July 21, 2002

Hi Rick:

Here is your envelope back, with a fresh new copy of the F.R.E.D. manual for you! Thanks very much for sending the envelope, and for the check--as I told you in advance, I didn't really need or expect any money for the copy itself, but your check was a kind gesture and a nice surprise.

A few things I wanted to point out about the manual itself:

First of all, there are three pages (#4, 24, and 30, I think) that are blank, but they are blank in my original copy, as well. I think the authors wanted each new chapter to begin on a right-hand page, so they inserted these three blank pages to make it come out that way. However, since they didn't even print *page numbers* on these pages (or a "This page intentionally left blank" message), I realize it looks a little weird. But anyway, I just wanted to reassure you that I didn't skip any pages.

Secondly, I never really noticed this before we started discussing what FRED's underside looked like, but the drawing on page 6 ("Figure 2 - FRED - Bottom View") is totally wrong, as you could tell by comparing it to the photo I posted previously. I'll attach my own drawing on the next page, but like I say, you can hopefully tell from the photo I sent what it "really" looks like.

Other than that, I don't notice or recall any glaring inaccuracies in the manual. You'll notice that it does mention the "optional battery recharging unit" which I told you about and showed in my pictures. It also mentions an optional "FRED Logo Extension" unit, though, that would have allowed you to control FRED using LOGO software on an Apple or Commodore computer. When I wrote to the people at Androbot to get the battery recharger, I remember them telling me a little about that LOGO interface, and promising me that they would let me know when one became available, but I think that was the last time I ever heard from them. I notice that there is a circular (RS232?) jack on the bottom of FRED's remote control (as it is correctly shown in "Figure 3") so obviously they had taken steps on the hardware side of things to include this capability in FRED and his remote.

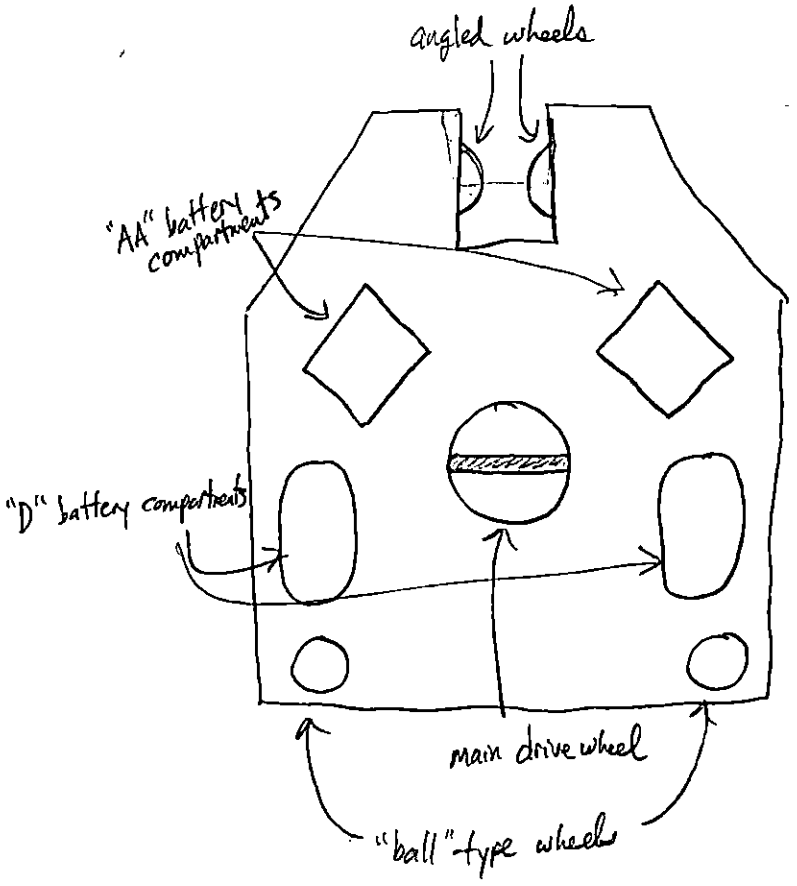
Thanks again for writing and for sending the envelope & check; it's been a real pleasure talking to you about Androbot and FRED and all this stuff, so I hope we continue to do so.

Best wishes,

Jove

Jove Graham

A corrected "Figure 2" – FRED's Bottom View (not totally to scale ☺)



P.S. One more thing – I noticed on page 1 there was a pencilled-in note (which faintly shows up in your copy), meant as a reminder to myself that I purchased a new (and first) set of batteries for FRED on 11/16/84, which must have also been the same day he was delivered to me. Just FYI.... ☺

F.R.E.D.

Owner's Manual

550 Charcot Avenue
San Jose, California 95131
(408) 262-8676

Table of Contents

Chapter 1

MEET FRED!

Congratulations! With your purchase, FRED becomes a member of your family, and you become a member of the family of robot users - one of a growing group of pioneers in personal robotics.

FRED, which stands for Friendly Robotic Educational Device, is a remote-controlled robot with three main abilities: movement, graphics and speech. This robot can move over any flat level surface, draw pictures with a felt-tip pen, and talk with a 57 word vocabulary.

You control FRED from a hand-held, infrared (wireless) remote control unit, which we'll just call the communicator. Commands are given to FRED simply by pressing the 25 buttons on the communicator. FRED can also be remote-controlled using Logo from your Apple or Commodore 64 computer, with either Apple Logo or Commodore Logo software and FRED Logo Extension, an interface option that connects to FRED's communicator.

EQUIPMENT DESCRIPTION

FRED's controls are mostly located on the communicator, with the ON/OFF switch and the pen collar located on FRED's body. This section tells a little about all of FRED's controls and what they do.

The control's descriptions are provided here mostly for reference. In the procedures for operating FRED we tell you when and what controls to press, so you don't have to memorize this part or worry about knowing exactly what all the buttons do right now.

FRED has two controls located on the body. The ON/OFF switch is located on FRED's front chest panel. Pressing it to the right turns FRED on and pressing it to the left turns FRED off. The pen collar is located on the top of FRED's pen arm mechanism. The wing nut tightens and loosens the pen in the collar. (Figure 1)

