

# SCM9B-D100 Series

## DIN Rail Mount Sensor-to-Computer Modules



### Description

The SCM9B-D100 Sensor to Computer Modules are a family of data acquisition modules that convert analog input signals to digital data and transmit via RS-485 to a controller which may be a computer or other processor-based equipment. The modules can measure temperature, pressure, voltage, current, digital input or digital output signals. The modules provide direct connection to a wide variety of sensors and perform all signal conditioning, scaling, linearization and conversion to either linearized ASCII data values or Modbus RTU data values.

Features such as address, baud rate, parity, echo, etc., are selectable using simple commands over the RS-485 port. The selections are stored in nonvolatile EEPROM which maintains data even after power is removed.

Data is acquired on a per channel basis so you only buy as many channels as you need. The modules can be mixed and matched to fit your application. They can be placed remote from the host and from each other. You can string up to 247 modules on a twisted pair of wires by using RS-485 with repeaters.

All modules are supplied with screw terminal plug connectors. The connectors allow system expansion, reconfiguration or repair without disturbing field wiring.

Utility software is available from Dataforth to make the D100 easier to learn and use. The software is provided at no charge on request with a purchase order and is not copy protected.

### Theory Of Operation

Each Dataforth module is a complete single-channel data acquisition system. Each unit contains analog signal conditioning circuits optimized for a specific input type. Sensor signals are converted to digital data with a micro processor-controlled integrating A/D converter. Offset and gain errors in the analog circuitry are continuously monitored and corrected using microprocessor techniques. The D100 converts the digital signal data and stores the resultant data in a memory buffer. The modules continuously convert data at the rate of 8 conversions per second and store the latest result in the buffer.

Host processors may request data by sending a query to the module. The D100 will instantly respond by communicating the memory buffer data back to the host processor. Up to 247 modules may be linked to a single RS-485 port. Each module on a serial line is identified by a unique user-programmable address. This addressing technique allows modules to be interrogated in any order.

### Digital Inputs/Outputs

D170 digital input/output modules contain open-collector transistor switches that may be controlled by the host processors. These switches may be used to control solid-state relays which in turn may control heaters, pumps and other power equipment. The digital inputs may be read by the host processor and used to sense the state of remote digital signals. They are ideal for sensing the state of limit or safety switches.

### Digital Filter

The D100 analog input modules include two unique programmable single pole digital filters. The filter is used to smooth analog data in noisy environments. Separate time constants may be specified for small and large signal changes. Typically a large time constant is specified for small signal changes to filter out noise and provide stable output readings. A smaller time constant may be chosen for large signal changes to provide fast response to such changes.

### ► Features

- Complete Sensor to RS-485 Interface
- 500Vrms Analog Input Isolation
- 15 Bit Measurement Resolution
- Continuous Self-Calibration; No Adjustments of Any Kind
- Programmable Digital Filter
- Requires +5VDC Supply
- Transient Suppression on RS-485 Communications Lines
- Screw Terminal Plug Connectors Supplied
- CE Compliant

### Command Set

The D100 series uses the Modbus RTU or the Dataforth ASCII protocol for communication.

The Modbus RTU binary protocol uses a master-slave technique, in which only the master device can initiate transactions. The slave devices respond by supplying the requested data to the master or by taking the action requested in the query. The master can address any slave device. The returned messages are considered response messages. The supported master codes are:

### Modbus RTU Functions and Descriptions

- |    |   |
|----|---|
| 01 | Read Coil Status (Digital Inputs)               |
| 04 | Read Input Register (Analog Inputs)             |
| 05 | Force Single Coil (One Digital Input)           |
| 06 | Preset Single Register (Dataforth/RTU Protocol) |
| 15 | Force Multiple Coils (Multiple Digital Output)  |

The Dataforth ASCII protocol is a command and response protocol using ASCII characters for easy troubleshooting and interpretation of data values.

