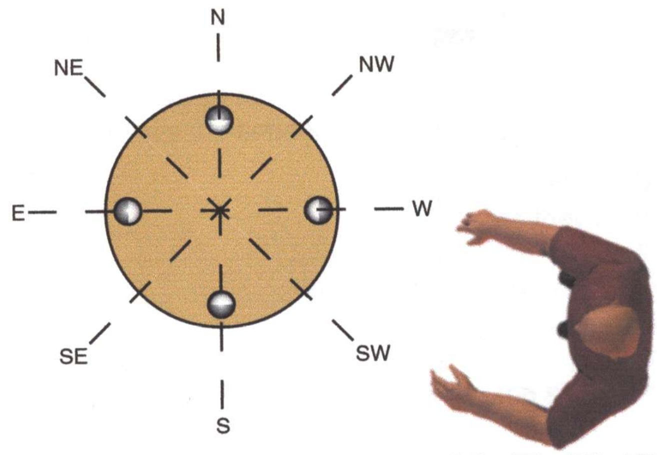
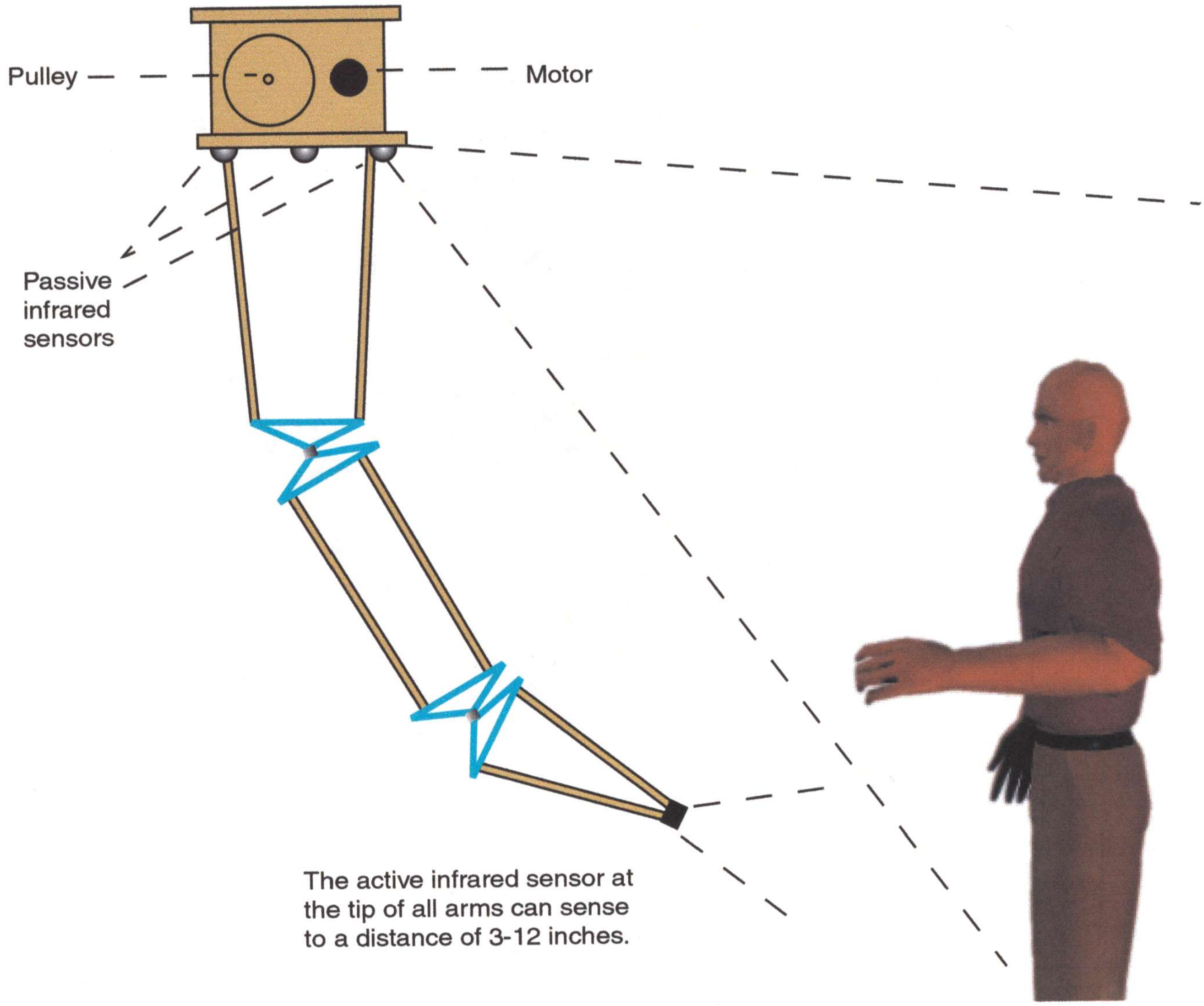
I 15 p

SKETCHES, DESIGN, PARTS AND HARDWARE INDEX FOR AUTOPOIESIS

mart Sensor Layout: 4 passive infrared sensors focused out north, south, east and west allow th software to respond to eight sectors. When the participant approaches the piece the passive infrarec sensors instructs software to move the arm toward the participant, while an active infrared sensor at the tip, causes the arm to pull away from the participant. This creates a software attraction-repulsion loop.

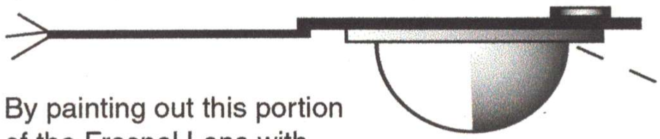


The passive infrared sensors, which face toward the floor, are mounted underneath the wooden structure that houses the motors. They see a range of 7-9 feet and notice a change in infrared light. Here the participant would be seen in the (SW) Southwest and (W) West sectors.



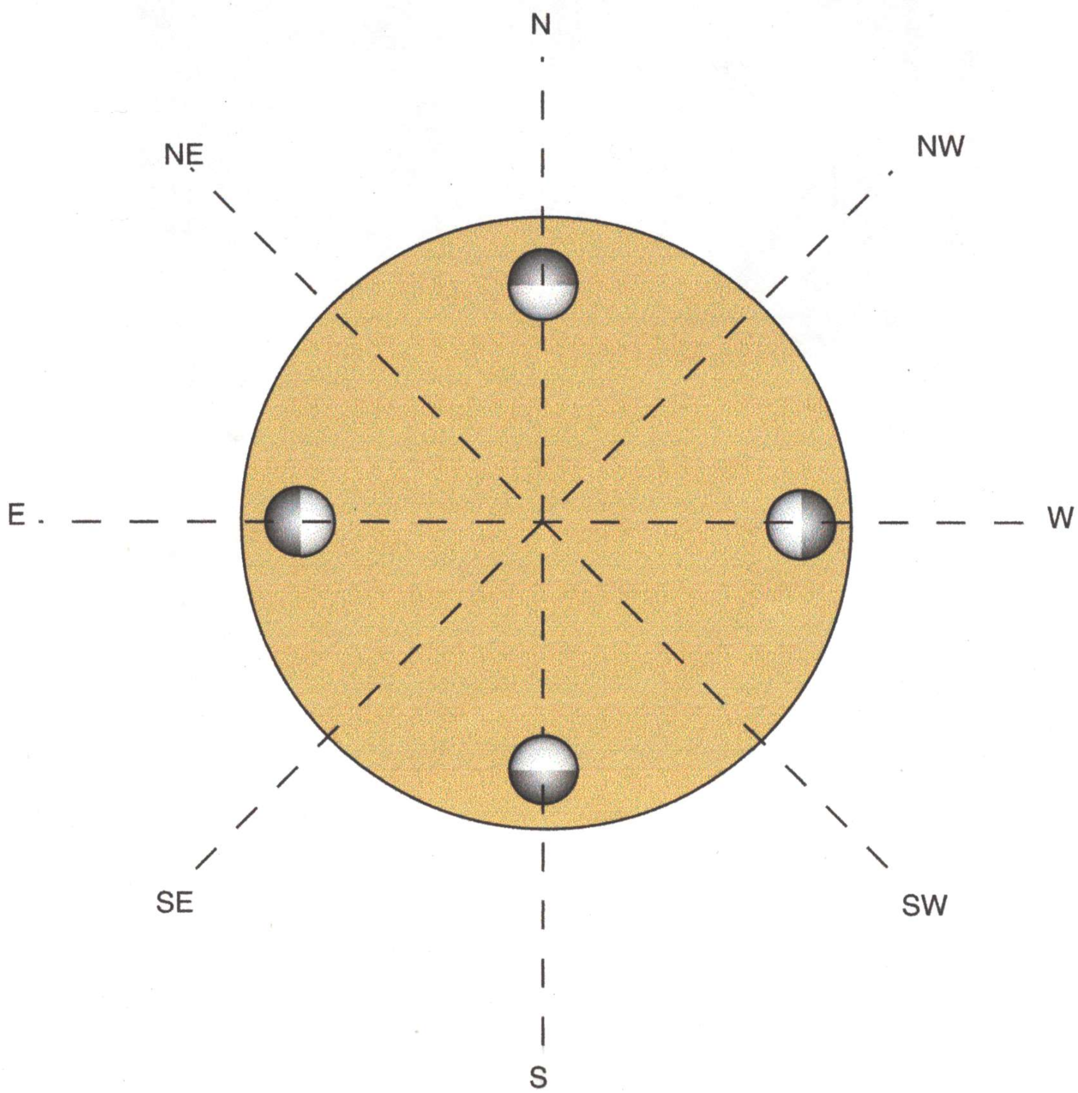
The active infrared sensor at the tip of all arms can sense to a distance of 3-12 inches.

