Section 7

Scanning temperature at a set time interval

In this section:

Introduction

This application example demonstrates how to use the DMM6500 to log temperature measurement data from multiple scan card channels, one every minute for 24-hours The data is saved to a flash drive.

During production or storage, the temperature of the testing environment can be important. You can use the DMM6500 to monitor temperature at a fixed time interval for an extended period.

This application requires a Keithley Instruments 2001-TCSCAN card. The 2001-TCSCAN card provides up to nine channels of thermocouple temperature measurements.

For this application example, the card is populated with a Type K thermocouple on each channel.

Equipment required

- One DMM6500
- One 2001-TCSCAN card
- One computer setup for communication with the instrument
- One USB flash drive
- One device or component to be tested

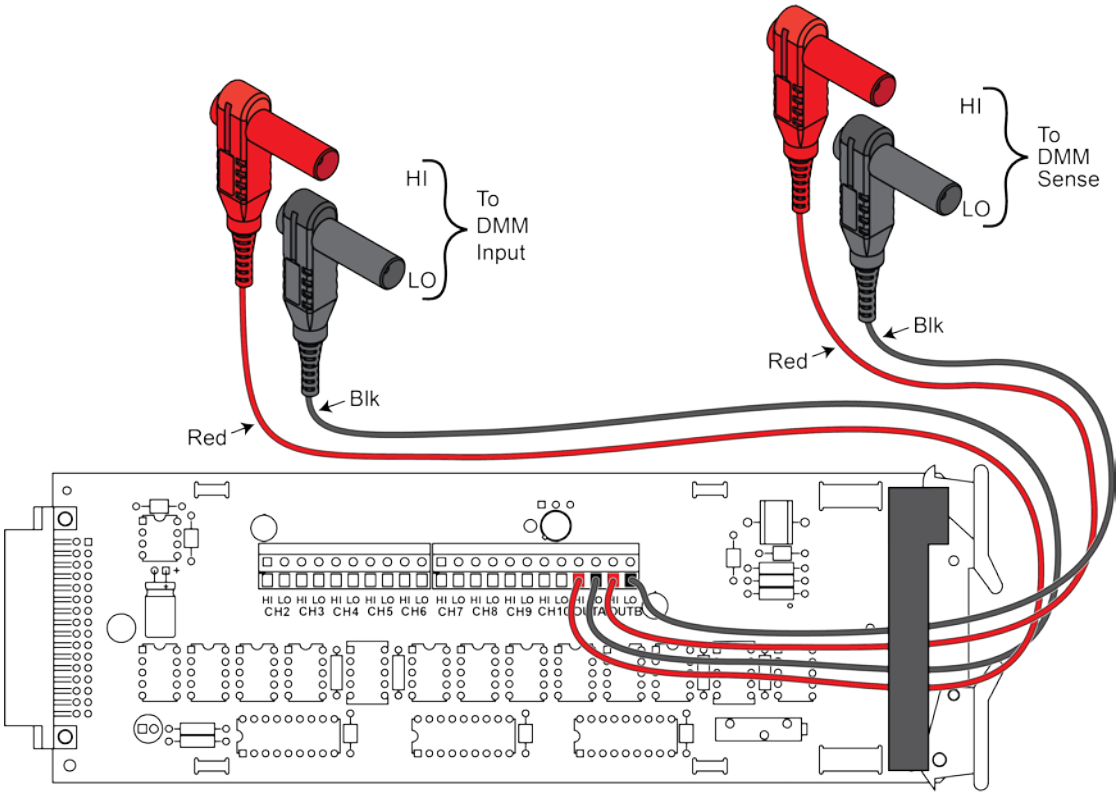
Device connections

This application requires a 2001-TCSCAN card. The 2001-TCSCAN card provides up to nine channels of thermocouple temperature measurements. For this example, the card is populated with a Type K thermocouple on each channel. The card is then inserted into the rear of the DMM6500 as seen in the figures below. The instrument must be switched to rear terminals.

