the unit on using the **<TOP>** key will re-display the **MEAL PENALTY** message. If they produce no results (display stays blank) the power supply shut down circuit is still engaged.

9.3 TURNING OFF THE BATTERY

If you plan to leave the Lil'DMXter unplugged for more than 20 days at a time, you will prolong battery life by turning off the battery. This will prevent the battery from going into deep discharge. Leaving a battery in deep discharge for any length of time greatly decreases battery life. To turn off the battery, you will need to access the battery switch inside the case.

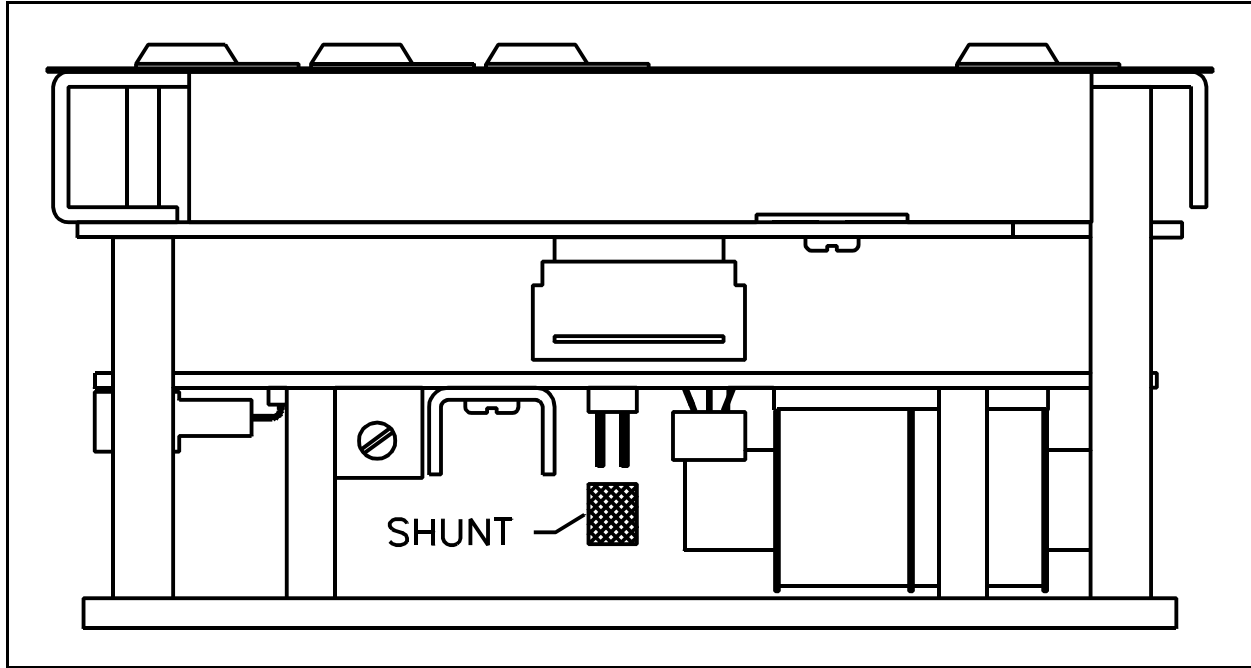
**FIRST UNPLUG THE LIL'DMXTER FROM THE AC LINE!!!!
NEVER OPERATE THE UNIT FROM THE AC LINE WHEN IT IS
OUTSIDE ITS CASE.**

To remove the unit from the case, **DO NOT USE THE FOUR SCREWS ON THE FRONT PANEL. USE THE ONE SCREW ON THE BOTTOM OF THE CASE.** The unit will drop out of the open case into your hand (or the floor if you're a klutz about this...remember that the display is glass!) Place the uncased unit on a table with the legends facing away from you. Look for a switch mounted to the base plate next to the right hand spacer. The "on" position is switch towards the spacer; the "off" position is switch away from the spacer. Put the Lil'DMXter back into its case and put the bottom screw back in loosely. This will help remind you to check the battery switch before you next try to use the unit. We also recommend that you tag the unit as further reminder.