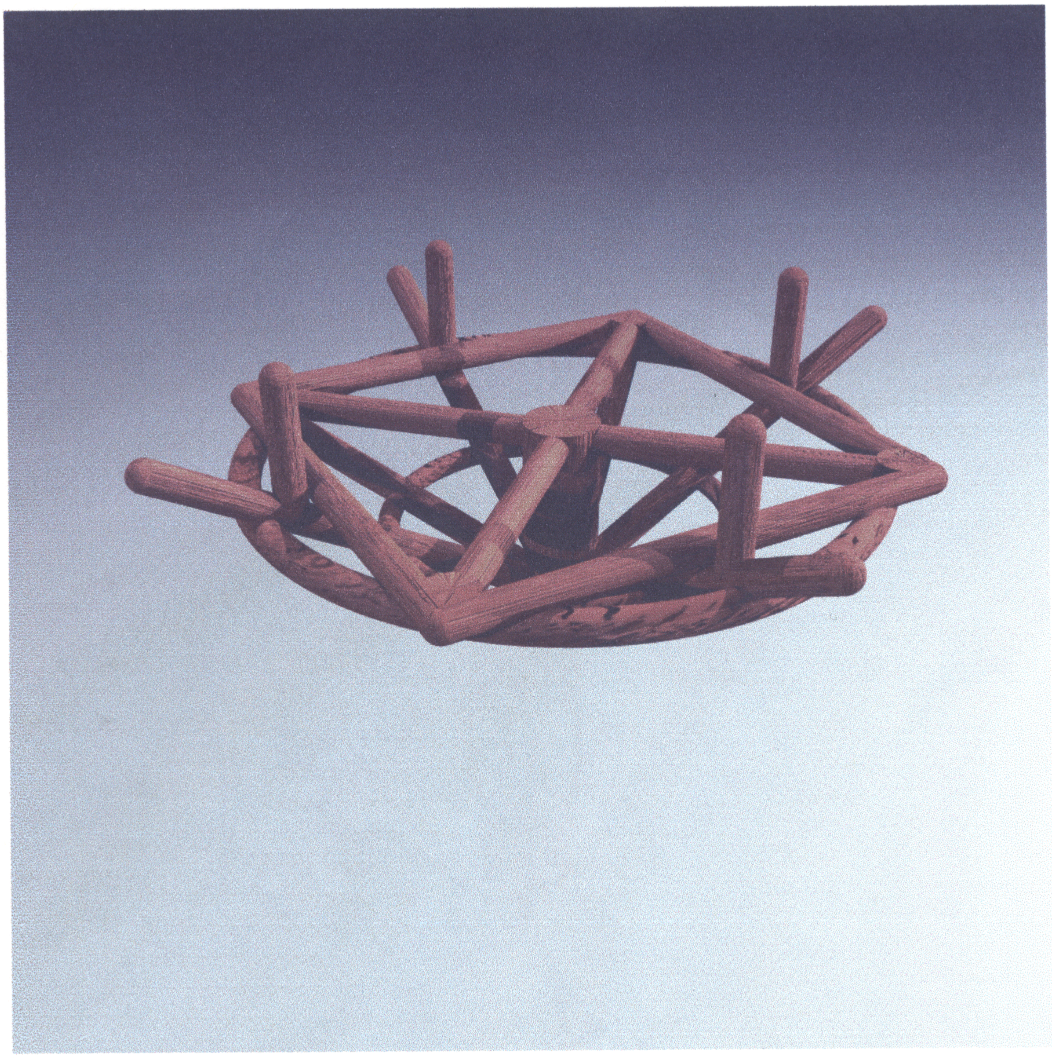
Volt Passive Infrared Sensor from the side. There are four of these sensors per sculpture which allows 8 separate sectors of seeing by the robot.

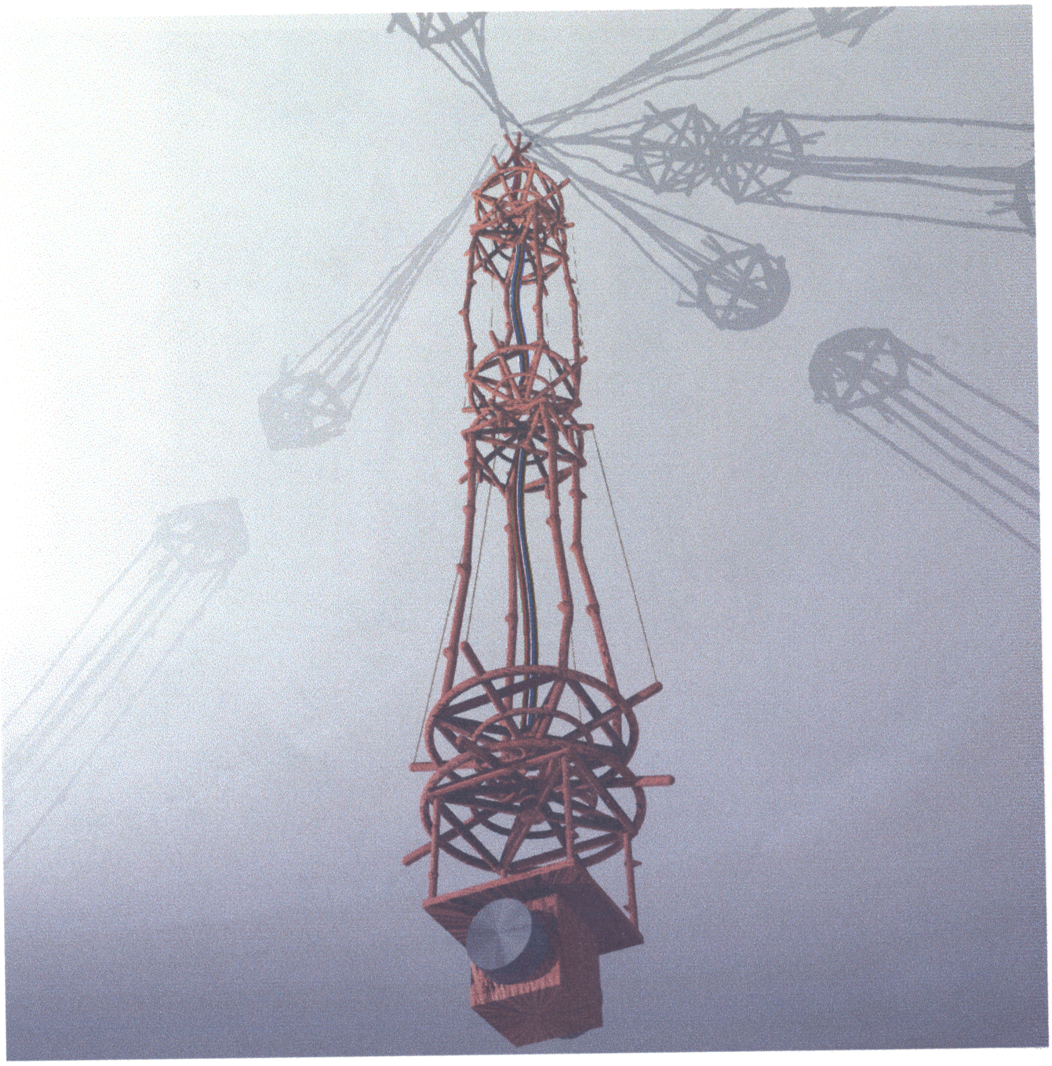


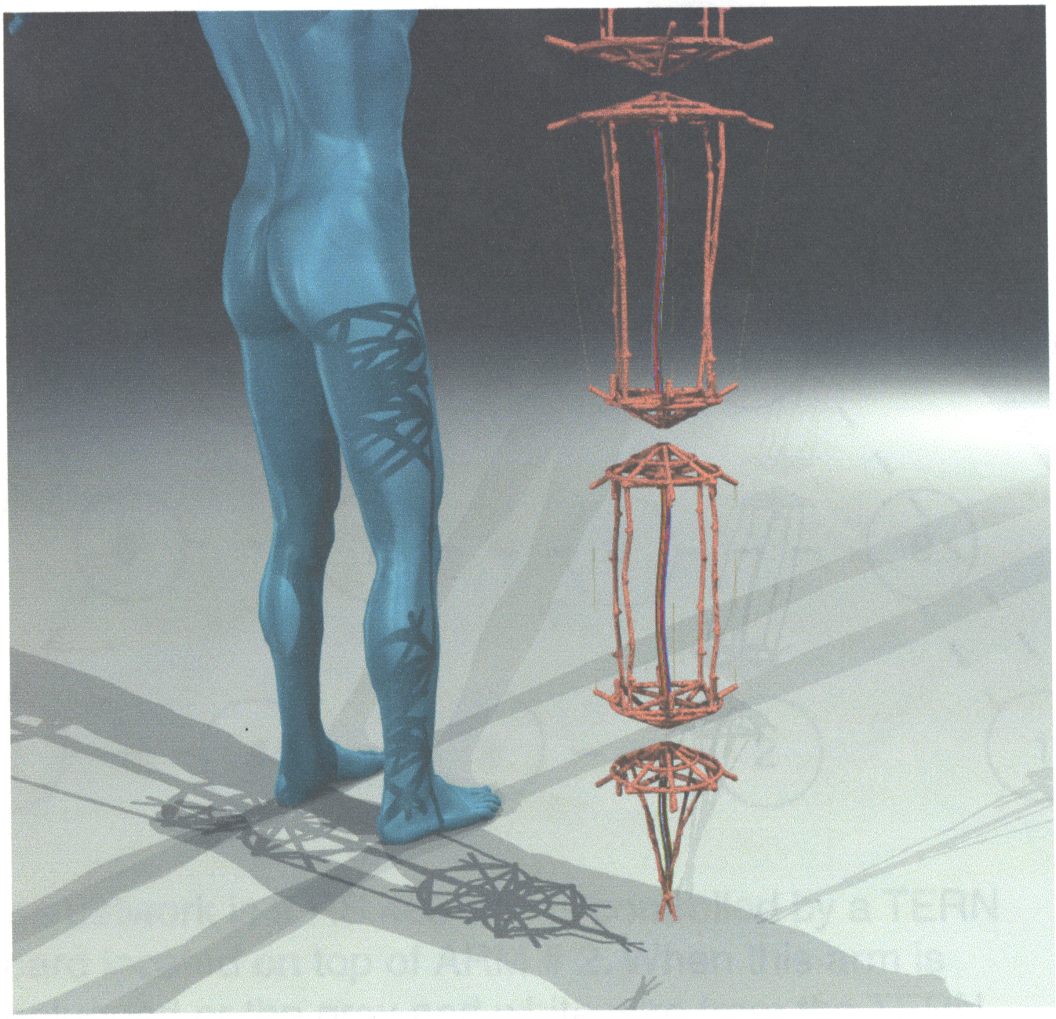
By painting out this portion of the Fresnel Lens with acrylic paint it allows me to customize where the sensor images.

