



LOW OFFSET DC GAIN BLOCK

CONNECT OUTPUT TO  
DIGITAL PANEL METER (DPM)  
OR DMM IN 2V RANGE

1mV PER  
DEG C

ALL RESISTORS MFR 1% UNLESS SPECIFIED

VCC = +5V (7805)  
VDD = -5V (7905)

FACTS OF J THERMOCOUPLE. ANSI SYMBOL 'J'.

1. J IS A THERMOCOUPLE MADE OF IRON + VE & CONSTANTAN -VE.
2. CONSTANTAN IS AN ALLOY OF COPPER AND NICKEL.
3. FULL RANGE OF USE IS FROM -200 TO +700 DEG C
4. PRACTICAL TO USE ONLY FROM 0 TO 400 DEG C.
5. USEFUL IN REDUCING AND ALKALINE ATMOSPHERE.
6. CORRODES/RUSTS IN ACIDIC AND OXIDIZING ATMOSPHERE.
7. COLOR CODE OF WIRES NEGATIVE-RED & POSITIVE-WHITE.
8. J TYPE POPULAR BECAUSE OF LOW PRICE AND HIGH mV OUTPUT.
9. J TYPE TC USED IN RUBBER/PLASTIC FORMING, GENERAL PURPOSE USE.

TABLE 1

mV Thermocouple	Temperature in Deg C	AS COLD JUNCTION IS NOT ZERO BUT IS AT ROOM TEMPERATURE (RT) ADD RT TO TEMPERATURE.
0	0	
2.585	50	
5.268	100	
10.777	200	EXAMPLE :
16.325	300	FEED 10.777mV TO THE TC+ AND TC- TERMINALS IF RT THEN IS 30 DEG C READING ON 2V DPM WILL BE 230 COUNTS 230mV.
21.846	400	
27.338	500	
33.096	600	

REFERENCE JUNCTION OR COLD JUNCTION AT 0 DEG C

DESIGN OF GAIN BLOCK.

1. MINIMUM INPUT FROM THERMOCOUPLE IS VERY LOW LIKE 1-2 mV. HENCE ULTRA LOW OFFSET < 100uV OPAMP REQUIRED OP07 USED.
2. INPUTS MAY BE SUBJECTED TO WRONG CONNECTIONS OR HIGH VOLTAGE. USE OF R1 LIMITS CURRENT AND Z1 CLAMPS VOLTAGE TO SAFE LEVEL.
3. GAIN REQUIRED IS 400mV/21.8mV WHICH IS APPROX 18 AT 400 DEG C. GAIN  $A_v = (R_f + R_i) / R_i$  here  $R_f$  is  $R_5$  &  $R_i = R_6 + R_7 + P1$  HENCE VALUES.
4. DESIGN OF TH1 COLD JUNCTION COMPENSATION COPPER THERMISTOR. J TYPE TC OUTPUT CHANGES BY 0.052mV PER DEG C AS PER ABOVE TABLE. COPPER HAS A TEMPERATURE COEFFICIENT OF 0.0042 OHM PER OHM/DEG C. FOR A COPPER WIRE OF 12 OHMS  $12 \times 0.0042 = 0.05$  OHM/DEG C. FOR R4 OF 5K CURRENT THRU TH1 =  $5V/5K = 1mA$ . CHANGE OF VOLTAGE ACROSS TH1 WITH TEMPERATURE IS  $0.05 \times 1mA = 0.05mV/DEG$ . THIS RATE IS SAME AS J TYPE TC HENCE IT SIMULATES COLD JUNCTION.

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