DATA SHEET

DN405

100 OHM PLATINUM RTD SIGNAL CONDITIONING CIRCUIT

General Description

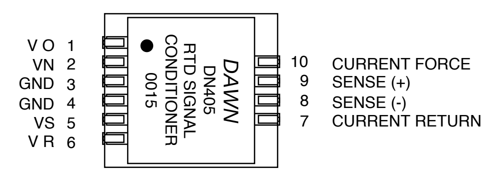
The DN405 is a four wire 100 ohm platinum resistance temperature detector (RTD) signal conditioning circuit that transforms RTD resistance to a voltage that is proportional to temperature in °C. This device was designed to operate with a 100 ohm IEC/DIN-grade Platinum RTD that exhibits an alpha value of 0.00385Ω/Ω/°C. Analog circuit linearization provides typical accuracy of ±0.5°C over a temperature range of -100°C to +400°C. The four wire measurement circuit eliminates the effect of lead resistance that allows the RTD to be remotely located from the DN405 signal conditioning circuit. The DN405, which operates from a single supply voltage of +2.7V to +5.5V, draws only 1.3mA of current, making it ideal for portable applications.

The DN405 compensates for the inherent non-linearity of all platinum RTDs. The output voltage of the device is directly proportional to the temperature of the RTD. ***No digital signal processing is required to make accurate temperature measurements.*** The four wire capability of the DN405 makes it possible to multiplex several RTDs with one device. This is useful in data acquisition systems.

Features

- -100°C to -400°C Range
- ±0.5°C Accuracy
- 2.7 to 5.5 Volt Operation
- 1.3mA Current Drain
- Four Wire Measurement System
- One mV/°C Sensitivity
- Reduced Accuracy Temperature Range -200°C to +800°C
- Small Size 0.8" x 0.8"

Pin Configuration



ACTUAL SIZE

BLOCK DIAGRAM OF THE DN405
RTD SIGNAL CONDITIONER

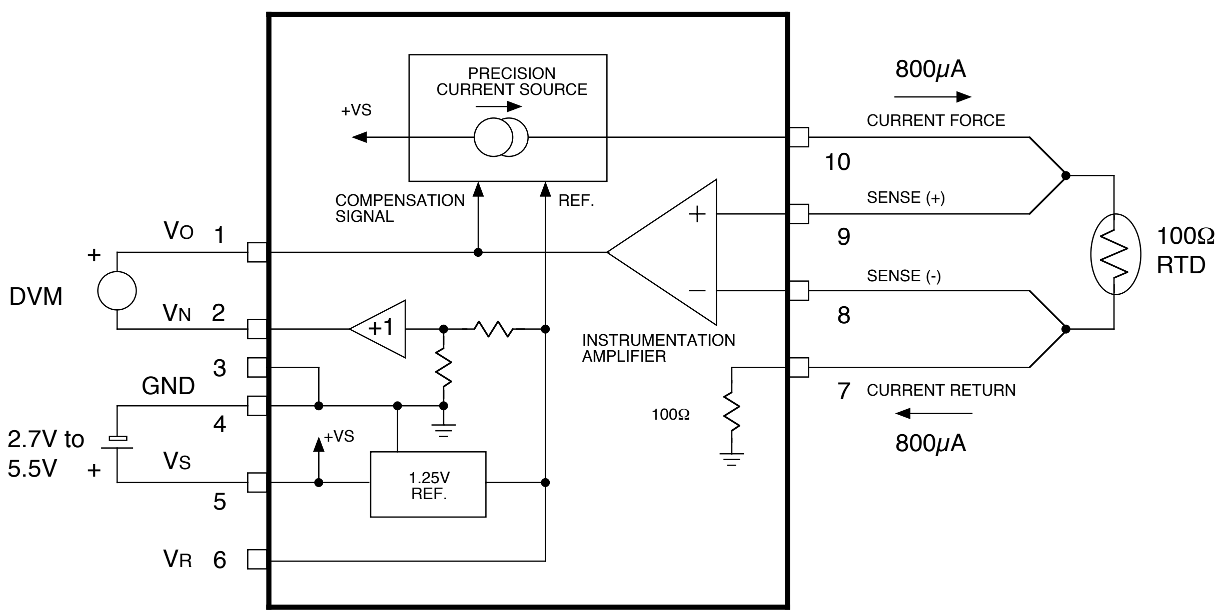


Figure 1

The DN405 Operation:

