Linn Midi Retrofit

Installation/Owners Manual

This manual covers the installation and usage of the J.L.Cooper Electronics Linn Midi Retrofit (LMR) Kit.

IMPORTANT--- READ THIS!

The installation of this kit requires skill in electronics in general and knowledge of the Linn Drum in specific. Some amount of soldering, trace cutting and drilling is necessary, and although this shouldn't cause any problems to qualified personel, it could cause considerable damage to the LinnDrum in the hands of an amateur.

For this reason, and since every unit is 100% tested at the factory, the LMR Kit is warranteed only when installed by a service center approved by J.L.Cooper Electronics. In certain locations, that may require the LinnDrum be sent to our factory for installation. The included warranty card has a place for writing in the name, address, and phone number of the installer. We request that you make sure that you have this filled out.

What does the LMR Kit give to the Linn Drum?

* Receive Midi Note commands to trigger drum sounds.
* Send Midi Note commands whenever a sound is triggered, either by manual pressing of a button, or playback of a pattern/song.
* Receive Midi Real Time commands to sync the LinnDrum to another Midi device.
* Receive Midi Song Position Pointers to be compatable with the newest SMPTE compatable Midi equipment.
* Send Midi Real Time commands to sync other Midi equipment to the LinnDrum.
* Midi Bulk Data dump allows you to use off-line storage like the J.L.Cooper Midi Disk to store your song and pattern data. With the Midi Disk, you can load this data in just six seconds.
* You automatically get your software updated to the LinnDrum 3.2 (the final rev. This adds single-stepping and extra trigger output rates.

NOTES

INSTALLATION: When you see one of these " ⇒", it is a particularly important item you should heed.

⇒ Before going on, save your songs and patterns to tape. Failing to do this could easily result in loss of all song and pattern information.

In the LMR Kit you should find the following:

- The LMR PC board.
- Two MIDI DIN female connectors with cables attached. One should terminate with a two pin connector and one with a three pin connector.
- A front panel "Midified by..." label and a "Midi In/Midi Out" label.
- Two 1" 4-40 screws with nuts.
- Two 1/2" 6-32 threaded standoffs.
- Two 6-32 screws.
- A 74HC02 IC
- A 14 Pin IC socket.

To do the installation, you will need the following:

- A high-quality soldering iron.
- An Xacto knife.
- Either a 5/8" Greeley punch or a 5/8" drill.
- A 1/8" drill.
- Patience.

A) Locate a well-lit, uncramped space to work on. Disconnect the power cord and remove the three screws along the front edge that secure the top of the LinnDrum to the bottom.

B) At this point, you get to make a decision: decide whether the MIDI connectors should go into the right-side wooden end-bell, or out of the rear of the LinnDrum. If you don't have a 5/8" Greeley punch, but have a drill press, putting the connectors into the end-bell may be easier. The problem with this approach is that some musicians don't like the MIDI cables coming out of the side. Make your choice and either:

1) **Into the End-Bell:**

a) Remove the four screws securing the right side end-bell to the LinnDrum. Refer to figure 1, showing the right side end-bell. At the

locations shown, mark and then drill two 5/8" holes. Make sure that they are drilled straight up and down.

b) Insert one of the DIN connectors into each hole and carefully mark where the mounting screws' holes should be drilled.

c) In these four locations, drill a 1/8" hole, again making sure that they are straight.

d) Mount the two DIN connectors into these holes, making sure that the connector with the three pin connector goes into the righthand hole.

e) Re-mount the end-bell onto the LinnDrum.

f) Place the MIDI IN-MIDI OUT label directly below the connectors.

or,

2) Into the rear of the LinnDrum. Refer to Figure 2, showing a rear view of the LinnDrum.

a) Carefully mark the appropriate locations and make holes in the middle of the two louvre slots.

⇒ Be very careful where any metal drillings end up. Any that you miss can float around and someday short out the electronics. After you finish all drilling, turn the LinnDrum upside down and shake it well.

b) Using a 5/8" Greeley punch, enlarge the two holes.

c) Put a DIN connector into each hole. If you mount them diagonally you can use the slots for the mounting screws. When mounting, make sure that the one with the three pin connector goes into the left most hole. This is the Output connector.

d) Apply the MIDI IN-MIDI OUT lable to the top of the Linn, right above the connectors so that you can read it from the front, much like the other labeling is done on the Linn's top.

