

mSDC20D

Microprocessor Controlled 12-Volt Automotive Personal Computer Shutdown/Startup Controller

General Description

The uSDC or Micro-Shut-Down-Controller is an electronically controlled automotive power switching device. It is primarily designed for the purpose of starting up or shutting down a personal computer used in a motor vehicle. It interfaces with a computer motherboard's power switch header that would normally connect to the push-button switch on the front of a personal computer case. The uSDC includes a high current relay that will cut off or apply all power to the power supply of the personal computer to prevent any substantial current draw when the computer is not in use. The uSDC also provides a timing mechanism that is user selectable allowing the computer to remain "on" for an amount of time after the ignition has been turned off. The uSDC allows the user to mount the personal computer in remote locations (such as a trunk) and provides hands off method automating the startup and shutdown sequence while constantly monitoring the environmental conditions.

Figure 1
Product Photo:



Features

- Microprocessor Control
- Voltage Sensing of Battery to prevent over discharge
- Temperature Sensing (Environmental Protection)
- Adjustable Low Voltage Threshold
- Adjustable Power Down Timer Control
- State indicator feedback LED (Flashes at different rates)
- 20-Amp Load Switch
- Fuse Protection
- Reverse Voltage Protection
- Load Dump Protection (Over Voltage)
- Very Low standby power (50 micro-Amps Typical)
- Startup/Shutdown Motherboard On/Off Pulse
- Startup on Engine Running
- Computer "On Sensing" to prevent unknown states
- User Optional Switch for Instant Off

Applications

- Automotive Personal Computer Power Control
- Automotive MP3 Player Power Control
- Automotive Display Power Control
- Low Battery Cut-Off Controller for 12V Accessories (Air Compressor, Flashlight, Electric Cooler, Lighting, Etc.)
- OEM Application (Inquire about Custom Firmware)
 - o Solar Powered Systems
 - o Telematics/GPS Systems
 - o Battery Controlled Systems

Operation

Quick Overview:

The uSDC has three main inputs, 12 Volts In (VIN), Accessory (ACC), and Ground (GND). These signals supply power to the uSDC and tell it when to turn on/off. There are two main outputs, 12 Volts Out (VOUT) and the Motherboard Power Switch signal (MB Power SW). The signals VIN, GND, ACC, and VOUT are blade connectors that are capable of carrying a lot of current. The MB Power SW signal resides on the Jumper Block (JP1) and consists of two pins from the 14-pin header. A 2-wire jumper must be connected from the controller to the PC Motherboard in order for the uSDC to turn on and off the computer.

In normal operation if VIN is supplying 12 volts the uSDC is always sensing for activity on the ACC line. When the Accessory Input (ACC) goes high, the uSDC will wake up if the Temperature of the uSDC and the Battery Voltage (measured at VIN and GND) are in the "Operating Range." The uSDC will turn on the switch (Relay) connecting VIN to VOUT and power will now be applied to the computer power supply. The uSDC will then proceed to send a startup pulse to turn on the computer and the computer will boot and remain on. This is called "Running Mode" The uSDC will stay in this state as long as ACC doesn't go low or the Temperature/Voltage doesn't go out of the safe operating range. The indicator LED stays "Full On" in this mode.