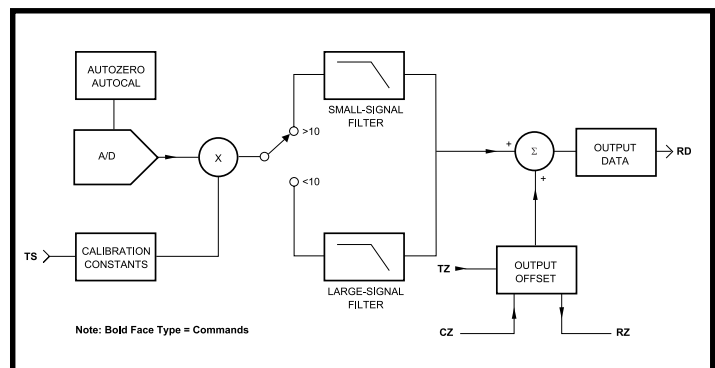


Figure 1: SCM9B-D100 Block Diagram

## D100 Series ASCII Command Set

Command and Definition	Typical Command Message (\$ prompt)	Typical Response
DI Digital Input	\$1DI	*0003
DO Digital Output	\$1DOFF	*
RD Read Data	\$1RD	*+00072.00
RS Read Setup	\$1RS	*31070142
RSU Read Setup	\$1RSU	*31070142
RZ Read Zero	\$1RZ	*+00000.00
WE Write Enable	\$1WE	*

## Write Protected Commands

CZ Clear Zero	\$1CZ	*
RR Remote Reset	\$1RR	*
SU Setup Module	\$1SU31070142	*
TS Trim Span	\$1TS+00600.00	*
TZ Trim Zero	\$1TZ+00000.00	*

## Specifications

Typical at  $T_A = +25^\circ\text{C}$  and nominal power supply unless otherwise noted

### Analog

- Single channel analog input.
- Maximum CMV, input to output at 60Hz: 500Vrms.
- Leakage current, input to output at 115Vrms, 60Hz:  $<2\mu\text{A rms}$ .
- 15 bit measurement resolution.
- 8 conversions per second.
- Autozero & autocalibration—no adjustment pots.

### Digital

- 8-bit CMOS microcomputer.
- Digital scaling, linearization and calibration.
- Nonvolatile memory eliminates pots and switches.

### Digital filtering

- Small and large signal with user selectable time constants from 0 to 16 seconds.

### Communications

- Communications in MODBUS-RTU via RS-485 ports.
- Selectable baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400.
- NRZ asynchronous data format; 1 start bit, 8 data bits, 1 parity bit and 1 stop bit.
- Parity: odd, even, none.
- User selectable channel address.
- Up to 247 multidrop modules per host serial port.
- Communications distance up to 4,000 feet (RS-485).
- Transient suppression on RS-485 communications lines.
- All communications setups stored in EEPROM.

### Power

- Requirements: Regulated +5VDC, 0.75W max (DIN-150, 2.0W max.).
- Protected against power supply reversals.

### Environmental

- Temperature Range: Operating  $-25^\circ\text{C}$  to  $+70^\circ\text{C}$ .  
Storage  $-25^\circ\text{C}$  to  $+85^\circ\text{C}$ .
- Relative Humidity: 0 to 95% noncondensing.

## Setup

The D100 series are initiated at the factory using the Dataforth ASCII protocol. This allows setup and configuration, including the Modbus device address, to be easily performed using the Dataforth setup software or a dumb terminal. Each D100 module must be properly configured before installation into a Modbus system.

## Utility Software

Complimentary Utility Software is included with each purchase order. The software is compatible with Windows 95, 98, NT 4.0+, 2000 operating systems and distributed on CD-ROM. The Utility Software simplifies configuration of all user-selectable options such as device address, baud rate and filtering constants.

## Process Control Software

Modbus RTU protocol is supported by virtually all commercial process control software programs available today. These programs operate on IBM and compatible personal computers in the Windows 95, 98, NT and IBM OS/2 environments.

