GEMINI ROBOT KITS

GEMINEX Kit Instructions

1. ASSEMBLY INSTRUCTIONS

You will assemble your GEMINEX kit in three phases as follows:

PHASE	TASK
1	Construction of Subassemblies
2	Testing of Subassemblies
3	Final Assembly and Checkout

Each phase of construction is broken down into several subtasks. These subtasks are ordered so you will start with easy tasks and then progress to more difficult tasks.

Before you commence with Phase 1, you should read the pamphlet entitled **"General Assembly Instructions"**. This pamphlet contains important general instructions for assembling GEMINI Robot kits and you should refer to these instructions often as you proceed with construction.

PHASE 1

The order in which to construct the subassemblies is listed below. After you complete the construction of a subassembly, check this item off the list and again review the general instructions. Read each subassembly instruction in its entirety before you commence construction. After construction, all PC boards should be stored in a safe, static free place until ready for testing.

CONSTRUCTION ORDER	SUBASSEMBLY
1	Charger
2	IR Beacon Receiver Board
3	Room Beacons
4	Power Distribution Board
5	Propulsion Computer
6	Sonar, Stepper & Signal Conditioner Board
7	Main Computer
8	Head Structure
9	Head Cable Assembly
10	Torso Structure
11	Torso Cable Assembly - Part A
12	Torso Cable Assembly - Part B
13	Base Drive Assembly

PHASE 2

You are now ready to commence with the testing of all subassemblies. Refer to the pamphlet entitled, "Testing and Calibration Procedures" and perform the tests and calibrations in the following order:

TESTING ORDER	INSTRUCTION
1	Testing Charger
2	Testing and Calibration of Power Distribution Board
3	Testing and Calibration of Room Beacons
4	Testing the CPU (Main Computer) Board
5	Testing the Procon (Propulsion Computer) Board

If you encounter any problems during these tests that you cannot solve, do not proceed to Phase 3. Contact the factory for assistance.

PHASE 3

You are now ready to perform the final assembly and system checks. Before you do this, read chapters 3 and 14 of the USER'S MANUAL. Refer again to the pamphlet entitled "Testing and Calibration Procedures" and perform the "GEMINEX Initial Testing and Calibration". This completes the construction of your GEMINEX kit.

2. OPERATING INSTRUCTIONS

GEMINEX, like GEMINI, is fully capable of autonomous operation. With GEMINEX, however, you will have to write 65C02 programs to call the various subroutines in the Navigation ROM that is installed on the Main Computer Board in the address space $C000-$DFFF.

Before attemping navigation with GEMINEX, you should thoroughly familiarize yourself with Section VI of the GEMINI REFERENCE MANUAL, particularly Chapters 13 and 16, which cover the SYSTEM MONITOR and NAVIGATION ROM based programs respectively. Please note that the entry points for the NAVIGATION ROM listed in Table 16.2 of the REFERENCE MANUAL have been changed. The new entry points are listed in Table 1 of these instructions.

You should become very familiar with the SYSTEM MONITOR command language described on pages 116 and 117 of the REFERENCE MANUAL. After you feel at home with this language, you can start experimenting with the NAVIGATION ROM routines. First you will have to enter certain constants into RAM that are used by the NAVIGATION program. These constants, described in Table 14.4, pages 136-137, of the REFERENCE MANUAL, are to be located at $0600-$0635 as follows:

```
$0600          25 00 00       DISFAC
$0603          FA 03 00       DEGFAC
$0606          80 00 00       N.0.5
$0609          1E 01 00       N.1.118
$060C          80 01 00
$060F          00 0A 00       N.10
$0612          00 1E 00       N.30
$0615          6F 3F 00       N.63.4
$0618          00 4B 00       N.75
$061B          00 5A 00       N.90
$061E          00 B4 00       N.180
$0621          00 37 01       N.360
$0624          00 B8 0E       CHGDIST = 2.122 FT = WALL DIST + 6"
$0627          00 EF 06       N.1FT
$062A          00 DE 0D       N.2FT
$062D          00 BC 1B       N.4FT
$0630          4B 39 00       NDPR = 57.295 (DEG/RAD)
```

These constants are used by the Fractional Integer Math Pack described on pages 119-126 of the REFERENCE MANUAL. The data is given low byte first and stored in memory that way. Enter these data bytes as follows:

$0600:25 00 00 FA 03 00 ...etc. followed by a carriage return (CR).

You will have to enter the data in two steps. The buzzer will sound to inform you when the line buffer is full. ($0600L)

To get the robot to move by itself onto its charger, follow these instructions:

1. Place the charger on the antistatic mat against a wall where two electrical outlets are accessible and where the robot has free uncluttered access to the charger. Above the charger, mount one room beacon about 38 inches off the floor. Be sure the dip switch on the back of this beacon is set with only SW1 ON and the others off. Plug both the charger and beacon into the wall outlet.

2. Next enter the following routine at $1000.

```
A9 11          LDA #$11
8D 67 05       STA MSPSTP
20 6F E4       JSR INITHD
A9 01          LDA #$01
A2 EF          LDX #$EF
20 BE C9       JSR FIND.RM.BEC
00             BRK
```

That is, type in $1000:A9 11 8D ...20 BE C9 00 CR.

3. Make sure you have entered the program correctly by disassembling the code starting at $1000. That is, type in $1000L CR.

4. Now run this program by typing in $1000G CR. The head should turn counter clockwise to its left most stop and then rotate clockwise until it finds the beacon or reaches the right stop. If the robot finds the beacon, the head will stop, reverse position and jitter along until it has read the code. When the program breaks, examine memory location $0985 (RMCODE) by typing in $0985D CR. This memory location holds the beacon code read by the robot. It should contain 01. If this memory location does not contain 01, check the switch setting on the back of the beacon. If it is set properly, try another beacon. If the robot does not find the beacon, adjust its height.