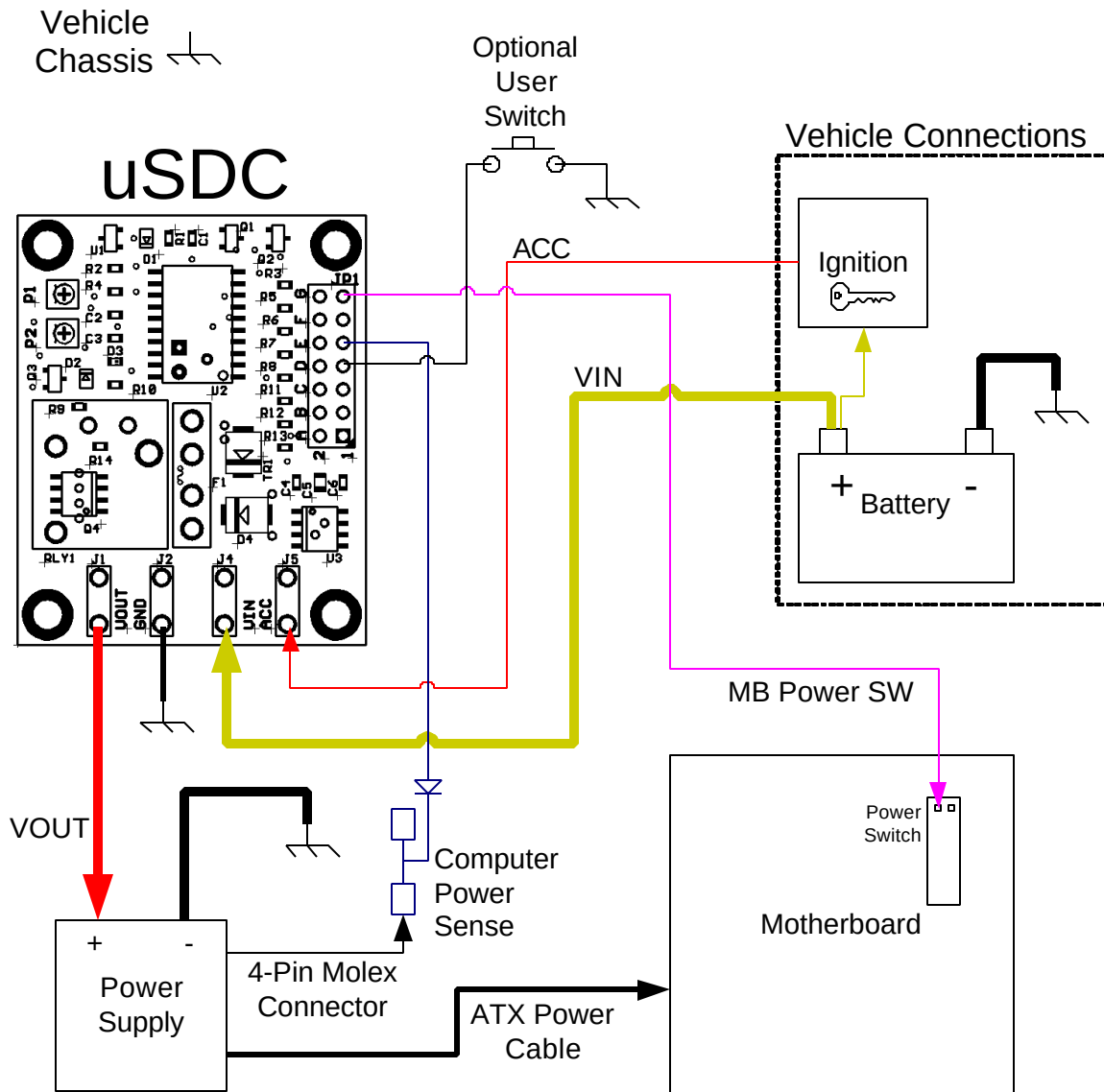
Operation Continued

When the ACC line goes low the uSDC will go into "Count Down Mode" where it starts a timer that is user adjustable by the potentiometer at location P1. During Count Down Mode, the LED will flash once per cycle. If ACC comes back at any time during Count Down Mode, it will abort the Count Down Mode and go back to Running Mode.

When the counter expires, the uSDC will go into "Power Down Mode" where it first sends a pulse to the personal computer over the MB Power SW line (unless the computer was already off) causing the personal computer to initiate the shut down sequence. In this mode the LED will flash twice per cycle. After a fixed amount of time passes or the uSDC detects that the computer is now off, the uSDC disconnects VOUT from VIN and goes into "Sleep Mode" where it remains in this state and draws very little power.

If there is an over or under temperature condition, power will be cut instantly and the LED will flash three times per cycle.

Figure 2
Connection Diagram



Operation Continued

Connection Diagram Details (Figure 2)

1. The Yellow VIN connection should be a heavy gauge connection (12 or 10 gauge) wire directly connected to the battery. This is the line where most of the current will flow in.
2. The Red ACC (Accessory) line can be light gauge wire. This is the same line that turns on a vehicle stereo only when the ignition is clicked into the second position.
3. Red VOUT line connects to the + side of a 12-volt computer power supply or DC-AC inverter connected to a computer power supply. It should be heavy (12 or 10) gauge wire.
4. The purple MB Power SW is a 2-pin jumper cable that is connected from the controller to the motherboards power switch. Make sure the polarity is correct, if it is backwards it won't damage anything but it won't turn on or off the computer.
5. The Computer On Sense cable consists of a signal Diode that connects from the controller to a 4-pin Molex computer Hard Drive or CD-Rom Power connector connecting to +12 volts. This is how the controller detects the computer is on so that it doesn't inadvertently turn on/off the computer when it is already on or off. It also allows "Power Down Mode" to be very short. The diode's polarity points **away** from the uSDC.
6. The Optional User Switch is a momentary switch that is pressed to turn off the computer faster, see the operational timing diagram, when pressed "Count Down Mode" is finished and "Power Down Mode" is started.
7. The Thick Black wires are heavy gauge Ground wires. The black wire going to the controller should be at least 18 gauge or thicker. It doesn't carry much current, but is used for voltage sensing.