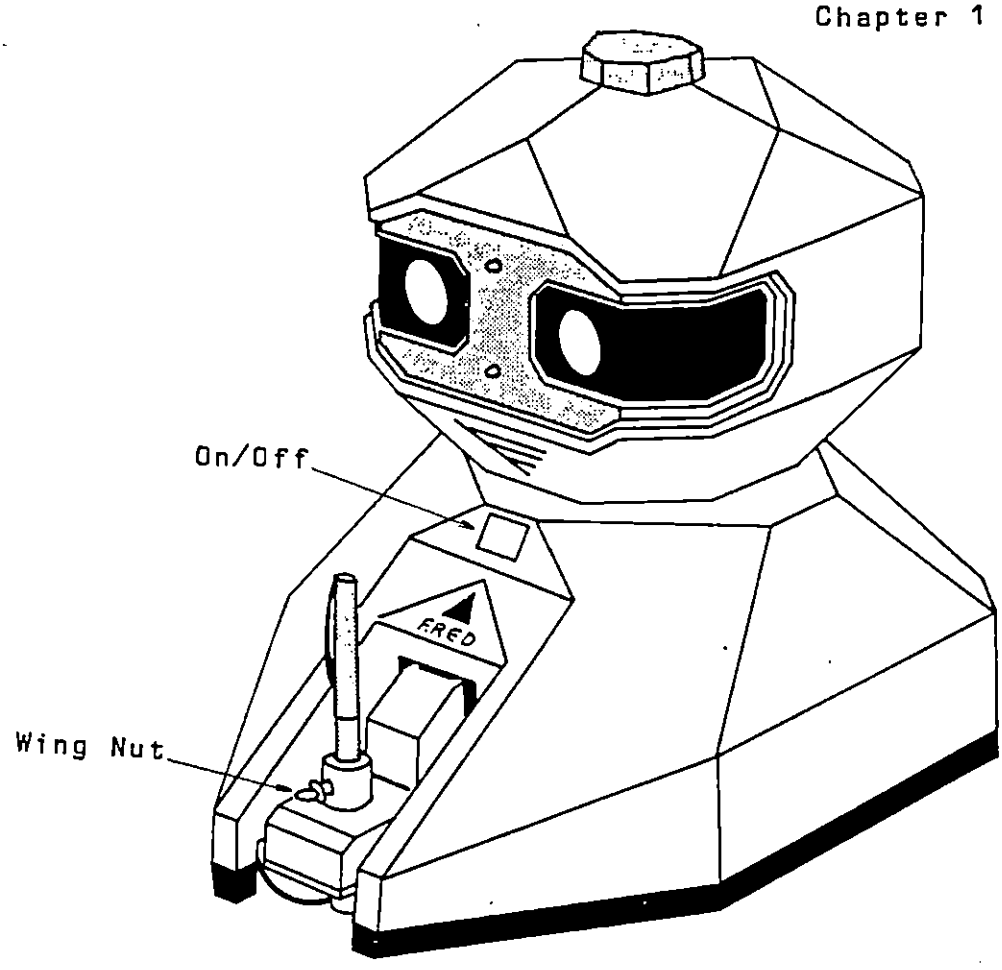


Figure 1

FRED has two red LEDs (Light Emitting Diodes) in the center of the forehead. They both light up when commands are received from the communicator. In addition, FRED speaks (echos) each button that is pressed so you can hear whether the correct signal was received.

The communicator has twenty-five buttons and a red LED on its front. The LED lights up when commands are being sent to FRED.

The Communicator buttons are used to send commands to FRED. The number buttons, 0,1,2,3,4,5,6,7,8, and 9 are used to enter numbers that signify distances, degrees, or words in FRED's vocabulary.

The LEFT, RIGHT, FWD, and BACK buttons are used to tell FRED which direction to move.

The ARC button is used to get FRED to move in a counter-clockwise circular motion. The minus button is used with the ARC button to get FRED to move in a clockwise circular motion. See Chapter 5 for more on circular motion.

Pressing the RESET button stops whatever FRED is doing, (even if FRED isn't doing anything) and erases the command memory, so that FRED is reset and ready for a new command. Whenever this button is pressed, FRED says, "I'm FRED," lifts the pen and is ready to move in straight line motion.

The SPEAK button is used with the number buttons to tell FRED to talk.

Pressing the MUTE button will disable automatic button echo. Pressing it again will re-enable the button echo.

The PEN button is used with the + ("plus") and - ("minus") buttons for making FRED draw. The plus button tells FRED to lower the pen to the drawing surface, and the minus button tells FRED to raise the pen.

The COMMA button is important, because it's used between the number commands for making FRED say words, and between different commands to store a sequence, or program of commands. In speech, the comma tells FRED that one word is over and the next number is a new word. It's a lot like putting spaces between words when you write. FRED will say "next" each time the comma is pressed.

The ENTER button is used at the end of <u>every</u> sequence of commands to tell FRED "this is the end of the commands, now carry them out." In this book when we want you to press the ENTER button, which is at the end of every string of commands, we'll just put this symbol: E . FRED will say the word "go" each time the enter button in pressed.

Pressing the HALT button makes FRED immediately stop any movement in progress. Pressing HALT again tells FRED to continue the movement of the halted command. It's important to remember the difference between the HALT and the RESET buttons: when RESET is pressed, FRED stops and erases the memory, ready for a new command. When HALT is pressed, FRED stops but remembers the command and finishes it when HALT is pressed again. FRED says "stop" when this button is pressed and will say "go" when you press it again.

The MOVE key is used for re-executing programs stored in FRED's command memory. When MOVE is pressed, followed by ENTER, all the commands entered since the last RESET command will be executed again in order.

Chapter 2

GETTING FRED STARTED

This chapter tells you how to get FRED started, and for this little robot that's pretty simple: just unpack FRED, install the batteries (not supplied), and turn FRED on.

Unpacking FRED

Since you're obviously reading this manual, you've already unpacked FRED to some extent, hopefully in a gentle and careful way. But if you have room to keep them around, save FRED's box and styrofoam packing blocks. They'll come in handy when you want to transport FRED to or from school, to a friend's house, or anywhere else.

What You Need To Use FRED

All you need to use FRED are the following:

FRED (provided)

Communicator (provided)

FRED Owner's Manual (provided)

1 Felt-Tip Pen (provided)

BATTERIES (not included)

- 6 AA size batteries, either NiCad or Alkaline (for FRED)
- 4 D size batteries, either NiCad or Alkaline (for FRED)
- 1 9-volt transistor-type battery, Alkaline type only (for communicator)

If you want to use regular non-rechargeable batteries for FRED, Androbot recommends that you use only the Alkaline-type batteries.

If you decide to use rechargeable batteries there is a specially-designed recharger unit available which will recharge all the NiCad (nickel-cadmium) batteries used with FRED at one time. This will eliminate the need for replacing batteries since the charger plugs directly into the back of FRED. These batteries are more expensive to buy than Alkalines, but they'll last longer because you can recharge them with the recharger unit.

