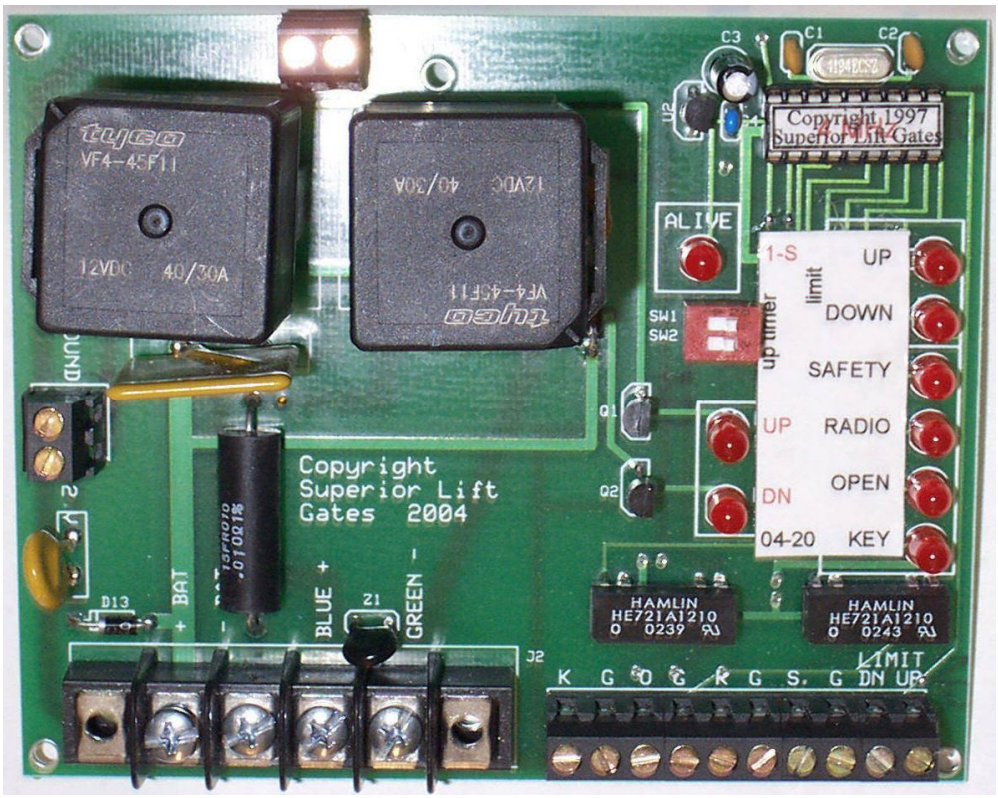
Operation of the
Gate Controller



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Gate Controller
Superior Security Gates, Inc

Introduction

The gate controller board was specifically designed to control the lift gate manufactured by Superior Lift Gates, Inc. This board uses the best technology currently available—a microcontroller integrated circuit. The PIC16F84 manufactured by MicroChip, Inc. of Chandler, AZ was chosen for this application because it can very efficiently perform all of the control functions required. A custom program for the PIC16F84 was developed to perform the required control functions. All timers have been implemented in this program. The control board is small in size measuring 4 x 5 inches (the motor control relays are included on the board).

Control Inputs

All of the control inputs are activated by grounding the input. Caution must be exercised to prevent static from reaching an input. Do not apply 12-volts to an input because this will damage the microcontroller and it will have to be replaced.

There are four control inputs to the controller board and they have been named: KEY, OPEN, RADIO, and SAFETY. The description of each is as follows:

KEY: The intent of this control input is to service a *key operated switch* and external gate open/close timers. If the gate is not open when this input is activated (grounded), the up motor is turned on until the up switch closes. The gate will open or will remain open as long as this input is active. When this input is no longer active, the gate will close immediately. While this input is active all other inputs are ignored and have no affect.