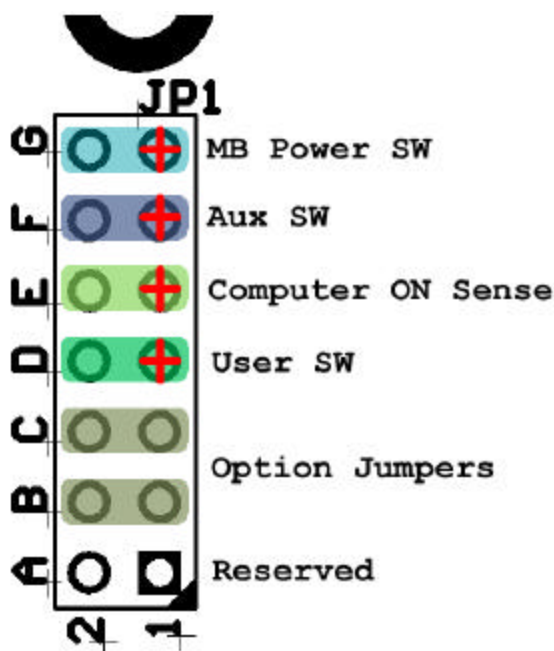


Figure 3
Jumper Block Diagram

Note: the Red + terminal indicates the active signal. The other signal in each pair is ground. Be careful when connecting signals that could be damaged from being plugged in backwards.

Jumper Block Details

MB Power SW: This output signal goes to the motherboard to turn on/off the computer. When asserted, this signal shorts to ground. To detect which pin on the motherboard to connect to, use a voltmeter set to **Ohms** and probe both pins on the motherboard while the motherboard is off. Connect the black probe (-) to a mounting hole or (Ground.) The + pin on the motherboard is the pin with the higher number or more resistance to ground.

Aux SW: This optional output signal turns on an auxiliary supply or other device. When asserted, this signal shorts to ground.

Computer On Sense: This optional input signal detects if the computer has power so that it knows if it should turn if on/off (I.E. Don't press the off button if already off.) When the power is off, this signal gets pulled to ground (0 Volts) through a diode.

User SW: This optional input signal is for connecting an external momentary push-on switch. This signal is connected to ground when the switch is pushed and disconnected when released.

Option Jumpers: These two settings allow up to 4 different configurations of the uSDC. See the below diagram for different user mode options.

Configuration

Figure 4
User Jumpers

0: Default User Mode, explained in the timing diagram below. Start up pulse is sent when ACC goes high.

1: Voltage Sense Start Mode. In this mode the controller will wait until the car battery voltage is above 13 volts indicating that the engine is running and the alternator is charging the battery or keeping it charged. This mode is useful if you have a power supply that requires more than 12 volts to operate or your worried about the "Engine Cranking Transients." When the car is turned off (ACC goes low), the controller behaves the same as the default mode.