The voltage (V_O) at Pin 1 of the DN405 increases at the rate of 1.0 mV/°C. V_O is equal to 245.8 mV ±5 mV when the temperature of the RTD is 0°C. The "NULL" voltage (V_N) at Pin 2 is factory adjusted to be equal to V_O at 0°C. Temperature in °C is then measured between Pin 1 and Pin 2 and is equal to the temperature of the RTD in mV. For instance, the measured voltage (V_O -V_N) between Pin 1 and Pin 2 is 78.3 mV when the temperature of the RTD is 78.3°C. Likewise, the voltage between these two Pins is -46.5 mV when the temperature of the RTD is -46.5°C.

The DN405 was designed to operate with an ideal IEC/DIN-grade 100Ω platinum RTD. Selected resistance values versus temperature for the ideal RTD are shown in Table 1. The computed temperature error as function of actual temperature for the DN405 when interfaced with an ideal RTD are shown in Figures 2 and 3. In practice, platinum RTDs will deviate from the ideal. Therefore, the overall accuracy of temperature measuring system is dependent on the RTD used as well as the accuracy of the DN405. It should be noted that some platinum RTD manufacturers will guarantee RTD resistance to better than 0.01% at 0°C.

IEC/DIN-grade 100Ω Platinum RTD Resistance vs Temperature

TEMP °C	RT Ω
-100	60.25
-50	80.31
0	100.00
50	119.40
100	138.50
150	157.31
200	175.84
250	194.07
300	212.02
350	229.67
400	247.04

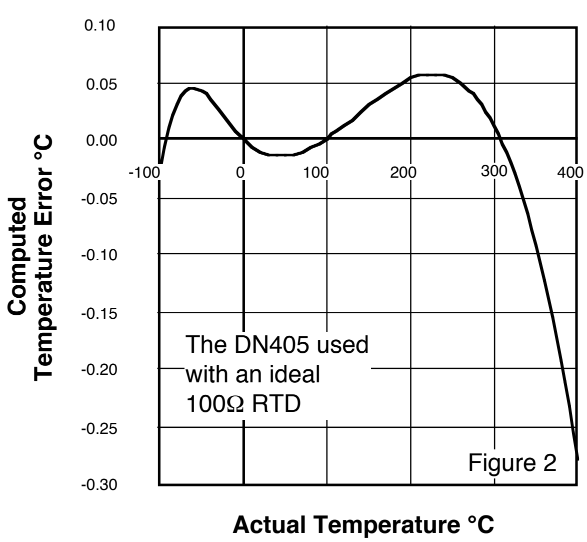
Table 1

Electrical Characteristics:
(0°C < T_A < 50C) Supply Voltage 2.7volts to 5.5 Volts

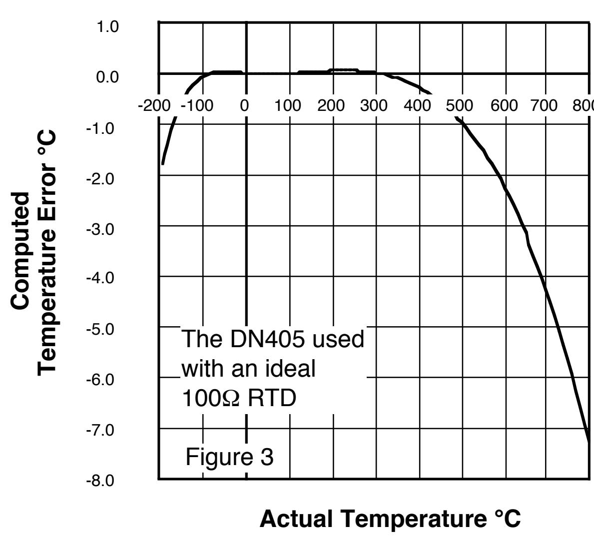
PARAMETER		MIN	TYP	MAX	UNITS
V_N	Pin 2 to Pin 3	240.7	245.7	250.7	mV
I_D	Current Drain		1.3	1.5	mA
V_{REF}	Pin 6 to Pin 3	1.238	1.250	1.263	V
Lead Resistance		0		50	Ω
V_O -V_N	Pin 1 to Pin 2	See Equation Below			