To set up and install the 2001-TCSCAN card:

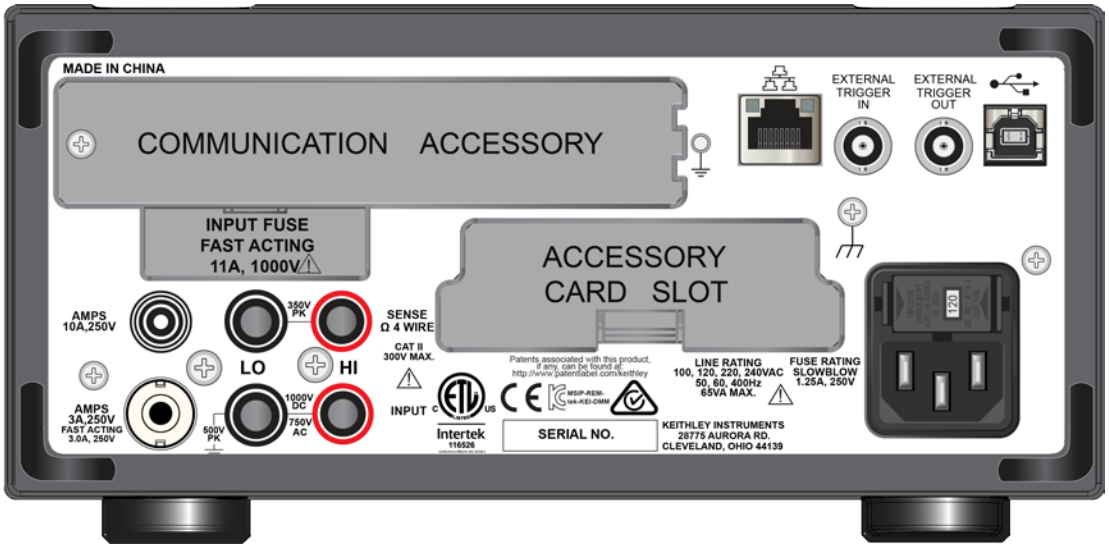
1. Power off the instrument.
2. Make connections to the 2001-TCSCAN card as shown in the figure below.

Figure 36: 2001-TCSCAN card



3. Install the 2001-TCSCAN card into the accessory card slot of the DMM6500. For information on installing the 2001-TCSCAN card, refer to the *DMM6500 Reference Manual*.

Figure 37: DMM6500 rear panel



4. Power on the instrument.

⚠ WARNING

To prevent electric shock, test connections must be configured such that the user cannot come in contact with test leads or any device under test (DUT) that is in contact with the conductors. It is good practice to disconnect DUTs from the instrument before powering the instrument. Safe installation requires proper shields, barriers, and grounding to prevent contact with test leads.

There is no internal connection between protective earth (safety ground) and the LO terminals of the DMM6500. Therefore, hazardous voltages (more than 30 V_{rms}) can appear on LO terminals. This can occur when the instrument is operating in any mode. To prevent hazardous voltage from appearing on the LO terminals, connect the LO terminal to protective earth (safety ground) if your application allows it. You can connect the LO terminal to the chassis ground terminal on the front panel or the chassis ground screw terminal on the rear panel. Note that the front-panel terminals are isolated from the rear-panel terminals. Therefore, if you are using the front-panel terminals, ground to the front-panel LO terminal. If using the rear-panel terminals, ground to the rear panel LO terminal. Failure to follow these guidelines can result in injury, death, or instrument damage.

Sample temperatures at a specific time interval

This example application uses the DMM6500 to scan a set of channels, measuring temperature at fixed intervals You can control the instrument from the front panel or by using SCPI code or TSP code using the remote interface. For information about setting up remote communications, see Remote communications interfaces (on page 3-1).