2: Not yet defined

3: Not yet defined

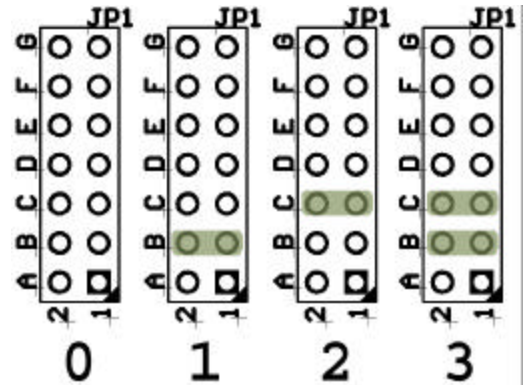
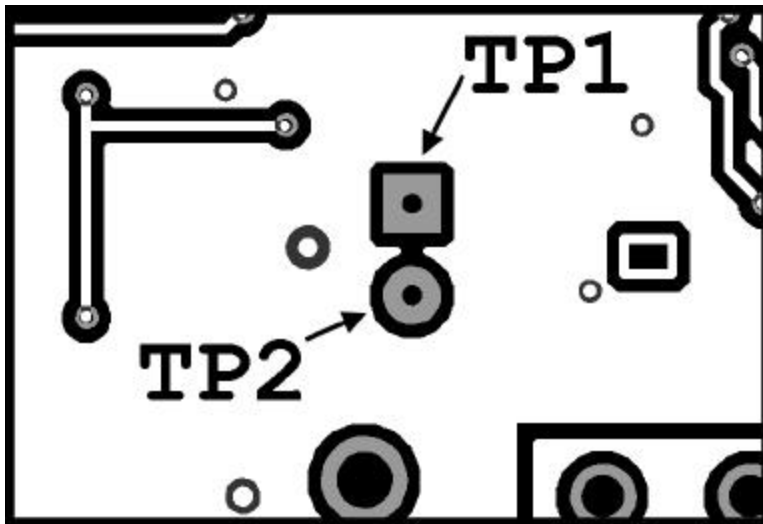


Figure 5
Potentiometer Probe Points



These test points are useful for fine-tuning the Potentiometer settings. The voltage measured at these test points can be correlated into a Time or a Voltage Value. By making small adjustments to P1 and P2, the user can get an accurate setting by probing these points.

Use a voltmeter to probe these test points. Connect the Black or Negative (-) wire to ground. The mounting holes are convenient ground locations. Connect the Red or Positive (+) probe of the voltmeter to a test point.

The controller must be powered for these tests. Connect the positive terminal to both VIN and ACC. Connect the negative side to GND. 12 volts or a 9 volt battery can power on the uSDC

Test Point Equations:

TP1 "Count Down Mode Timer Value" (0-30 minutes) $Time\ in\ minutes = TP1\ Voltage * 6$ $Time\ in\ seconds = TP1\ Voltage * 360$	Example: With P1 set in the middle of its range, TP1 reads 2.50 Volts. $Count\ Down\ Timer = 2.50 * 6 = 15\ minutes$
TP2 "Low Voltage Detect Value" (Measured at VIN, 10-12 Volts) $Low\ Voltage\ Detect\ Value = (TP2\ Voltage) * 0.4 + 10$	Example: With P2 set in the middle of its range, TP2 reads 2.50 Volts. $Low\ Voltage\ Detect\ Value = (2.50 * 0.4) + 10 = 11\ Volts$

Note: In the above example, when the voltage at VIN goes down to 11 volts, the uSDC will go into "Power Down Mode." It will not recover from this mode until the voltage is above this voltage plus the hysteresis voltage of 450mV, which would be a total of 11.45 Volts.

Mechanical

Figure 4
uSDC Top

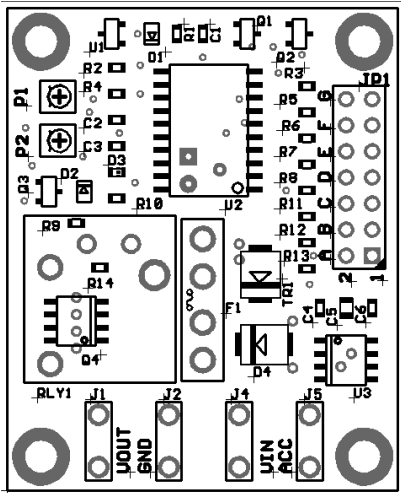


Figure 5
uSDC Bottom

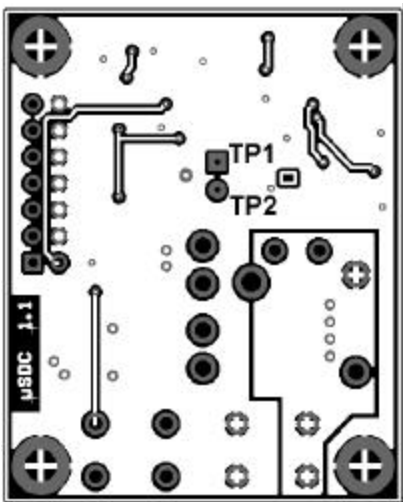


Figure 4 shows the top view of the uSDC. Note the potentiometers or “trimmer pots” P1 and P2. A small Philips head screwdriver is required to adjust.