Note that when the unit is turned back on, if it has enough charge to operate, you will momentarily see the message Lil'DMXter is sleeping.

9.3 MODIFICATION FOR CONTINUOUS LINE OPERATION

If you plan to use the unit plugged into AC on a continuous basis, you may wish to make a simple modification to the unit to prolong battery life. As above, remove the unit from the case. Place the unit on a table with the Goddard Design Co. logo on the left. Approximately in the center of the open side of the end towards you, you will see a flat cable connector. Below it, on the other side of the PC board is the shunt. Pull this straight down, using your fingernail, to remove it. This removes the trickle charger; the unit will work just the same without it. Do hold onto the shunt you have removed in case you use the unit in a field situation in the future. The unit will certainly work on



battery operation without the shunt; installing the shunt will prolong battery life where the battery is cycled regularly.

9.4 BATTERY OPERATING TIME

Approximate operating time on a fully charged battery:

Shelf life between charges	20 days
Receiving	30 hours
Transmitting	12 hours
Running Cable test	6 hours

9.5 LINE VOLTAGE REQUIREMENTS

Units are shipped to operate from a 120 VAC line, 50 or 60 Hz. Units should operate on any voltage from 85 to 135 VAC. Units should be able to fully charge the battery at any voltage from 100 to 135 VAC. At line voltages below 110 volts charging time will increase markedly. At 100 volts charging time will be nearly double the 120 volt time. Units may be ordered strapped for 230 volt operation. Existing units may be restrapped in the field for 230 VAC operation. Consult the factory.

10.0 LIL'DMXTER TECHNICAL DISCUSSION

Following are discussions of a few items of interest that we couldn't find a better place to put...

10.1 LINE TERMINATION AND CONNECTOR WIRING

Pins 2 and 3 of the DMX IN connector are always wired to a differential line receiver. This line receiver consists of a standard RS485 receiver chip protected by a transient and overvoltage protection network. Pins 2 and 3 of the DMX OUT connector are always wired to a DMX512 line driver. The line driver consists of an RS485 transmitter and a protection network. If the DMXter is in a terminated mode, Pins 2 and 3 of the DMX IN connector are loaded by a 100 ohm half-watt termination resistor and there is no connection between Pins 2 and 3 of the INPUT connector and Pins 2 and 3 of the OUTPUT connector. If the DMXter is in unterminated mode, the termination resistor is removed and Pins 2 and 3 of the INPUT connector are connected to Pins 2 and 3 of the OUTPUT connector. In the unterminated mode the DMXter can passively transfer a DMX signal from its IN connector to its OUT connector so that the Lil'DMXter may be put in line between a console and the dimmers transparently. The switching from terminated to unterminated mode is done by a magnetically latched relay. The advantage of using a latched relay is that the DMXter maintains its state even when off. If you place the DMXter on a cable after the last dimmer rack, you will wish to terminate the line by answering <YES/Q> to the "AT END OF LINE?" question in **RECEIVE DMX512**. If the Lil'DMXter turns off while sitting at the end of the line, it would be embarrassing if it removed the line termination - but it won't. Similarly, if the Lil'DMXter is placed between the console and the dimmers, it will stay in the Pass-Thru mode when turned off. The following list of functions causes the DMXter to terminate the line:

- 1- answering <YES/Q> to the **END OF LINE?** question - this is the only function that leaves the DMXter terminated if exited in a normal manner
- 2- any function that transmits data - if exited in a normal fashion, transmit functions unterminates the line on exit, but note that exiting a function via <TOP> is not a normal exit and will leave the line terminated
- 3- **SINGLE ENDED CABLE TEST** terminates the line - the condition on exit is the same as in **TRANSMIT**
- 4- **DOUBLE ENDED CABLE TEST** terminates the line - the condition on exit is the same as in **TRANSMIT**

10.2 STANDARDS - DXM512, RS422 AND RS485

Detailed discussion of DMX512 is beyond the scope of this manual. We would recommend that persons wishing to know more consult a good book discussing asynchronous serial communications in computers.

