

# MODIFIED LOW-COST ENERGY METER USING ADE7757

The low-cost energy meter project as published in May'05 issue of EFY, which made use of 8-digit, 7-segment displays in conjunction with two counter-cum display driver ICs MM74C926 and a 5V power supply, has been modified to display the KWH reading on an 8-digit LCD calculator in an identical manner, thereby doing away with a large number of components. The modified circuit diagram is shown here in Fig.1.

Difficulty had been experienced regarding non-availability and high price of counter-cum-LED display driver IC MM74C926 (IC6 and IC7), which led us to present this alternate scheme. An 8-digit LCD calculator with character display height of 0.56" for good visibility has been used.

**Connection method.** Output from collector (pin 5) and emitter (pin 4)

PARTS LIST	
<i>Semiconductors:</i>	
IC1	- ADE7757 metering IC
IC2	- 7805 5V regulator
IC3, IC4	- MCT2E optocoupler
D1	- 1N4007 rectifier diode
ZD1	- 15V, 1W zener diode
LED1	- Red LED
<i>Resistors (all 1/4-watt, ±5% carbon):</i>	
R1, R3, R7,	
R8	- 500-ohm
R2	- 6.2-kilo-ohm
R4	- 470-ohm
R5, R6	- 680-ohm
R9	- 350-micro-ohm (shunt)
R10	- 1.8-mega-ohm
R13	- 470-ohm, 1W
R14	- 1-kilo-ohm
VR1	- 470-kilo-ohm trimpot
<i>Capacitors:</i>	
C1, C3, C7,	
C8-C10	- 0.1µF ceramic disk
C2, C6	- 10µF, 25V electrolytic
C4, C5, C11,	
C12	- 0.068µF ceramic disk
C13	- 0.47µF, 630V polyester
C14	- 470µF, 35V electrolytic
<i>Miscellaneous:</i>	
L1, L2	- Two 6-pin IC base
	- 2 turn on 22/24 SWG on ferrite bead inductor
Calculator	- 8-digit, LCD based calculator (with coin cell)
J1, J2, J3	- 3-pin SIP connector with a shorting link each.