Figure 5 shows the bottom view of the uSDC the only user areas here are TP1 and TP2 which are used to “fine tune” the adjustments at P1 and P2 using a volt meter.

Mechanical Specification (Table 1)

Board Dimensions	1.85"L X 1.5"W X 1"H	The circuit board is 0.062" thick.
Mounting Holes	4 - 0.125" grounded holes	Mounting holes are located at (0.13",0.13"),(0.137",0.13"),(0.13",0.172") (0.137",0.172")
Power Terminals	0.052"Thick, 0.250"Wide Lug	Lugs use standard off the shelf mating connectors VIN, GND, VOUT, ACC
Jumper Block (JP1)	2x7, 0.1"Spacing	Used for connecting signals to the computer and user settings
Operating Temperature	-40C to 85C	The temperature at which the uSDC Micro Controller will operate and provide protection for the devices connected to it.
Allowable Temperature	0C to 50C	The uSDC will detect if the ambient is too hot or too cold to function without damage. Will prevent power-up and initiate immediate power-down if out of the operating range

Notes:

Use caution when connecting metal mounting hardware to the uSDC. Do not short out connections around mounting holes.

The Temperature Sensor is located in the upper left hand corner of the uSDC. The upper left mounting hole can act as a heat sink for the temperature sensor. The uSDC will only be effective at temperature protection if it is near the devices it is protecting.

Electrical

Electrical Specification (Table 2) Input Signals

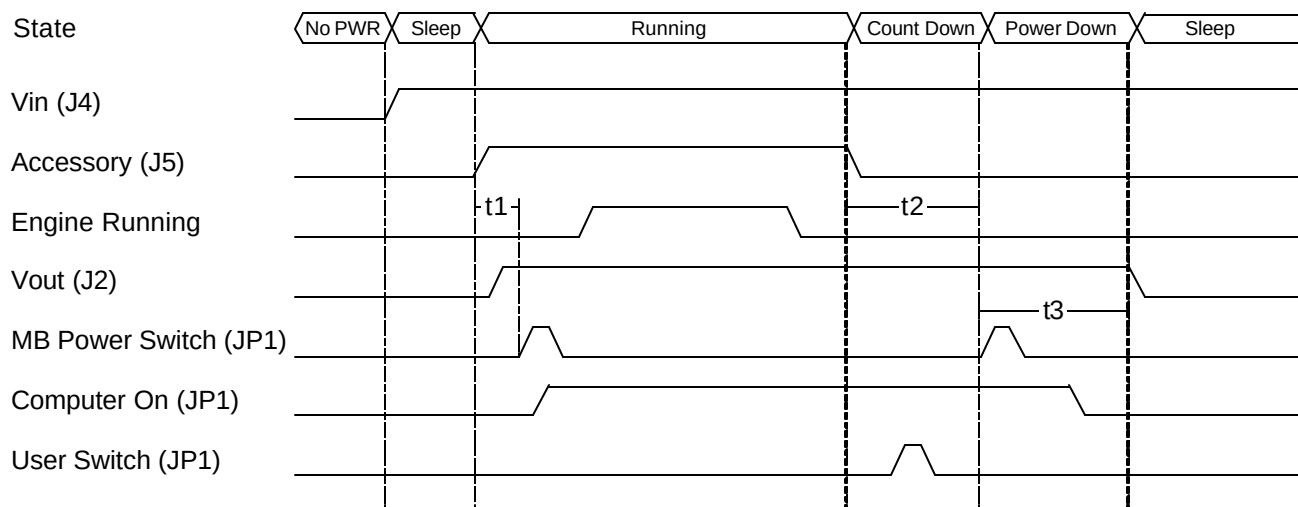
Connection	Parameter	Min	Typ	Max	Units	Notes
VIN	Operating Voltage	7	13.8	22	V	The voltage range at which the uSDC will operate. The uSDC will NOT output 12 volts over this range. It is a switch/relay device
VIN	Operating Current		80	100	mA	The maximum amount of current the uSDC itself will draw when on and functioning
VIN	Standby Current		50	100	uA	The amount of current the uSDC draws when in "Sleep Mode." A small number here means the longer the vehicle can sit without draining the battery.
VIN	Over-Voltage Clamp		22	24	V	If the voltage at the input goes over this voltage, the uSDC will try to blow the fuse before damaging the uSDC and other downstream devices
VIN	Reverse Voltage Clamp	-0.8	-0.3		V	If the polarity is reversed at VIN and GND, the uSDC will try to blow the fuse before damaging the uSDC
VIN	Low Voltage Detect Range	10		12	V	Sets the Low Voltage trip point. Adjustable by trim pot P2
VIN	Low Voltage Hysteresis		450		mV	The voltage added to the Low Voltage Detect value to exit "Low Voltage Shutdown Mode" (Voltage must be this much higher than the trip point to be considered good)
VIN	Low Voltage Time Hysteresis		5		Sec	The amount of time the voltage must remain below the "Low Voltage Detect" setting to enter "Low Voltage Shutdown Mode"
VIN	Engine Running Voltage	12.9	13	13.1	V	The voltage at which the uSDC detects that the alternator/engine are running
ACC	Input Low Voltage	-0.5	0	2	V	The voltage at which this signal detects a Low Level
ACC	Input High Voltage	6	13.8	22	V	The voltage at which this signal detects a High Level
User SW	Input Low Voltage	-0.5	0	1	V	This signal is asserted when in this range. (Short to ground to assert)
User SW	Input High Voltage	3	5	5.5	V	This signal is not asserted when in this range. This signal has an internal pull-up resistor.
Computer On Sense	Input Low Voltage	-0.5	0.6	1	V	This input should be connected with a diode to the +5 or +12 volt power supply rail of the main PC Power Supply. When the power supply rail goes low, it will pull this signal low through the diode.
Computer On Sense	Input High Voltage	3	5	5.5	V	This signal has an internal pull-up resistor. This signal is asserted when in this range and the external diode will be reversed biased.