### D11x Voltage Inputs

- Voltages:  $\pm 10\text{mV}$ ,  $\pm 100\text{mV}$ ,  $\pm 1\text{V}$ ,  $\pm 5\text{V}$ ,  $\pm 10\text{V}$ ,  $\pm 100\text{VDC}$ .
- Resolution: 0.01% of FS (4 digits).
- Accuracy:  $\pm 0.02\%$  of FS max.
- Common mode rejection: 100dB at 50/60Hz.
- Zero drift:  $\pm 1$  count max (autozero).
- Span tempco:  $\pm 50\text{ppm}/^\circ\text{C}$  max.
- Input burnout protection to 250VAC.
- Input impedance:  $\leq \pm 1\text{V input} = 100\text{M}\Omega$  min.  
 $\geq \pm 5\text{V input} = 1\text{M}\Omega$  min.

### D125 Current Inputs

- Currents: 4-20mADC.
- Resolution: 0.04% of FS.
- Accuracy: 0.04% of FS.
- Common mode rejection: 100dB at 50/60Hz.
- Zero drift:  $\pm 1$  count max (autozero).
- Span tempco:  $\pm 50\text{ppm}/^\circ\text{C}$  max.
- Voltage drop:  $\pm 0.1\text{V}$  max.

### D13x Thermocouple Inputs

- Thermocouple types: J, K, T, E, R, S, B, C (factory set).
- Ranges:
 

J = $-200^\circ\text{C}$ to $+760^\circ\text{C}$	B = $0^\circ\text{C}$ to $+1820^\circ\text{C}$
K = $-150^\circ\text{C}$ to $+1250^\circ\text{C}$	S = $0^\circ\text{C}$ to $+1750^\circ\text{C}$
T = $-200^\circ\text{C}$ to $+400^\circ\text{C}$	R = $0^\circ\text{C}$ to $+1750^\circ\text{C}$
E = $-100^\circ\text{C}$ to $+1000^\circ\text{C}$	C = $0^\circ\text{C}$ to $+2315^\circ\text{C}$
- Resolution:  $\pm 1^\circ$ .
- Overall Accuracy (error from all sources) from 0 to  $+40^\circ\text{C}$  ambient:  $\pm 1.0^\circ\text{C}$  max (J, K, T, E).  
 $\pm 2.5^\circ\text{C}$  max (R, S, B, C)(300°C to FS).
- Common mode rejection: 100dB at 50/60Hz.
- Input impedance:  $100\text{M}\Omega$  min.
- Lead resistance effect:  $<20\mu\text{V}$  per 350 $\Omega$ .
- Open thermocouple indication.
- Input burnout protection to 250VAC.
- Overrange indication.

## Specifications (cont.)

### D14x RTD Inputs

- RTD types:  $\alpha$  = .00385, .00392, 100 $\Omega$  at 0°C, .00388, 100 $\Omega$  at 25°C.
- Ranges: .00385 = -200°C to +850°C.  
.00392 = -200°C to +600°C.  
.00388 = -100°C to +125°C.
- Resolution: 0.1°.
- Accuracy:  $\pm 0.3^\circ\text{C}$ .
- Common mode rejection: 100dB at 50/60Hz.
- Input connections: 2, 3, or 4 wire.
- Excitation current: 0.25mA.
- Lead resistance effect: 3 wire - 2.5°C per  $\Omega$  of imbalance.  
4 wire - negligible.
- Max lead resistance: 50 $\Omega$ .
- Input burnout protection to 120VAC.
- Automatic linearization and lead compensation.

### D145 Thermistor Inputs

- Thermistor types: 2252 $\Omega$  at 25°C, TD Series.
- Ranges: 2252 $\Omega$  = -0°C to +100°C.  
TD = -40°C to +150°C.
- Resolution: 2252 $\Omega$  = 0.01°C or F.  
TD = 0.1°C or F.
- Accuracy: 2252 $\Omega$  =  $\pm 0.1^\circ\text{C}$ .  
TD =  $\pm 0.2^\circ\text{C}$ .
- Common mode rejection: 100dB at 50/60Hz.
- Input burnout protection to 30VDC.