OPEN: The intent of this control input is to service *open* commands from devices such as keypads or free exit loop detectors (vehicle detectors). In some applications, it may be desirable to connect the radio to the OPEN input instead of to the RADIO input. If the gate is not already open or opening, the OPEN motor is turned on and the UPTIMER is initialized. The UPTIMER is held while OPEN is active.

RADIO: The intent of this control input is to service *single button* devices such as radio control or remote buttons. If the gate is closed, the up motor is turned on and the UPTIMER is initialized. If the gate is open, the down motor is turned on. If the gate is moving either up or down, the motor is turned off. If the gate is stopped but is in neither the up nor down position, gate motion is started in the opposite direction to the previous direction of motion.

SAFETY: The intent of this control input is to service *safety* inputs from a device such as a photo-electric sensor, loop detectors, or contact sensor. If the gate is moving down when this input is activated, the gate's direction of motion is reversed to open the gate. If the gate is either moving upward or is stopped in the open position, the UPTIMER delay time is set to 1 sec by a safety input. An active safety input holds the UPTIMER thereby preventing the turning on of the down motor.

The state of the four control inputs and the UP and DOWN limit switches are indicated by LEDS. An active state is indicated by an illuminated LED. The LED flashing at a 1-second interval indicates that the micro-controller and it's control program are functioning. You can use this flashing LED to check the timing of events by counting the number of on and off cycles.

Timers

UPTIMER: The usual mode of operation of the lift gate is: after fully opening, the gate will remain up for a selected length of time after which it will automatically close. The UPTIMER is bypassed by the KEY input and is held by an active OPEN input. If the gate is either moving upward or is stopped in the open position, activity on the safety input will cause the UPTIMER delay time is be set to 1 sec. Four times UPTIMER delay times are available: 2-sec, 4-sec, 8-sec, and 12-sec. One of these times should fulfill the needs of most applications, however, if you require something different, custom time intervals can be programmed by contacting the factory.

One of the four available UPTIMER delay times is selected using the DIP switches on the board. Use the table below to determine the switch setting required to set a desired time. UP is towards the edge of the board and DOWN is away from the edge of the board. The switches are labeled 1 and 2 on the switch.

TIME	SWITCH-2	SWITCH-1
6	DOWN	DOWN
12	DOWN	UP
18	UP	DOWN
24	UP	UP

TIMEOUT TIMER: If for any reason, the UP or DOWN limit switch does not close, the hydraulic motor will continue to run in an attempt to open or close the gate. The most common reasons for this are that the limit switch is out of adjustment, or something obstructed the movement of the gate. If the limit switches is out of adjustment such that the even though the gate is actually fully open or closed, the switch does not send that indication to the control board, the motor will continue to run. If the hydraulic motor runs for a long time, it will be destroyed by excessive heat. Therefore, a time-out timer has been included in the control program that will not allow the motor to run for longer than 30 seconds at a time.

TURN-ON TIMER: When power is first turned on to the board, a two second timer activates. This timer prevents the board from responding to any of the inputs to the board until the two second delay has expired. The reason for this delay is to allow devices such as loop-detectors or keypads to initialize and not command the gate to open during their power up process.

Other Features

The hydraulic system used in the gate built by Superior Lift Gates has many advantages. It produces a smoothly operating gate than can change direction almost instantaneously when the safety input is activated. It has the disadvantage that if the check valves in the hydraulic system leak, the gate may not stay closed, but may creep up because of the pull of the powerful springs in the operator. This problem was overcome by using the controller to monitor the closure of the down switch. If the down switch opens when the gate should be closed, the down motor will be turned on for two seconds to push the gate securely closed again. The up switch is monitored in a similar manner.

Microswitches are used to signal the control board that the gate is open or closed. These microswitches must be properly adjusted so that they reliably close when the gate closure mechanism approaches the end of its travel. The motor will continue running for ½ second after a switch closes to insure that the gate reaches the end of its travel before the motor shuts off. This makes the adjustment of the switch less critical than it would be otherwise.