T = (V_O - V_N) °C/mV	Temperature Range	Measurement Accuracy
Temperature measurement accuracy using an ideal 100Ω IEC/DIN-grade platinum RTD for an ambient temperature range of the DN405 from 0°C to +50°C	-100°C to 0°C	±1.0°C
	0°C to +100°C	± 0.5°C
	+100°C to +400°C	± 1.5°C

Theoretical Temperature Error vs Actual Temperature

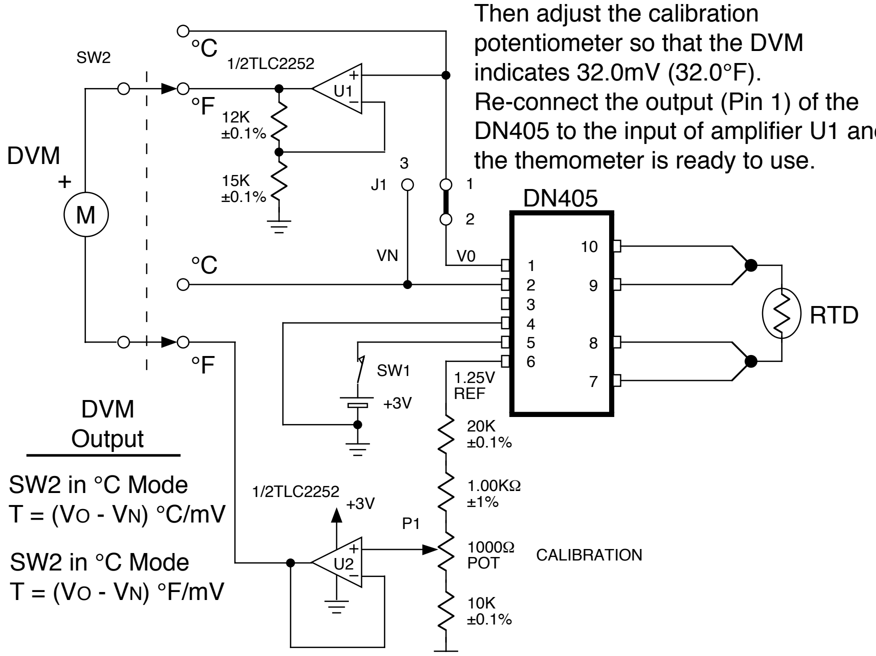


Extended Range Theoretical Temperature Error vs Actual Temperature

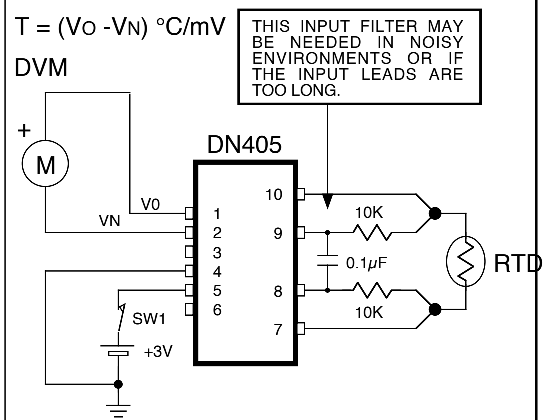


Configuring the DN405 to Measure in Both Degrees Fahrenheit and in Degrees Centigrade

The output voltage VO at Pin 1 of the DN405 is amplified by U1 by a factor of 1.8. The ouput of this stage then increases at the rate of 1 mV/°F. The null voltage VN at Pin 2 of the DN405 is equal to Vo when the RDT is at 0°C. To calibrate the Thermometer in °F, connect the input of amplifier U1 to VN. Then adjust the calibration potentiometer so that the DVM indicates 32.0mV (32.0°F). Re-connect the output (Pin 1) of the DN405 to the input of amplifier U1 and the themometer is ready to use.



