Disk drivin'
Tips; on shunt packs, cables and drive select lines

The following article refers specifically to Shugart-type drives (originally used by TI), with comments on TEAC-type drives. Most of the information should be applicable to all drives.

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Connecting disk drives to a TI99/4A is a fairly simply item. You have basically three things to worry about:

1. Cable Connections.
2. Setting up shunt packs.
3. Termination resistor packs.

One area that TI seemed to do things right was in using standard interfaces for peripherals. Sometimes you have to rearrange pinouts to get equipment to work, but it will work.

However, on disk drives, you don't even have to worry about pinouts because TI conforms to the default industry standard.

Fig. 1 shows the pinout for disk drives and the disk drive controller card. Since the original TI controller card did not support four drives, pin 6 of the card was not used. With the exception of pins 10, 12, 14 (and 6), all the lines go to all the drives connected to the system. Lines 10, 12, 14 and 6 are the drive select lines.

Figure 2 shows how the normal Shugart drives are connected at the factory. If all the drive select lines are connected to the drive and nothing is done to the shunt pack, any one of the drive select lines going low will cause the drive to be activated.

There are a number of ways to go about setting up the drives so that only the appropriate drive is activated. One method is to make up your cables with all pins connected then punch the shunt pack as shown in Fig. 3. You'll notice that DS2 and DS3 are punched out. The drive would then respond as DSK2.

Another method is the one TI used. To make hooking up the drives as simple as possible for the owner, all drives were punched as DSK1. Then, when additional drives were connected, they were connected using the small circuit card that came with the controller card. All the circuit card did was to connect line 12 from the controller card to line 10 on the second drive, and if a third drive was used line 14 (which was line 12 going to the second drive) was connected to line 10 on the third drive (see Fig. 4).

Radio Shack also made it simple to connect drives. But instead of using the jumper card, they removed pins from the connector plugs, such that pins 10 and 14 were not connected to the second drive, and pins 10 and 12 were not connected to the third drive. Using this method the owner did not have to worry about the shunt pack, because the cable did the drive selection.

This method caused me a small amount of grief. When I first installed my double-sided drives I had trouble trying to get them to work. As it turned out, I was using a Radio Shack cable. For some reason, Radio Shack also pulled the pin out of line 32, which is the side select line. So I could never access side 2.

TEAC-type drives don't have a shunt pack. Instead they come with a jumper which you have to move to the appropriate drive select line. Fig. 5 shows the jumper set up for DS2.

When installing your own drives, you have to insure that only the appropriate lines are connected. If you have the TI drives, but you don't have the circuit connectors, you could remove the shunt pack and try to restore the straps that have been punched by pushing them back out and soldering them. Or, remove the shunt pack altogether and install a DIP switch and set the switches according to how the lines should be connected.

Whatever you do, if you are going to install your drives yourself, take the time to examine the drive carefully. Even Shugart drives that appear identical to the TI units can have different configurations. For example, I bought a Radio Shack drive that did not have the shunt packs. To set the drive for DSK1, 2 or 3 you would have to cut a circuit trace on the drive, in which case you would be better off using their cables or making your own cables and remove the appropriate pins from the connecting plugs.

TERMINATION RESISTOR PACKS

Five of the lines going to the controller (shown with an asterisk in Fig. 1), in addition to the drive select lines, must have a termination resistor installed in the end of the line. If you have one drive it would be in DSK1, if three drives in DSK3.

A drives come with the termination resistors installed. When installing your additional drives you have to remove the resistor packs from all but the last drive in the line. However, this creates another problem. Referring to Fig. 2 again, you can see that one termination resistor is used for all three drive select lines. If you remove the termination resistor pack from DSK1 or DSK2 then line 10 or 12 would not have a termination resistor. To get around this you have to install a 150 ohm resistor from pin 5 to any of the pins on the opposite side of the IC socket the resistor pack came out of (the exact location may be different for other than Shugart-type drives).

If you don't remove the resistor pack the drive will still work, but you could wind up damaging your controller card. With two drives this may take a while, and with three drives I would imagine it would be fairly quick.

As with anything, there are exceptions. When I picked up my present TEAC drives the dealer told me that I didn't have to worry about the resistor pack. For one thing, the resistors were not socketed, so I would have had to cut the resistors off the board.

When I got the units home I checked to see what value resistors were used, and it turned out that where Shugart drives use 150 ohm resistors, the TEAC drives used 500 ohm resistors. Four TEAC drives would have about as much effect on the controller card as one Shugart drive. If you are going to use drives other than Shugart and TEAC types, check with the seller on how they have to be set up. In any case, if the resistor packs are socketed, remove them. If not, check to see what resistance value is used, and insure that the resistance seen by the controller card is no less than 125 ohms.