5. Once the robot has found the charger beacon (RMCODE=01) you can get the robot to go to its charger by running the HOME routine located at $DBCA. Do this by typing in $DBCAG CR. Be sure to disconnect your terminal from the robot immediately after hitting CR. The robot will first search for the home beacon. Once it has found the beacon, the robot will make two 360 degree turns, approximately, to calibrate its turning degree factor for your floor. It will then proceed to align itself with the beacon and move onto the charger. The robot will perform the floor calibration test only once. See page 145 of the REFERENCE MANUAL for details.

When the robot is in motion, it uses its front body sonars and bumpers to avoid obstacles. If you place an obstacle in its path (low enough so it can still find the charger beacon), the robot will attempt to maneuver around this obstacle.

The HOME routine trys very hard to get the robot onto its charger. If the routine determines that the robot cannot make electrical contact with the charger, it will exit with an error code. The error code is stored in memory location $090A (ERRCODE). Table 12.1, page 85, of the USER'S MANUAL lists the possible error codes and their meanings for both the "HOME" routine and the "MOVETO" routine described below.

When the robot successfully docks with its charger, it powers down all auxilliaries and connects the battery grounds. It is extremely important for the life of the batteries and to insure that all batteries are charged, that the battery grounds are connected when the robot is on its charger. IMPORTANT: When you leave the robot on the charger, type in $E060: 21 CR. Then check to make sure the on charge LED (at the right of the rear sonar) is lit.

To get the robot to move to another room, follow these instructions:

1. Read Chapter 6 of the USER'S MANUAL and Chapter 16 of the REFERENCE MANUAL.

2. Install a door edge reflector on one side of an open doorway (approximately 38 inches off the floor) that is near (say less than 10 feet) from the charger. Make sure the robot has a clear path from the charger to this doorway.

3. Place the robot on its charger and run the FIND.DOOR.EDGES routine at $C7D4 by typing in $C7D4G CR. The robot will rotate its head 359 degrees while searching for door reflectors. Examine memory location $0981 (NDREDS) by typing in $0981D. This memory location should contain 01, the number of door edges found. If NDREDS=00, adjust the height and/or location of the reflector and continue to rerun this routine until the robot sees the door edge reflector. If NDREDS equals 02 or greater, it means that the robot is picking up reflections from some object in the room such as a window, mirror, bright metal object, etc. These objects will have to be removed or covered.

4. Study Table 16.1, page 144 of the REFERENCE MANUAL. You will now enter a test set of room table data as follows:

$0700:06 07 01 01 20 82 00 00 02 01 20 01 CR

The meaning of this data is as follows:

BYTE NO.	DATA	MEANING
0	06	Lo Byte of address of next table entry
1	07	Hi Byte of address of next table entry
2	01	Room No. 01, reflectors can be seen from room center
3	01	Number of doors in room
4	20	Width of door in inches ($20=32 inches)
5	82	Room No. 02 on other side of door, reflector on right side of door
6	00	No more table entries after the following one
7	00	"
8	02	Room No. 02, reflectors can be seen from room center
9	01	Number of doors in room
10	20	Width of door in inches ($20=32 inches)
11	01	Room No. 02 on other side of door, reflector on left side of door

Examine this data to make sure you have entered it properly.

5. Place the robot on its charger. Enter the desired room in memory location $0999 (DESRM) by typing in $0999:02 CR. Then run MOVE.-TO.RMN by typing in $CB5FG CR. Make sure you disconnect your terminal from the robot immediately after pressing carriage return.

The robot will move off its charger by backing up about two feet. It will then scan for the charger beacon. (Should the robot not find this beacon, it will move back onto the charger.) The robot will next scan for the door edge reflector. After it finds the reflector, it will align itself with the reflector and move to a position about four feet from the reflector. The robot will then use its head ranging sonar to scan the doorway in order to find the door edges. Following this, the robot will position itself approximately one door width in front of the center of the door. The robot will make one final centering scan and then proceed through the doorway.

Once the robot enters the next room, Room 02, it will scan for the room beacon in that room. Since we did not place a room beacon in that room, it will be unable to find it. The robot will consequently backup through the doorway and try again. You may stop the robot once it passes through the doorway by pressing the reset key on the robot.

You may now wish to experiment on your own with other programs. Should you wish to write more involved programs concerning navigation, we recommend that you purchase the source code for the Navigation ROM. You may also wish to purchase the ROM CARD and high level software availabe for GEMINI. The BASIC language for GEMINI is particularly powerful. BASIC navigation commands like "HOME" and "MOVETO(N)", where N is the room number are very handy.

TABLE 1

NAVIGATION ROM SUBROUTINES ENTRY POINTS

(see TABLE 16.2 of REFERENCE MANUAL)

CB5F	MOVE.TO.RMN
CC15	LEAVE.CHARGER
C9BE	FIND.RM.BEC
D07E	MOVE.TO.RM.CTR
CC4C	FIND.PATH
CE5E	ENTER.ADJRM
CF31	GET.DEG.TAB
D068	GET.DOOR.COUNT
C85C	SEN.SCAN
D39D	MOVE.4FT.FM
C7D4	FIND.DOOR.EDGES.
D971	DOOR.SECTOR.SCAN
D34E	REPOSITION
D1E1	ORDER.DOORS
D5A1	MOVE.TO.DR.CTR
D221	MOVE.THRU.DOORWAY
D6C5	PASS.THRU.DOOR
C627	TRACK.AVOID
DBCA	HOME
DC71	HOOK.UP