For this application, you will:

- Power on the instrument.
- Configure channels two to ten to measure temperature using Type K thermocouples and the internal reference junction.
- Use the Scan menu to set up a temperature scan of channels two to ten that occurs every minute for 24-hours, a total of 1440 times.

Using the front panel

Restart the instrument and select the function, integration rate, autozero, and filter settings:

1. Press the **POWER** button on the front panel to turn on the instrument.
2. Select the **REAR** terminals.
3. Swipe to the SCAN swipe screen, select **Build Scan.**
4. Select the **+** button on the left half of the screen.
5. Select channels **two to ten** and select OK.
6. In the Function menu that appears, select **Temperature.**
7. Using the Settings tab on the right side of the screen:
   - Transducer to **TC**
   - Thermocouple to **Type K**
   - Reference Junction to **Internal**
   - Set Unit to **Celsius**
   - NPLC to **one**
8. On the Scan tab, set the **Scan Count to 1440 (24 hours * 60 minutes).**
9. Set Interval Between Scans to **60 seconds.**
10. Select the **Start** button.

To save the data after the scan completes to a CSV file on a flash drive inserted into the front of the instrument:

1. Select the **MENU** button.
2. Select **Reading Buffers** from the Measure column.
3. Select **Save to USB.**
4. Select **OK**.

Using SCPI commands

This sequence of SCPI commands executes a thermocouple-based temperature scan every minute for 24 hours.

You may need to make changes so that this code will run in your programming environment. In the table, the SCPI commands have a light gray background. The light-brown shaded code represents pseudocode that will vary depending on the programming environment you use. The light-green shaded code represents pseudocode that will vary depending on the programming environment you use.

Ensure that the **TERMINALS** switch is set to REAR.

Send the following commands for this example application:

	Commands	**Descriptions**
DMM6500	`*RST` `:ROUT:SCAN:COUNt:SCAN 1440`	• Reset the DMM6500 • Set the scan count to 24hrs * 60 min/hr = 1440

Pseudocode	`int scanCnt = 9`
	
	`int sampleCnt`
	
	`int chanCnt`
	`int actualRdgs`
	
	`totalRdgs = scanCnt * chanCnt`
	
	`:TRACe:POINts totalRdgs,`
	`"defbuffer1"`
		• Define a variable for the nine channels on the card
		• Create a variable to hold the full sample count (total number of readings)
		• Create a variable to hold the channel count
		• Create a variable to hold the actual reading count
		• Set total readings to number of scans times number of channels
		• Size the buffer with capacity equal to total readings

	`:TRACe:CLEar "defbuffer1"`
	`:SENS:FUNC "TEMP", (@2:10)`
	`:SENS:TEMP:NPLC 1, (@2:10)`
	`:SENS:TEMP:TRAN TC, (@2:10)`
	`:SENS:TEMP:TC:TYPE K, (@2:10)`
	`:SENS:TEMP:TC:RJUN:RSEL INT, (@2:10)`
	`:ROUT:SCAN:CRE (@2:10)`
	`:ROUT:SCAN:COUN:SCAN scanCnt`
	`:READ?`
		• Clear the data buffer
		• Set the instrument to measure temperature
		• Set NPLC to 1
		• Set transducer type to thermocouple
		• Set thermocouple type to K
		• Set reference junction to internal
		• Create scan of channels 2 through 10
		• Set number of scans to scan count variable
		• Read the resistance value

Using TSP

The following TSP code is designed to be run from Keithley Instruments Test Script Builder (TSB). TSB is a software tool that is available from the Keithley webpage on the Tektronix website (tek.com/keithley). You can install and use TSB to write code and develop scripts for TSP-enabled instruments. Information about how to use TSB is in the online help for TSB and in the "Introduction to TSP operation" section of the *DMM6500 Reference Manual*.

To use other programming environments, you may need to make changes to the example TSP code.

By default, the DMM6500 uses the SCPI command set. You must select the TSP command set before sending TSP commands to the instrument.