### D15x Bridge Inputs

- Voltage ranges:  $\pm 30\text{mV}$ ,  $\pm 100\text{mV}$ .
- Resolution: 10 $\mu\text{V}$  (mV Spans).  
0.02% of FS (V Span).
- Accuracy:  $\pm 0.05\%$  of FS max.
- Common mode rejection: 100dB at 50/60Hz.
- Input burnout protection to 30VDC.
- Offset control: Full input range.
- Excitation voltage: 5V, 10VDC, 50mA max.
- Zero drift:  $\pm 1\mu\text{V}/^\circ\text{C}$  max.
- Span tempco:  $\pm 50\text{ppm}/^\circ\text{C}$  max.

### D161 Frequency Inputs

- Range: 1Hz to 20kHz.
- Resolution: 0.005% of reading  $\pm 0.01\text{Hz}$ .
- Accuracy:  $\pm 0.01\%$  of reading  $\pm 0.01\text{Hz}$ .
- Tempco:  $\pm 20\text{ppm}/^\circ\text{C}$ .
- Input impedance: 1M $\Omega$ .
- Switching level: selectable 0V, +2.5V.
- Hysteresis: adjustable 10mV-1.0V.
- Input burnout protection: 250VAC.

### D17x Digital Inputs/Outputs

- 6 digital inputs or 6 digital outputs.
- Input voltage levels:  $\pm 30\text{V}$  without damage.
- Input switching levels: High, 3.5V min., low, 1.0V max.
- Outputs: open collector to 30V, 100mA max. load.
- Vsat: 1.0V max at 100mA.
- Inputs/Outputs are read/set in parallel.
- Isolated from power supply ground.

## Ordering Information

### Voltage Input

Model	Description
SCM9B-D110	$\pm 10\text{mV}$ Input/RS-485 Output
SCM9B-D111	$\pm 100\text{mV}$ Input/RS-485 Output
SCM9B-D112	$\pm 1\text{V}$ Input/RS-485 Output
SCM9B-D113	$\pm 5\text{V}$ Input/RS-485 Output
SCM9B-D114	$\pm 10\text{V}$ Input/RS-485 Output
SCM9B-D115	$\pm 100\text{V}$ Input/RS-485 Output

### Current Inputs

Model	Description
SCM9B-D125	4-20mA Input/RS-485 Output

### Thermocouple Inputs

Model	Description
SCM9B-D131	J Thermocouple Input/RS-485 Output
SCM9B-D132	K Thermocouple Input/RS-485 Output
SCM9B-D133	T Thermocouple Input/RS-485 Output
SCM9B-D134	E Thermocouple Input/RS-485 Output
SCM9B-D135	R Thermocouple Input/RS-485 Output
SCM9B-D136	S Thermocouple Input/RS-485 Output
SCM9B-D137	B Thermocouple Input/RS-485 Output
SCM9B-D138	C Thermocouple Input/RS-485 Output

### RTD/Thermistor Inputs

Model	Description
SCM9B-D141	.00385 RTD Input/RS-485 Output
SCM9B-D142	.00392 RTD Input/RS-485 Output
SCM9B-D143	.00388 RTD Input/RS-485 Output
SCM9B-D145	2252 $\Omega$ Thermistor Input/RS-485 Output
SCM9B-D146	TD Thermistor Input/RS-485 Output

### Bridge Inputs

Model	Description
SCM9B-D151	30mV Bridge Input, 5V Excitation/RS-485 Output
SCM9B-D152	30mV Bridge Input, 10V Excitation/RS-485 Output
SCM9B-D153	100mV Bridge Input, 5V Excitation/RS-485 Output
SCM9B-D154	100mV Bridge Input, 10V Excitation/RS-485 Output

### Timer and Frequency Inputs

Model	Description
SCM9B-D161	Frequency Input/RS-485 Output

### Digital Inputs/Outputs

Model	Description
SCM9B-D171	6 Digital Inputs/RS-485 Output
SCM9B-D172	6 Digital Outputs/RS-485 Output