This area senses movement by participants as they move from one fresnel lens to another and causes the robot to move toward the participant. When the sculpture moves too close the active infrareds take over and move the arm away from the viewe.

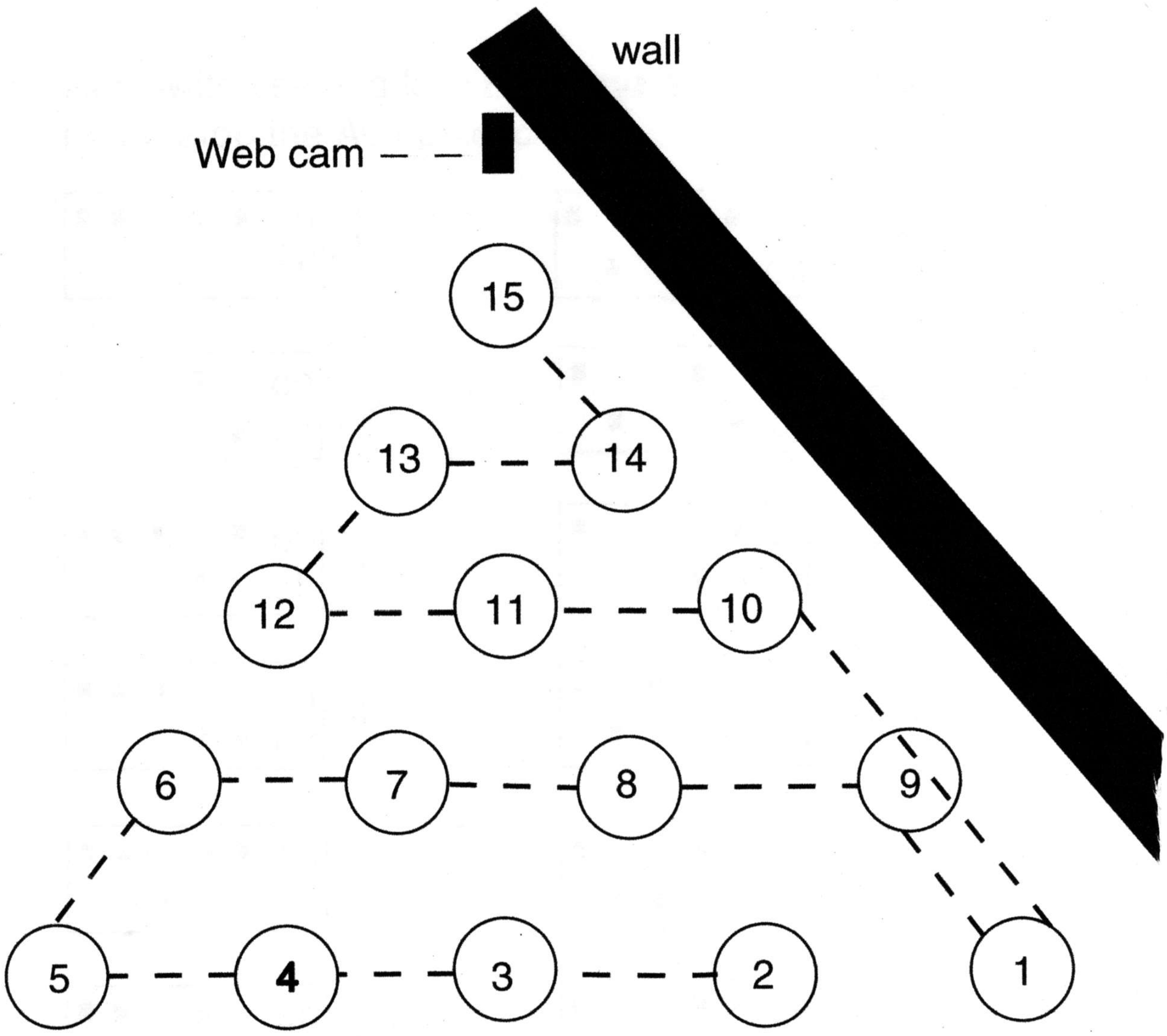






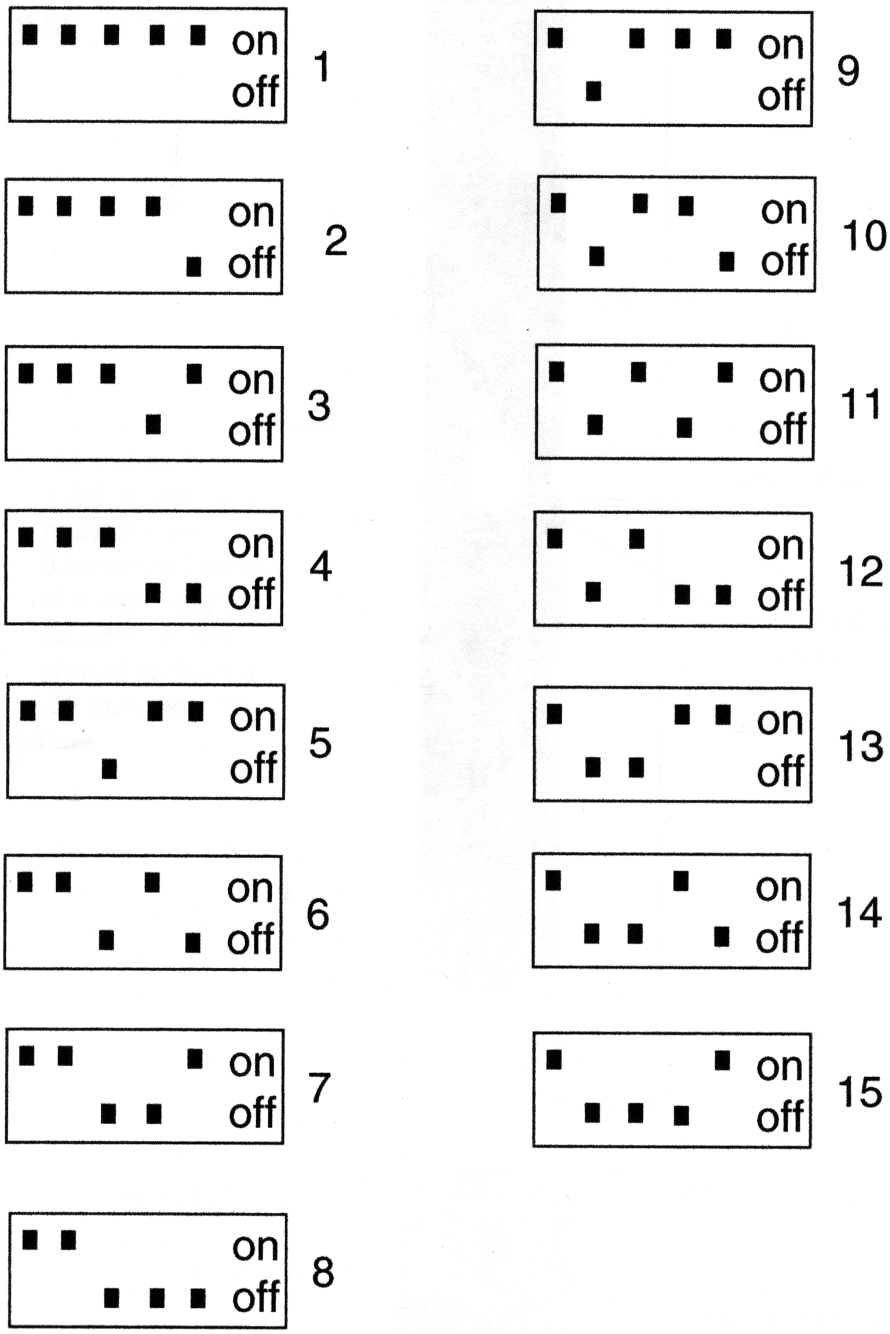


Autopoiesis network wiring and address layout for RS 485 network



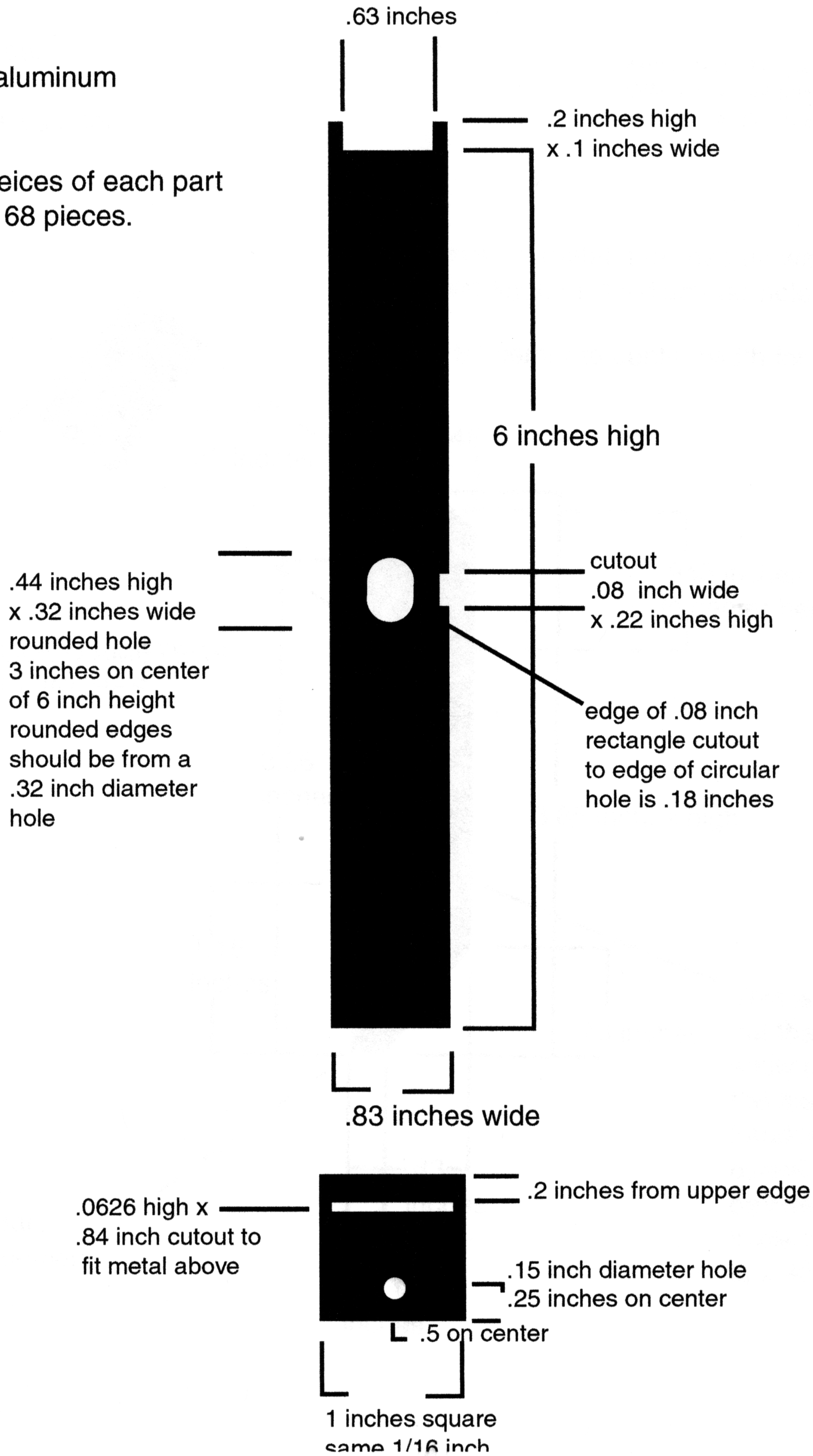
The network is a RS 485 and is controlled by a TERN board located on top of ARM # 2. When this arm is unplugged or the gray and white wire from the TERN board (twisted white and gray wire) is unplugged at arm #2 then this will stop only the network functioning but all the arms will continue to function in local mode. Therefore if the twisted pair 485 wire is unplugged from arm # 11 then arm 12-15 will continue to function in in local mode but will stop working in network mode, etc.

Red switch setting for TERN addressing on each board atop the Autopoietic arms



material
cut from
1/16 inch aluminum
or steel

need 34 peices of each part
for total of 68 pieces.



material
cut from
1/16 inch steel

need 65 pieces total

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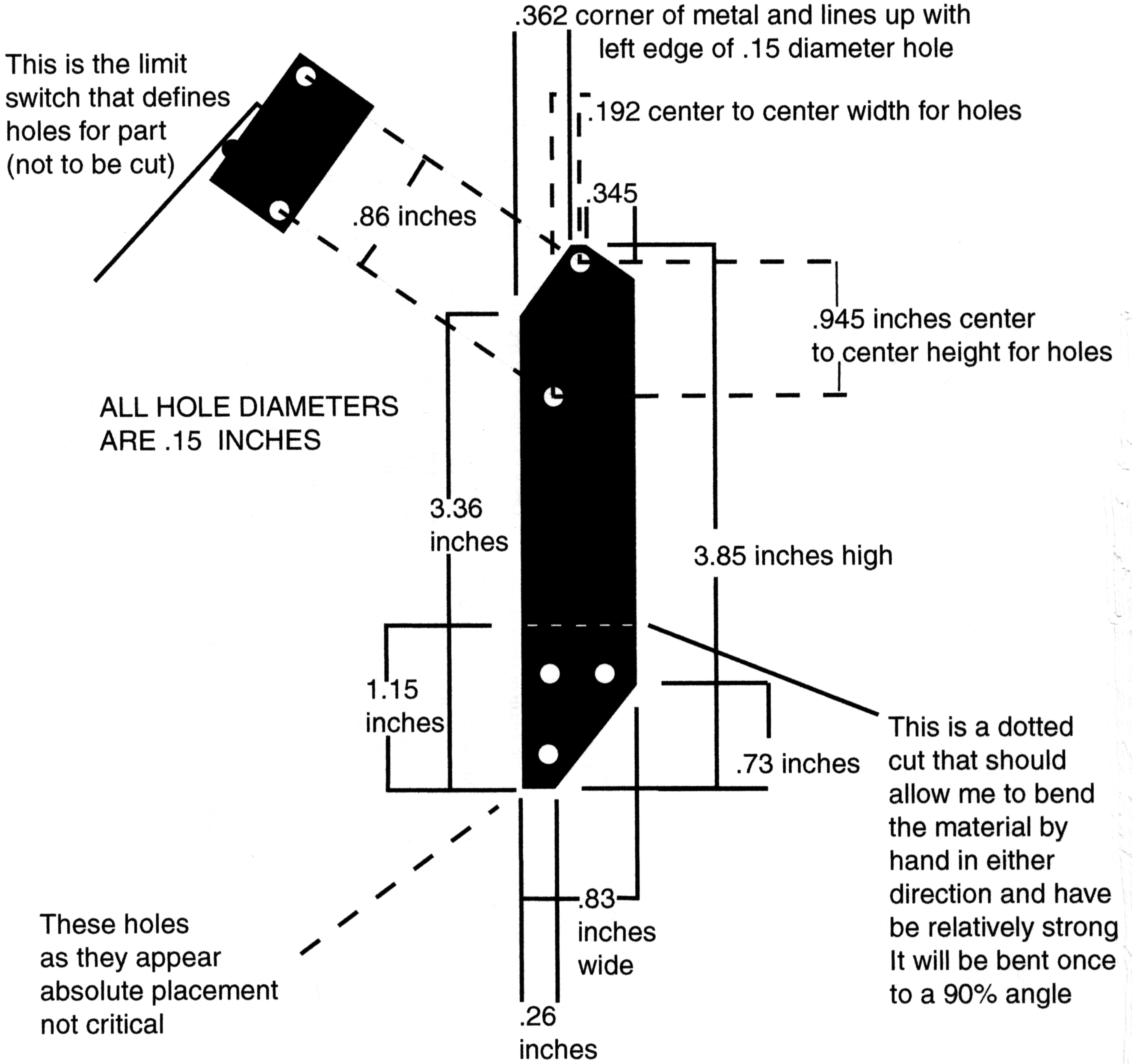
Home 614 291-3085



K76. PIR MOVEMENT DETECTOR MODULE

A complete passive infra-red movement detector module on a PCB 25mm x 35 mm (1" x 1.35"). The main components are a PCB-mounted Fresnel lens, an RE200B PIR sensor from Nicera and a custom-made, surface-mount movement detector IC. Pulse width output, and unit sensitivity have been fixed.

Only three connections need to be made to the unit. Power and capturing the output signal. The output pulse is about 1 second long. It is up to the user to take this output signal and connect it to the alarm or other device.

Connections:

- 4V to 12V between V+ and GND marked on the bottom layer of the PCB
- output pulse between OUT and GND marked on the back of the PCB

Operating conditions: It is important to remember that PIR sensors need about one minute to fully charge-up before they are ready for stable operation. Best results are obtained if the sensor is placed up high, about 7 to 10 feet in the area it is being used in. For a quick visual test of the sensor connect an LED & current-limiting resistor between OUT & GND.