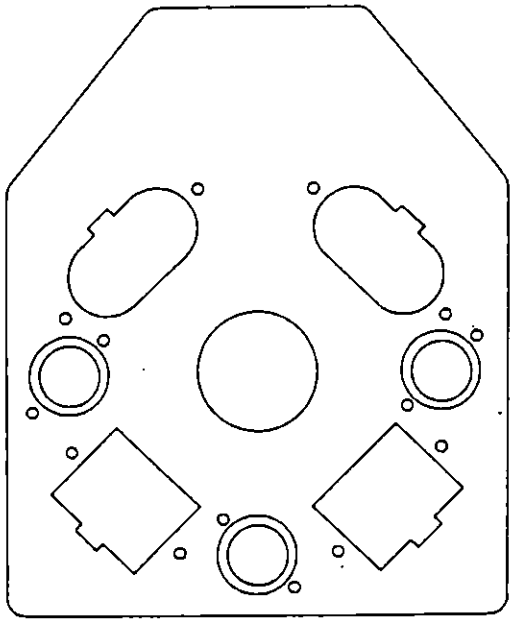


Figure 2

FRED - Bottom view

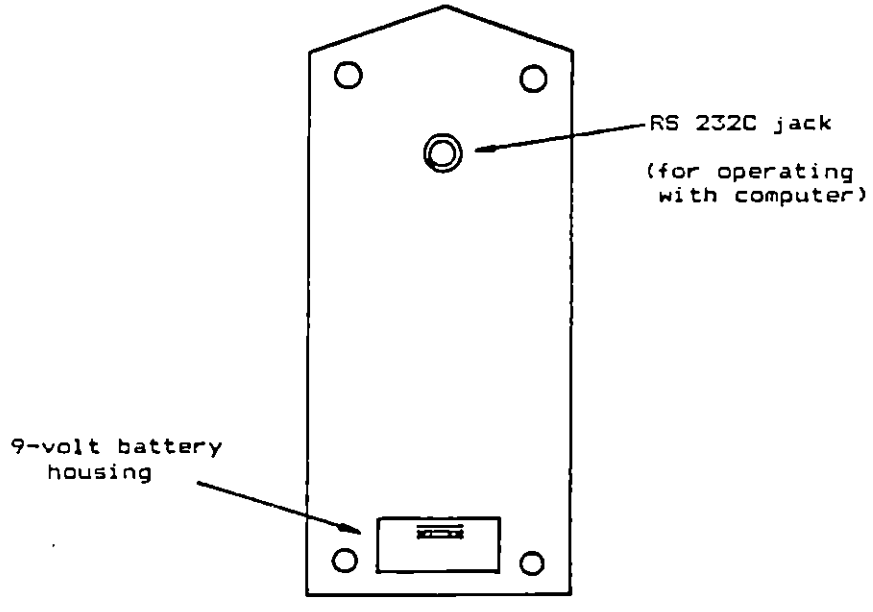


Figure 3

Communicator - Back view

The communicator uses only a non-rechargeable 9-volt transistor type battery. Androbot recommends using an Alkaline battery. The communicator battery does not recharge with the recharger unit.

It's important that you use all batteries of the same brand and type in the robot. Different brands and types have different weights, and mixing differnt-weight batteries might throw off FRED's fine-tuned balance and could cause drawings to be inaccurate.

Installing the Batteries

FRED's batteries are installed in four separate battery housings located in FRED's bottom plate, as shown in the illustration. (Figure 2) Place FRED on its side while installing the batteries.

FRED's Batteries:

1. Push in on the tabs of the two oval battery housing covers. The covers come completely off.
2. Install two (2) D-size batteries in EACH oval housing, matching polarity as shown in the illustration and on the inside of the housings.
3. Replace the oval battery housing covers gently but firmly.
4. Push in on the tabs of the two rectangular battery housing covers.
5. Install three (3) AA-size batteries in EACH rectangular housing, matching polarity as shown in the illustration and on the inside of the housings.
6. Replace the rectangular battery housing covers gently but firmly.

Communicator Battery:

The communicator's battery is installed in the 9-volt battery housing located in the bottom of the Communicator, as shown in the illustration. (Figure 3)

1. Slide off the 9-volt battery housing cover.
2. Connect the plug to the terminals of the 9-volt battery.
3. Tuck the battery and plug into the communicator.
4. Slide the housing cover back on, gently but firmly.

The communicator is always ON when its battery is installed. The battery will last for a few months this way, but it's a good idea to unplug or remove the battery if the communicator will not be used for an extended period of two weeks or more.

Turning FRED On

Press the ON/OFF switch on FRED's chest panel to the right. FRED will say, "I'm FRED", and is now ON.

FRED is now ready to use. Remember to turn FRED off when you are done since the robot draws power when the switch is on even if it isn't talking or moving.

Installing FRED's Pen

FRED uses felt-tip pens of any color. One PILOT felt-tip pen is included with FRED but any standard felt-tip pen of a comparable size will work.

Make sure the pen collar is "up" before removing or installing a pen. FRED's pen collar will be in the "up" position when leaving the factory.

1. Loosen the wing nut on FRED's pen collar.

2. Remove the pen cap. We recommend that you put the pen cap on the other end of the pen, so it doesn't get lost.

3. Drop the pen, point down, into the pen collar until it almost touches the paper.

4. Tighten the wing nut on the front of the pen collar by turning it clockwise until it is snug against the pen.

Remember to remove the pen when you are finished drawing and put the cap back on so the pen tip won't dry out.

Recharging FRED's Batteries with the Optional Recharger Unit (NiCad Batteries Only)

Recharging FRED's batteries is easy to do. Just plug the optional recharger unit's 3-pin connector into the plug on FRED's back, and plug the other end into a standard 110-120 VAC electrical outlet. FRED will recharge in about eight hours. We recommend that you recharge FRED at night after every day of use.

Chapter 3

MAKING FRED MOVE

FRED can move in straight lines, can turn, and can move in a curved, or circular path. FRED can do these different moves in any combination.

Before trying anything with FRED, press the RESET button. If FRED says, "I'm FRED", you'll know that the infrared communicator and receiver are lined up sufficiently. If FRED doesn't say anything, point the infrared tower of the communicator toward the infrared tower of the robot. Continue pressing the RESET buttonuntil the robot and the communicator are in line-of-site and FRED says "I'm FRED".

The best way to learn how to make FRED move is by example, so let's get going.

Straight Lines

Straight line commands are given by entering a direction, then entering a distance, then pressing ENTER. (All commands are followed by pressing ENTER.) For example, to make FRED move forward 20 centimeters, enter:

FWD 20 [E]

This means press the FWD (Forward) button on the communicator, then the 2 and the 0 buttons, and then press the ENTER button. In this book we use the symbol [E] to mean pressing the ENTER button.

To make FRED go back, enter:

BACK 20 [E]

FRED can move as far as 285 centimeters (about 10 feet) in one command.

Those straight lines are fun, but pretty soon you'll want to add some...

Turns

Turn commands are given by entering a direction and a turn distance and pressing ENTER. To make FRED perform a 90-degree right or clockwise turn, enter:

RIGHT 90 [E]

To make FRED do an about-face turn, enter:

RIGHT 180 [E]

To make FRED look silly, enter:

RIGHT 360 [E]

Left or counterclockwise turns are made simply by pressing the LEFT button instead of RIGHT.

Now that you have both straight lines and turns, you can make FRED do...

Squares and Rectangles

Squares and rectangles are made by entering combinations of straight lines and turns. To make FRED move in a 10-centimeter square, enter:

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

You probably noticed that this was simply a matter of entering the same two commands almost four complete times. To make rectangles, simply change the FWD distances for the first and third FWD commands, like this:

FWD 30 [E]

RIGHT 90 [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 30 [E]

RIGHT 90 [E]

FWD 10 [E]

By changing the degrees of turns, you can have FRED do...

Triangles

Triangles are like squares with larger angles and one fewer side. To have FRED move in a triangle with 25 centimeter sides, enter:

FWD 25 [E]

RIGHT 120 [E]

FWD 25 [E]

RIGHT 120 [E]

FWD 25 [E]

With triangles, you must remember that FRED, when going forward makes OUTSIDE TURNS, so you have to enter the degrees of the outside angle (i.e. 180 - inside degrees)

Of course, you can have FRED make all these shapes with left turns, just by substituting LEFT for RIGHT. Or you can make FRED do the shapes backwards, by substituting BACK for FWD. (Except for triangles: when FRED goes backwards, use the INSIDE angles.)

You might find it fascinating to think of these shapes as being made of distances, directions, and degrees. Some people start to see how things like shapes and movement are better understood when broken down into their individual elements. This kind of thinking is the kind used in programming computers. In fact, FRED's commands are adapted from the LOGO computer language and use the same logic.

There's one more way that FRED can move, and it's only a bit more complicated - Curved Path. But first, you'd better learn a little about...

Encountering Obstructions

Sometimes, probably through no fault of its own, FRED will run into obstructions like walls, refrigerators, and table legs. When this happens, FRED automatically stops movement, forgets the command, and says, "Help, I'm stuck!" If this happens, just remove the obstruction or move FRED and enter a new command.