Electrical continued

Electrical Specification (Table 3) Output Signals

Connection	Parameter	Min	Typ	Max	Units	Notes
VOUT	Load Current			20	A	The relay is rated at 25 amps. The uSDC ships with a 20 amp fuse
MB Power SW	Output Sink Current		5	50	mA	This open collector output pulls to ground when asserted
AUX SW	Output Sink Current		5	50	mA	This open collector output pulls to ground when asserted
TP1	Count Down Timer Probe Point	0		5	V	The voltage at this probe point is linearly proportional to the "Count Down Timer Range" and is Set by P1
TP2	Low Voltage Detect Probe Point	0		5	V	The voltage at this probe point is linearly proportional to the Low Voltage Detect Range and is Set by P2

Figure 6
Timing Diagram



Timing Diagram Details (Figure 6)

“No PWR Mode”

When you first connect power to VIN of the uSDC, it will power up into “Sleep Mode.” To be in “No Power Mode” the VIN terminal isn’t connected to the battery yet.

“Sleep Mode”

After long periods of inactivity the controller will go into this mode drawing minimal battery power.

“Running Mode”

When the Accessory line (ACC) goes high the uSDC checks to see if the Voltage at VIN set by the threshold at P2 is high enough, and the temperature is in the operating range. At that point VOUT gets connected to VIN (and the relay clicks). The LED comes on solid and a time (t1) later the power up pulse (MB Power SW) is sent to the motherboard. At this point the computer turns on and starts booting. The engine would be started some time during this interval and the devices connected must be able to survive engine cranking. To exit running mode

the Accessory line must go low or the voltage must drop below the threshold. The engine is typically turned off before the ACC line goes low, but both can turn off simultaneously.

(t1) is 2 seconds by default.

“Count Down Mode”

In this mode the computer is waiting for an amount of time (t2) specified by the adjustment at P1. The LED flashes once per second in this mode. Fully clockwise allows maximum delay time and fully counter clockwise is minimal delay. Any time during this count down, the user switch can be pressed forcing the timer to go to zero and starting the Power Down Mode. If the Accessory signal comes back on during this time, the controller will go back into the middle of Running Mode not sending any pulses to the motherboard. If the voltage at VIN falls below the threshold (set by P2) the time spent in this mode will be very short.

(t2) is adjustable between 0 and 30 minutes.

“Power Down Mode”

After the previous timer expires, the power down pulse is sent to the motherboard (MB Power SW).The controller then waits for a time (t3) for the computer to shutdown or detects that the computer has turned off by monitoring the (Computer On) signal. The LED flashes twice per second in this mode. If the ACC line comes back on during this time the controller will wait for the computer to shut down and start over at the beginning of Running Mode sending a pulse to the motherboard to start back up.

(t3) is 90 seconds (less if the Computer On signal is used.)