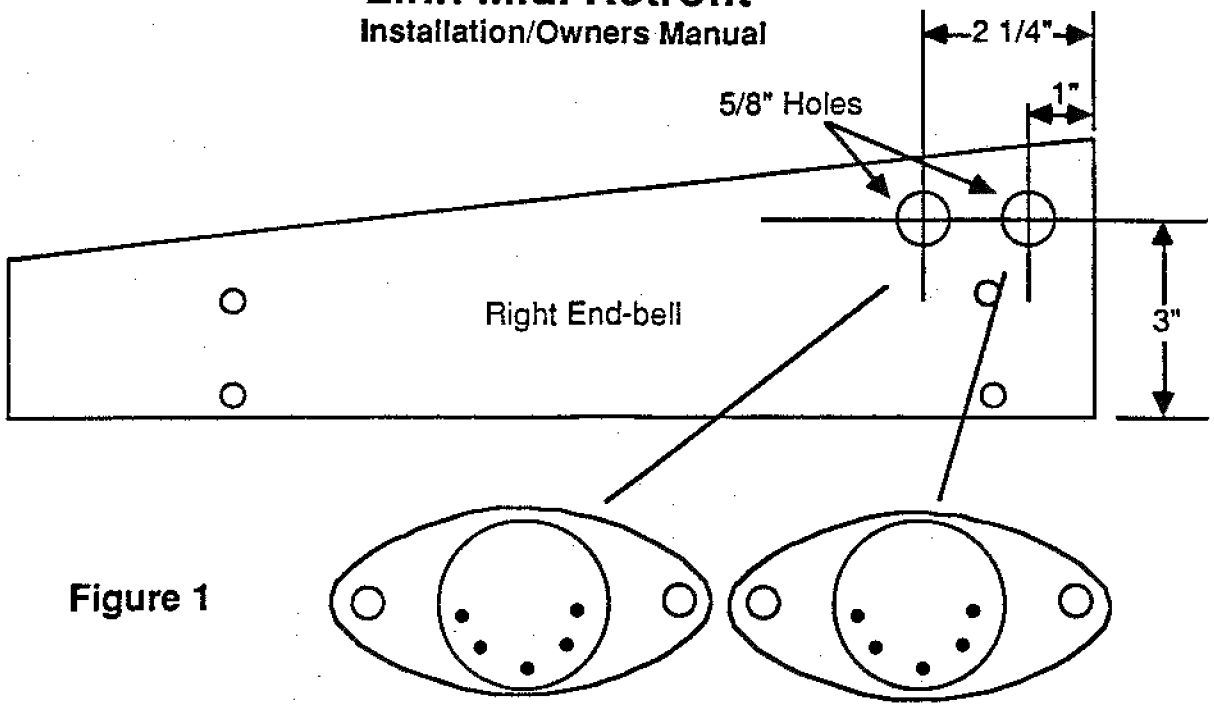
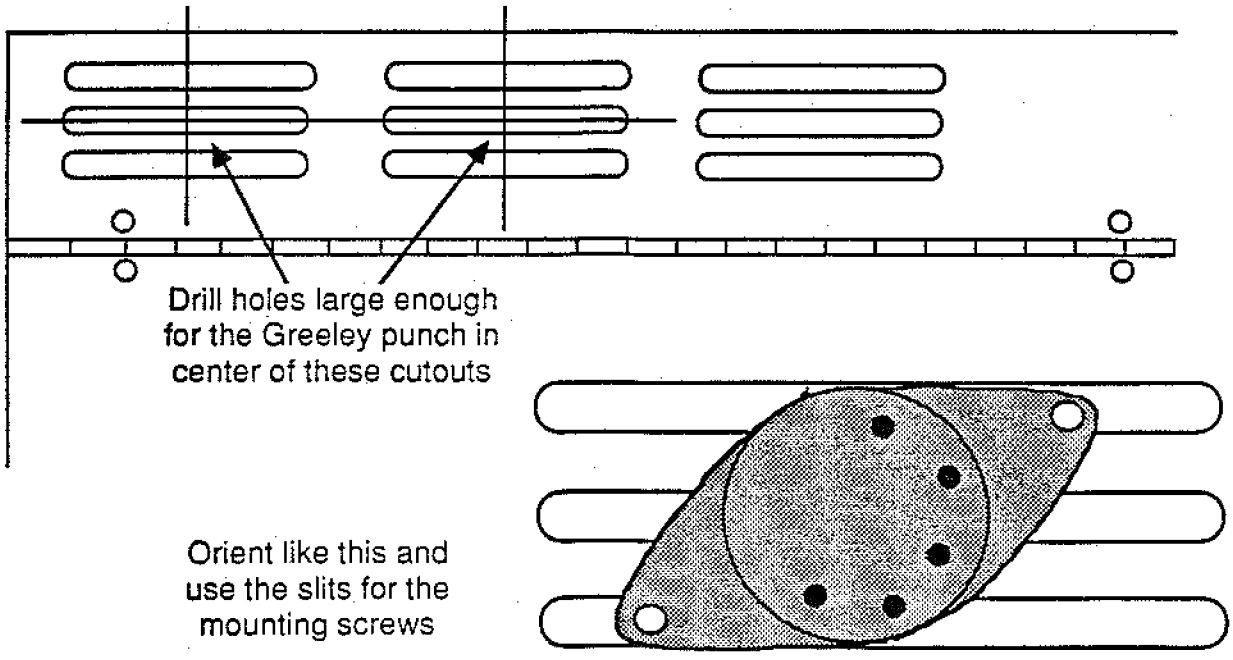