Interrupting Movement

You can think of the HALT button as a "pause" button. Pressing the HALT button immediately stops any movement in progress. FRED says "stop" the first time this button is pressed. Pressing the HALT button again tells FRED to continue with the movement of the halted command and FRED will say "go".

Pressing the RESET button also stops any movement in progress, but also erases FRED's command memory. This just means that you'll have to enter a new command. FRED says, "I'm FRED" whenever the RESET button is pressed.

Curves and Circles

FRED can also move in curved paths. There are basically two kinds of curved path movements: complete circles, and arcs. Arcs are really circles that are incomplete - just <u>parts</u> of circles.

Curve commands are made by pressing the ARC button, entering numbers for the desired angle of the drive wheel, then pressing ENTER or COMMA. Next you press FWD, the numbers for the distance forward, and ENTER again. FRED then moves in the curve or circle described by the <u>angle</u> and <u>distance</u>.

To figure out the right angles and distances for a particular circle or arc is a pretty complicated procedure. To make things go a lot quicker, we've figured some of them out for you and put them in the following table.

CIRCLE AND ARC TABLE

RADIUS (inches/centimeters)	ARC ANGLE (in degrees)	DISTANCE (for complete circle, in cm)
0.5 in / 1.27 cm	86	108
1.0 in / 2.54 cm	82	109
2.0 in / 5.08 cm	74	112
3.0 in / 7.62 cm	67	118
4.0 in / 10.16 cm	60	125
5.0 in / 12.70 cm	54	134
6.0 in / 15.24 cm	49	144
7.0 in / 17.78 cm	45	155
8.0 in / 20.32 cm	41	167
9.0 in / 22.86 cm	38	180
10.0 in / 25.40 cm	35	193

To use the Circle and Arc Table,

1. Find the RADIUS of the desired circle in the first column. (Remember, the **radius** of a circle is the distance from the center of the circle to the curved edge.)

2. Look on the same line in the center column for the ANGLE number for that circle.

3. Look on the same line in the right column for the DISTANCE number to make a complete circle.

Now press ARC, then the ANGLE number (found in the chart), then ENTER. Then press FWD, then the DISTANCE number (found in the chart), then ENTER again. FRED will now make a complete counterclockwise circle.

For example, to have FRED make a circle with a five inch radius, enter:

ARC 54 [E] FWD 134 [E]

Of course, you can also enter different angle and distance figures to see what happens. For example, you can enter an angle a few numbers above or below the number on the chart to get a slightly larger or smaller radius.

To make FRED move in an arc (part of a circle), enter less distance than the chart indicates. For example, enter

ARC 54 [E] FWD 67 [E]

and FRED will make a half-circle, with a radius of five inches. Have FRED make a quarter turn by entering

ARC 54 [E] FWD 34 [E]

You can also use quarter turns for fancy effects in place of the regular turns with the RIGHT and LEFT buttons.

To make FRED look really silly, enter twice the distance and FRED will go around in a circle twice:

ARC 54 [E] FWD 268 [E]

But remember, FRED can only move a maximum of 285 centimeters at a time, so don't try to double higher numbers. If you want to you can enter them twice:

ARC 35 , FWD 195 , FWD 195 [E]

With the above examples, FRED moves in the counterclockwise direction when making these circles and arcs. But you can also make FRED move in the clockwise direction. Just enter the minus sign ("-") after ARC and before the angle number, like this:

ARC - 54 [E] FWD 134 [E]

FRED will now make a clockwise circle with a five inch radius.

Chapter 4

MAKING FRED DRAW

Making FRED draw is just like making FRED move, with one big exception. FRED draws by lowering the pen to the paper and moving. The pen leaves a line wherever FRED moves, making whatever drawing you want.

All you have to do to make FRED draw is give the command for lowering the pen before giving a movement command. For example, to make FRED draw a square, first you install the pen, then give FRED the command to lower the pen, and then enter the commands for a square as shown in Chapter 3.

This chapter tells how to install and remove the pen, tells about the pen up and down commands, and gives sample commands for drawing a few simple figures.

Installing FRED's Pen

FRED uses felt-tip pens of any color. One PILOT felt-tip pen is included with FRED.

Make sure the pen collar is "up" before removing or installing a pen. FRED's pen collar will be in the "up" position when leaving the factory.

1. Loosen the wing nut on FRED's pen collar.

2. Remove the pen cap. We recommend that you put the pen cap on the other end of the pen, so it doesn't get lost.

3. Drop the pen, point down, into the pen collar until it stops.

4. Tighten the wing nut on the front of the pen collar by turning it clockwise until it is snug against the pen.

Remember to remove the pen when you are finished drawing and put the cap back on so the pen tip won't dry out.

What to Write On

When FRED lowers the pen and starts moving, the pen will draw. Tape some paper on the floor, making sure that it is smooth and flat BEFORE you practice the pen up and down commands. One of the best kinds of paper for FRED's drawings is white butcher paper that comes in a roll.

Also, be sure the paper is big enough for your planned drawing BEFORE you lower the pen! It's a good idea to make FRED move through a figure before you lower the pen to have it drawn.

Lowering and Raising the Pen

The PEN button is used with the plus ["+"] and minus ["-"] buttons to make FRED lower and raise the pen. The plus button lowers the pen for drawing, and the minus button raises the pen to stop drawing. To lower the pen to the drawing surface, enter:

PEN + [E]

To raise the pen from the drawing surface, enter:

PEN - [E]

It's a good idea to get into the habit of raising the pen every time FRED completes a drawing. This keeps the paper from soaking up too much ink and keeps the pen tip from getting smashed. In the samples in this chapter, the pen is raised after the figure is drawn.

"Help, I'm Stuck!"

If FRED says "Help, I'm stuck!" make sure that the batteries are not low. If this doesn't take care of the problem, service is needed. For more information, see Chapter 7, Troubleshooting.

Different Colors

If you have felt-tip pens in different colors, you can make multi-colored drawings just by changing pens between movement commands. For the best accuracy, try not to move FRED when changing pens between movement commands. Remember to make sure that the pen is "up" before changing pens.

Drawing a Square

This sample has FRED draw the same square that was only moved through in Chapter 3. To make FRED draw a square with 10-centimeter sides, check that the pen is installed and that the paper is in position on a smooth surface, and enter:

PEN + [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

RIGHT 90 [E]

FWD 10 [E]

PEN - [E]

Drawing a Circle

To make FRED draw a circle with a ten inch radius, enter:

PEN + [E]

ARC 35 [E] FWD 193 [E]

PEN - [E]

Drawing a Triangle

To make FRED draw a triangle with 25 centimeter sides, enter:

PEN + [E]

FWD 25 [E]

RIGHT 120 [E]

FWD 25 [E]

RIGHT 120 [E]

FWD 25 [E]

PEN - [E]

More Drawings

You might try changing some of the movement commands in the above samples and see what happens. You can increase the ARC for bigger circles, or increase distances for bigger squares or rectangles, or change angles for different triangles. You could also try some of the advanced shapes given in Chapter 5.

Of course, the most rewarding drawings are the ones you and FRED design on your own. Write down the commands to recreate your designs at any time.

For a special effect, have FRED draw any shape, then move FRED over a little bit and have FRED draw the exact same shape again. Do this a few times and you'll get an unusual drawing. Try changing pen colors between each shape.

Try anything. Your only limit is your imagination.

Chapter 5

DRAWING SAMPLES

This chapter gives some samples for advanced drawings. We list these here to show you some of the exciting things that FRED can do, and as an inspiration for you to invent more of your own.

