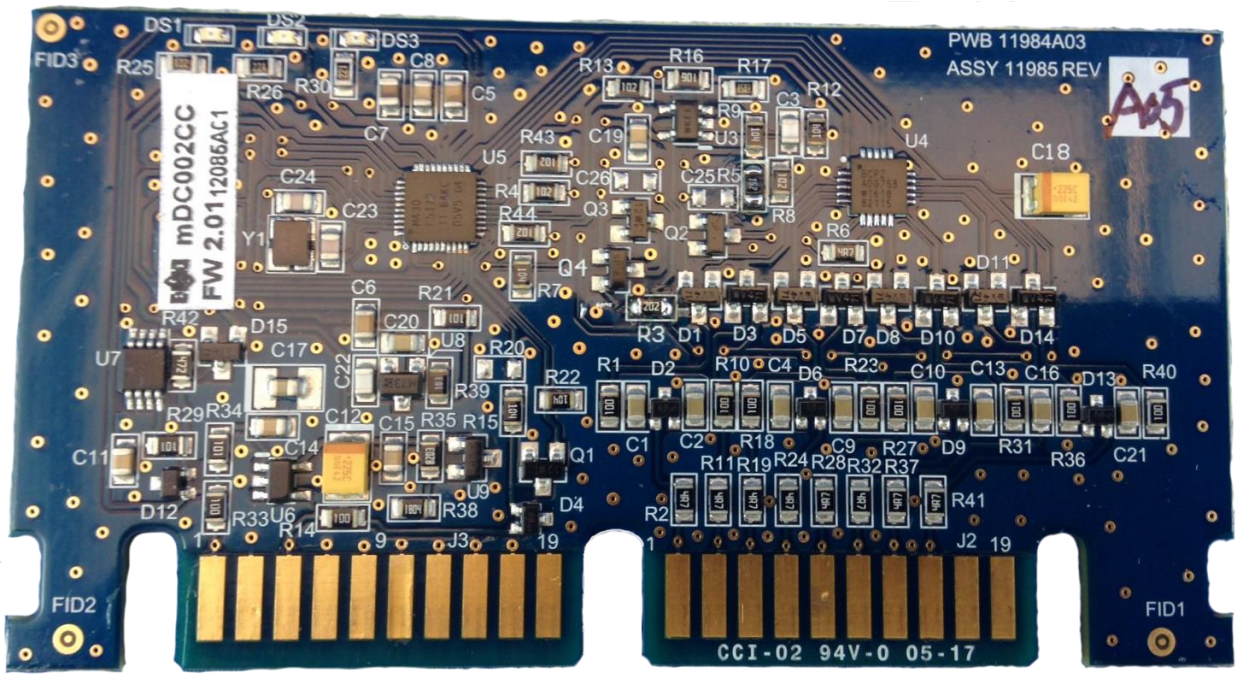
mDC002
Digital Cable Controller Card
FW 2.01



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Revision History

REV	Description	Date	App.
A00	First Release	July 21/17	VB
A01	Description of functionality added	April 16/18	VB
A02	Starting addresses of cables added	Oct. 28/19	JP

Table of Contents

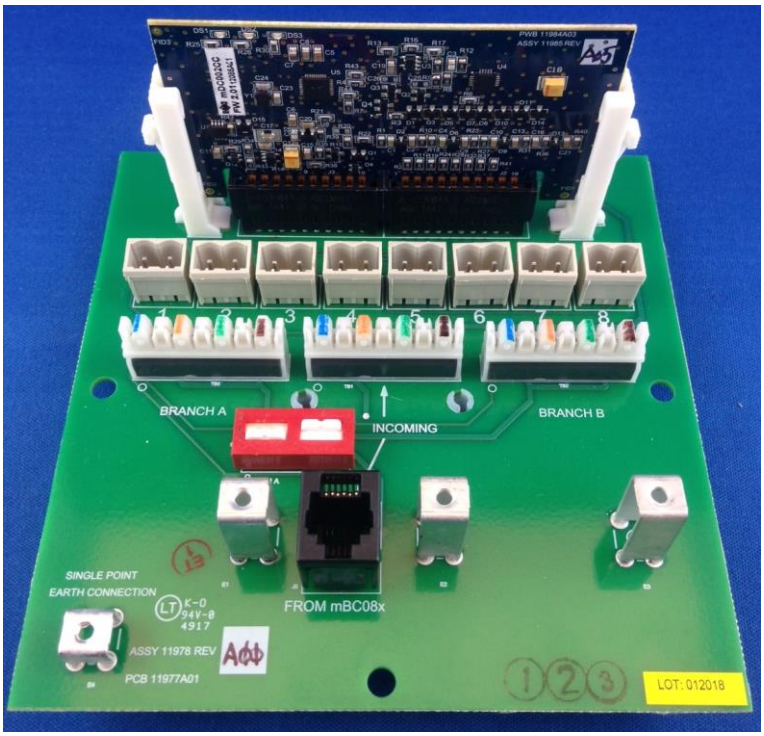
1. Overview

The mDC002 Digital thermometer Converter converts maximum 224 Thermometers to scaled temperature values. It is designed to measure the temperature of commodities in bulk storage bins such as grains and wood chips. Ultralow power technology is used to allow operation on CMC Industrial Electronics deployment of the Dallas 1-Wire® bus for intrinsically safe locations. When used with the mBC081 or mBC083 Bus Converter the device is Intrinsically Safe.

