EE344:ELECTRONIC DESIGN LAB SOLAR POWERED STREET LIGHT: BATTERY MANAGEMENT SYSTEM

Group 12

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Project Objective: To prolong the lifetime of batteries used in solar powered street lights by maintaining their voltage within optimal limits

DESIGN APPROACH

The four subsystems and their primary objectives are

1. Overvoltage Protection: Ensuring that the voltage across the battery is limited to 14.7 V
2. Undervoltage Protection: Stopping discharge when the voltage reaches 10.5 V
3. Load Control Circuit: Automatically turn the LED on when its sufficiently dark
4. State of Charge Measurement: Measure and display the SoC on an LCD screen

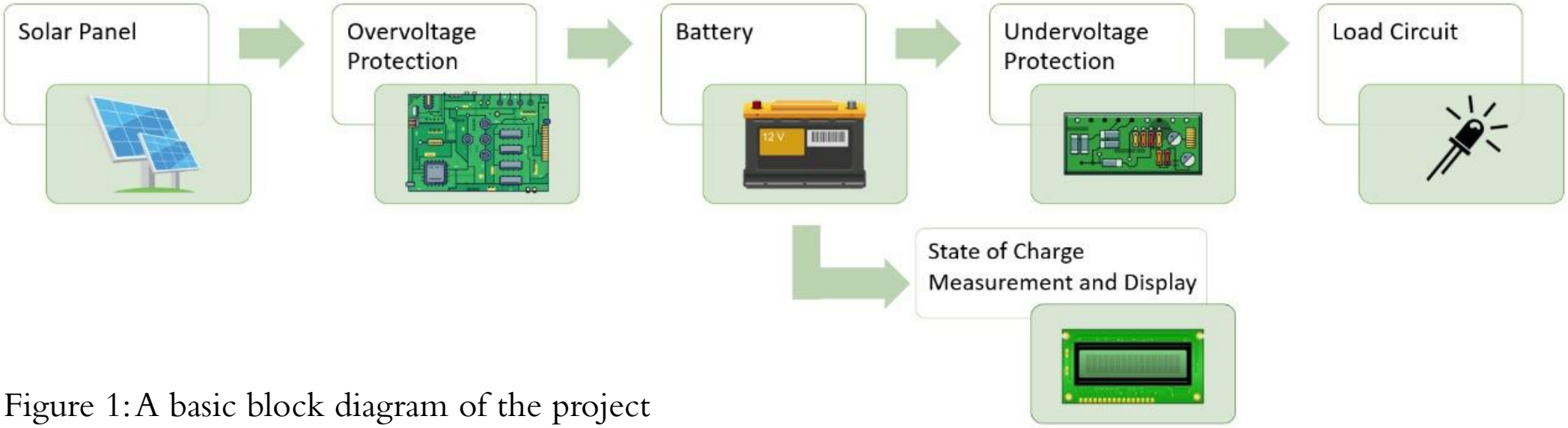

Figure 1: A basic block diagram of the project

OVERVOLTAGE PROTECTION CIRCUIT

The key aspects of this subsystem are as follows:

1. LM317 used as adjustable voltage regulator to generate 14.7 V
2. LM324 used to compare the battery voltage to LM317 output
3. LM324 energizes the relay and disconnects battery when supply voltage exceeds 14.7 V