The data sheets on the components used in this unit, especially the movement IC, are available in DIY Kit 62.

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HVW Technologies
Infra-Red Object Detection System (IRODS)

Overview

IRODS is a low-cost, short-range Infra-Red (IR) alternative to ultrasonic detection systems. By setting a detection distance threshold via a tiny potentiometer, the user can reliably detect the presence of any object that comes within that distance. Usable detection range is 10 cm to 80 cm (approx. 4" to 31.5").

The IR Object Detection System consists of the Sharp GP2D05 Distance Measuring Sensor and a custom cable assembly. The GP2D05 is a compact, self-contained IR object detection system incorporating an IR transmitter, receiver, optics, filter, detection, and amplification circuitry. The unit is highly resistant to ambient light and impervious to variations in the surface reflectivity of the detected object.

Unlike many IR systems, IRODS has a fairly narrow field of view; making it ideal for sensing even small objects such as candlesticks. The field of view changes with the threshold distance (see the graph at the end of this document), but is no wider than 10 cm (5 cm either side of centre) when set at maximum range.

Specifications

ABSOLUTE MAXIMUM RATINGS (Ta=25 °C, Vcc= 5V)

Parameter	Symbol	Rating	Unit
Supply Voltage[1]	V_{cc}	-0.3 to + 10	V
Input Terminal Voltage[2]	V_{in}	-03. To + 3	V
Output Terminal Voltage	V_o	-0.3 to + 10	V
Operating Temperature	T_{opr}	-10 to + 60	°C
Storage Temperature	T_{stg}	-20 to + 70	°C

NOTES:

1. The *operating* voltage of the unit is 4.4 – 7 VDC and **should normally be run on 5 VDC**
2. The input terminals maximum voltage rating is **3 V**. Exceeding this level may cause **permanent damage.**

ELECTRO-OPTICAL CHARACTERISTICS (Ta=25 °C, Vcc=5V)

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Distance Measuring Range	ΔL	-	10	-	80	cm
Output Terminal Voltage	V_{OH}	Note 1	Vcc-0.3	-	-	V
	V_{OL}	Note 2	-	-	0.3	
Average Supply Current	I_{cc}	Note 3	-	10	22	mA
Standby Supply Current	I_{ccoff}	Note 4	-	3	8	μA
Vin Terminal Current	I_{vin}	Vin=0V	-	-160	-270	μA

Notes:
1) Output HIGH
2) Output LOW
3) Average current during measurement period (56 ms MAX.)
4) Current consumption when Vin terminal is HIGH

Mounting the Sensor

The sensor unit may be mounted using the included piece of double-sided foam, or 2 appropriately-sized screws.