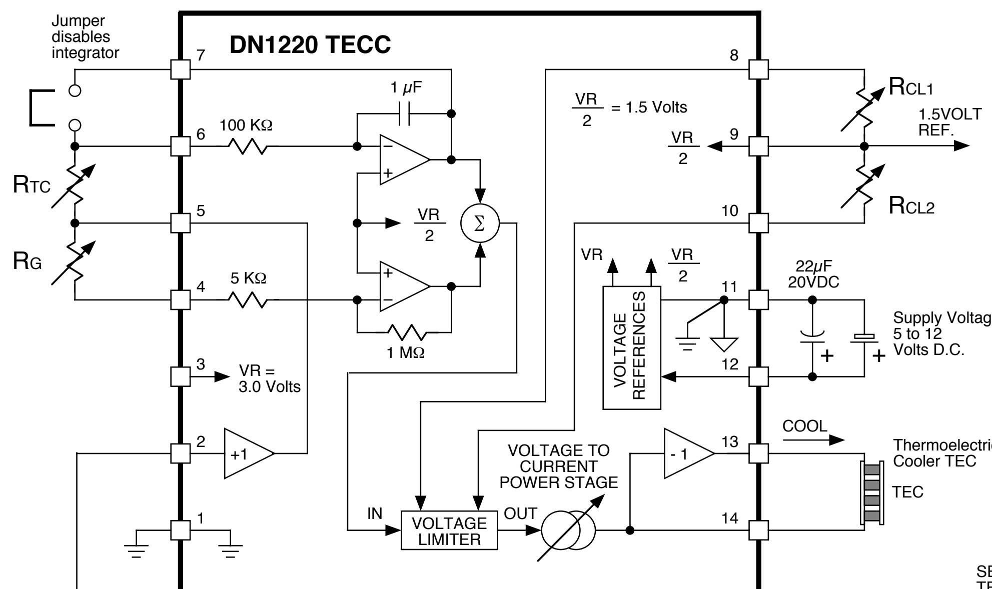
-100°C to +400°C Thermometer

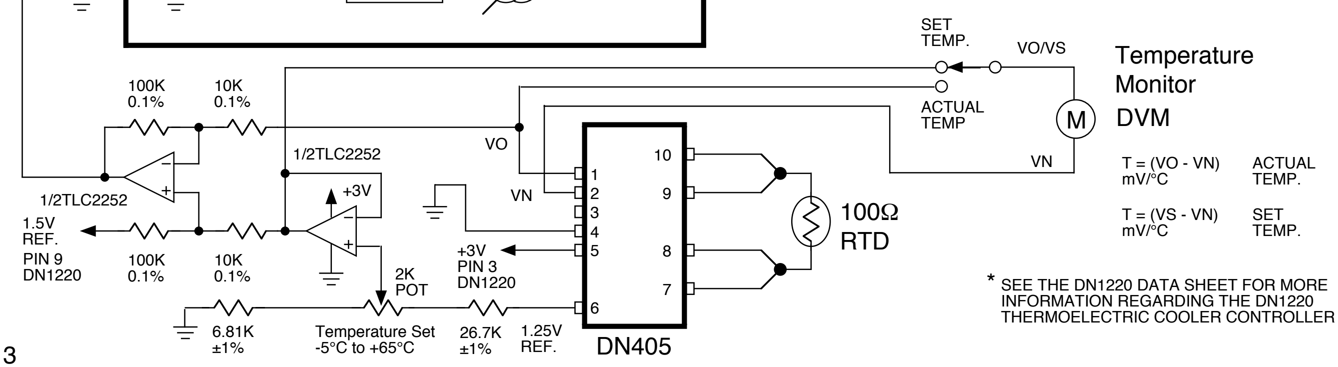


The DN405 will measure temperature from -200°C to +800°C with reduced accuracy in the extended temperature range (see Figure 2). In addition, the RTD used must be designed to withstand these temperature extremes.