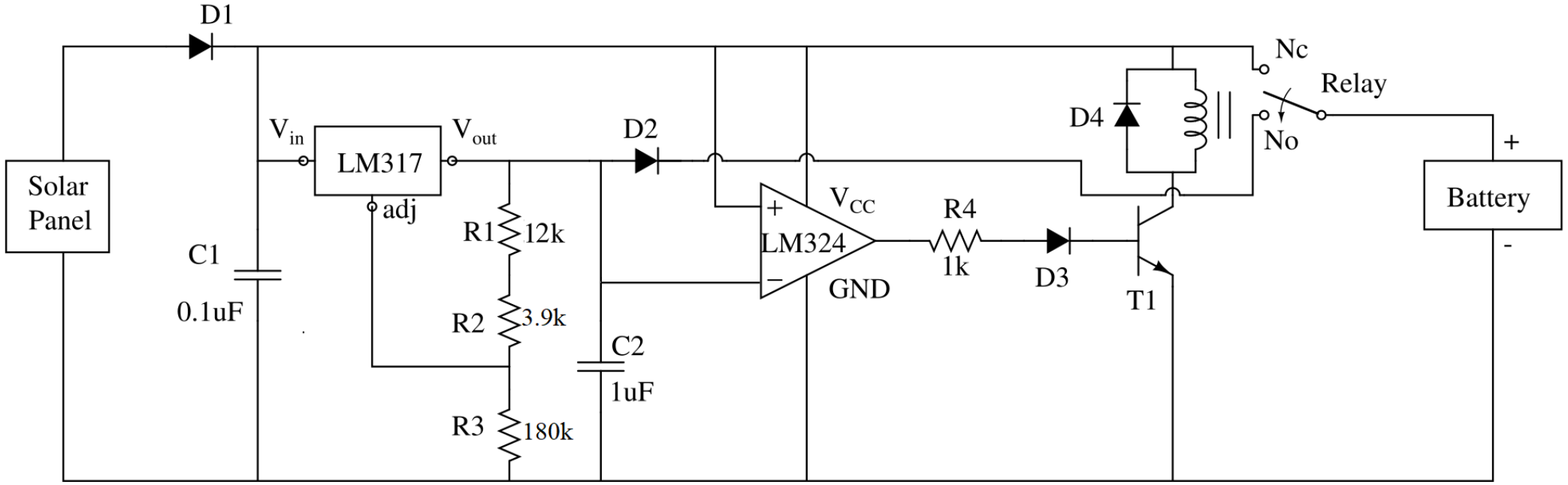

Figure 2: Overvoltage Protection Circuit

UNDERVOLTAGE PROTECTION CIRCUIT

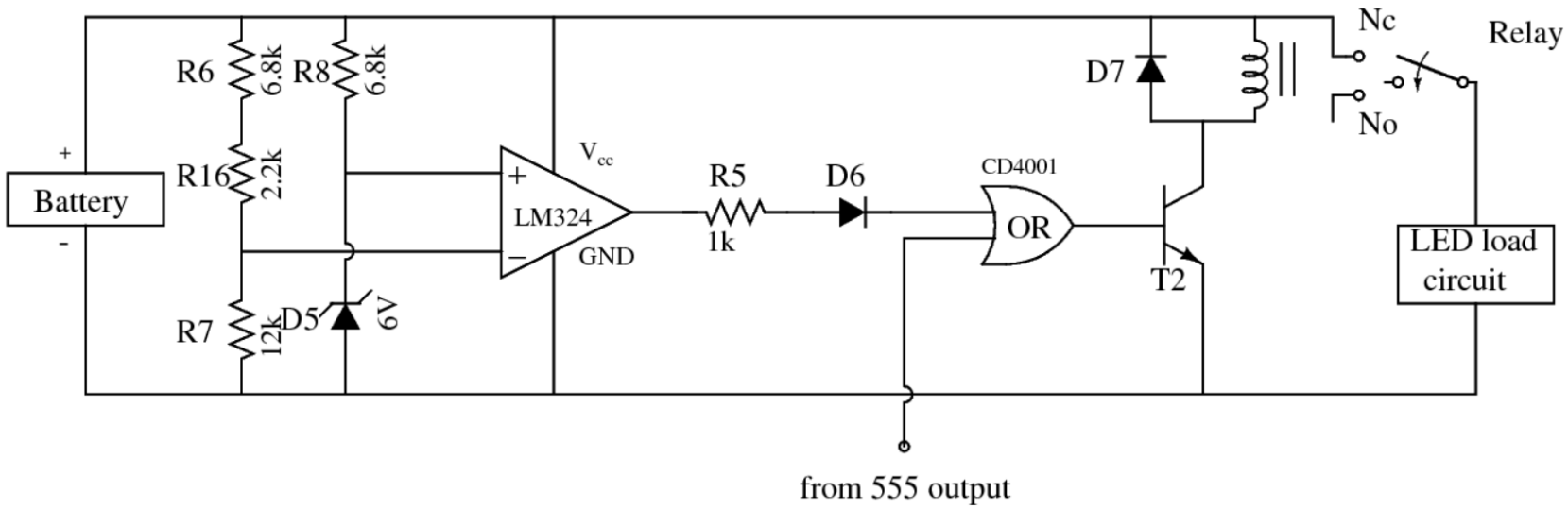

Figure 3: Undervoltage Protection Circuit

LOAD CONTROL CIRCUIT

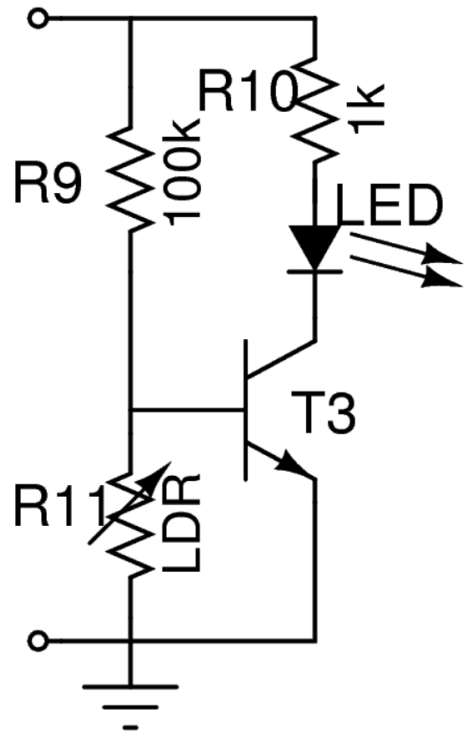

Figure 4: Load Control Circuit

STATE OF CHARGE MEASUREMENT

The key aspects of this subsystem are as follows:

1. LM555 timer in monostable vibrator mode disconnects the LED load for 5 minutes to power Pt-51 and ADC
2. Battery voltage is converted to a digital input and fed into the microcontroller which calculates SoC