Connecting to the Sensor

A custom cable assembly is included with the IRODS kit. The miniature connector is keyed so that it may only be inserted one way. The following table shows the necessary connections:

Pin	Symbol	Wire Colour	Connect To
1	V_{in}	Green	Voltage divider going to microcontroller pin (**MAX. 3.0 Volts !)***
2	GND	Black	Ground
3	V_{out}	Blue	Input pin of microcontroller
4	V_{cc}	Red	+ 5 V DC

*The maximum voltage the input can tolerate is 3 V. Use two 1K resistors (included) to make a voltage divider (fig. 1)

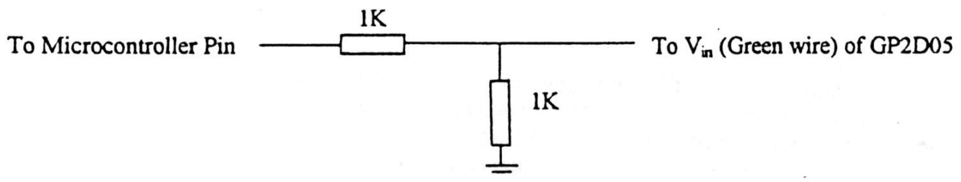


Fig. 1.

Calibration

To calibrate the unit to the desired threshold distance, turn the small potentiometer (next to the connector). To set the threshold distance closer, turn the pot counter-clockwise. To set it farther, turn it clockwise. Note that turning the potentiometer during a measurement sequence will invalidate the result. Therefore, you must cause a single measurement sequence, adjust the pot, then initiate another sequence. A program suitable for calibrating the unit is shown below.

Operation

The GP2D05 makes repeated measurements before it indicates the presence (or absence) of an object. The time it takes to make these measurements varies slightly from unit to unit and can be from 28 ms to a maximum of 56 ms. We recommend that you allow the full 56 ms, just to be safe. If you have a time-sensitive application, you should experiment with the specific unit(s) you have to determine the minimum reliable measurement time. The following 4 steps illustrate a detection cycle:

1. The V_{in} line is normally held HIGH (+3V). To begin a measurement sequence, pull this line LOW (0V).
2. Wait 56 ms.
3. Scan the V_{out} line's status. If it is LOW, an object was detected within the threshold distance. If it is still HIGH (+5V), no object was detected.
4. Raise the Vin line (back to +3V) for a minimum of 1 ms (3 ms recommended) before beginning the next measurement sequence. This resets the V_{out} register within the GP2D05. Since the result remains until explicitly cleared, the host microcontroller need not have interrupt capability since the result will wait until the micro has time to read it.

Example

```
'Measurement and Calibration Routine for IRODS using a BASIC Stamp II
'P0 is connected to the voltage divider, which in turn goes to Vin (green wire)
'P1 is connected to Vout (blue wire)

START: High 0                    'Make sure that Vin sees a high-low transition
       Pause 3                   'Wait for it to be seen
       Low 0                     'Begin measurement sequence
       Pause 56                  'Wait for measurement sequence to complete
       If IN1=0 Then SHOW        'If object detected, tell me
       Goto START                'No object detected, start over
SHOW:  Debug "Object Detected", cr  'Display "Object Detected" in debug window
       Pause 5000                'Wait 5 seconds (remove when done calibrating)
       Goto START                'Start over
       END
```

Using Multiple Sensors

In order to minimize the number of I/O lines required, we suggest that when using multiple sensors, that the V_{in} lines be connected together and brought to a single output pin on the micro. This means that all sensors will start measuring at the same time but you will only need 1 input per sensor, plus 1 output to start them all. Using this techniques, an effective obstacle avoidance system for a mobile robot, such as our Mobile Robotics Platform (MRP), can be implemented using only 3 I/O lines (for 2 sensors). Since the V_{in} line draws only microamps, many sensors can be connected like this.

Some Observations on the Effect of Different Kinds of Light

Ambient Light

Tests have shown the GP2D05 to be highly immune to ambient light levels. Incandescent, fluorescent, and natural light don't appear to bother it. The only instance where we were able to get it to falsely trigger was when a flashlight was pointed *directly* into the sensor's receiver; even a few degrees off-centre is enough for the sensor to ignore it.

IR Light

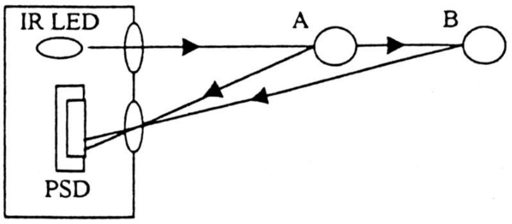
The GP2D05 uses a modulated IR beam to guard against false triggering from the IR component of incandescent, fluorescent, and natural light. Tests with several kinds of IR remote controls have shown that even with 2 or 3 remotes pointed at the GP2D05, the unit still functions normally.

Laser Light

Tests with a laser pointer had results similar to the flashlight; only a beam aimed straight into the sensor's receiver would cause a false reading. If the beam comes from even a few degrees off-center, it has no effect.

How Does it Work ?

Figure 2 shows how the GP2D05 uses an array of photodiodes (called a Position Sensitive Detector, or PSD) and some simple optics to detect distance. An infra-red diode emits a modulated beam; the beam hits an object and a portion of the light is reflected back through the receiver optics and strikes the PSD. Object A is closer and therefore the reflected light from it enters the receiver's lens at a greater angle than does light from object B.



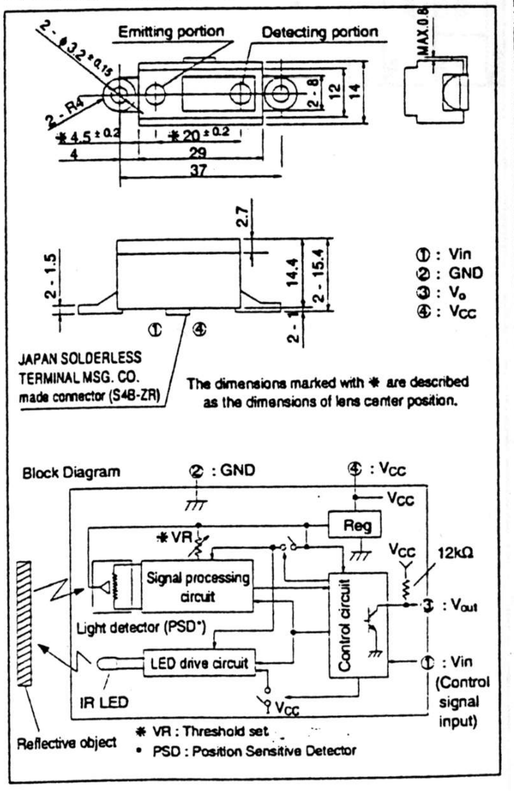
Here, Object A is at the limit of the PSD's range (about 10 cm away). Notice how that if it were any closer, the light would not hit the PSD at all. Similarly, if B were moved farther away, its' light would eventually go past the 'top' of the PSD and would not be seen either (at about 80 cm). This explains why IRODS has these limits

Fig. 2.

Think of the PSD as a resistor with a large number of taps (wires coming out at various points along the resistor). When light hits the PSD, it hits one of the 'taps' and causes current to flow out each end of the resistor, forming a voltage divider similar to that of figure 1. As an object moves closer or farther from the sensor, incoming light hits a different 'tap' causing the current coming out each end of the resistor to change. These currents are compared and a voltage proportional to the position of the 'tap' (and hence the distance of the object) is generated. This voltage is compared with the voltage that you set with the threshold pot to determine whether the V_{out} line should be sent low. A block diagram of the inner workings of the GP2D05 can be found at the end of this document.

CAUTION: The GP2D05 is a precision device. **DO NOT** attempt to open the unit. Doing so will ruin the delicate alignment of the optics.

■ **Outline Dimensions** (Unit : mm)



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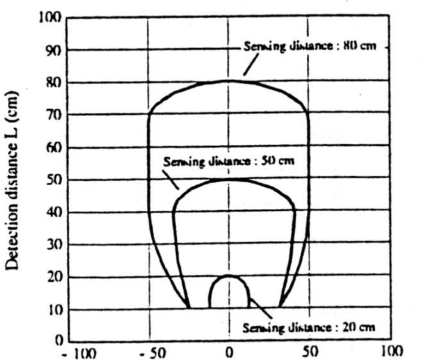
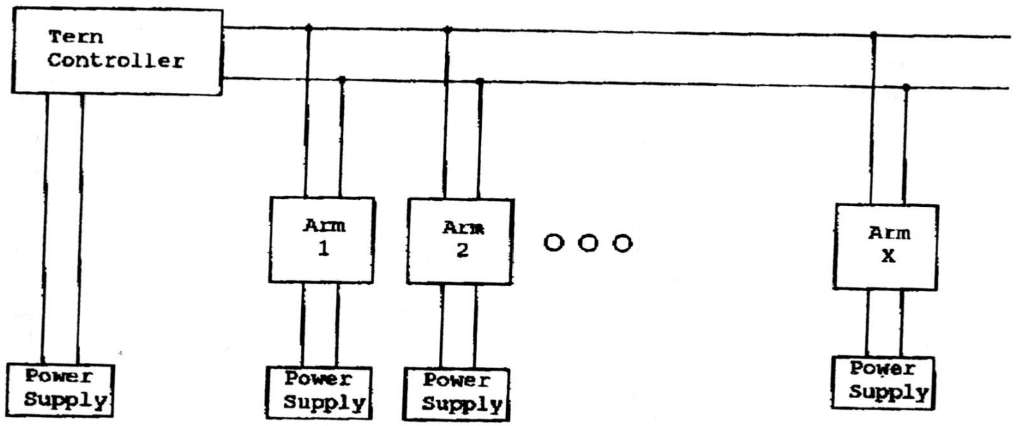
Detection Distance vs. Sensing Range