Figure 1

Figure 2



C) Remove the main Linn CPU board by removing the securing nuts, and the tempo knob. The connecting cables may remain attached if desired.

D) Locate and remove IC 36, which is a 74C02. This part is marginally too slow for the modification. In some units this part will work, but may start to have problems later. Use your very best de-soldering techniques here. Since this installation is only recommended for qualified technicians, I'll not bore you with instructions on how to remove ICs from PC boards.

E) Install the 14 pin IC socket into this spot, making sure of your pin 1 direction. Into this socket, install the 74HC02 provided.

F) Replace the CPU board into the Linn, replacing all nuts except the ones just above and below the rear of the TEMPO pot. See Figure 3. These should be replaced with the two 1/2" standoffs.

G) Remove both of the program EPROMS located next to the Z80. Save them in case you ever need to remove the LMR board (see the section on "Removing the LMR" for more on this.)

H) Mount the LMR board onto the standoffs, with the ribbon cable dangling down. Use the two 6-32 screws.

I) Using an Xacto knife, carefully cut the trace going between pins 16 and 17 of the Z80. See figure 4.

J) Tin the following pins of the Z80: 4, 5, 6, 16, 21, and 22. See Fig. 5.

K) Cut the bare ends of the six wires coming from the LMR board so that only about 1/8" of bare wire shows. Tin these ends with a little solder.

L) Refering again to Figure 5, solder the six wires carefully to the pins of the Z80. Be particularly careful not to bridge across two pins with solder and/or wire.

M) Fold over the ribbon cable from the LMR board. Refer to Figure 6, and:

⇒ **Very carefully**, plug the 24 pin DIP plug into the left-most ("A") EPROM socket on the LinnDrum CPU board. Most problems with installation will happen here, either because you shift the plug to one side by one pin, or because a pin gets folded under.

N) Plug the connectors from the MIDI IN and MIDI OUT connectors onto the LMR board. Refer to Figure 7. Make sure that the words "UP" show on both, and that the two-pin connector is as shown.

O) Apply the "Midified by....." label to the front of the LinnDrum to give us free advertising.

That is the end of the installation proceedure of the LMR Kit. Now hold your breath and test it.