Schematic

A schematic of the Gate Controller board is provided. It is intended that this schematic be used to assist in the trouble shooting and repair of the control board. The heart of the control board is the program written into the PIC16F84 micro-controller integrated circuit.

Connections

All connections to the Gate Control board are made through the terminal barrier strips mounted on the board. The four command inputs are connected directly to indicator LEDs with no LED drivers. Therefore the devices connected to these inputs must be able to sink 11 ma, the amount of current flowing through the LED. Since all known devices that are likely to be connected to the control board inputs use either relay contacts, open emitter, or open drain outputs, this arrangement works well. Two 2-pin terminal strips have been provided to supply power to auxiliary devices. The one on the top of the board is intended to supply power to the radio and loop detectors mounted on the back plate, and the one on the side is intended to supply power to external devices such as keypads.

Controller Wiring

The gate control board must be connected to a power source, the hydraulic motor, limit switches, control inputs, etc. to form a complete system. Devices such as remote control radios, loop detectors, photoelectric sensors, keypads, etc., that are used to operate the gate are connected through the small terminal strip on the right hand side of the board. The +12 volt primary power lead is connected through a switch to the + BAT terminal of circuit board and the negative power lead is connected to the – BAT terminal (both located on the large terminal strip at the left hand side of the board). The blue (+) and the green (-) motor wires are connected to the large terminal strip. The output at the blue wire is +12 volts when the gate is commanded to open.

Trouble Shooting

There are many reasons why the gate will not operate as expected or not at all. The first thing to check is to see that the LED at the upper left is blinking on and off at a 1 sec interval. A blinking LED indicates that the control board has power and that the microcontroller is alive. If the LED is not blinking, try turning the power off to the gate for a few seconds and then back on again using the power switch. Next, check to see what other LEDs are lit. Is one or more of the four control inputs (KEY, OPEN, RADIO, or SAFETY) stuck on? If so, this may cause the gate not to operate as expected. If none of the control inputs are stuck on and the gate is open and did not close automatically, try commanding it with the radio or the key.

The four control inputs can be tested using a jumper wire from one of the ground terminals on the terminal strip to the input to be tested. Tighten the screw on the ground terminal to the wire to prevent static buildup on the wire that could damage the microcontroller. When the jumper is connected to an input, the corresponding LED on the control board should light. If it doesn't this indicates an open connection.

Microswitches (called limit switches) are used to signal the control board that the gate is open or closed. These microswitches must be properly adjusted so that they reliably close when the gate closure mechanism approaches the end of its travel. The motor will continue running for ½ second after a switch closes to insure that the gate reaches the end of its travel before the motor shuts off. This makes the adjustment of the switch less critical than it would be otherwise. Make sure that these switches are securely closing while at the same time there is not so much motion of the switch lever that it is damaged. The closure of these switches is indicated by the "UP" and "DOWN" LEDs on the control board.

The upper LED located at the lower left hand side of the control board indicates that the hydraulic motor is being commanded to open the gate (UP) while the other LED indicates that the hydraulic motor is being commanded to close the gate (DN). The corresponding relay should activate and should click when it either opens or closes. Use a voltmeter to check the voltage at the hydraulic motor. The polarity of the motor voltage indicates whether the gate is opening or closing. The hydraulic control valve near the output of the motor can be opened to bypass the hydraulic fluid away from the cylinder to allow the hydraulics to be tested without actually moving the gate.

If the transient absorber connected between the relay terminals to which to the wires supplying power to the hydraulic motor are connected becomes defective or disconnected, the gate will operate in an erratic manner. One symptom is that, when the gate is moving downward, instead of reversing direction upon activation of the safety input, the gate will stop. Another symptom is that the gate will not properly execute the radio sequence of stopping, move in the reverse direction, stop, move in the reverse direction, stop, etc.

Board Tests

The first thing to check is to see if the ALIVE LED (upper left) is flashing on and off at a 1-second rate. If it is, there power to the control board and the microcontroller is operating.