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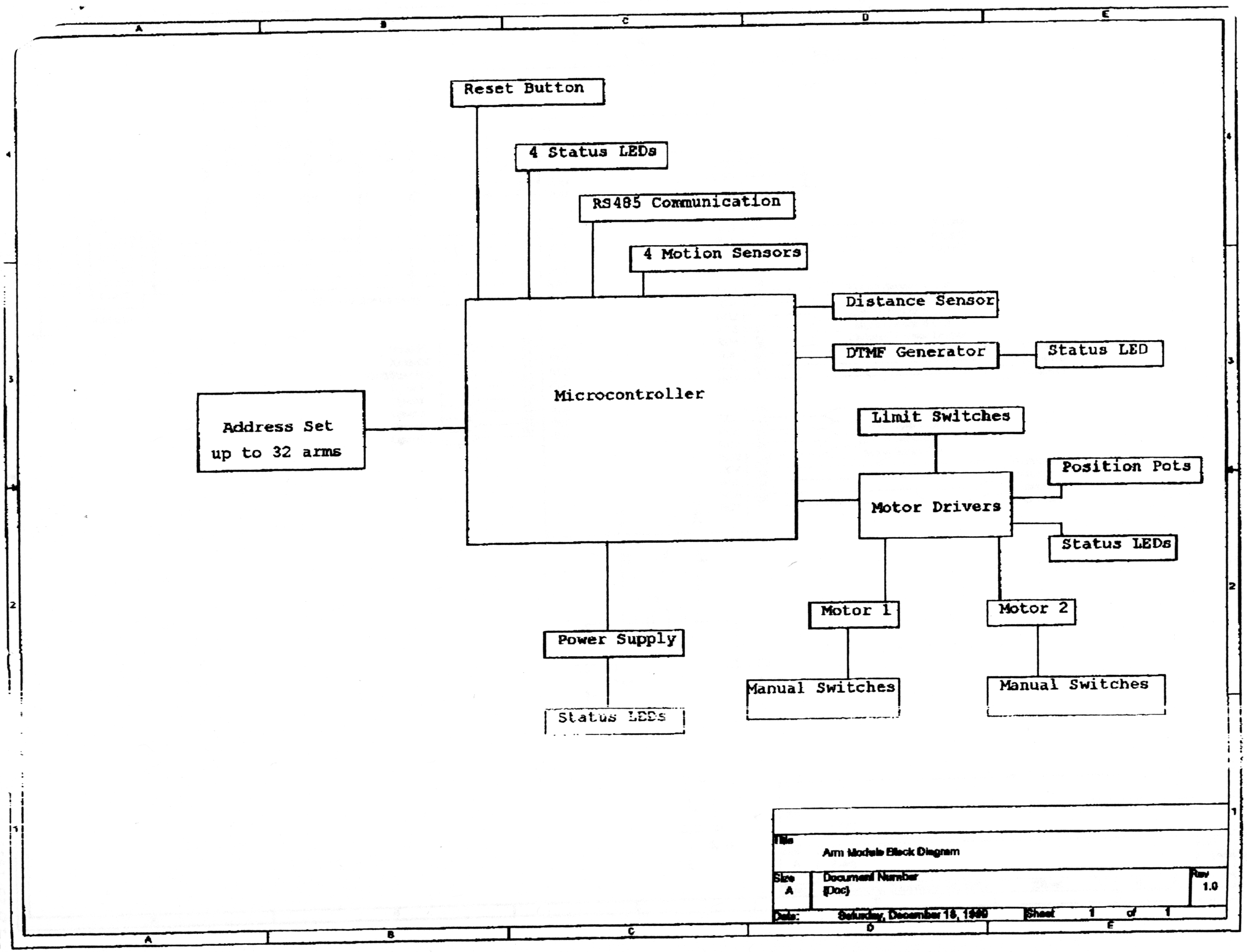
Reset Button
4 Status LEDs
RS485 Communication
4 Motion Sensors
Distance Sensor
DTMF Generator
Status LED
Microcontroller
Address Set
up to 32 arms
Limit Switches
Position Pots
Motor Drivers
Status LEDs
Motor 1
Motor 2
Power Supply
Manual Switches
Manual Switches
Status LEDs
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Arm Module Block Diagram
Size
A
Document Number
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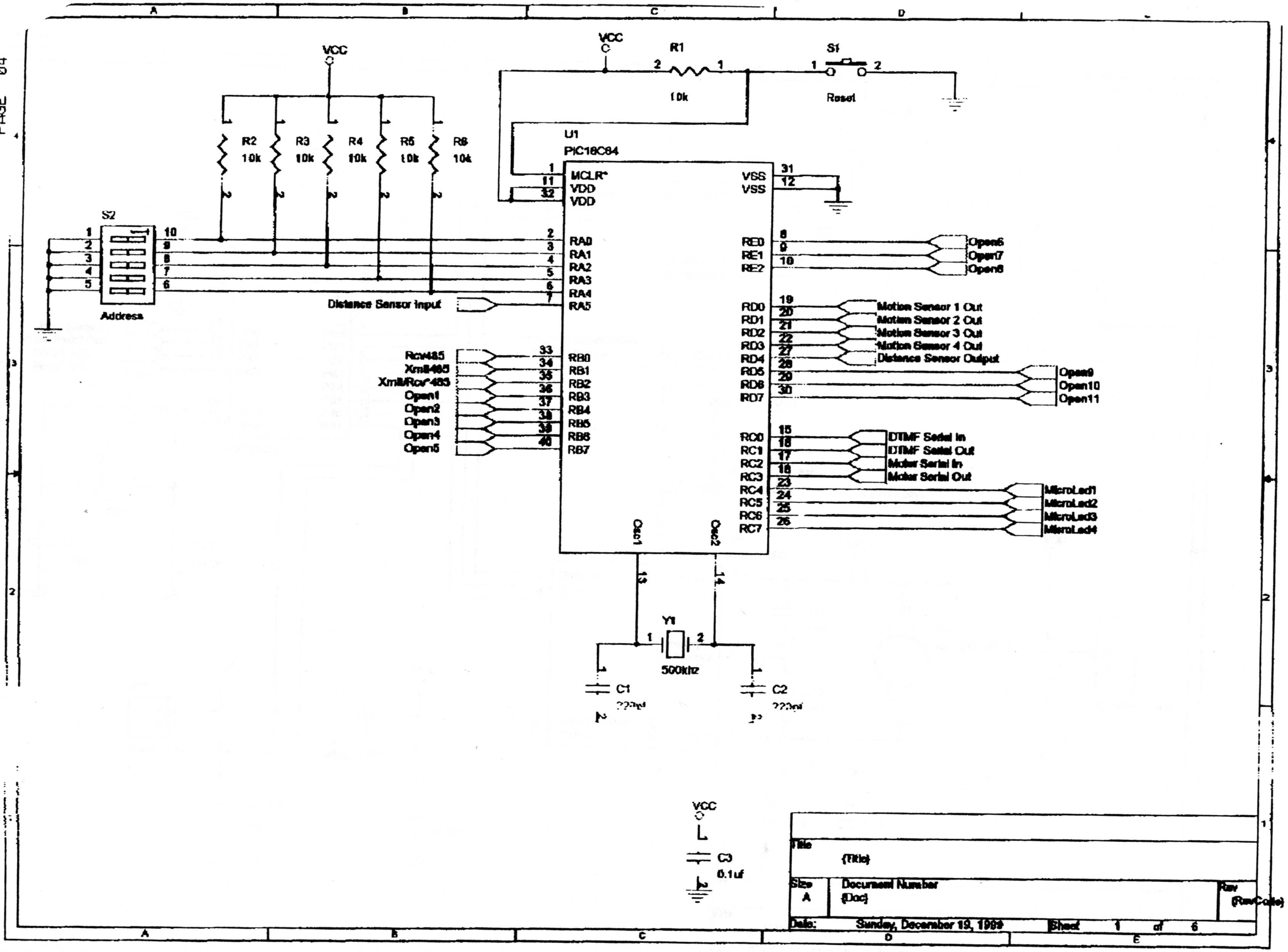
Rev
1.0
Date: Saturday, December 18, 1999
Sheet 1 of 1