Since all these samples are for drawing, we start each sample with the pen down command and end each sample with the pen up command. Of course, you can omit these commands and use the samples for just moving FRED, but these particular samples are designed for drawings.

Before keying in a sample, it's a good idea to check a few things:

1. Make sure the pen is installed correctly.
2. Make sure that the paper is large enough for the drawing. The samples give approximate sizes for this reason.
3. Make sure that the drawing surface is smooth with no obstructions and that the paper is taped securely.

Star

To make FRED draw a five-pointed star approximately 20 centimeters in diameter, enter:

```
PEN + [E]
FWD 10 [E]
RIGHT 144 [E]
FWD 10 [E]
RIGHT 144 [E]
FWD 10 [E]
RIGHT 144 [E]
FWD 10 [E]
RIGHT 144 [E]
FWD 10 [E]
PEN - [E]
```

Offset Bullseye

We use the offset bullseye because it's a bit easier than the true bullseye. If you don't know what an offset bullseye looks like, try this and see. To make FRED draw an offset bullseye approximately 20 inches in diameter, enter:

```
PEN + [E]
ARC 74 [E] FWD 112 [E]
ARC 60 [E] FWD 125 [E]
ARC 49 [E] FWD 144 [E]
ARC 41 [E] FWD 167 [E]
ARC 35 [E] FWD 193 [E]
PEN - [E]
```

To try a real bullseye add the command:

```
RIGHT 90 , FWD 5 , LEFT 90 [E]
```

after each circle in the above example.

Figure 8

To make FRED draw a Figure 8 approximately 20 inches long, enter:

```
PEN + [E]
ARC 54 [E] FWD 134 [E]
ARC -54 [E] FWD 134 [E] (Be sure to enter the minus sign!)
PEN - [E]
```

Calibration

Because of wear and differences in manufacturing, FRED's drawings may gradually become slightly distored. To correct for this, FRED may be calibrated to reset the internal software to compensate for the small differences. FRED remembers this calibration until the next time calibration is performed or if you turn FRED off. There are five types of calibration:

1. If FRED draws an arc when instructed to go straight forward, perform the FWD/ARC calibration as follows:

   Simply enter the command:

   FWD ARC <calibration factor> [E]

   The value of the calibration factor depends on the direction and amount of error. If FRED curves counterclockwise, the calibration factor should be negative:

   FWD ARC -20 [E]

   Use positive values for clockwise error. The straighter the line, the smaller the factor to be entered. Experiment with different factors to see the results.

2. If a curve is drawn when FRED is told to go straight backwards, perform the BACK/ARC calibration as follows:

   Enter:

   BACK ARC <calibration factor> [E]

   If FRED curves when attempting to go straight back, it will always be in the clockwise direction. The calibration factor, then, is always positive. Remember, the straighter the curve, the smaller the factor.

3. If FRED does not move exactly the distance commanded to on straight lines, perform the FWD/MOVE calibration as follows:

   PEN + [E]
   FWD 100 [E]
   PEN - [E]

   Note: This calibration should only be done <u>after</u> the FWD/ARC calibration has been done.

FRED will move forward approximately 100 cm. Pick up FRED and measure the exact length of the line in cm to the next nearest millimeter and perform the following arithmetic calculation:

100 - actual line length in centimeters (cm) * 17.92

and round the answer to the nearest whole number. For example, if FRED moved 98.3 cm then calculate:

$$\frac{100}{98.3} * 1792 = 1822.99$$

Then type in: FWD MOVE 1823 [E]

BACK MOVE n [E] is equivalent to FWD MOVE n [E]

4. If FRED does not rotate exactly the number of degrees commanded to on RIGHT and LEFT commands, perform the RIGHT/MOVE calibration factor as follows:

```
PEN + [E]
FWD 10 [E]
RIGHT 360 [E]
FWD 10 [E]
PEN - [E]
```

Note: This command should only be done after both the FWD/ARC and FWD/MOVE calibrations have been done.

FRED will draw a line, rotate approximately 1/2 turn and draw another line. Measure the angle between the lines to the nearest 1/10 degree with a protractor. If FRED rotated more than 1/2 turn, add the measured angle to 180° otherwise subtract it from 180° . Take that value and perform the following calculaton:

$$n = \frac{180 \pm \text{measured angle}}{180} * 544$$

Round off n to the nearest integer and then enter:

RIGHT MOVE n [E]

All further angular rotations should now be correct. If they are still slightly wrong, re-enter with a slightly smaller (if rotates too far) or larger (if rotates not far enough) value of n. For example, if the lines generated formed an angle of 6.5 degrees and FRED did not quite reach 1/2 full turn, calculate n as:

$$n = \frac{180 - 6.5}{180} * 544 = \frac{173.5}{180} * 544 = 524.35$$

Then enter the calibration factor:

RIGHT MOVE 524 [E]

LEFT MOVE n [E] is equivalent to RIGHT MOVE n [E]

5. Before performing motion operations, FRED's drive wheel must be at the correct angle. It should be straight ahead for straight lines, perpendicular for right and left turns, and at some point in between for circles and arcs. The closer this wheel is to the corresponding position, the more accureetly FRED will draw. The physicel characteristics of the gears inside FRED make it difficult to get the wheel in the exact position quickly. For this reason, FRED has an accuracy calibration factor. This factor tells FRED how hard to try to be accurate. The more accurate you want FRED to be, the linger it may take for the drive wheel to reach an acceptable position for the requested motion. This calibration factor is used as follows:

ARC MOVE n [E]

Where n is the accuracy factor desired between 0 and 7. If n = 0 FRED will keep moving the drivewheel until it is exactly at the required angle before performing the motion requested. This may take up to 10 seconds for each motion command. If n ≠ 0 FRED will move the drive wheel until it is within +/- n/10 degrees from the required angle before performing the motion requested. This will ususally take place in less than 1 second for n = 7. The drawing accuracy will be reduced, however.

This calibration can be used with a large n for fast development of routines (rough sketches) and then set to a smaller n or 0 for a final, accurate drawing which may take much longer to perform. This final drawing could be done using the buffer re-execution command (MOVE [E]), while you go off and do something else until it is finished. You can experiment with different values of n for your particular taste as to the accuracy required and the time you feel like waiting for the drawing to be completed.

Chapter 6

MAKING FRED TALK

FRED can talk. You've already heard at least one of the automatic phrase FRED says, like "I'm FRED". But FRED can say more than the automatic phrases. You can make FRED say words, phrases, and sentences from the 57 word vocabulary.

Programmed Speech

You make FRED talk by pressing the SPEAK button, then entering the numbers for the words you want. Each word must be separated by pressing the COMMA button. When you press ENTER to end the entry, FRED says the words in the order you entered them. FRED's complete vocabulary, with corresponding numbers, is shown below:

NUMBER:	WORD:	NUMBER:	WORD:
1	FRED	29	Learn
2	Go	30	Is
3	Left	31	Stuck
4	Right, write	32	Robots
5	Forward	33	Are
6	Back	34	Fun
7	Turn	35	Cute
8	Help	36	I'm
9	Can	37	Tired
10	Teach	38	Bored
11	One	39	Funny
12	Two, To, Too	40	Smart
13	Three	41	Good
14	Four, for	42	Patterns
15	Five	43	Lines
16	Six	44	Likes
17	Seven	45	Humans
18	Eight, ate	46	Not
19	Nine	47	Say
20	Zero	48	Stop
21	Units	49	Done
22	Degrees	50	Children
23	Pen	51	I.R.
24	Up	52	Arc
25	Down	53	Straight
26	Move	54	You
27	Draw	55	Pictures
28	Speak	56	Talk
		57	Next

When we want you to press the COMMA button, we'll just show the regular comma symbol: ",". The comma is important between the numbers, but is not necessary after the last word before pressing ENTER.