To enable TSP commands:

1. Press the **MENU** key.
2. Under System, select **Settings**.
3. For Command Set, select **TSP**.
4. At the prompt to reboot, select **Yes**.

This sequence of TSP commands makes a series of temperature measurements. After the code executes, the data is displayed in the Instrument Console of Test Script Builder.

Ensure that the **TERMINALS** switch is set to REAR.

Send the following commands for this example application:

```
--Reset the instrument to the default settings.
reset()
--Establish variables to make a measurement every 60 seconds 1440 times (24 hours).
local scanCnt = 24 * 60 --1440 minutes = 24 hours
local chanCnt = 9
local totalRdgs = scanCnt * chanCnt
--Empty the buffer and set it to the capacity calculated by totalRdgs.
defbuffer1.clear()
defbuffer1.capacity = totalRdgs
-- Set up the channels to measure temperature using type K thermocouples using
   internal reference junction.
channel.setdmm("2:10", dmm.ATTR_MEAS_FUNCTION, dmm.FUNC_TEMPERATURE)
channel.setdmm("2:10", dmm.ATTR_MEAS_UNIT, dmm.UNIT_CELSIUS)
channel.setdmm("2:10", dmm.ATTR_MEAS_NPLC, 1)
channel.setdmm("2:10", dmm.ATTR_MEAS_DIGITS, dmm.DIGITS_5_5)
channel.setdmm("2:10", dmm.ATTR_MEAS_TRANSDUCER, dmm.TRANS_THERMOCOUPLE)
channel.setdmm("2:10", dmm.ATTR_MEAS_THERMOCOUPLE, dmm.THERMOCOUPLE_K)
channel.setdmm("2:10", dmm.ATTR_MEAS_REF_JUNCTION, dmm.REFJUNCT_INTERNAL)
-- Set up the scan; channel 2 is first available channel on a 2001-TCSCAN card.
scan.create("2:10")
scan.scancount = scanCnt
-- Set the amount of time for each scan.
scan.scaninterval = 60.0
-- Write the data to a USB flash drive at the end of the scan.
scan.export("/usb1/TempData", scan.WRITE_AFTER_SCAN, buffer.COL_ALL)
-- Start the scan.
trigger.model.initiate()
waitcomplete()
-- Get the data.
printbuffer(1, defbuffer1.n, defbuffer1)
```

Test results

The following figures show a sample graph and final test measurement for this application.

Figure 38: DMM6500 graph of temperature measurements

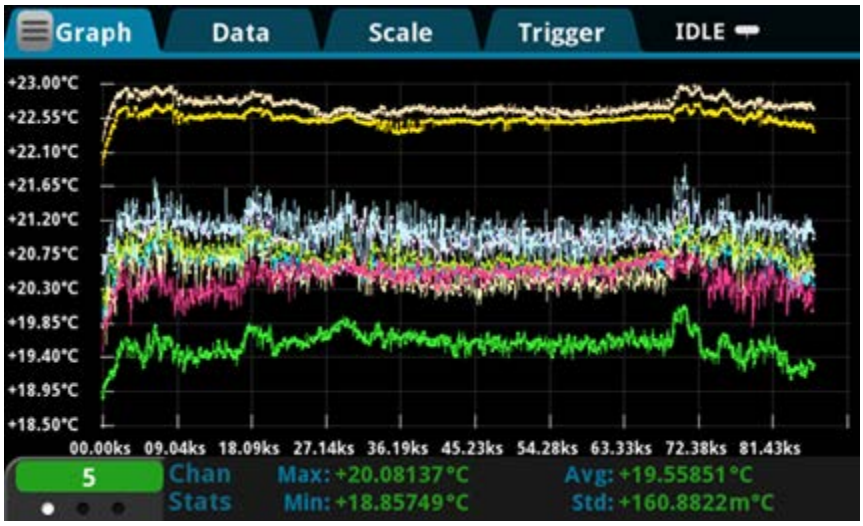


Figure 39: DMM6500 final temperature measurement