USB-5200 Series

24-bit Temperature Data Loggers

MC MEASUREMENT COMPUTING™

USB-5200 Series data loggers provide eight temperature inputs. Measurements are stored onto a CompactFlash card and downloaded for conversion to text or csv.

Overview

The USB-5200 Series provides temperature measurement flexibility and convenience in devices that can be moved and installed anywhere temperature measurements are needed, without the need for a dedicated host computer. The USB-5200 Series offers the most accurate temperature measurement possible, since the internal measurement electronics accuracy exceeds the accuracy specifications of the temperature sensors.

The combination of the USB-5200 Series and the Measurement Computing DAQ software suite gives you a complete data acquisition solution that will have you taking measurements in minutes.

Temperature Input

The USB-5200 Series provide eight temperature input channels.

The USB-5201 is programmable for different thermocouple types. The USB-5203 is programmable for different sensor categories, including thermocouple, RTDs, thermistors and Semiconductor sensors.

A 24-bit analog-to-digital (A/D) converter is provided for each pair of analog inputs. Users can connect a different category of sensor to each temperature channel pair.

Open thermocouple detection (OTD) is provided to detect broken thermocouples. Cold junction compensation (CJC) sensors are provided for TC measurements, and built-in current excitation sources for resistive sensor measurements.

Sample Rate

Each channel can be sampled at up to two samples per second for a total device throughput of 16 samples per second.

Digital I/O

Eight independent digital I/O lines are independently configurable for input or output, and can be used to monitor TTL-level inputs, communicate with external devices, and generate alarms.

Data Logging

USB-5200 Series devices store temperature data on a Compact Flash (CF) card. The data can be read from a CF reader or by connecting the device directly to a USB port on a PC. External power is required for data logging operations.
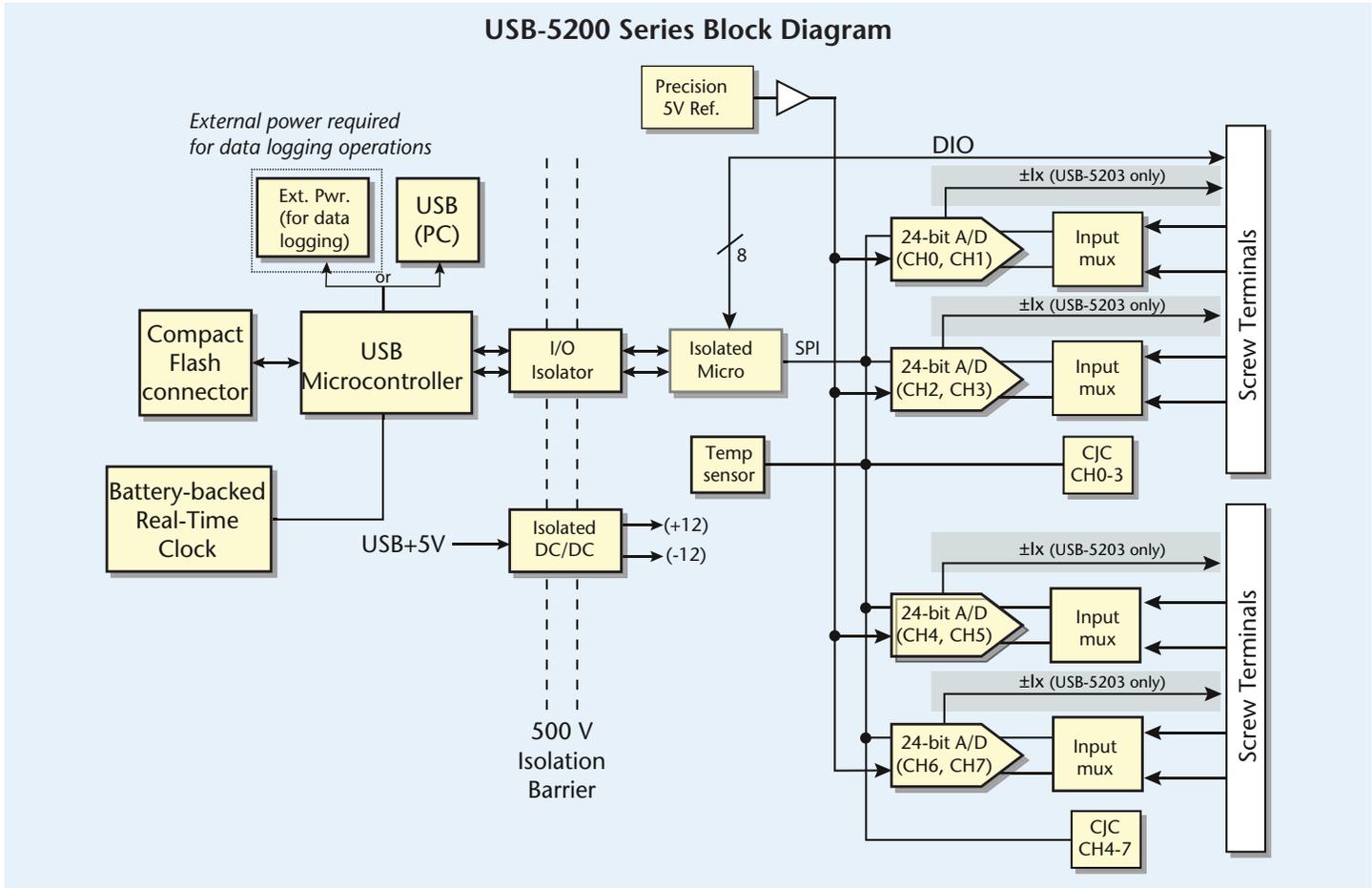
Users can configure the device to log temperature (°C) or raw data, timestamp data, and CJC sensor readings. All logging options are configurable with software.