Like the motion commands, FRED's speech phrases can be used in a program, or sequence of commands. FRED will say the phrases when that point in the program is reached. For example, if you enter

FWD 20, SPEAK 1, 44, 12, 27 [E]

FRED will draw a 20 centimeter line and say "FRED likes to draw" when finished.

FRED can store programs of up to 64 motion commands, 120 word commands, or combinations of both.

Entry Echo

You've probably noticed that FRED "echoes", or repeats, the commands as they are entered. With speech, FRED will echo the numbers and commas (FRED says "next" instead of "comma") until ENTER is pressed, and will then say the phrase.

MUTE Button Operation

FRED's automatic button echo can be enabled and disabled with the MUTE Button. Pressing the mute button changes the state of the button echo. If buttons are being echoed, pressing MUTE will disable the button echo. If button echo is disabled, pressing MUTE wil echo the word "say" and all keys entered thereafter.

Space Between Words

FRED automatically puts a 1/10 of a second delay between words. You can modify this delay by entering:

SPEAK - <delay factor> [E]

The delay factor is any number from 1 to 15. Each number represents the number of 1/40 of a second intervals to delay between words. A small delay factor will cause FRED to speak very quickly, a large factor will cause slower speech. If delays longer than 3/8 second (delay factor 15) are desired between words simply chain together multiple delay commands. For example:

SPEAK 36 , - 10 , -10 , -10 , -10 , 37 [E]

Will say "I'm tired" with a one second delay between "I'm" and "tired". (Note: SPEAK - 10 will delay for 1/4 second.)

AUTOMATIC SPEECH

FRED's automatic phrases consist of the following:

"I'm FRED" -- When FRED is turned on and when RESET is pressed.

"Help, I'm stuck" -- When "D" cell batteries are low and need replacement or recharging.

"I'm Tired" -- When "AA" cell betteries are low and need replacement or recharging.

"FRED can not move" -- When MOVE ENTER is entered and more commands than the buffer can hold have already been entered.

"Units are not good" -- When a value greater than 285 is entered for a FWD or BACK command or a value greater than 57 is entered for a SPEAK command.

"Degrees are not good" -- When a value greater than 90 is entered for an ARC command or a value greater than 360 is entered for a RIGHT or LEFT command.

SAMPLE PHRASES

To make FRED say "Robots are fun" enter:

```
SPEAK 32, 33, 34 [E]
```

Remember the commas! For the rest of the speech examples in this chapter, we'll print the words FRED says in quotation marks with the commands for those words below, like this:

"FRED can help children learn"

```
SPEAK 1, 9, 8, 50, 29 [E]
```

"Bored children can learn."

```
SPEAK 38, 50, 9, 29 [E]
```

"Bored children are tired children."

```
SPEAK 38, 50, 33, 37, 50 [E]
```

"Robot's children are smart."

```
SPEAK 32, 50, 33, 40 [E]
```

"FRED likes cute children,"

```
SPEAK 1, 44, 35, 50 [E]
```

"I'm not tired!"

```
SPEAK 36, 46, 37 [E]
```

"Smart children are good children."

```
SPEAK 40, 50, 33, 41, 50 [E]
```

"Humans are smart, too"

```
SPEAK 45, 33, 40, 12 [E]
```

"Robots are too smart to help humans." (Sometimes FRED gets cranky.)

```
SPEAK 32, 33, 12, 40, 12, 8, 45 [E]
```

"Children are too good for FRED"

```
SPEAK 50, 33, 12, 41, 14, 1 [E]
```

"FRED can draw good patterns."

```
SPEAK 1, 9, 27, 41, 42 [E]
```

"Children help FRED learn, too."

SPEAK 50, 8, 1, 29, 12 [E]

"FRED likes to teach children to draw patterns."

SPEAK 1, 44, 12, 10, 50, 12, 27, 42 [E]

"FRED can go for help."

SPEAK 1, 9, 2, 14, 8 [E]

"FRED can draw for children."

SPEAK 1, 9, 27, 14, 50 [E]

FRED can say some pretty goofy things, too:

"FRED ate three humans for fun." (Not really.)

SPEAK 1, 18, 13, 45, 14, 34 [E]

Here are some lines to write down your own commands so that all of your information can stay in the same place.

Chapter 7

TROUBLESHOOTING

FRED is designed to be reliable and operate at peak efficiently for a long time. But sometimes things can go wrong, and FRED just won't operate the way it should. Sometimes this is due to improper operation, and sometimes this is due to a failure in FRED or the Communicator.

This chapter show you how to troubleshoot FRED's problems and find a solution. Sometimes the solution is as simple as recharging or replacing batteries, or even just remembering to turn FRED on! Sometimes the solution is more involved.

Problem:	Solution:
1. FRED doesn't say "I'm FRED" when turned on.	1) Check AA batteries and recharge or replace. 2) If problem persists with good batteries, take FRED to your dealer for servicing.
2. FRED says "I'm FRED" when turned on, then says, "Help, I'm stuck" about 4 seconds later.	1) Check D size batteries and recharge or replace. 2) If problem persists, get FRED serviced.
3. FRED says, "I'm FRED" and "I'm tired" when turned on.	1) Recharge or replace size AA batteries.
4. FRED doesn't respond to controls after saying "I'm FRED" when turned on.	1) Make sure the LED on the Communicator lights when buttons are pressed. If not, check controller battery or have controller serviced. 2) Make sure the LEDs on FRED light and FRED echoes the keys when button is pressed on Communicator. Try both close up, and then far away. If it works at close range only, recharge or replace the Communicator batteries. If not, have FRED and Communicator serviced.

5.	FRED says. "Help I'm stuck," for no apparent reason.	1) Check D size batteries and recharge or replace. 2) If problem persists, have FRED serviced.
6.	FRED says, "I'm tired."	1) Recharge or replace AA batteries.
7.	FRED says, "Units are not good" or "Degrees are not good."	1) Invalid number entry. Re-enter and try again.
8.	FRED says, "I'm bored."	1) Give FRED more things to do or turn off - FRED needs to stay active.

Valid UNIT ranges are as follows:

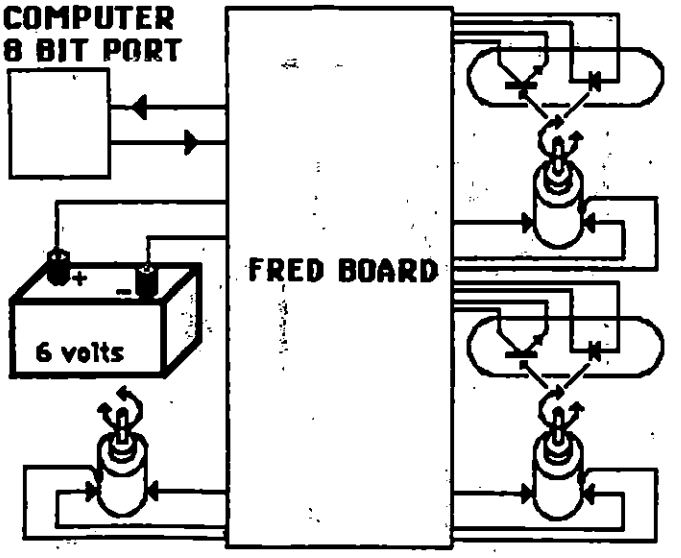
SPEAK	(0-57, -1 to -15)
FWD or BACK	(-285 to 285)

Valid DEGREE ranges are as follows:

RIGHT or LEFT	(-360 to 360)
ARC	(-90 to 90)

Description

This simple interface controls three 6 volt 1 amp Dc motors from one eight bit port. Forward, Reverse, Off and PWM operation are supported from a single voltage source. Two channels of optical encoder feed back are supported and two reflective led sensors are provided. The printed ckt board is double sided custom designd with plated through holes and component silk screen.