The next thing to check is the battery voltage at the left end of the terminal strip on the board. This voltage should be at least 12-volts when the motor is running. If the voltage drops increasingly lower as the motor runs, the battery is run down or bad and needs to be charged or replaced. It also possible that a battery terminal is corroded or the wire going to the battery is bad.

If the gate is up and will not come down, then look at the LEDs to see if any of the KEY, OPEN, or SAFETY LEDs are on. If any of these LEDs are on, the gate will not come down. The fix is to determine what external input to the board is causing the LED(s) to be on and to clear it. For testing purposes, the wire(s) going to the K, O, or S inputs can be disconnected from that input to the board.

The KEY and OPEN button at the left of the control board can be used for testing. When the KEY switch is on (up position), the KEY LED should come on and the gate should go up. The gate will stay up until the KEY switch is turned off. The OPEN push button can be used to test the OPEN function. If this button is pushed when the gate is down, the gate should open and stay up until the UP-timer times out, then the gate should come down again

Notice that the corresponding UP and DOWN LEDs (on the left side) turn on when the gate is commanded to move either up or down.

There are two limit switches in the gate operator. One switch closes when the gate is down, and the other closes when the gate is up. These switches must be properly adjusted so that they close just before the gate reaches the end of its travel, whether this be up or down. The UP and DOWN LEDs at the top of the right column of LEDs will light when the corresponding limit switch closes.

Relay and Motor Problems

A possible problem area is the relays and motor. This problem area can be troubleshot as follows:

When the gate is commanded to move up or down, the corresponding UP or DOWN LED (left column of LEDs) should light and the motor should turn on. If this happens but the gate does not move or moves very slowly, then the problem is in the hydraulics. Check to see if there is sufficient oil in the reservoir. If so, the pump may be leaking internally, or the oil may be leaking internally past the piston in the hydraulic cylinder. Another possible problem is that there is a blockage in the hydraulic line. This can happen at the fitting of a flow control valve (remove the fitting to check).

If the UP or DOWN LED comes but the motor does not run, the problem could be with the relays, the wiring, the motor, or with the thermally reset circuit breaker. A voltmeter is very helpful in diagnosing the problem. Use the voltmeter to the measure the voltage at the

terminal strip where the blue and green motor wires attach to the board. If there is voltage at these terminals (should be at least 12-volts), then the problem must be with the motor or the wiring. A common problem is that the motor brushes have worn out.

If voltage is not present between the green and blue motor wires when the gate is commanded to move up or down the problem could be one of the relays. Note that the polarity of the blue wire will be positive when the gate is moving up and negative when the gate is moving down. A relays can be replaced by pulling it from it's socket and inserting a new relay.

If the gate still does not operate correctly, further testing is needed.

There could be a problem on the control board itself. In most cases, the board can be repaired on site. To determine whether or not the board can be repaired on site or must be replaced, follow the steps below.

These steps are designed to find out what is working and what is not.

1) Does the ALIVE LED blink?

2) Do the KEY and OPEN LEDs light when the KEY switch is turned on or the OPEN button pushed?

3) Does the radio LED turn on when the radio control button is pushed?

4) Does the DOWN LED light when the gate is down and activates the down limit switch?

5) Does the UP LED light when the gate is up and activates the up limit switch?

If the answer to all of the above is yes, then most likely, the board itself is working fine.

Microcontroller Problems

If all of the tests above pass and the controller is acting strange, then the problem is most likely that the microcontroller has been damaged by lightning or static. If this is the case, the microcontroller must be replaced. This can be done on site.

REPLACING MICROCONTROLLER INTEGRATED CIRCUIT IN THE SUPERIOR LIFT GATES CONTROLLER

INTRODUCTION In the majority of cases in which the gate controller has stopped working or is working in a strange manner, the problem is that the microcontroller integrated circuit has been damaged. This damage is usually caused by over voltage from static, a lightning strike, or connecting an input to +12 volts. Replacing the microcontroller will fix the problem.