Logged data is stored on the memory card in binary files and can be transferred to the computer. Use InstaCal to convert the files to .csv or .txt format for use in other applications.

USB-5200 Series Selection Chart				
Model	Channels	Thermocouple Inputs	RTD, Thermistor, Semiconductor Sensor Inputs	Stand-Alone Logging to CF Card
USB-5201	8	✔	—	✔
USB-5203	8	✔	✔	✔

USB-5200 Series

General Information

USB-5200 Series Block Diagram

Calculating the Logging Time for a Memory Card

The following formula calculates the approximate amount of logging time in seconds that a supported memory cards allows. USB-5200 Series supports 512 MB, 1 GB, and 2 GB CompactFlash memory cards.

$$time = R \times \frac{N_{Disk}}{N_{TS} + N_{DIO} + (N_{Temp} \times n_{Channels}) + N_{CJC}}$$

where:
- *time* = total disk time in seconds
- N_{Disk} = size of memory card in bytes
- N_{DIO} = 1 byte for digital I/O
- $n_{Channels}$ = number of channels logged
- R = logging rate in seconds
- N_{TS} = 6 bytes for timestamp, if enabled
- N_{Temp} = 4 bytes for a temperature reading (always enabled)
- N_{CJC} = 8 bytes if CJC sensor readings are enabled

For example, if logging from one channel to a 512 MB card with all logging options selected, the calculation is as follows:
- N_{Disk} = 512,000,000 bytes (512 MB)
- N_{DIO} = 1
- $n_{Channels}$ = 1
- R = 1 S/s
- N_{TS} = 6 (timestamp enabled)
- N_{Temp} = 4 (temperature readings)
- N_{CJC} = 8 (CJC sensor readings enabled)

Inserting these values into the formula creates the following equation:

$$time = 1 \times \frac{512,000,000}{6 + 1 + (4 \times 1) + 8} = 26947368 \text{ seconds} = 311.9 \text{ days}$$

Changing the number of channels logged from 1 to 8 in the above formula ($n_{Channels}$ = 8) yields the following equation:

$$time = 1 \times \frac{512,000,000}{6 + 1 + (4 \times 8) + 8} = 10893617 \text{ seconds} = 126 \text{ days}$$

USB-5200 Series

Software

Calibration

USB-5200 Series are factory-calibrated using a NIST-traceable calibration process. Specifications are guaranteed for one year.
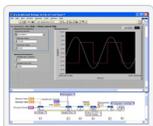
The USB-5200 Series also supports field calibration for users to calibrate the device locally with the InstaCal utility.