Caution

This ckt is not optically isolated and a malfunction or defect may dammage the computer it is connected to.
This ckt has no hardware protection against asking a motor to go in both directions at the same time! If your program does this then dammage to the hardware can result.

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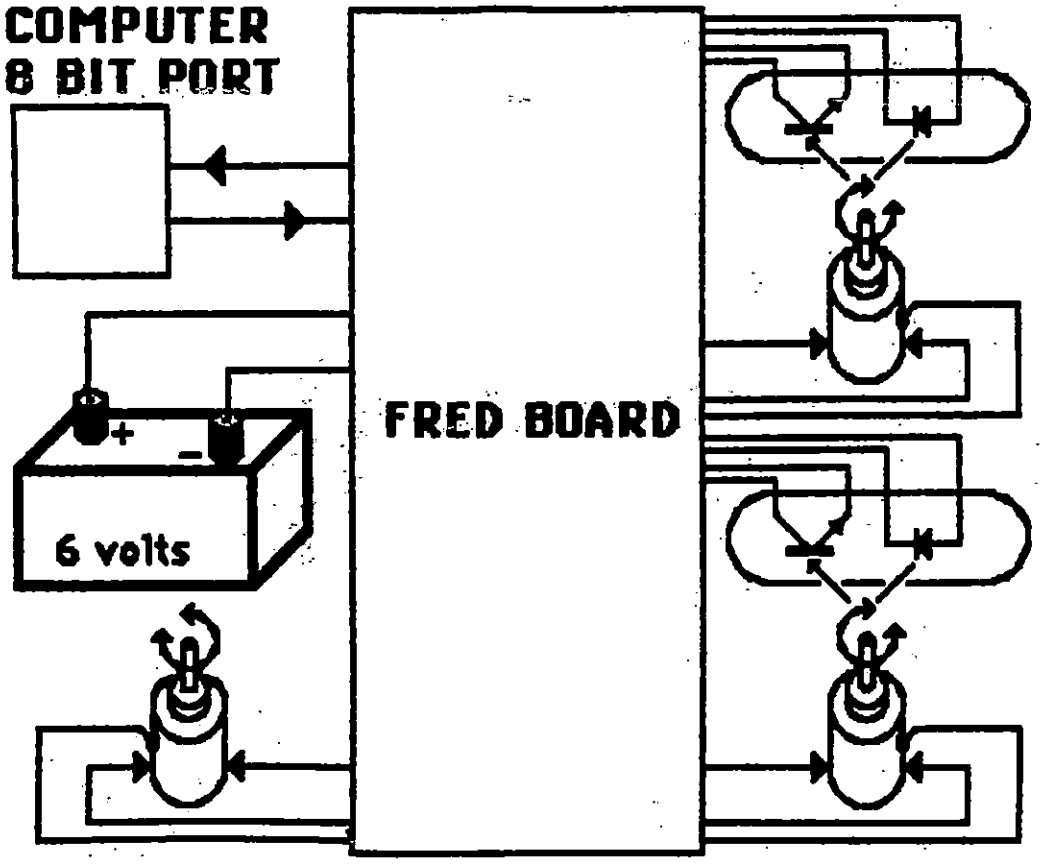

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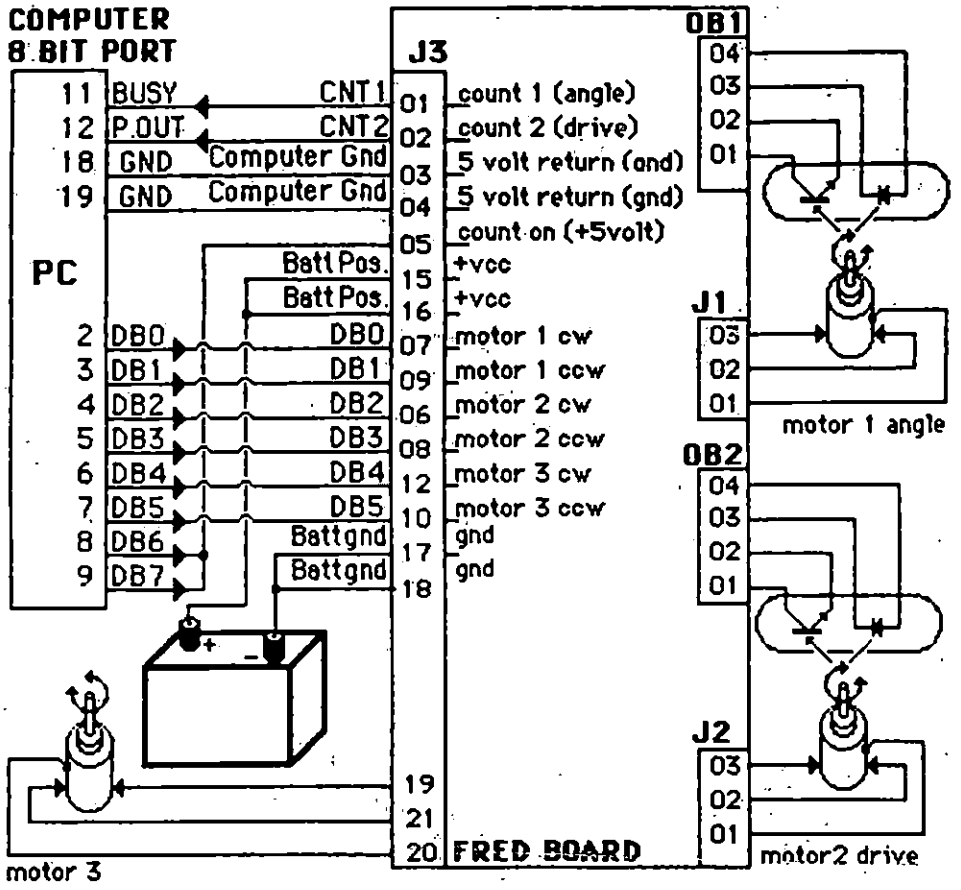
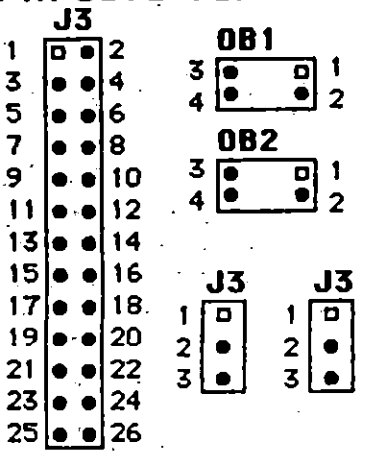
FRED INTERFACE

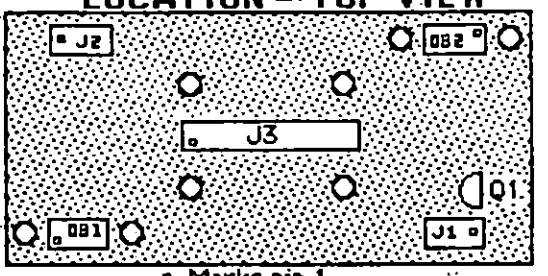
BLOCK DIAG.