VCC
R1
10k
S1
Reset
U1
PIC16C84
MCLR*
VDD
VDD
VSS
VSS
R2 10k
R3 10k
R4 10k
R5 10k
R6 10k
S2
Address
RA0
RA1
RA2
RA3
RA4
RA5
Distance Sensor Input
Rcv485
Xmit485
Xmit/Rcv*485
Open1
Open2
Open3
Open4
Open5
RB0
RB1
RB2
RB3
RB4
RB5
RB6
RB7
RE0
RE1
RE2
Open6
Open7
Open8
RD0
RD1
RD2
RD3
RD4
RD5
RD6
RD7
Motion Sensor 1 Out
Motion Sensor 2 Out
Motion Sensor 3 Out
Motion Sensor 4 Out
Distance Sensor Output
Open9
Open10
Open11
RC0
RC1
RC2
RC3
RC4
RC5
RC6
RC7
DTMF Serial In
DTMF Serial Out
Motor Serial In
Motor Serial Out
MicroLed1
MicroLed2
MicroLed3
MicroLed4
Osc1
Osc2
Y1
500khz
C1
C2
C3
0.1uf
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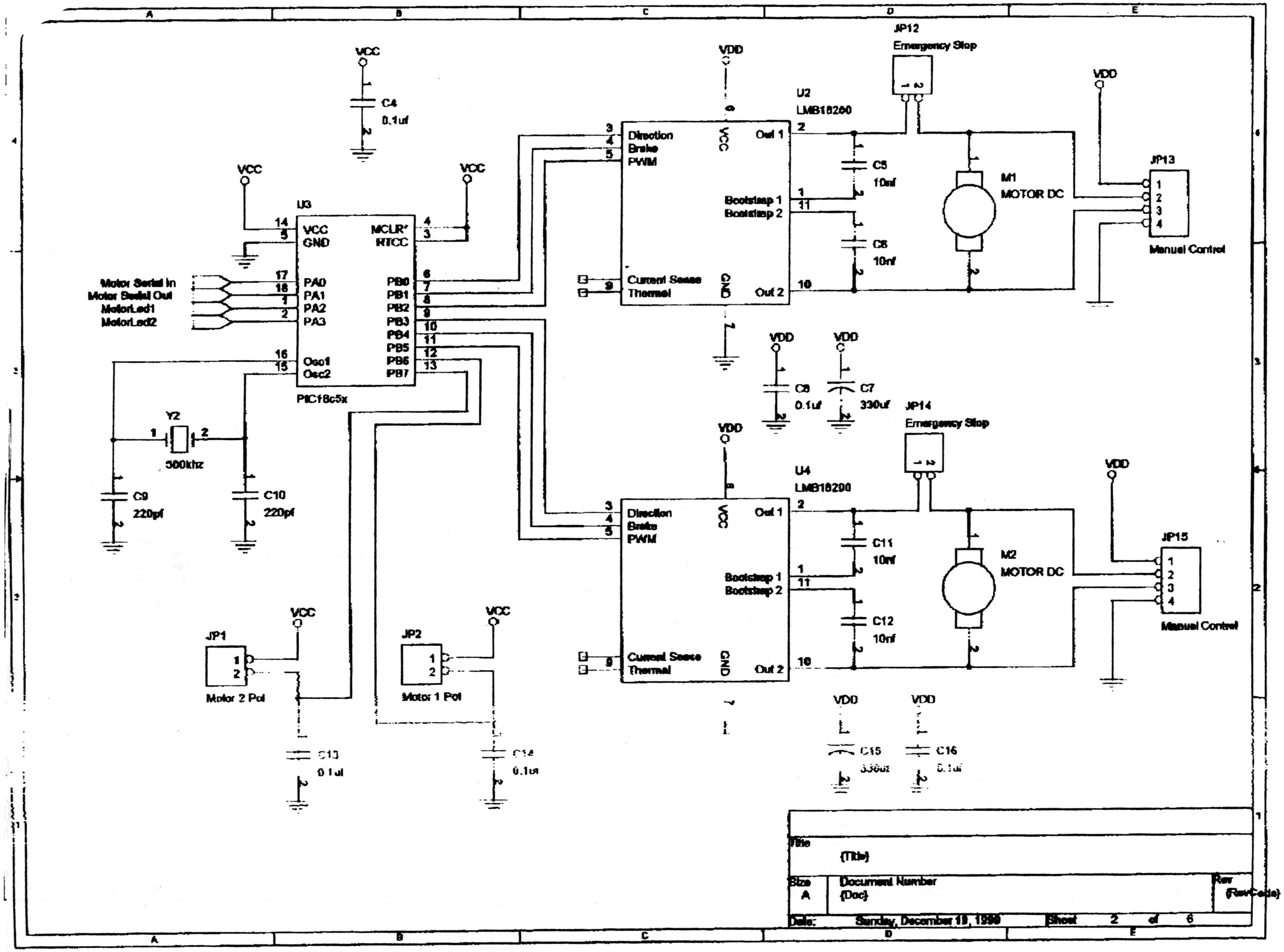

VCC
C4
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U3
VCC
GND
MCLR'
RTCC
PA0
PA1
PA2
PA3
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
Osc1
Osc2
PIC16c5x
Motor Serial In
Motor Serial Out
MotorLed1
MotorLed2
Y2
500khz
C9
220pf
C10
220pf
JP1
Motor 2 Pot
C13
0.1uf
JP2
Motor 1 Pot
C14
0.1uf
VDD
U2
LMB18200
Direction
Brake
PWM
Current Sense
Thermal
VCC
GND
Out 1
Bootstrap 1
Bootstrap 2
Out 2
C5
10nf
C6
10nf
JP12
Emergency Stop
M1
MOTOR DC
JP13
Manual Control
C8
0.1uf
C7
330uf
U4
LMB18200
C11
10nf
C12
10nf
JP14
Emergency Stop
M2
MOTOR DC
JP15
Manual Control
C15
330uf
C16
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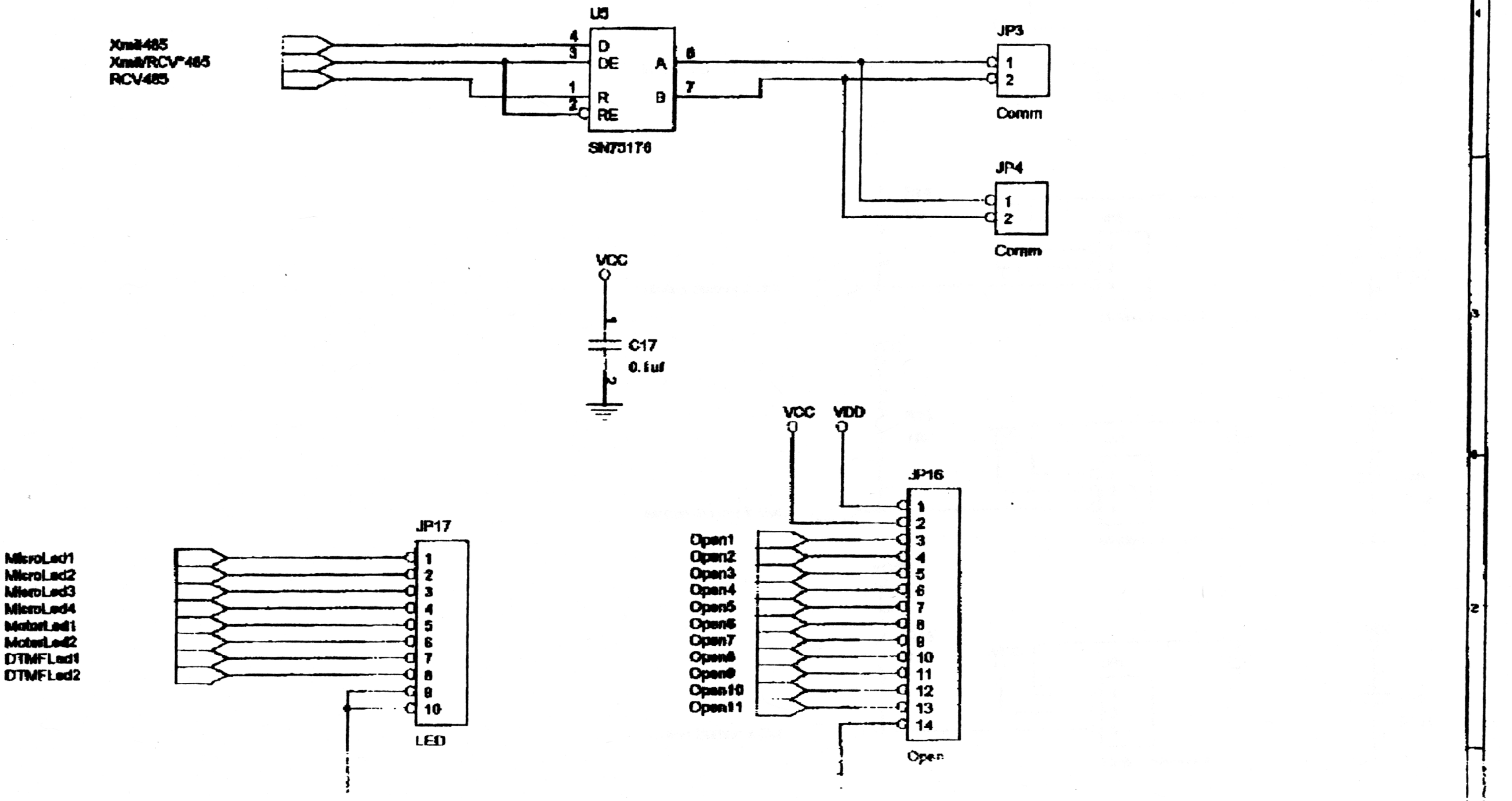
6



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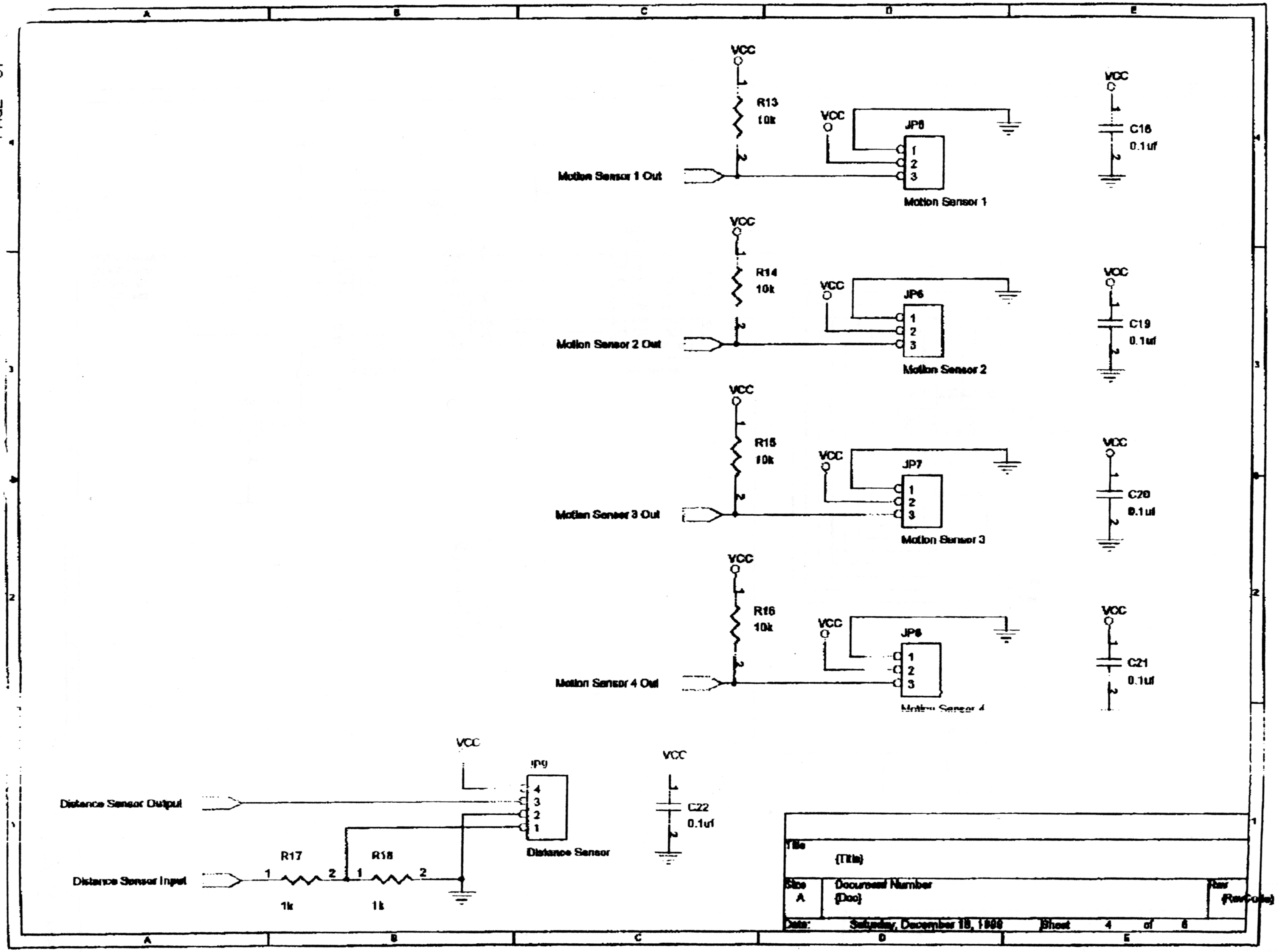