The electrical standards on which DMX512 is based are both RS422 and RS485. Many textbooks and catalogs discuss the features of these standards. Copies of these standards may be obtained from the Electronic Industries Association, 1722 Eye Street N.W., Washington D.C. 20006

A copy of the DMX512 standard may be obtained from the US Institute for Theater Technology, 10 West 19th Street, New York NY 10011.

10.3 VERIFYING SYSTEM TIMEBASE ACCURACY

The Lil'DMXter has a highly accurate crystal timebase, but it is not traceable to a certified calibration standard. For normal DMX512 testing and evaluation, the stock accuracy of the crystal should be more than adequate. If you have any need or desire to know the absolute accuracy of your particular DMXter, continue reading. If not, skip the rest of this section as it will only serve to confuse matters!

To verify the actual accuracy of the system timebase, it is necessary to measure the operating frequency of the microprocessor. To do this will require a frequency counter capable of measuring 2.6666666 Mhz with an accuracy of better than 20 PPM.

**FIRST UNPLUG THE LIL'DMXTER FROM THE AC LINE!!!!
NEVER OPERATE THE UNIT FROM THE AC LINE WHEN IT IS
OUTSIDE ITS CASE.**

OK, so now take the unit apart. Start by removing the single screw in the back of the case (careful as the unit will drop on the floor if you are clumsy). Remove from case. Next remove the 4 screws in the corners of the front panel. The unit will separate into two pieces connected by a ribbon cable and a twisted pair.

The DMXter needs to be on and running, on battery power, in the **FUNCTION MENU** for the rest of this test. No DMX cables should be connected, nor should the DMXter be in any other mode for this test other than the **MAIN FUNCTION MENU!**

Next locate the 40 pin microprocessor. The signal that needs to be examined is on pin 30. This signal is called ALE. The frequency of the crystal is the frequency of this pin multiplied by six. The nominal crystal frequency is 16 Mhz. Therefore the frequency appearing on this pin should be 2.666666 Mhz. The deviation from the nominal crystal frequency can be used to calculate the correction factor that would have to be applied to all time measurements and settings for this particular DMXter.

A side note: Do not try to measure the frequency of the crystal directly with any normal probe system as the additional capacitance of the probe and counter will detune the crystal oscillator and result in extremely inaccurate readings.

10.4 SPECIFICATION TABLES

TRANSMITTED DMX512 PARAMETERS

FUNCTION	DEFAULT	MINIMUM	MAXIMUM	RESOLUTION
BREAK LENGTH	88us	50us	49144us(1)	1uS
MARK AFTER BREAK	8us	3us	49064us(2)	1uS
INTERBYTE MARK TIME	4uS	4uS	330us	22uS
INTERPACKET MARK TIME	4uS	4uS	1.442SEC	22uS
DIMMERS TRANSMITTED	512	1	999	1
UPDATE RATE	40	.594(3)	5200(4)	NA
START CODES SENT	0	ANY	START	CODE

(1) Maximum with MAB set to 8uS

(2) Maximum with break set to 88uS

(1 or 2) The Total of break and mark can not exceed 49152uS.

(3) 512 dimmers, 49,144us break, 8uS mark, 334uS IBT(15 units), 1.454 second IPT (65535 units)

(4) 1 dimmer, 88us break, 8us mark

RECEIVED DMX512 PARAMETERS

FUNCTION	MINIMUM	MAXIMUM	NOTES
BREAK LENGTH	65uS	-	
MAB LENGTH	3uS	-	
NUMBER OF DIMMERS	1	512	OVFL reported for over 512 dimmers
BREAK-BREAK TIME	170uS	3 SEC.	