TESTING If the microcontroller is functioning the 1-S LED will blink on and off at a 1-second rate. But often, even if this LED is flashing, the program in the microcontroller has been damaged and is not operating correctly. Even through the microcontroller is not working correctly, the input LEDs on the right side of the board will still function. This gives you a way to test the 5-volt power supply. If the gate is down, the DOWN LED should light and if the gate is up, the UP LED should light. You can operate the DOWN and UP limit switches by pushing them with your fingers to see that the corresponding LED lights up. If the +5V power supply seems to be working, proceed to change the microcontroller.

REPLACING THE MICROCONTROLLER Insert the tip of a small screwdriver or the tip of a small knife blade between the end of the integrated circuit and it's socket and carefully pry the microcontroller from its socket. Use caution since the end of the integrated circuit you are prying on can suddenly come loose bending the pins at the other end.

Align the pins of the replacement integrated circuit with the pins of the socket and carefully push the integrated circuit into the socket with the same orientation as the original. The label should be right side up so you can read it. Make sure that all the pins have been inserted into the socket and none have bent over or have been inserted on the outside of the socket

Loop Detector Terminals and Wire Conventions

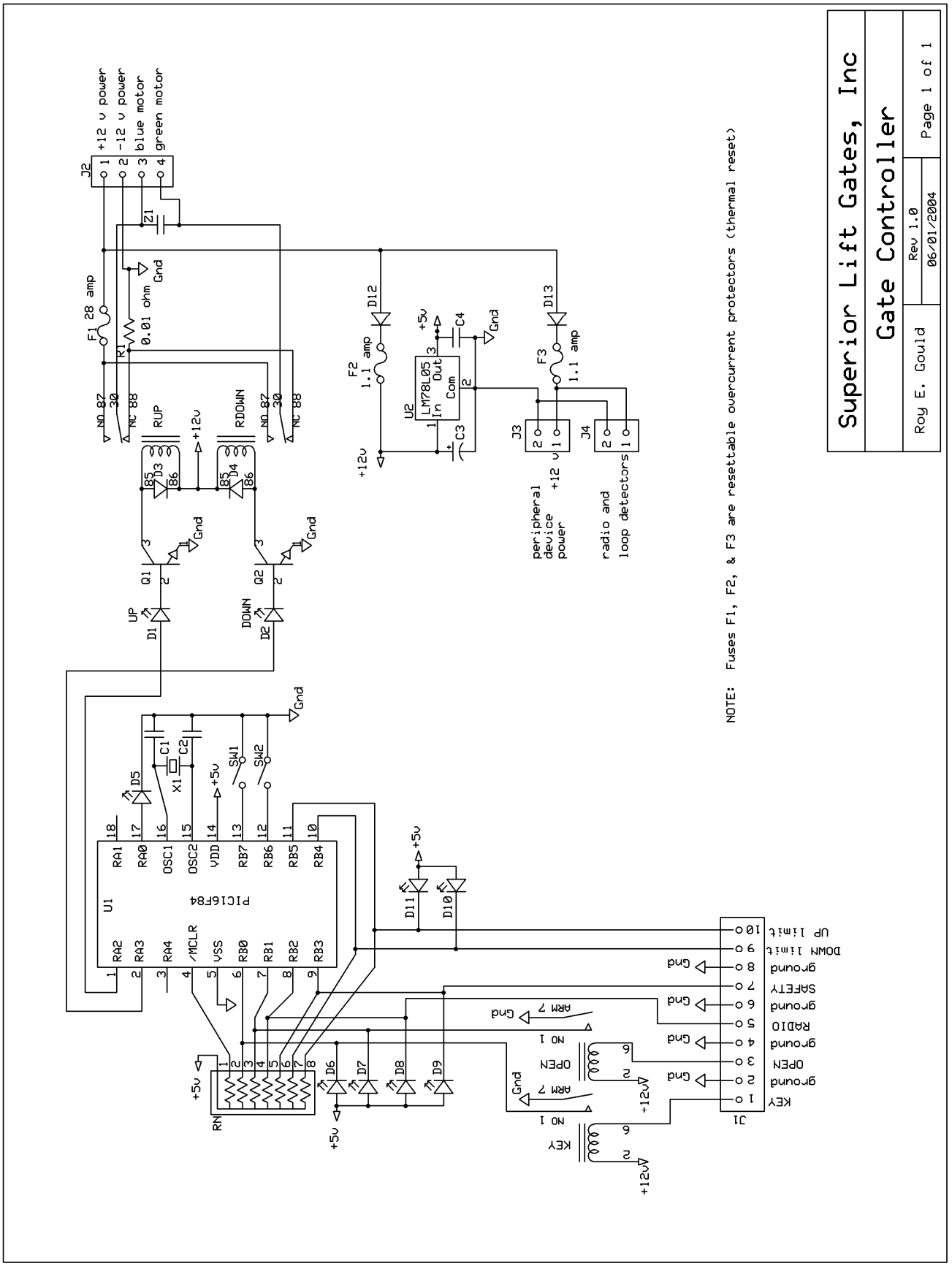
Pin	Function	Wire Color	Connect to
1	+12-V power	Black	+12 V)
2	-12-V (common)	White	ground
3	Relay 2 N.O.	Orange	
4	Chassis Ground	Green	ground
5	Presence relay common	Yellow	ground
6	Presence relay N.O.	Blue	OPEN or SAFETY
7	Loop	Gray	loop
8	Loop	Brown	loop
9	Relay 2 Common	Red	
10	Presence relay N.C.	White/Black	
11	Relay 2 N.C.	White/Red	