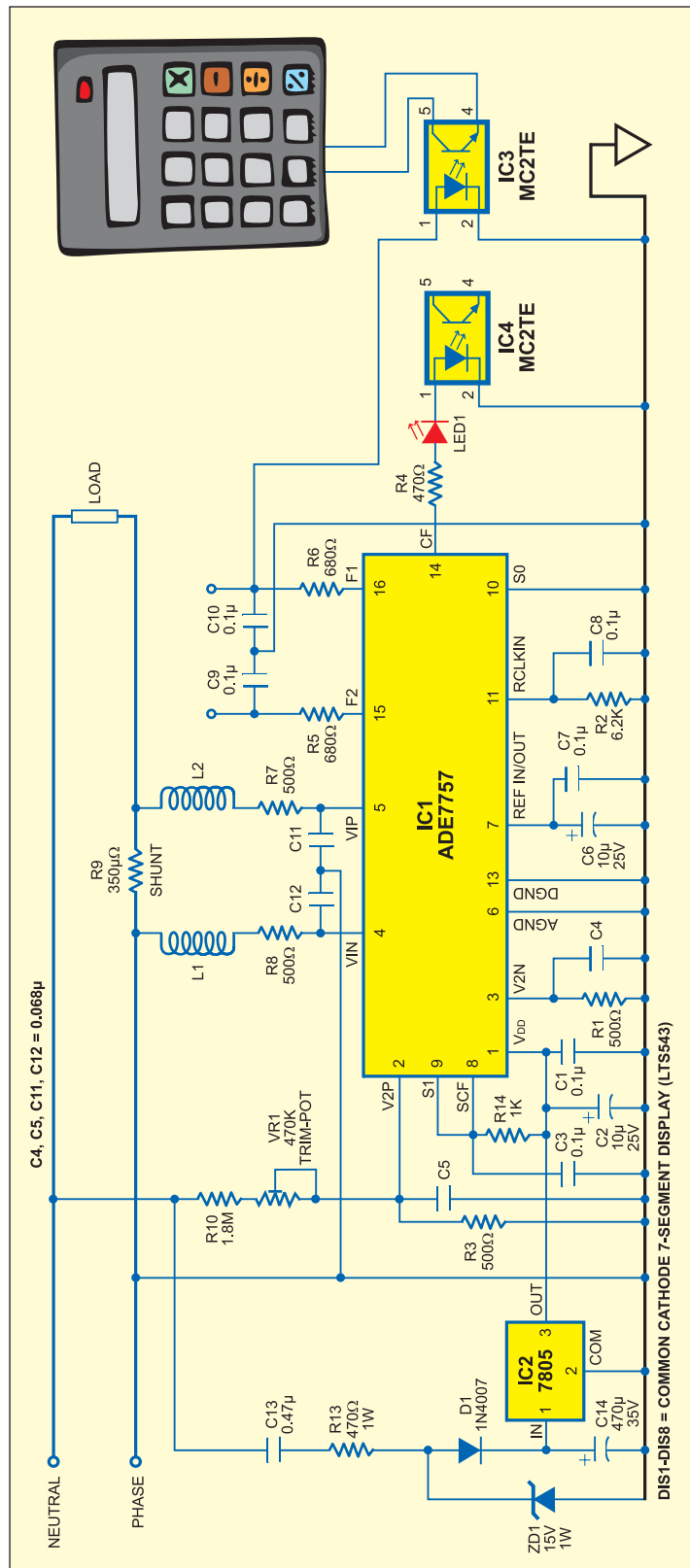


Fig. 1. Schematic of Low-cost Energy meter Using calculator

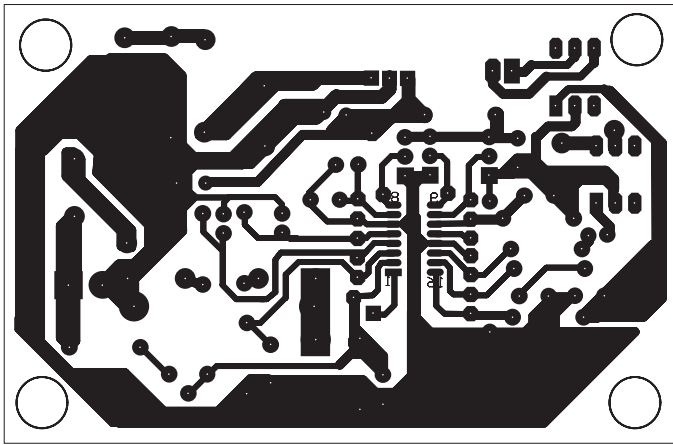


Fig. 2. PCB layout

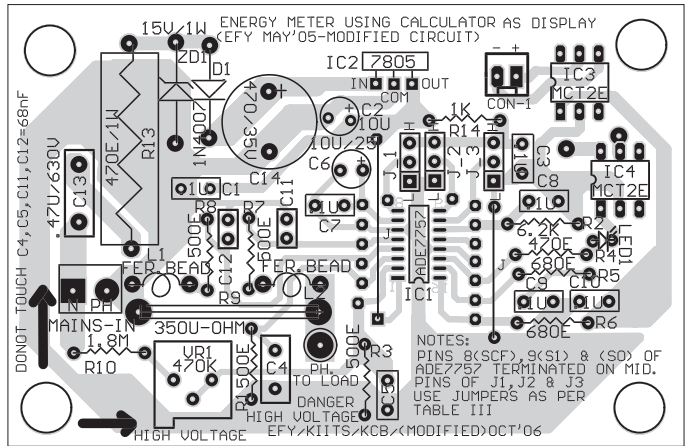


Fig. 3. Component layout

of MCT2E optocoupler (IC3) is extended to '=' terminals on the PCB inside the calculator. To make things easy for the customer, M/S Kits 'N' Spares will supply the calculators with the connection from the '=' terminals brought out. Thus the customer has to simply connect the 'red' and 'black' leads from the calculator to collector pin 5 and emitter pin 4 of IC3 of Energy meter PCB. A 2-pin connector is used on the PCB for terminating output (100 pulses per KWH unit) from IC3 optocoupler.

**Note.** Shorting links for J1 and J2 and J3 determine output frequency on CF pin of IC1. In this application, J1 and J2 select logic 1 (short pins 2 to3) and J3 selects logic 0 at pins 8, 9 and 10 respectively to get 100 pulses per KWH.

An actual-size PCB layout for the circuit of Fig. 1 is shown in Fig.2, while its component layout is shown in Fig. 3. The fresh parts list using identical parts designation is given in the box.

**Activation procedure.** The calculator has its own supply from a coin cell, which can last for a long period without replacement. Follow the simple steps given below for its activation:

- (a) Switch on the calculator.
- (b) Press decimal Key '.', followed by entry of two zeros '00'.
- (c) Press plus key '+' followed by entry of decimal, zero and one '.01'.

The reading on calculator LCD screen shows '0.01'

Now you can switch on your energy meter and its load. On receiving the first pulse via optocoupler (IC3), the reading will continue to show 0.01. With each successive pulse the reading will increment by .01 to show '0.02', '0.03', '0.04', '0.05', '0.06', '0.07', '0.08', '0.09', '0.10' and so on as was the case when original circuit/PCB was used. Hence the reading will be identical.

**Cost advantage.** M/S Kits 'N' Spares have decided to pass on the cost advantage of Rs.500/-, as a result of use of this alternate method, to the customers. The redundant items, as mentioned above, will not be supplied by M/S Kits 'N' Spares with the kit, while calculator will be included as part of the kit.

### Circuit

IC ADE7757 (IC1) is at the heart of the energy meter. It directly interfaces with the shunt resistor and operates off the AC input. The only analogue circuitry used in IC ADE7757 is in the sigmadelta ADCs and reference circuit. All the other signal processing is carried out in digital domain. The power supply for IC ADE7757 is derived directly from mains using the capacitor divider network comprising C13 and C14. Most of the voltage is dropped across C13 (0.47µF polyester capacitor rated for 630V), while resistor R13 (470-ohm, 1W) is used

as a current limiter. The output across C14 is limited to 15V DC, which serves as an input to regulator 7805 (IC2). The regulated 5V is fed to IC1 at its VDD

**Pin 1.** In this application, the phase line is connected to AGND (pin 6) and DGND (pin 13) and hence to the common terminal of regulator IC2.

### Tips for soldering of SMT ICs

Please note that SMD IC ADE7757 (IC1) is to be soldered on track-side after aligning the pin numbers as printed on track-side following the tips as given here.

1. Apply flux to the pads where the IC is to be soldered.
2. Add a small amount of solder to one of the corner pin pads.
3. Line up the IC with the pads on the PCB. Double-check the IC orientation.
4. Melt the solder with your iron and move the IC into position with tweezers. Let the solder solidify.
5. Solder the diagonally opposite pin. Check under magnification that all pins line up with their respective pads.
6. Solder the rest of the pins and check under magnification.

**Note.** Special techniques may be needed for some packages.

(For more details refer May'05 issue of EFY.)