ACCURACY

PARAMETER	ACCURACY	NOTES
TIMEBASE & BAUD RATE ACCURACY	+/- 150 PPM	0 - 70 Degrees C, by design, not tested in production
TRANSMITTED BREAK JITTER	NEGLIGIBLE	Timebase jitter is the major source of break jitter
TRANSMITTED MAB JITTER	NEGLIGIBLE	START CODE = 0 BREAK + MAB less than 16.380 MSEC
TRANSMITTED MAB JITTER	+/- 4uS	NON-ZERO START CODE or BREAK + MAB time greater than 16,380MS
DIMMER BYTE JITTER	+/- 2uS	
SCOPE TRIGGER TO BREAK JITTER	NEGLIGIBLE	Timebase jitter is the major source of jitter
RC'D BRK,MAB ACCURACY	+/- 250nS +/- 150PPM	Sum of both errors, rounded as needed for display
RC'D BREAK-TO-BREAK		See section 5.2(5)

VOLTAGE AND CURRENT LIMITS

	VOLTAGE OR CURRENT	NOTES
LINE VOLTAGE	85 - 135 VAC 100 - 135 VAC	- To operate - To charge fully (1)
MAX VOLTS MAX CURRENT DMX512-OUT PINS 2&3	+20VDC -5VDC +/- 100 MA	Withstanding voltage & current
MAX VOLTS MAX CURRENT DMX512-IN PINS 2&3(2)	+50VDC -30VDC +/-7 MA	Withstanding voltage & current
PIN 4&5 IN or OUT	+/-70 VDC	SCOPE TRIGGER OFF DOUBLE ENDED CABLE TEST OFF
PIN 4&5 OUT	+12 -0.6 VDC(3)	SCOPE TRIGGER ON

(1) At line voltages below 110 volts charging time will increase markedly. At 100 volts charging time will be nearly double the 120 volt time. Units may be ordered strapped for 230 volt operation.

(2) In terminated modes, in unterminated modes DMX512-OUT limits apply.

(3) Maximum do not exceed!

11.0 WARRANTY

The GODDARD DESIGN CO. warrants each unit it manufactures to be free from defects in material and workmanship under normal use and service for the period of 1 year from date of purchase. This warranty extends only to the original purchaser. This warranty shall not apply to fuses, disposable batteries (rechargeable type batteries are warranted for 90-days), or any product or parts which have been subject to misuse, neglect, accident or abnormal conditions of operations.

In the event of failure of a product covered by this warranty, GODDARD DESIGN CO. will repair a unit returned to us within 1 year of the original purchase provided the warrantor's examination discloses to its satisfaction that the product was defective. The warrantor may, at its option, replace the product in lieu of repair. With regard to any unit returned within 1 year of the original purchase said repairs or replacement will be made without charge. If the failure has been caused by misuse, neglect, accident or abnormal conditions of operation, repairs will be billed at a nominal cost. In such case, an estimate will be submitted before work is started, if requested.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS OR ADEQUACY FOR ANY PARTICULAR PURPOSE OR USE. GODDARD DESIGN CO. SHALL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER IN CONTRACT, TORT OR OTHERWISE.

If any failure occurs, the following steps should be taken:

1 Notify the GODDARD DESIGN CO. giving full details of the difficulty, and include the serial number. On receipt of this information service data or shipping instructions will be forwarded to you.

2 On receipt of the shipping instructions, forward the unit, shipping prepaid. Repairs will be made at the GODDARD DESIGN CO. and the unit returned, shipping prepaid.

All shipments to GODDARD DESIGN CO. should be made via United Parcel Service or similar "best way" carrier prepaid. The unit should be properly packed either in its original container, or if in a substitute container, in one that is rigid and of adequate size to allow for suitable packing padding to protect the unit from shock.

The unit should be thoroughly inspected immediately upon original delivery to purchaser. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the unit is damaged in any way, a claim should be filed with the carrier immediately. Final claim and negotiations with the carrier must be completed by the customer.

12.0 LOOK UP REFERENCE

Not really an index, this is an aid to help the user look up items of interest.

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