Power Adapter

Connect the external power supply to the USB-5200 Series device when logging data. Due to processing limitations, you cannot log data to the memory card when the device is connected to an active USB port.

Software Support

USB-5200 Series devices are supported by the software in the table below.

Ready-to-Run Applications		
DAQami™		Data acquisition companion software with drag-and-drop interface that is used to acquire, view, and log data, and generate signals. DAQami can be configured to log analog, digital, and counter channels, and to view that data in real-time or post-acquisition on user-configurable displays. Logged data can be exported for use in Excel® or MATLAB®. Windows OS DAQami is included with the free MCC DAQ Software bundle (CD/download). Install DAQami and try the fully-functional software for 30 days. After 30 days, all features except for data logging and data export will continue to be available – data logging and data export features can be unlocked by purchasing the software. USB-to-PC connection only.
InstaCal™		An interactive installation, configuration, and test utility for MCC hardware. Windows OS InstaCal is included with the free MCC DAQ Software bundle (CD/download).
TracerDAQ™ and TracerDAQ Pro		Virtual strip chart, oscilloscope, function generator, and rate generator applications used to generate, acquire, analyze, display, and export data. Supported features may vary by hardware. The Pro version provides enhanced features. Windows OS TracerDAQ is included with the free MCC DAQ Software bundle (CD/download). TracerDAQ Pro is available as a purchased software download. USB-to-PC connection only.
General-Purpose Programming Support		
Universal Library™ (UL)		Library for developing applications in C, C++, VB, C# .Net, VB .Net, and Python. Windows OS The UL is included with the free MCC DAQ Software bundle (CD/download).
Application-Specific Programming Support		
ULx for NI LabVIEW™		A comprehensive library of VIs and example programs for NI LabVIEW that is used to develop custom applications that interact with most MCC devices. Windows OS ULx for NI LabVIEW is included with the free MCC DAQ Software bundle (CD/download). USB-to-PC connection only.
DASYLab®		Icon-based data acquisition, graphics, control, and analysis software that allows users to create complex applications in minimal time without text-based programming. Windows OS DASYLab is available as a purchased software download. An evaluation version is available for 28 days. USB-to-PC connection only.

USB-5200 Series

Specifications

Specifications

All specifications are subject to change without notice.
Typical for 25 °C unless otherwise specified.

Analog Input
A/D converters: Four dual 24-bit, Sigma-Delta type
Number of channels: 8 differential
Input isolation: 500 VDC minimum between field wiring and USB interface
Channel configuration: Software-selectable to match sensor type
Differential input voltage range for each supported sensor categories
    Thermocouple: ±0.080 V
    RTD (USB-5203 only): 0 V to 0.5 V
    Thermistor (USB-5203 only): 0 V to 2 V
    Semiconductor (USB-5203 only): 0 V to 2.5 V
Absolute maximum input voltage:
    ±C0x through ±C7x relative to GND: ±24 V power on, ±24 V power off
Input impedance: 5 GΩ, min
Input leakage current
    Open thermocouple detect disabled: 30 nA max
    Open thermocouple detect enabled: 105 nA max
Normal mode rejection ratio: fIN = 60 Hz: 90 dB min
Common mode rejection ratio: fIN=50 Hz/60 Hz: 100 dB min
Resolution: 24 bits
No missing codes: 24 bits
Input coupling: DC
Warm-up time: 30 minutes min
Open thermocouple detect: Automatically enabled when the channel pair is configured for thermocouples. The maximum open detection time is 3 seconds.
CJC sensor accuracy
    15 °C to 35 °C: ±0.25 °C typ,±0.5 °C max
    0 °C to 70 °C: –1.0 °C to +0.5 °C max