Connect pins 2, 4, & 5 to ground

Testing the Loop

A good loop is critical for consistent operation from your detector. When installing your loop take great care not to damage the insulation of the wire. Breaks in the insulation can cause the wire to act as a wick and pull in moisture corroding the wire itself and causing erratic operation from the detector. Cross-link polyethylene is the most popular insulation and is strongly recommended (XHHW), 16 or 18 gauge. If the lead-in is extremely long increase the wire size. The insulation must be able to withstand wear and abrasion from pavement shifting, moisture and attacks by solvents and oils, as well as withstand high temperature sealants. Stranded wire is recommended over solid wire because of its mechanical characteristics. Stranded wire is more likely to survive bending and stretching than solid wire.

Megging a loop and lead-in should have an insulation resistance to earth greater than 20M ohms, measured at 500 volts. One end of the loop goes to one lead from the ‘meggar’ and the other lead from the ‘meggar’ goes to a good ground. The resistance of the loop should be less than 10 ohms when measured with a standard ohmmeter. If a problem with a loop is suspected try swapping the detector with a known good detector and see if the problem follows the detector or the loop.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Roy E. Gould
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NOTE: Fuses F1, F2, & F3 are resettable overcurrent protectors (thermal reset)
J2
+12 v power
-12 v power
blue motor
green motor
Z1
F1 28 amp
R1 0.01 ohm
Gnd
NO 87
30
NC 88
RUP
RDOWN
+12v
D3
D4
Q1
Q2
UP
DOWN
D1
D2
D12
F2 1.1 amp
U2 LM78L05
In Out Com
C3
C4
+5v
D13
F3 1.1 amp
J3
J4
peripheral device power +12 v
radio and loop detectors
U1
PIC16F84
RA1
RA0
OSC1
OSC2
VDD
RB7
RB6
RB5
RB4
RA2
RA3
RA4
/MCLR
VSS
RB0
RB1
RB2
RB3
C1
C2
X1
SW1
SW2
D5
RN
D6
D7
D8
D9
D10
D11
ARM 7
NO 1
OPEN
KEY
J1
key
ground
OPEN
ground
RADIO
ground
SAFETY
ground
DOWN limit
UP limit