CONNECTOR PIN OUTS-TOP VIEW



CONNECTOR LOCATION—TOP VIEW



▫ Marks pin 1

PROGRAMMING

The Fred board has no protection logic. If your program tells it to self destruct it will. The chart below lists all valid codes ! Any code not listed in the chart will cause hardware dammage. The basic rule is never issue a command for forward and reverse at the same time. This applys for one, two, or three motors For example motor1 forward and motor 2 reverse will destroy the fred board

Decimal value	Binary Bit Pattern						Motor 1	Motor 2	Motor 3
	D0	D1	D2	D3	D4	D5			
00	0	0	0	0	0	0	off	off	off
01	1	0	0	0	0	0	forward	off	off
04	0	0	1	0	0	0	off	forward	off
16	0	0	0	0	1	0	off	off	forward
02	0	1	0	0	0	0	reverse	off	off
08	0	0	0	1	0	0	off	reverse	off
32	0	0	0	0	0	1	off	off	reverse
05	1	0	1	0	0	0	forward	forward	off
10	0	1	0	1	0	0	reverse	reverse	off
17	1	0	0	0	1	0	forward	off	forward
34	0	1	0	0	0	1	reverse	off	reverse
20	0	0	1	0	1	0	off	forward	forward
40	0	0	0	1	0	1	off	reverse	reverse
21	1	0	1	0	1	0	forward	forward	forward
42	0	1	0	1	0	1	reverse	reverse	reverse
	1	2	4	8	16	32			

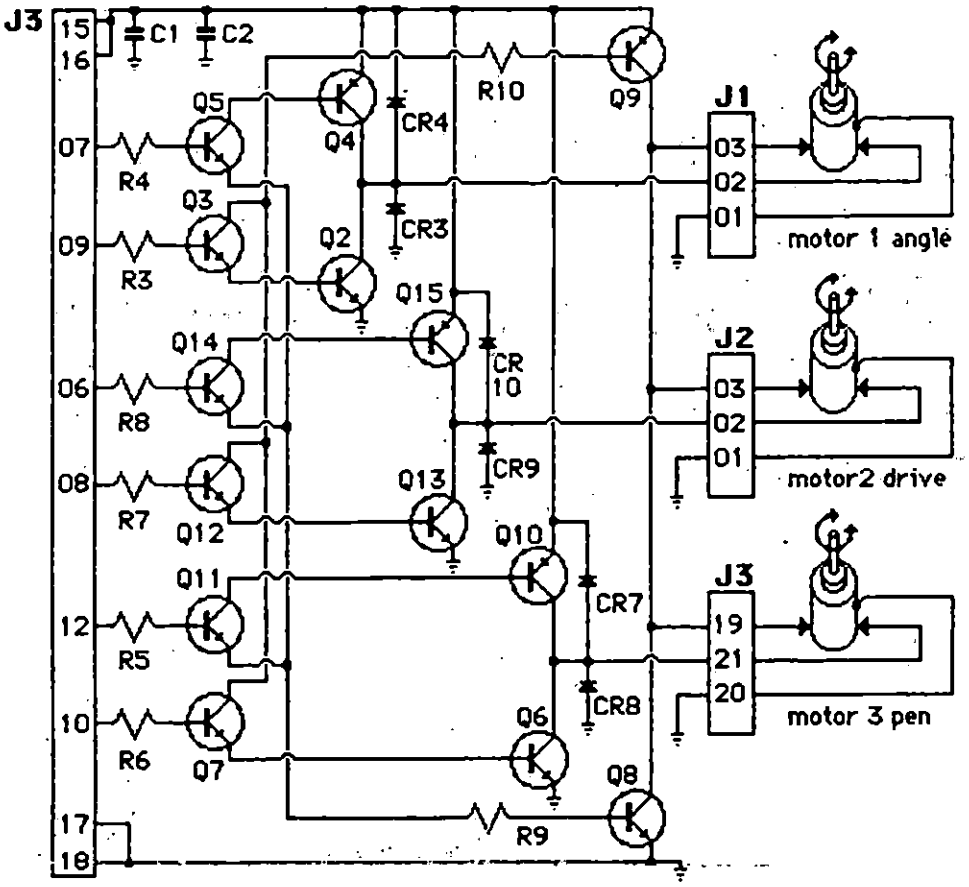
Any code not on chart will destroy the hardware

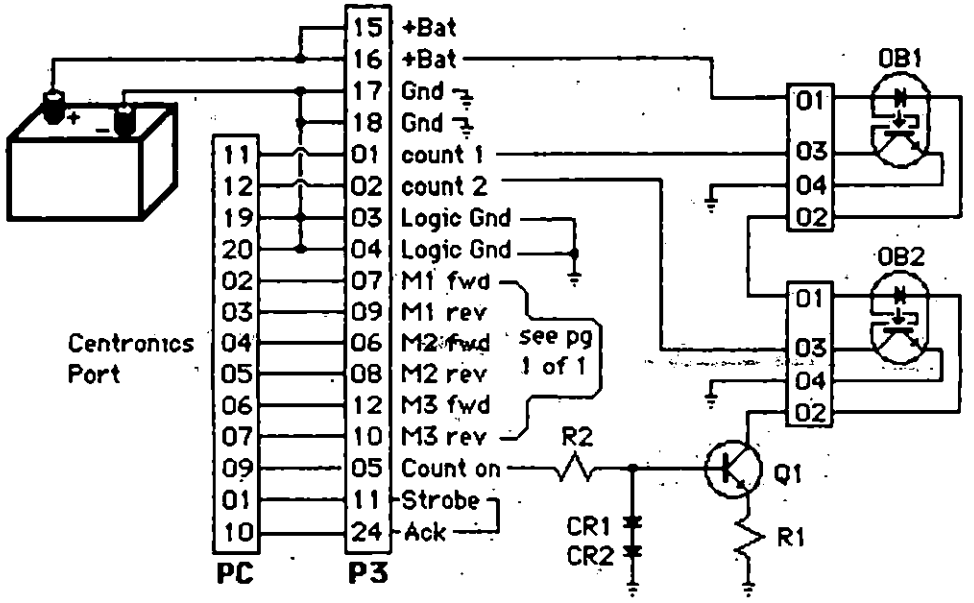
Caution

Computers designed for motion control have isolated out-puts that prevent or limit the dammage caused by power control circuit malfunctions. If you computer is not so equipped please send a stamped self addressed envelope and we will send you a schematic for a simple optical isolator suitable for the fred motor control board.

FRED INTERFACE

schematic





CAUTION

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Androbot FRED Motor driver PCB parts list		
Qty	Part #	Location
1	2N3904 (NPN)	Q1
6	2N5305 (NPN)	Q3, Q5, Q7, Q11, Q12, Q14
4	TIP41 or 2N5190 (NPN)	Q2, Q6, Q8, Q13
4	TIP42 or 2N5193 (PNP)	Q4, Q9, Q10, Q15
8	1N4005	CR3-CR10
2	1N414	CR1, CR2
7	3K ohm 1/4w	R2-R8
1	18 ohm 1/4w	R1
2	20 ohm sand 2W or greater	R9, R10
1	.022uf ceramic disc	C1
1	10uf electrolytic	C2
2	TIL143 Optical Photo Interrupter	OB1, OB2