Interfacing the DN405 With the DN1220 TECC to Control the Temperature of a TEC*

Temperature control of a Thermoelectric Cooler (TEC) can be achieved by using the circuit shown in this diagram. TEC temperature is monitored by the RDT/DN405 circuit. The ouptut voltage (VO) of the DN405 is compared to an input temperature set voltage (VS) by connecting VS and VO to the input of a differential amplifier. The amplifier output, which is applied to the input of the DN1220, causes the TEC to heat or to cool until the output voltage (VO) of the DN405 is equal to the temperature set voltage (VS).



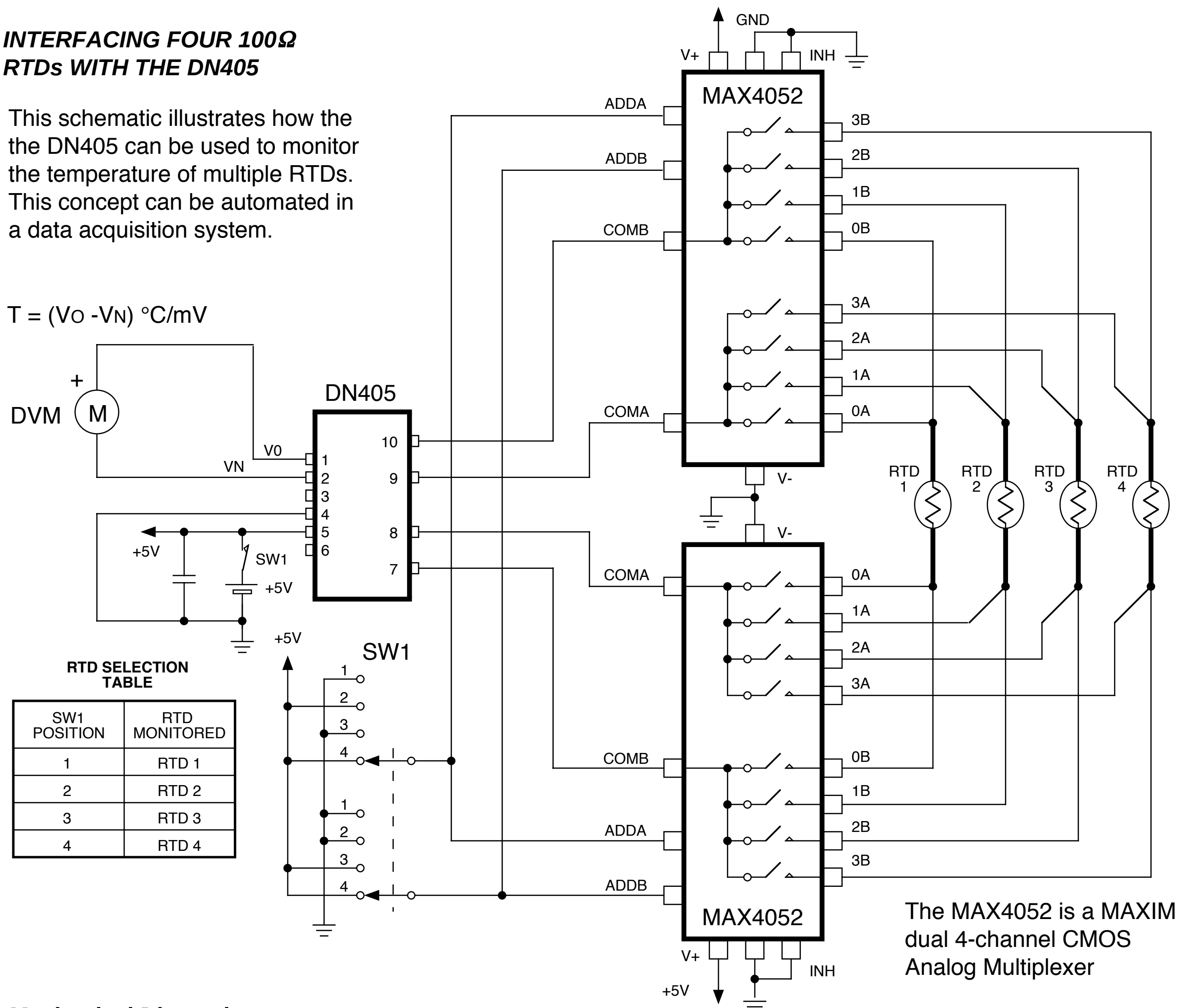


* SEE THE DN1220 DATA SHEET FOR MORE INFORMATION REGARDING THE DN1220 THERMOELECTRIC COOLER CONTROLLER

INTERFACING FOUR 100Ω RTDs WITH THE DN405

This schematic illustrates how the the DN405 can be used to monitor the temperature of multiple RTDs. This concept can be automated in a data acquisition system.

T = (VO -VN) °C/mV

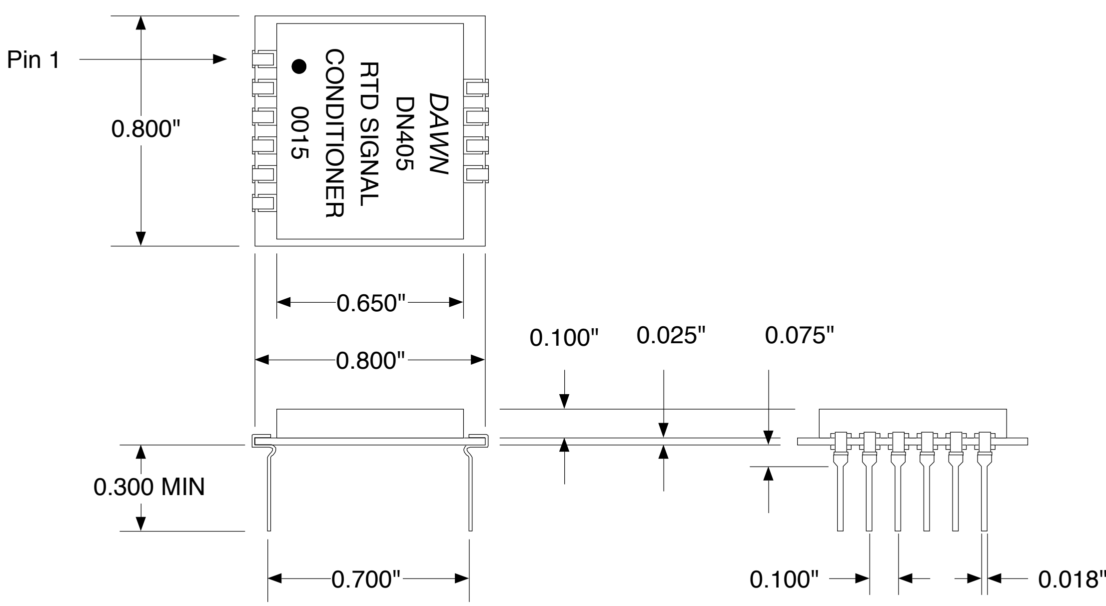


RTD SELECTION TABLE

SW1 POSITION	RTD MONITORED
1	RTD 1
2	RTD 2
3	RTD 3
4	RTD 4

The MAX4052 is a MAXIM dual 4-channel CMOS Analog Multiplexer

Mechanical Dimensions



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