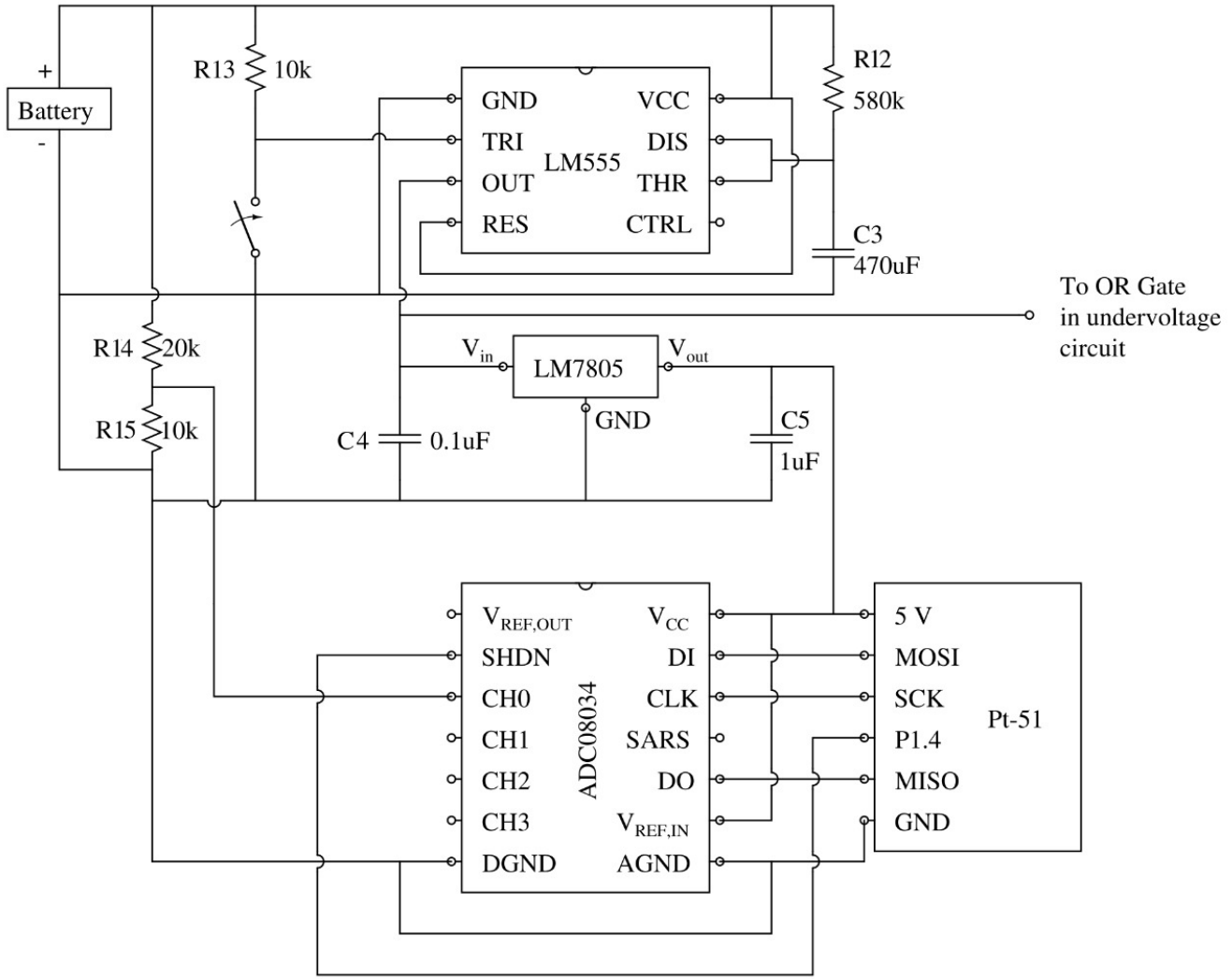

Figure 5: SoC Measurement and Display Circuit

THANK YOU

BACKUP 1: PCB DESIGN

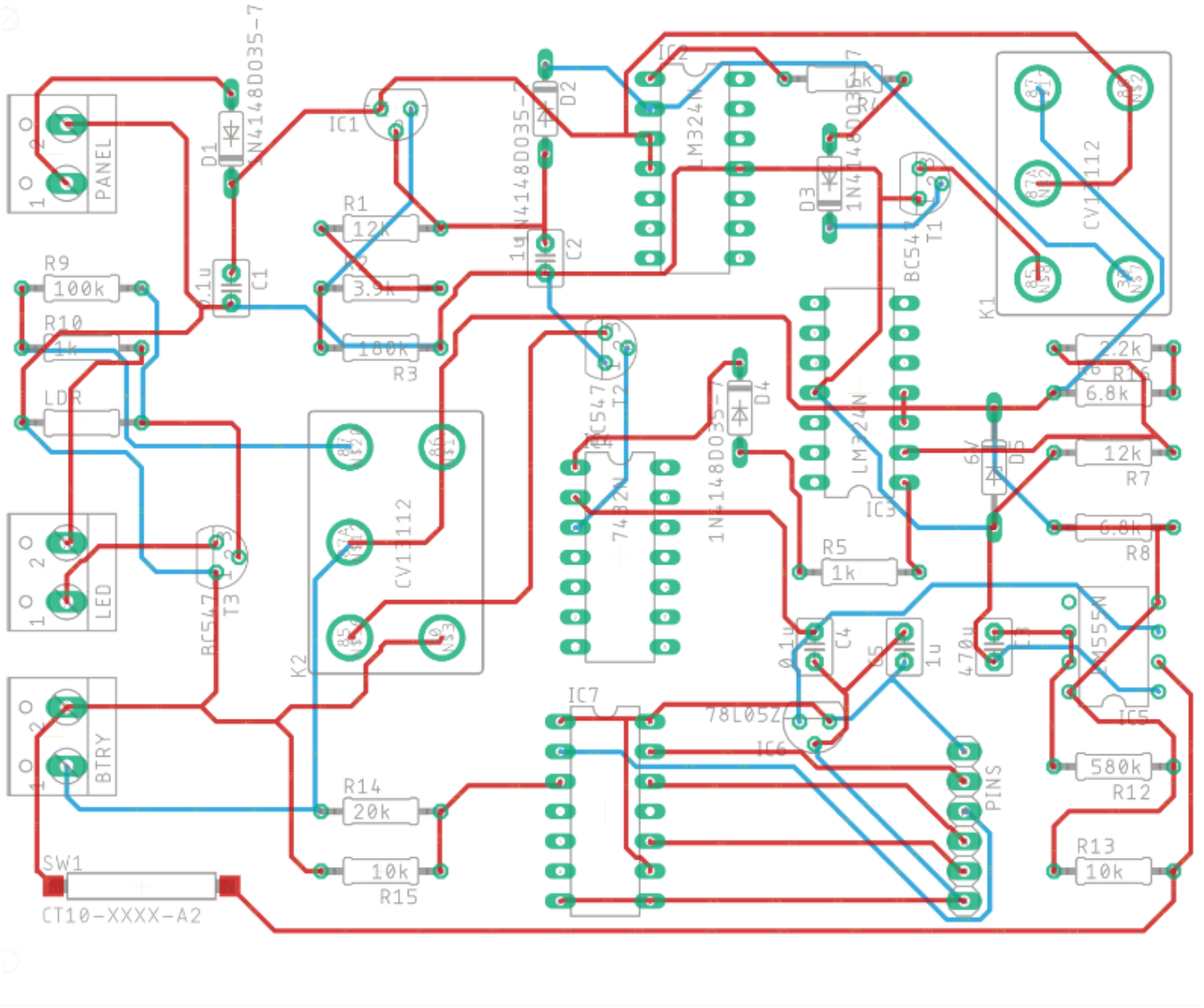

Figure 6: PCB designed

BACKUP 2: BILL OF MATERIALS

Qty	Value/Device	Parts	Description	Cost per Qty (in Rs.)
1	ADC08034N	IC7	A/D Converter	350
1	LM317L	IC1	Voltage Regulator	50
1	PINHD-1X6	PINS	Pin header	5
3	W237-102	BTRY, LED, PANEL	WAGO Screw clamp	15
2	0.1u	C1, C4	Capacitor	10
2	1u	C2, C5	Capacitor	10
1	470u	C3	Capacitor	50
1	100k	R9	Resistor	2
2	10k	R13, R15	Resistor	2
2	12k	R1, R7	Resistor	2
1	180k	R3	Resistor	3
3	1k	R4, R5, R10	Resistor	2
1	2.2k	R16	Resistor	2
1	20k	R14	Resistor	2
1	3.9k	R2	Resistor	2
1	580k	R12	Resistor	2
2	6.8k	R6, R8	Resistor	2
4	1N4148	D1, D2, D3, D4	Diode	10
1	6V	D5	6 volt Zener Diode	10
1	7432N	IC4	Quad 2-input OR gate	20
1	78L05Z	IC6	Positive Voltage Regulator	10
3	BC547	T1, T2, T3	NPN Transistor	10
1	CT10-XXXX-A2	SW1	CT10 Series Molded Switch	50
2	CV13112	K1, K2	Micro-280 Relay	150
1	LDR	R11	Light dependent resistor	100
2	LM324N	IC2, IC3	Single supply opamp	100
1	LM555N	IC5	Timer	10
			Total (on PCB) :	1,341
1	Pt-51 kit		8051 Microcontroller	500
1	10W, 18V		Solar panel	500
1	5W		LED load	50
1	12V		UP-PW1245P Battery	1500
1	16x2 with HD44780		LCD screen	100
			Total :	3,991