Channel Configurations
Thermocouple: J, K, S, R, B, E, T, or N; 8 differential channels
Semiconductor Sensor: 8 differential channels
RTD and Thermistor
    2-wire with a single sensor per channel pair, 4 differential channels
    2-wire with two sensors per channel pair, 8 differential channels
    3-wire with a single sensor per channel pair, 4 differential channels
    4-wire with a single sensor per channel pair, 4 differential channels
    4-wire with two sensors per channel pair, 8 differential channels
The analog input channels are configured in four channel pairs with CH0/CH1, CH2/CH3, CH4/CH5, and CH6/CH7 paired together. This pairing requires the channel pairs be configured to monitor the same sensor category. Mixing different sensor types of the same category (such as a type J thermocouple on channel 0 and a type T thermocouple on channel 1) is valid.

Compatible Sensors
Thermocouple
    J: –210 °C to 1200 °C
    K: –270 °C to 1372 °C
    R: –50 °C to 1768 °C
    S: –50 °C to 1768 °C
    T: –570 °C to 400 °C
    N: –570 °C to 1300 °C
    E: –570 °C to 1000 °C
    B: 0 °C to 1820 °C
RTD
    100 Ω PT (DIN 43760: 0.00385 ohms/ohm/°C)
    100 Ω PT (SAMA: 0.003911 ohms/ohm/°C)
    100 Ω PT (ITS-90/IEC751:0.0038505 ohms/ohm/°C)
Thermistor: Standard 2,252 Ω through 30,000 Ω
Semiconductor/IC: LM35, TMP35 or equivalent

Accuracy

Thermocouple Measurement Accuracy

Sensor Type	Maximum Error (°C)	Typical Error (°C)	Temperature Range (°C)
J	±1.499	±0.507	–210 to 0
	±0.643	±0.312	0 to 1200
K	±1.761	±0.538	–210 to 0
	±0.691	±0.345	0 to 1372
S	±2.491	±0.648	–50 to 250
	±1.841	±0.399	250 to 1768.1
R	±2.653	±0.650	–50 to 250
	±1.070	±0.358	250 to 1768.1
B	±1.779	±0.581	250 to 700
	±0.912	±0.369	700 to 1820
E	±1.471	±0.462	–200 to 0
	±0.639	±0.245	0 to 1000
T	±1.717	±0.514	–200 to 0
	±0.713	±0.256	0 to 600
N	±1.969	±0.502	–200 to 0
	±0.769	±0.272	0 to 1300

Semiconductor Sensor Measurement Accuracy

Sensor Type	Temperature Range (°C)	Accuracy Error Maximum (°C)
LM35, TMP35 or equivalent	–40 to 150	±0.50

RTD Measurement Accuracy

RTD	Sensor Temperature (°C)	Accuracy Error (°C)	
		Maximum	Typical
PT100, DIN, US, or ITS-90	–200 to –150	±2.85	±2.59
	–150 to –100	±1.24	±0.97
	–100 to 0	±0.58	±0.31
	0 to 100	±0.38	±0.11
	100 to 300	±0.39	±0.12
	300 to 600	±0.40	±0.12

Ix+ = 210 µA. All specifications are (±).