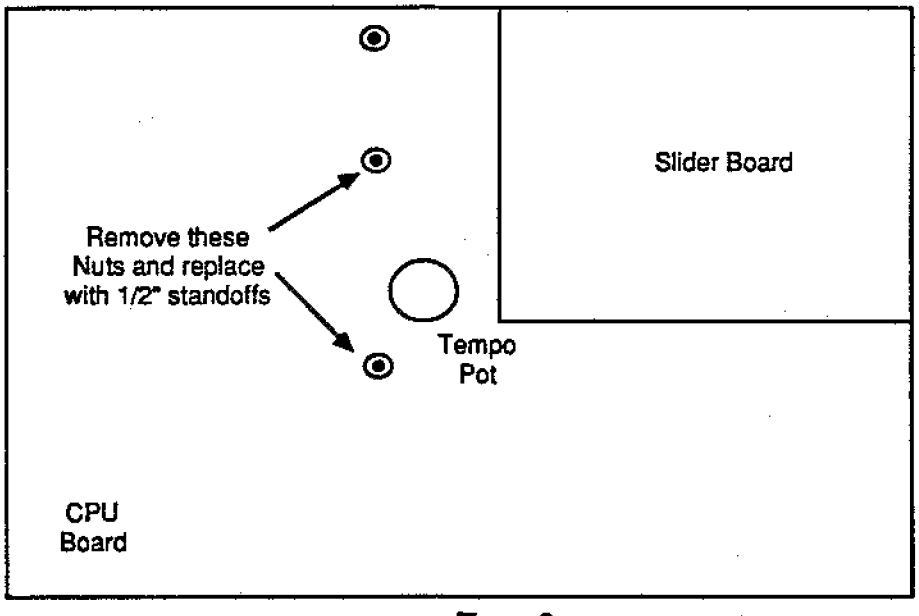


Figure 3

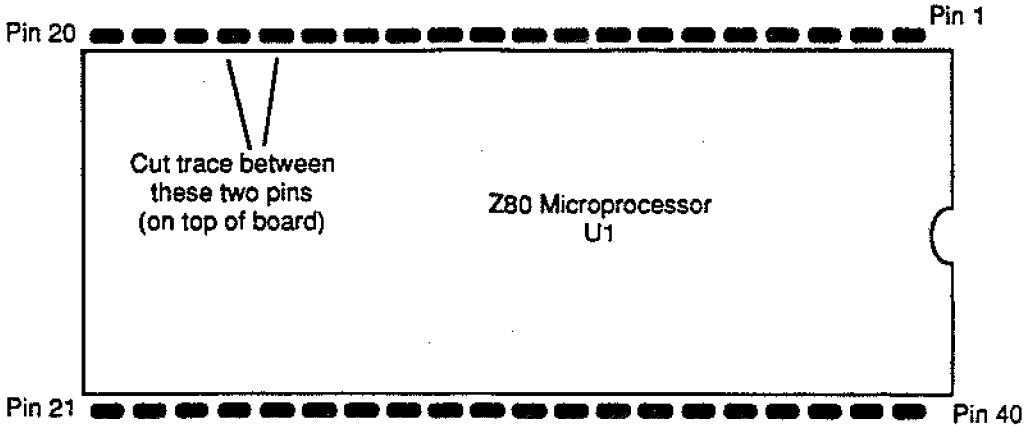


Figure 4

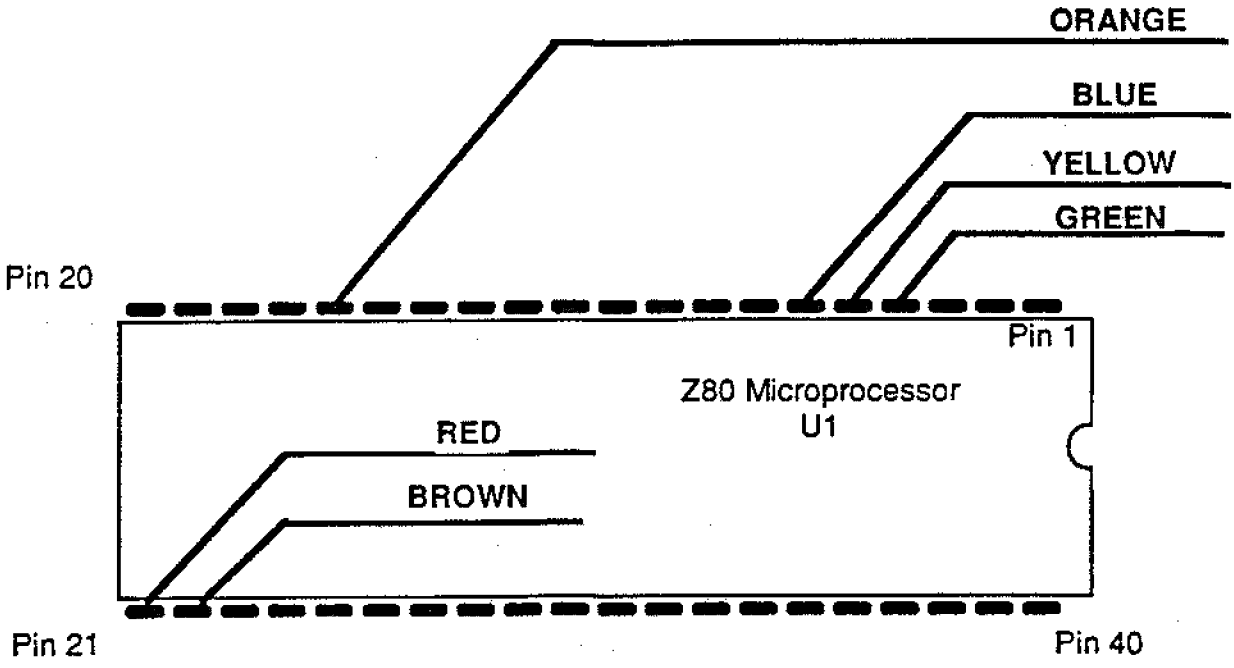


Figure 5

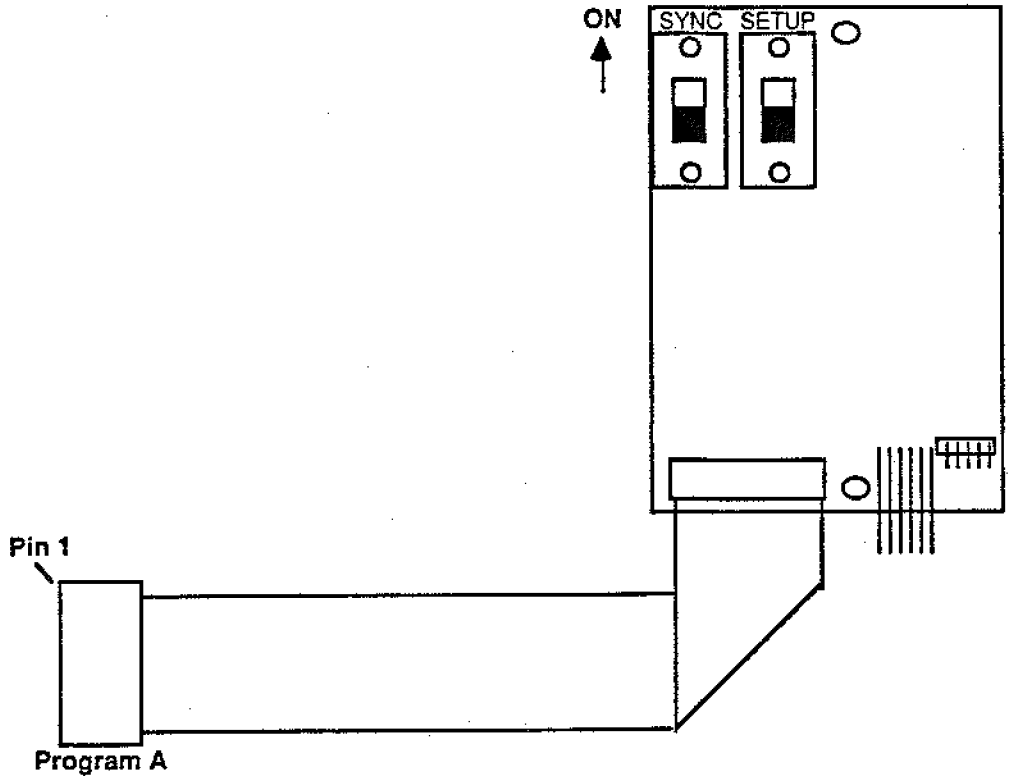


Figure 6

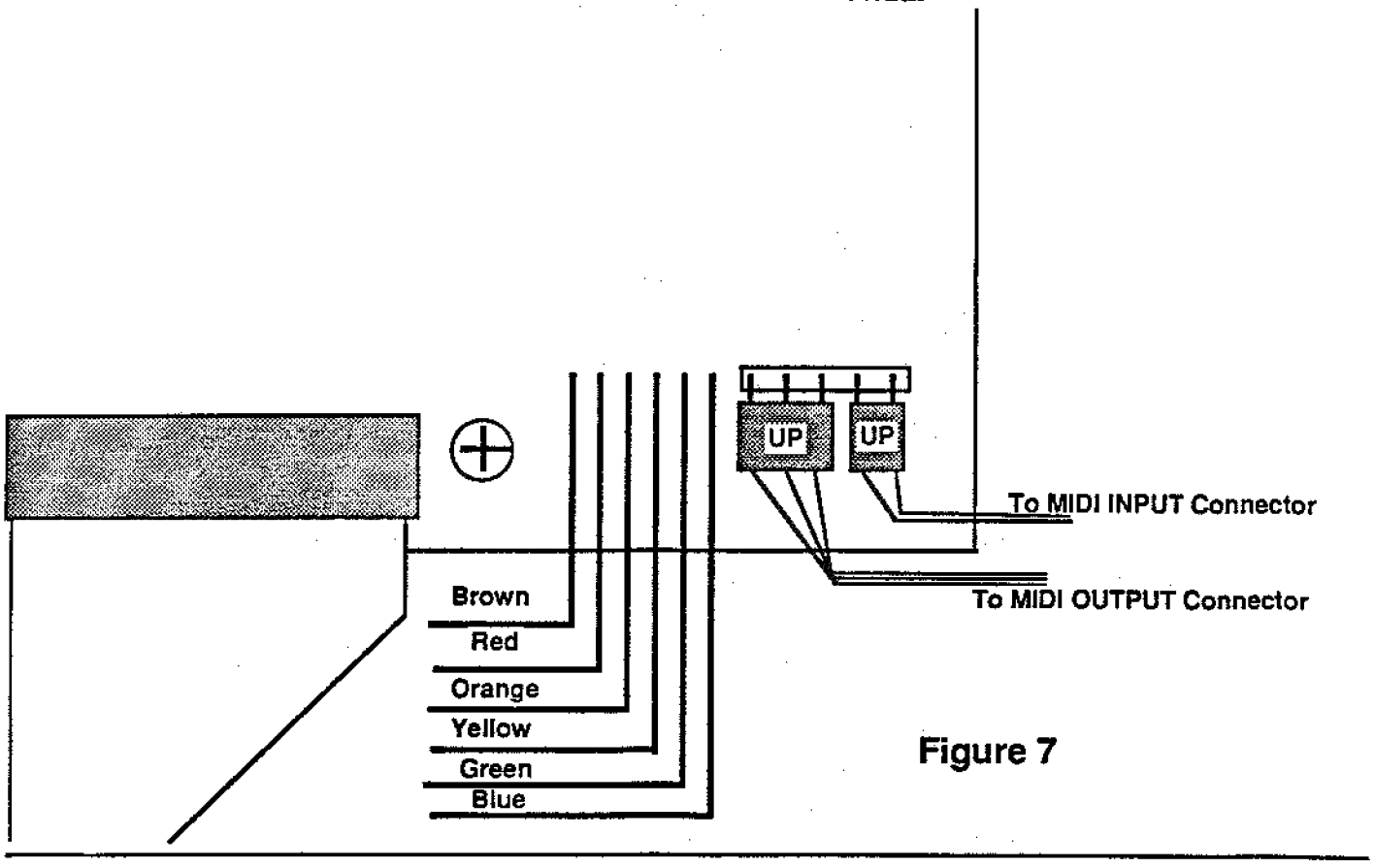

UP
UP
To MIDI INPUT Connector
To MIDI OUTPUT Connector
Brown
Red
Orange
Yellow
Green
Blue

Figure 7

TESTING:

⇒ There are two slide switches on the LMR board that will cause strange-looking things to happen if you have them switched to the wrong position. For the time being, make sure that they are both switched away from the closest edge of the board. See Figure 6.

A) Give a good visual examination of your installation. Have you bridged any pins on the Z80? Did you do a good job of