SHUNT PACKS

I have already covered the shunt pack as regards the drive select lines. The remainder of this article will be concerned with the remaining three lines. It should be noted that this information is specifically for the Shugart-type drives, although it should be similar for other types. In some cases you will find that these additional shunts are not provided.

Fig. 6 shows the basic logic used by the drive selection circuitry and how the shunt pack fits in this logic. Although not shown, line 16 also feeds additional circuitry.

The remaining shunts are labeled MX, HL and HM(MH).

HL shorted (connected) causes the head to load whenever the drive select line his taken low. This line should always be set up opposite of HM.

HM shorted causes the head to load whenever the motor on line is taken low.

MX shorted causes the drive output enable to be active all the time.

The safest way to set up the shunts is to have HL shorted and HM and MX cut. This will work regardless of how many drives you have connected. If you have the drives without the additional shunts this is the way the drive would be configured.

If you are using a single drive system, you may see a slight speed improvement if you set up the drive with HM and MX shorted and HL open.

CONNECTING CABLES

After you've gone through your drives and decided how to set up your have two options:

1. Have your cables made up
2. Make the cables yourself

If you have your cables made, tell your local dealer how you want your cables configured so he can make them for you. If you decide to set up your drive by punching the shunts, you can use standard PC cables for your internal and external drives, otherwise you will need to tell the dealer which pins you want removed from the connectors. Also, for your power connector you will need an IBM-type power splitter which consists of a four-line Molex male to two Molex female connectors.

If you make your own cables, you will need the following parts:

- 34-conductor flat ribbon cable
- 34-conductor edge card connector for each drive
- 34-conductor edge card connector for external drives
- 34-pin socket connector for internal drives

One conductor of the cable will normally be a different color than the others, to help keep track of which conductor is which, and the card side of the edge card connector will have the pin numbers imprinted on it. The 34-pin socket connector does not normally have the numbers on it but an arrow or indent will normally indicate which is pin 1.

To the cables, the colored conductor should be used as line 1. Insure that all of the connectors you use have the colored conductor in the pin 1 position and press the cable in to the pins on the connector. If you are setting up for multiple drives, install the edge card connectors in the appropriate location in the center section of the cable. Try to keep the length of the cable as short as possible. Longer cables may make locating your drives more convenient, but it could also cause noise pickup on the cable which could interfere with drive operation. Shugart recommends a maximum of 10-foot length for the signal cable, but you're less likely to have problems if you keep your cables as short as possible.

When you connect your cables to the drives you have a 50-50 chance of hooking up the cables backwards. If this happens, as soon as the unit is turned on the drive light on each drive will come on and the motors will spin. If you have more than one drive and they all come on simultaneously, reverse the connector on the controller card. If only one drive light comes on, reverse the cable for that drive. If you have only one drive, you may reverse either end.

After the drives are connected, enter BASIC and without using a disk try to read from each drive by typing OLD DSKX.TEST, where "X" is the drive number to read from. If the cables are properly configured, only the light for the selected drive will light. If more than one light comes on, you forgot to punch the shunt or remove the pin from the edge card connector. If no light comes on, you either punch the wrong shunt or removed the wrong pin, depending on how you decided to connect your drives.

Warning: If you are using an external drive which is the one with the terminating resistor pack installed, this drive MUST be powered up any time you are using any of the drives. The drive with the terminating resistor pack provides power to the various control lines coming off the controller card. If the drive with the resistor pack is not powered up you can force your other drives into the write mode even if your disk is write protected, normally resulting in the destruction of data on track 0, which can result in the loss of all data on the disk. I managed to do this on several disks until I realized what was causing it.

SUMMARY

If you are going to set up your own drives, take the time to examine your drives to see exactly how they are set up. Insure that only one drive select line is terminated on a drive by either punching the shunt straps, installing a jumper to the appropriate drive select line, or removing the pins from the connecting cable connector. All other lines should be connected 1 to 1, 2 to 2, etc.

Unless you have the new TEAC-type drives with the high resistance terminating resistor packs, insure that all the drives except the last one have the terminating resistor packs removed. On any drive in which the terminating resistor pack has been removed, insure that you have a 150 ohm resistor installed for the drive select lines.

One Final Note: If you have a CorComp or Myarc disk controller, check the head-step settings on the card. If the head-step setting is too fast, your drive may work erratically or not at all. If the head-step setting is too slow the drive will appear noisy when stepping, also causing excessive wear on the drive. Don't be afraid to experiment to find the best setting for the head-step speed. MG's Advanced Diagnostics program allows you to set the head-step times under software control, which you can use to check out the various head-step times without removing and installing the drive controller, a feature that by itself makes the program worthwhile to have.