The mDC002 Controller Card is plugged into a backplane where terminals for grain cables are. The backplane has branch-disconnect switches to assist in network diagnostics. The kit includes all hardware required for the installation, including drill templates for the sensor and main bus entries. A grounding plate is provided to provide an electrical grounding path if a metallic conduit system is used for the bus cabling.

The unit measures temperatures from –40°C to +85°C in 1°C increments.

2. Description



The mDC002 inputs are arranged as 8 groups – 8 terminals. Each group has a maximum 28 DS28EA00 thermometer sensors which are connected in a chain.
When digital grain cable is connected to the backplane the controller card must be power cycled otherwise it won't read the cable. The easiest way to do the power cycle is to turn off and on the sensor network using designated button for it in the web server web interface or the actual buttons on the web server.
The controller card reports following statuses of connected cables:

- OK – Everything is working without problem and connected sensors are read
- Open Wire – When cable is connected and read by the card and then it gets disconnected the card will report this as Open Wire. Same thing will be in case of short, if the terminal is shorted during the card power up and then the short is removed the cards will also report it as Open Wire. If the card is power cycled while the cable is disconnected it won't report Open Wire
- Short – When resistance between Data and Ground wire on the plug is lower than 2.4 kΩ the controller card will report a short
- Mismatch – Each cable has saved information about number of temperature sensors which are inside of the cable. If the numbers of read sensors differs it will be reported as mismatch. This is usually due to broken or disconnected sensor

3. Description of Indicators

There are 2 indicator LEDs:

Description	Color	Operation
Communication Status	Green	1 flash: There is no communication with bus convertor
		2 flashes: Communication with bus convertor is OK
Card Functionality	Orange	If orange is flashing card is not functional
Error Status	Red	1 flash: A cable or some cables are Open Wire
		2 flashes: Ambient sensor reading failure
		3 flashes: A cable or some cables are Short to ground
		4 flashes: Power on test failure
		5 flashes: Firmware test failure

4. Communications

The mDC002 is a fully compliant Dallas 1-Wire® device. The mDC002 connects to the CMCIEL wiring system using CAT5 cable. A single RJ-11 jack is provided for connecting an mBC081/83 Bus Converter or other approved CMCIEL 1-Wire® device to the wiring system.

The mDC002 requires a bus converter to convert the Dallas 1-Wire® signaling system to a system recognized by commercial programmable controllers. The Bus Converters provide a Modbus485 RTU interface. CMCIEL manufactures Bus Converters for both commercial and hazardous areas. The Bus Converters will automatically acquire the serial number of the mDC002 on request.

As a Dallas 1-Wire® device, the mDC002 value is returned using the read scratch function as 3 bytes, the first 2 bytes a signed word containing the multiplexed temperature values and the 3rd byte the Dallas 1-Wire® - 8 bit CRC. The family code for the converter is 182 decimal or B6 Hex. The mDC002 responds to the following Dallas function codes:

Code Decimal	Code Hex	Function
240	F0	Search ROM
85	55	Match ROM
15	0F	Read ROM
51	33	Read ROM
204	CC	Skip ROM
190	BE	Read Scratch
113	71	Read Firmware Version

Refer to Dallas Semiconductor documentation for complete details on the operation of the Dallas 1-Wire® signaling system.

5. Decoding of Scratch Data Word

The bus converter sends Read Scratch command to read 3 bytes of the output of the mDC002. The first byte is an 8 bit address, the second 8 bit is the value in the address, and the third byte is CRC. If the value represents a temperature, it will be an unsigned temperature offset by 40°C (i.e. a value of 40 corresponds to 0°C). If the temperature value is 0xFF, it means that the sensor reading failed. The converter provides up to 224 values over the multiplexed bus. The address and associated value are automatically incremented every 3 seconds. The mDC002 detects the location of each sensor in the chain and register the sensors in a sensor table after its power on. The mDC002 should be restarted if new sensors are added or any sensors are removed.

Address	Value
0	Bit 0: Open wire detected Bit 1: Ambient temperature sensor failure Bit 2: Data line short to ground detected Bit 3: Power on test failure Bit 4: Firmware corrupted
1	Ambient temperature + 40 in °C
X<=225[1]	Sensor temperature + 40 in °C @ sensor No. (X-1) Cable 1 starts at address 2 Cable 2 starts at address 30 Cable 3 starts at address 58 Cable 4 starts at address 86 Cable 5 starts at address 114 Cable 6 starts at address 142 Cable 7 starts at address 170 Cable 8 starts at address 198
226	Cable short, Bit 0: cable 1 …..Bit7:cable 8
227	Open wire (see description above), Bit 0: cable 1 …..Bit7:cable 8
228	Number of sensors doesn't match. Bit 0: Cable 1….Bit7: Cable 8
229	Number of sensors in Cable 1
230	Location number in bin for Cable 1
231	Bin number for Cable 1
232	Number of sensors in Cable 2
233	Location number in bin for Cable 2
234	Bin number for Cable 2

…	……
250	Number of sensors in Cable 8
251	Location number in bin for Cable 8
252	Bin number for Cable 8
253	Firmware Version Number - 200

Note[1]: The integer of 1+ (X-2)/28 will be the cable number.
1+(X-2)%28 will be the sensor number in the cable.

6. Specifications

Description	Characteristic
Sensor Bus Voltage Current	 5 VDC (MIN 3.5 VDC) 6.0 mA max, 4 mA avg.
Environment Temperature	 -40°C to +85°C (-40°F to 176°F)
Overall Capacitance	10µF
Overall Inductance	1µH