cutting the trace between pins 16 and 17? Are the proper wires going the proper places? And does the ribbon cable connection look correct? Did you get the MIDI IN and OUT connectors mixed up?

B) If you are confident so far, make sure that there are no bits of drillings anywhere.

C) Attach power to the LinnDrum.

D) Cross your fingers and turn on the power. If all is correct, an "11" should show in the display after a couple of seconds. If this doesn't happen, turn the power off immediately and re-examine your installation.

E) If all is well, go on to the Operation section of this manual.

REMOVING THE LMR:

If you should ever find it necessary to remove the LMR from your LinnDrum:

A) Carefully unplug the ribbon cable from the EPROM socket.
⇒ If you intend to ship the LMR board anywhere, be careful to protect the fragile pins of the DIP plug by "plugging" it into a piece of firm foam, preferably the black kind used to ship EPROMs.

B) De-solder the six wires from the pins of the Z80.

C) Form a solder bridge between pins 16 and 17 of the Z80.

D) Re-insert the original LinnDrum software.

Owners Manual:

This Owners Manual is split into two sections: one concerned with MIDI Note/Drum Sound implementation, and one concerned with Midi syncing.

Note Commands:

Most MIDI Drum Machines have some sort of provision to send and/or receive Midi Note Commands (exactly like a keyboard sends and receives) to correspond to the individual drum sounds. The LMR is no exception.