Thermistor Measurement Accuracy

Thermistor	Temperature Range (°C)	Maximum Accuracy Error (°C)
2252 Ω	–40 to 120	±0.05
3000 Ω	–40 to 120	±0.05
5000 Ω	–35 to 120	±0.05
10000 Ω	–25 to 120	±0.05
30000 Ω	–10 to 120	±0.05

Ix+ = 10 µA

Specifications

Typical Thermistor Resistance					
Temp (°C)	2252 Ω	3000 Ω	5 kΩ	10 kΩ	30 kΩ
–40	76 kΩ	101 kΩ	168 kΩ	240 kΩ	885 kΩ
–35	55 kΩ	73 kΩ	121 kΩ	179 kΩ	649 kΩ
–30	40 kΩ	53 kΩ	88 kΩ	135 kΩ	481 kΩ
–25	29 kΩ	39 kΩ	65 kΩ	103 kΩ	360 kΩ
–20	22 kΩ	29 kΩ	49 kΩ	79 kΩ	271 kΩ
–15	16 kΩ	22 kΩ	36 kΩ	61 kΩ	206 kΩ
–10	12 kΩ	17 kΩ	28 kΩ	48 kΩ	158 kΩ
–5	9.5 kΩ	13 kΩ	21 kΩ	37 kΩ	122 kΩ
0	7.4 kΩ	9.8 kΩ	16 kΩ	29 kΩ	95 kΩ

Throughput Rate to PC	
Number of Input Channels	Maximum Throughput
1	2 S/s
2	2 S/s per channel, 4 S/s total
3	2 S/s per channel, 6 S/s total
4	2 S/s per channel, 8 S/s total
5	2 S/s per channel, 10 S/s total
6	2 S/s per channel, 12 S/s total
7	2 S/s per channel, 14 S/s total
8	2 S/s per channel, 16 S/s total

Digital Input/Output
Digital type: CMOS
Number of I/O: 8 (DIO0 through DIO7)
Configuration: Independently configured for input or output. Power on reset is input mode unless bit is configured for alarm.
Pull up/pull-down configuration: Pulled up to +5 V via 47 kΩ resistors (default).
Digital I/O transfer rate (software paced)
    Digital input: 50 port reads or single bit reads per second typ
    Digital output: 100 port writes or single bit writes per second typ
Input high voltage: 2.0 V min, 5.5 V absolute max
Input low voltage: 0.8 V max, –0.5 V absolute min
Output low voltage (IOL = 2.5 mA): 0.7 V max
Output high voltage (IOH = –2.5 mA): 3.8 V min

Temperature Alarms
Number of alarms: 8 (one per digital I/O line)
Alarm functionality: Each alarm controls a DIO line as an alarm output. The input can be any temperature channel. When enabled, the DIO line is set to output and driven to the configured alarm option and input temperature. Alarms function both in data logging mode and USB mode.
Alarm input modes
    Alarm when input temperature > T1
    Alarm when input temperature > T1, reset when input temperature < T2
    Alarm when input temperature < T1
    Alarm when input temperature < T1, reset when input temperature >T2
    Alarm when input temperature is < T1 or > T2
T1 and T2 may be independently set for each alarm.
Alarm output modes
    Disabled: Digital I/O line may be used for normal operation
    Enabled: Active high output (DIO line goes high when alarm conditions met)
    Enabled: Active low output (DIO line goes low when alarm conditions met)
Alarm update rate: 1 second

Data Logging
Standalone power supply: 2.5 watt USB power adapter; interchangeable plugs
Memory card type: CompactFlash; 512 MB CompactFlash card included
Memory card host access: USB mass storage device
File systems supported: FAT16, FAT32
Log file format: Binary
Logging rate: Min 1 second between entries, max 232 seconds, 1 second granularity
Data items logged: Timestamp, temperature, raw, DIO state, CJC sensor readings
Logging start methods (software-selectable)
    Start logging on power up: Logging begins 5 seconds after power on
    Start logging on button: Device is idle on power on. Press and hold the button until the LED turns on to begin logging. First sample is acquired 1 second after the LED turns on unless <5 seconds since power on.
    Start logging at specified time: Device is idle until the real-time clock indicates the time is = or > the specified time, at which time the LED turns on. First sample acquired 1 second after the LED turns on unless <5 seconds since power on.
Logging stop methods
    Stop on button press: hold down the button until the LED turns off. The device caches logged data in volatile memory prior to writing to memory card.
Logging status indication: The LED operations when connected to the AC power adapter are different than when connected to USB.
    Logging off: The LED is off (disabled).
    Start logging on power up: LED turns on, blinks when data is captured.
    Start logging on button: The LED is initially off. When the button is pressed and held for approximately 1 second, the LED turns on and acts the same as *Start Logging on Power Up* mode.
    Start logging at specified time: the LED turns off, with a momentary on flash every second. When the specified date/time is reached, the LED turns on.
    Other indication: Press and hold until LED is off to stop logging and store remaining data. LED blinks when the card is full or removed when logging.