A
B
C
D
E
VCC
R13
10k
JP8
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2
3
Motion Sensor 1
Motion Sensor 1 Out
C18
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R14
10k
JP6
Motion Sensor 2
Motion Sensor 2 Out
C19
0.1uf
R15
10k
JP7
Motion Sensor 3
Motion Sensor 3 Out
C20
0.1uf
R16
10k
JP8
Motion Sensor 4 Out
C21
0.1uf
JP9
4
Distance Sensor
Distance Sensor Output
Distance Sensor Input
R17
1k
R18
1k
C22
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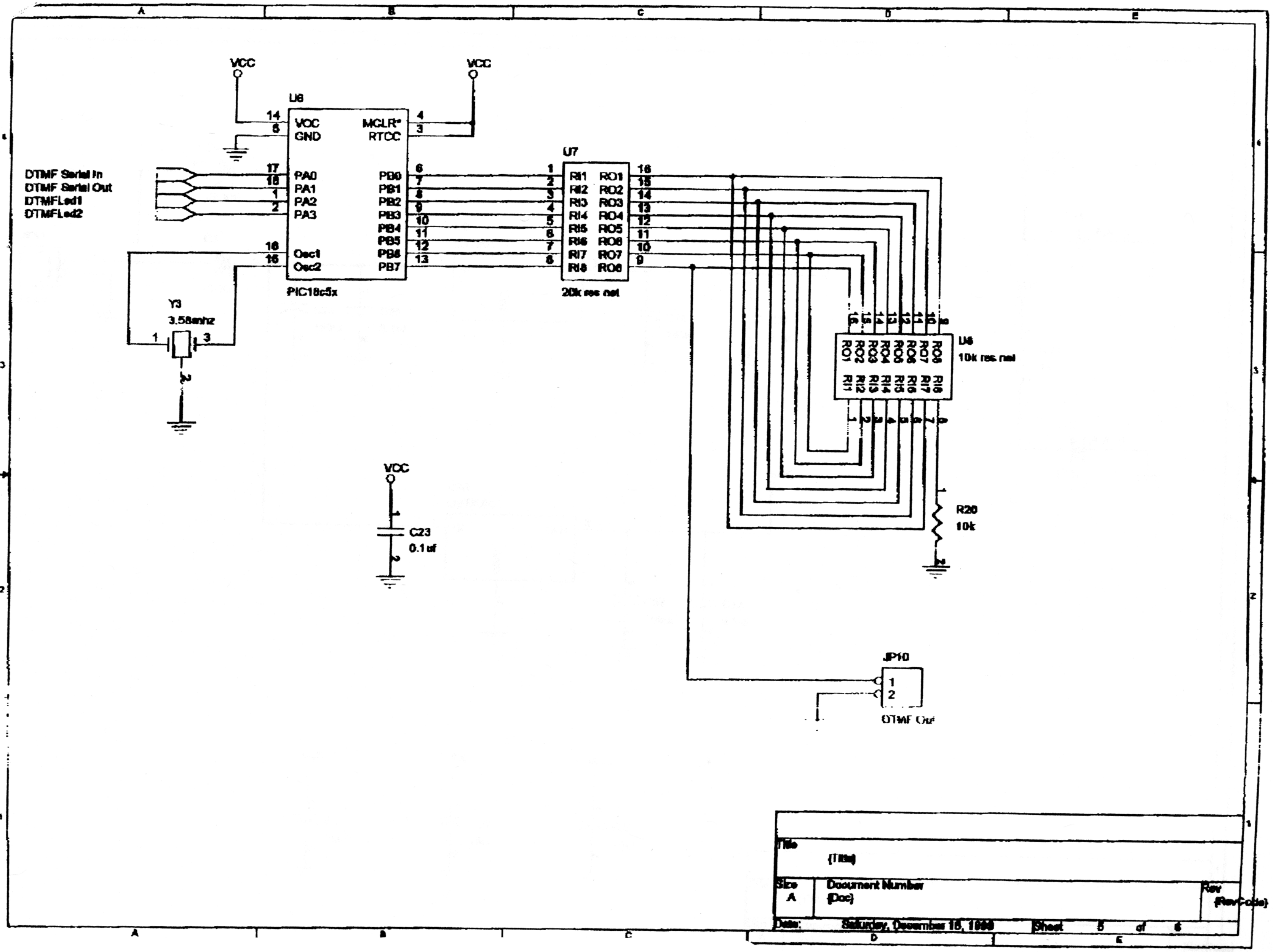
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GND
MCLR*
RTCC
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PA2
PA3
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
Osc1
Osc2
PIC16c5x
DTMF Serial In
DTMF Serial Out
DTMFLed1
DTMFLed2
Y3
3.58mhz
U7
20k res net
U8
10k res net
R20
10k
C23
0.1uf
JP10
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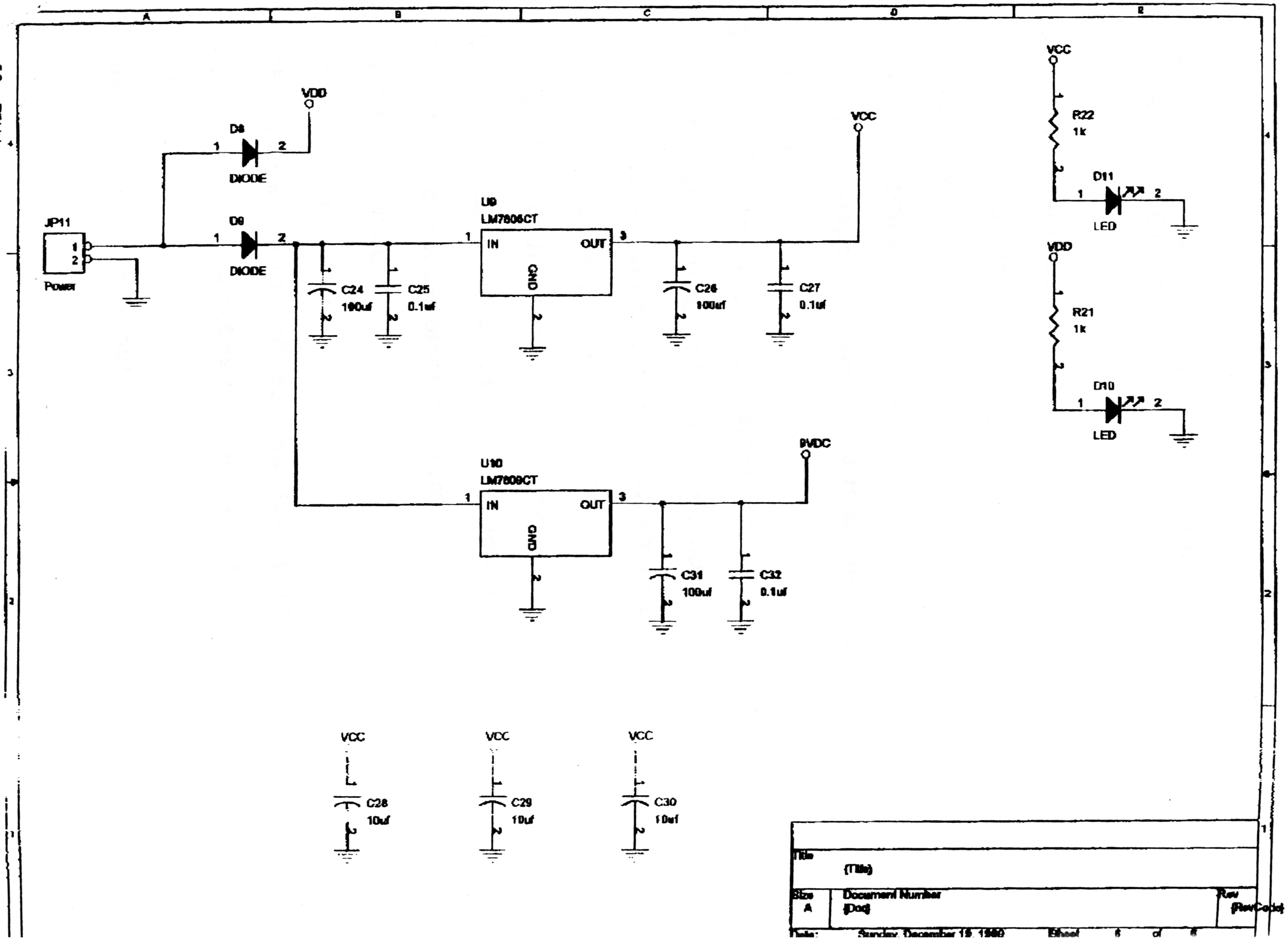

A
B
C
D
E
1
2
3
4
JP11
Power
1
2
D8
DIODE
D9
DIODE
VDD
U9
LM7805CT
IN
OUT
GND
VCC
C24
100uf
C25
0.1uf
C26
100uf
C27
0.1uf
U10
LM7809CT
9VDC
C31
100uf
C32
0.1uf
R22
1k
D11
LED
R21
1k
D10
LED
C28
10uf
C29
10uf
C30
10uf
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Date: Sunday, December 19, 1999
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