1) Sending:

Whenever a drum sound is triggered on the LinnDrum, whether from pushing a front panel button, bringing in an external trigger, or from the playback of a pattern, a MIDI Note On/Note Off pair is sent. The exact note number depends on which drum sound position is sounded. When you first turn on the LinnDrum, the assignments are made according to Table 1. As we will see, these assignments can be changed.

The main use of this feature is to allow you to program patterns on the LinnDrum and send trigger commands out to external drum machines and/or to sampling keyboards.

These MIDI Note commands go out on the MIDI Channel set by the small DIP switch on the LMR board. See Figure 8.

2) Receiving:

Whenever the LinnDrum is in its "idle" mode, (that is, not recording or playing a pattern or song) reception of MIDI Note On commands on the proper MIDI Channel can trigger individual sounds. As with the Send section above, the individual sounds are assigned to individual Note numbers.

The main use of this feature is to allow you to program in your songs on an external sequencer, and have it play the sounds in the LinnDrum.

As above, the internal DIP switch sets the MIDI Channel number. Also, as mentioned above, the note number assignment may be changed.

CHANGING NOTE NUMBER ASSIGNMENT:

Mounted on the LMR board are two large slide switches. The one on the right is for external sync, and will be covered later. The one on the left is labeled "SETUP", and is used to change Note number assignments and to also change sync offset, as you will see later.

Switch the SETUP switch UP (toward the closest edge of the PC board, and lower the front of the LinnDrum. Notice that the displays have gone blank. Push one of the drum sound buttons- notice that a Note number for that sound is being shown. As long as you are in the SETUP mode, pushing any sound button will show the current Note number assignment.

To change the assignment, use the ⇐ or ⇒ buttons while holding down the appropriate sound button to step down or up. The number changes by one each time you press the arrow buttons. If you hold an arrow button down for a second or so, the numbers will automatically step rapidly. When the correct number shows, go on to the next sound and so forth.

When thru making assignments, lift up the lid and switch the SETUP switch DOWN to go back to normal mode. Pushing any button on the front panel of the LinnDrum will restore the display to normal functions.

Remember that turning the LinnDrum off will revert the Note assignments to those shown in Table 1.

SETTING CHANNEL NUMBER:

Channel	Sw1	Sw2	Sw3	Sw4
1	Off	Off	Off	Off
2	On	Off	Off	Off
3	Off	On	Off	Off
4	On	On	Off	Off
5	Off	Off	On	Off
6	On	Off	On	Off
7	Off	On	On	Off
8	On	On	On	Off
9	Off	Off	Off	On
10	On	Off	Off	On
11	Off	On	Off	On
12	On	On	Off	On
13	Off	Off	On	On
14	On	Off	On	On
15	Off	On	On	On
16	On	On	On	On

MIDI SYNCING:

The LMR adds the ability to send or receive MIDI Real Time commands to the LinnDrum, allowing syncing to other MIDI equipment.

1) Sending:

As soon as you put the LinnDrum into the PLAY condition, a MIDI Start command is sent, and then a MIDI Clock command. Thereafter, for every two internal LinnDrum clocks, a MIDI Clock command is sent. (Remember that the LinnDrum operates at 48 clocks/quarter note and that MIDI Clocks are at 24/quarter note.)

This will continue until the PLAY/STOP button is pressed, stopping the LinnDrum. At this time, a MIDI STOP command is sent, and the unit stops sending the MIDI Clock.

2) RECEIVING SYNC:

It is necessary for you to choose whether the LinnDrum is operating as it always has (off its internal clock or external clock), or from MIDI sync. This selection is made via the right-hand slide switch on the LMR board, which is labeled "MIDI SYNC". If you wish for the LinnDrum to slave to external MIDI SYNC, switch this switch UP toward the closest edge of the PC board.
In this mode, the PLAY/STOP button appears to work, but nothing actually runs until MIDI Sync commands come in. Following are the specific responses to the different MIDI Real Time commands:

START- When this is received, the LinnDrum lights its PLAY LED and does the internal calculations it need to actually start playing. It then sits there and waits for a:

CLOCK- Reception of MIDI Clocks actually step the LinnDrum thru its patterns or songs. For each MIDI Clock in, two LinnDrum clocks are simulated.

