

General Circuit Description:

1. Voltage is supplied all the time to the 12V pad.
2. When voltage is applied to the IGN pad, voltage is output on the 12V-OUT pad.
3. Voltage from the IGN pad also supplied power to U3 and U1 through a jumper between the A1 and A2 pads. If the supplied voltage is greater than the cutoff set point then U1 will turn on T1 and turn on Relay 1. This causes voltage to go from the 12V supply to the 12V-OUT pad.
4. There is no longer any need for voltage on the IGN pad. As long as the voltage stays above the cutoff set point, Relay 1 will remain on, supplying voltage to the 12V-OUT pad.
5. When the voltage drops below the cutoff set point, U1 will turn off T1, which will turn off Relay 1, causing the voltage at the 12V-OUT pad to turn off. The system is now waiting for voltage to be applied to the IGN pad, at which time the process will begin again.
6. There is also a timer in the circuit that is selected using the A1 and A2 jumper. If the jumper is present, the timer is not used. If the jumper is not present, the timer is used.
7. The timer is based on U2 and will override the low voltage cutoff circuit.
8. When voltage is applied through the IGN pad, voltage flows into and charges the RC circuit comprised of R4, R5 and C2. It charges and remains fully charged as long as voltage is applied to the IGN pad.
9. Voltage also flows to the common leg of Relay 2, and flows through the Normally Closed contact to supply voltage to the low voltage cutoff circuit. If the voltage is above the cutoff point, the circuit turns on Relay 1.
10. When voltage is removed from the IGN pad, the RC circuit begins to discharge to ground. When it has discharged to a certain point, U2 will turn on Relay 2. Relay 2 no longer supplies voltage to the low voltage circuit, and Relay 1 turns off. This removes the voltage to the circuit and the entire circuit turns off.
11. The system is now waiting for voltage to be applied to the IGN pad to begin the process gain.

Circuit adjustments:

1. R3 is used to adjust the low voltage cut off point. U3 supplies 5VDC to U1. When the voltage output by R3 drops below 5V, relay 1 is turned off, when the voltage is above 5V, Relay 1 is on. 11.7 volts is a good voltage cutoff point. Supply 11.7 volts to the circuit and adjust R3 until there is 4.98 volts at pins 4, 6, 7 or 9.
2. R4 and R5 is used to set the timing of the timing circuit.
 - a. R4 controls how quickly the RC circuit charges, and therefore how quickly the timer reaches maximum charge, or time on. This is not used in this application.
 - b. R5 controls how quickly the RC circuit discharges, and therefore how quickly it will turn on Relay 2, after voltage is removed from the IGN pad. The greater the resistance of R5, the longer the time will be between turning on Relay 2 and turning off the system.

Considerations:

1. Do not set the timer to stay on too long. This circuit has been known to lock up in the off position when the timer is set longer than 10 minutes. This will cause the circuit to only work when voltage is applied to the IGN pad.
2. Do not set the cutoff point too low. This will cause the battery to drain below the point at which your vehicle will start. 11.5V is too low.
3. The relays are rated at 25A, the traces are rated at approximately 20A, depending on ambient temperatures.
4. D1 and D2 prevent back flow into the IGN circuit.

5. The IGN signal could be any method of supplying voltage to the circuit to turn it on. It is intended to be voltage from the ignition switch in a vehicle, but could be any 12 volt supply.
6. The jumper between A1 and A2 could be a switched circuit. This allows for the timer to be easily transitioned in and out of the circuit. The current here is negligible.
7. If there is no desire for the timing section of the circuit there is no need for these parts. The following components could be eliminated: C2, D2, D3, D4, Relay 2, SCKT1, and U2. The jumper between A1 and A2 must be used to provide power to the low battery cutoff circuit.

Parts List:

Item #	Description	Value	Price	Qty. Req	Mouser P#
C1 & C2	Polarized Capacitor	1000uf	0.34	2	140-XRL25V1000
D1 - D3	Diode	1N5400	0.15	3	821-1N5400
D4	Diode	1N4001	0.04	1	821-1N4001
SCKT1	IC Socket	Dip-8	0.26	1	575-193308
SCKT2	14pin Dip Socket	Dip-8	0.66	1	649-DIP-314-001B
R1	1K 1/2W resistor	1K	0.08	1	293-1K
R2	3.2K 1/2W resistor	3.2K	0.08	1	293-3.2K
R3	5k Multi Turn Pot	5k	1.55	1	652-3006P-1-502
R4 & R5	1M Multi Turn Pot	1Meg	1.55	2	652-3006P-1-105
RLY1-2	25A Power Relay	SPST	2.11	2	551-EP1-3N1S
T1	PNP Transistor	N/A	0.59	1	512-TIP42
U1	Quad Comparator	N/A	0.55	1	512-KA339
U2	555 Timer	Dip-8	0.55	1	511-NE555N
U3	5VDC Regulator	N/A	0.55	1	512-KA7805ATU

All prices are as of 7-10-05

Mouser parts selected based on price and functionality.

Comparable parts of similar functionality could be used.