Current Excitation Outputs (Ix+)	
Current Excitation Output	AI Channel
I1+/I1–	CH0/CH1
I2+/I2–	CH2/CH3
I3+/I3–	CH4/CH5
I4+/I4–	CH6/CH7

Current excitation output ranges
    Thermistor: 10 µA typ
    RTD: 210 µA typ
Tolerance: ±5% typ
Drift: 200 ppm/°C
Line regulation: 2.1 ppm/V max
Load regulation: 0.3 ppm/V typ
Output compliance voltage (relative to GND): 3.90 V max, –0.03 V min

Real-Time Clock
Battery backup: CR-2032 lithium coin cell, replaceable
Accuracy: ±1 minute per month

Power
Connected to USB
    Supply current
        USB enumeration <100 mA, **Continuous mode** 500 mA max
    +5 V output voltage range (self-powered hub): 4.75 V min to 5.25 V max
    +5 V output current (self-powered hub): 10 mA max
Isolation (measurement system to PC): 500 VDC min
Connected to AC adapter for data logging operations
    Output voltage: 5 V ±5%
    Output wattage: 2.5 W
    Input voltage: 100 VAC to 240 VAC, 50 Hz to 60 Hz
    Input current: 0.2 A

Environmental
Operating temperature range: 0 °C to 70 °C
Storage temperature range: –40 °C to 85 °C
Humidity: 0% to 90% non-condensing

Mechanical
Dimensions (L × W × H): 128.52 × 88.39 × 35.56 mm (5.06 × 3.48 × 1.43 ft)

USB-5200 Series

Ordering

Order Information

Hardware

Part No.	Description
USB-5201	Thermocouple input data logger (CompactFlash) with alarms and 8 DIO lines. Includes USB cable, power adapter, and MCC DAQ software
USB-5203	Temperature data logger (CompactFlash) supports multiple sensor types and 8 DIO lines. Includes USB cable, power adapter, and MCC DAQ software

Accessories

Part No.	Description
745690-E001	E-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 1 m
745690-E002	E-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 2 m
745690-J001	J-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 1 m
745690-J002	J-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 2 m
745690-K001	K-type thermocouples wire, fiberglass (0 °C to 482 °C , 32 °F to 900 °F), 1 m
745690-K002	K-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 2 m
745690-T001	T-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 1 m
745690-T002	T-type thermocouples wire, fiberglass (0 °C to 482 °C, 32 °F to 900 °F), 2 m
745691-01	3-wire, 100 Ω RTD, sealed with alumina tube, 1 m (USB-5203 only)
745691-02	3-wire, 100 Ω RTD, platinum (ready made), 2 m (USB-5203 only)
512 MB CF Card	CompactFlash card for Measurement Computing data loggers, 512 MB
1 GB CF Card	CompactFlash card for Measurement Computing data loggers, 1 GB
2 GB CF Card	CompactFlash card for Measurement Computing data loggers, 2 GB
USB Power Adapter	Replacement 5 W power supply for data logging; includes interchangeable plugs.

Software also Available from MCC

Part No.	Description
DAQami	Data acquisition companion software for acquiring data and generating signals
TracerDAQ Pro	Out-of-the-box virtual instrument suite with strip chart, oscilloscope, function generator, and rate generator – professional version
DASYLab	Icon-based data acquisition, graphics, control, and analysis software