STOP- When this is received, the LinnDrum will cease to respond to MIDI Clocks, and enter a special type of Stop condition. The PLAY LED will stay on, and in many ways the LinnDrum still "thinks" it is in the PLAY condition, waiting for the next clock to come in. If you need to do most of the

normal LinnDrum front panel operations, you will need to press the PLAY/STOP button to enter the "real" STOP condition.

The reason for this is that putting the LinnDrum into a real STOP condition makes it impossible to do anything other than start the pattern/song over from the beginning each time. Rather, we have decided on this approach so that we could recognize the following command.

CONTINUE- If this command is received when the LinnDrum is in the special STOP condition expained above, the pattern or song will continue from where stopped as soon as Clock commands come in again. This will not work from a dead STOP condition, such as when the unit is first turned on, or if you have pressed the PLAY/STOP button after a MIDI Stop command has come in. The Continue command will only work if a pattern/song has been playing, and a MIDI Stop command has been received.

SONG POSITION POINTER- This is a special MIDI command that is just now starting to be utilized by sequencer manufacturers. It is used to tell a slave device to start at a specific point partway into a song (usually when tied to SMPTE), and is "calibrated" in terms of number of 1/16th notes since the beginning. Naturally, your master device must be capable of sending this command.

When the LinnDrum receives this command, it must silently "play" the song at a very rapid rate to get up to the proper point. This takes place at about 30 times the normal rate. As soon as this point is reached, the LinnDrum beeps, telling you to press the (usually) "Continue" button on the Master device. The master device must not send out a Song Position Pointer while the LinnDrum is running, and should leave it up to the musician to wait for the beep before actually hitting the Continue button.

Some units such as the Fostek 4050 Autolocator don't quite adhere to the Midi Detailed Spec 1.0. This type of unit sends the Song Position Pointer, then the Continue command and Clock commands immediately. This Retrofit will try to accommodate this situation by buffering these commands as they come in. However, if more than 255 of these commands come in while the Linn is searching for the start point, the buffer will overflow, losing the commands. At a tempo of 120, this would be about 5 seconds worth of time. Since the Linn does its search at about 30 times real time, this would be the equivalent of about 2-3 minutes into a song.

OFF-SETTING MIDI SYNC:

As a bonus feature, we have added the ability to shift in time the absolute syncing of the LinnDrum. This description applies whether the LinnDrum is acting as master or slave.

As described above, enter the SETUP mode by turning on the SETUP switch. As before, the display will blank. This time, instead of pressing a sound button, press and hold the BPM/TRIGGER button. A number will appear in the display, indicating the number of LinnDrum clocks (48 per quarter note) that the LinnDrum will be offset from the other MIDI equipment. If the number is in the left window, the LinnDrum is behind, and if in the right window, the LinnDrum is ahead. To change this number, use the ⇐ or ⇒ buttons to make the LinnDrum behind or ahead respectively. The limit is 8 LinnDrum clocks, which gets pretty special effectish. Each LinnDrum clock is about 10msec at a tempo of 120. When you have set this number as desire, switch back out of the SETUP mode.

When the LinnDrum is powered down, this number reverts back to 0, or no offset.

TABLE 1

Normal Note Assignments

Button	Note	Button	Note
Sidestick	36	Lo Tom	48
Snare 1	37	Ride 1	49
Snare 2	38	Ride 2	50
Snare 3	39	Cabasa 1	51
Bass 1	40	Cabasa 2	52
Bass 2	41	Tamb 1	53
Crash	42	Tamb 2	54
HiHat 1	43	Hi Conga	55
HiHat 2	44	Lo Conga	56
HiHat Open	45	Cowbell	57
Hi Tom	46	Claps	58
Mid Tom	47		

BULK DATA DUMPS:

The LMR adds Systems Exclusive data dumping to the LinnDrum. A full load of data into the LinnDrum from an off-line storage device such as the J.L.Cooper Midi Disk takes only about 5 seconds. Contact J.L.Cooper for more information.

The format for requesting a data dump is as follows:

F0h-	Systems Exclusive header
15h-	J.L.Cooper I.D.
8	LinnDrum I.D.
1	Dump Request
F7h	End of Systems Exclusive

The data is dumped as follows:

F0h	Systems Exclusive header
15h	J.L.Cooper I.D.
8	LinnDrum I.D.
0	Data coming
data	4 bit nibbles, right justified
F7h	End of Systems Exclusive

data = 16192 nibbles for normal LinnDrum or
=32384 for a memory expanded unit.

data dump is full dump of ram including pointers, flags, etc.