Modulus Cellular Communications modules have a built-in 4G LTE cellular modem for data exchange over the Internet, alarming/notifications by e-mail and text message, and remote access. They also support wired communications with Modbus, DF1, Ethernet IP, SDX, MQTT, and SDI-12. The Cellular Communications modules have built-in analog and digital I/O for tank level and process monitoring, and pump control applications such as lift stations and booster pumping stations. The base modules have a choice of analog inputs supporting either mA, voltage or resistance/temperature measurement, along with a high-speed discrete input and a FET discrete output. Additional I/O, consisting of 16 discrete inputs, 5 relay outputs, a couple more 20mA analog inputs, and 4 analog outputs, is brought out on an external field wiring panel.

Modulus Cellular Communications modules have two serial ports (bus port plus one general purpose port). The bus port may also be used for general purpose RS-485 communications when not bussed with other Modulus I/O modules.

**STANDALONE OPERATION**
Modulus Cellular Communications modules can serve as standalone devices with SCADA communications, local and web human machine interfaces (HMIs), historical trending and data logging, alarming, reporting, and programmable logic.

**COMMUNICATIONS**
Modulus Cellular Communications modules have a built-in 4G LTE cellular modem that can be ordered to support either Verizon or AT&T / International cellular networks. The also have an Ethernet port and one or two serial ports to communicate with Modbus devices and Allen Bradley PLCs. They can serve as communications concentrators or master controllers, as well as providing web and data access to any other Modulus modules on the high-speed bus. They support Ethernet to Serial bridging, and routing through Ethernet ports in other Modulus modules on the bus.

**GRAPHICAL, MOBILE, AND LOCAL HMIs**
Configurable graphical and mobile device web interfaces, including the tools and libraries to build custom screens, are built in. The front panel display can also be customized to show live process values and states, and make setting changes.

**HISTORICAL TRENDING AND EVENT LOGGING**
Modulus Cellular Communications modules have an internal flash disk, as well as a micro SD memory card slot to record over 100 years of data! Use built-in web tools to retrieve and display historical trend and event data and extract it as spreadsheet files.

**REPORTING**
Reports with custom graphics and logos can be created in minutes, showing live values, totals, trend/event data, alarm summaries, etc. They can be called up on demand, or sent out automatically.

**ALARMING**
A Modulus Cellular Communications module can manage alarm conditions on any of its local inputs and other Modulus I/O on the bus, as well as external devices via communications. Alarms conditions can be displayed locally and annunciated by text message and e-mail alerts. Alarms can be acknowledged by text message or e-mail, discrete input, or local HMI button. The module maintains a journal spreadsheet file of when alarms occurred, when they were acknowledged, by whom, and when the alarm conditions clear.

**PROGRAMMABLE LOGIC**
Modulus Cellular Communications modules support programmable logic written in ladder logic, function block and text languages; all with 32-bit integer and floating point math. Programmable logic can supplement the built-in functions of the module.

**PID & PUMP CONTROL**
Modulus Cellular Communications modules have a quad PID controller and a triplex pump controller (float or level control) with error detection and alarming. The Cellular Communications Module is an ideal solution for SCADA operation of wells, lift stations, and booster pump stations.

**REDUNDANCY**
Modulus Cellular Communications modules support redundancy for enhanced reliability. If a module goes off-line, a designated backup can take over automatically.
## FIELD I/O

### Discrete Inputs:
- **1** High-speed, non-isolated DC or contact closure, DC to 20KHz maximum

#### Input Range:
Contact closure/open collector driver to ground, or 0 to 30Vdc (ON<1.5V, OFF > 2.5V)

#### Input Current:
- Approximately 0.5mA (internal current source)

#### Filtering:
Individually configurable: 5Hz, 10Hz, 20Hz, 50Hz, 100Hz, 500Hz, 1KHz, 2KHz, 5KHz, 10KHz+

#### Input Range:
- Optically Isolated, bipolar (AC/DC, not polarity sensitive)
- 0 to 30V (OFF < 6V, ON>9V)

#### Input Current:
- 1.2mA @ 12V, 3mA @ 24V

#### Filtering:
Individually configurable: 20Hz or 100Hz

### Discrete Outputs:
- **1** Solid-state Protected FET high-side drivers (switch to input power when ON)

#### Output Rating:
30Vdc, 2A maximum, current limited to approximately 2.25A.

#### Output Rating:
- 240/277 Vac, 30Vdc, 3A maximum per output (resistive load).

#### Output Rating:
- A snubber diode (DC) or RC snubber (AC) must be used across the relay contacts or load connections for any inductive load.

### Analog Inputs:
- **2** 16-bit, Delta Sigma, individually software configurable ranges

#### Input Range:
- • [8X-519X] 20mA (Minimum input for full accuracy is 0.5mA)
- • [8X-529X] 5V, +/-5V, 10V, +/-10V, 30V
- • [8X-539X] 50K ohms, temperature using 2.2K, 10K (type II, III and w/11.K shunt) thermistors

### Analog Outputs:
- **4** 12-bit

#### Output Ranges:
- 0-20mA, 4-20mA

## COMMUNICATIONS

### Ethernet:
- **1** 10/100mb/s (10/100 Base-T)

#### SCADA Protocols:
- Modbus TCP & UDP (master/slave), Ethernet IP (master/slave PLC's & SLC5/05 emulation), SDX (AES-128 Encryption), MQTT, Ethernet to Serial bridging

#### Internet Protocols:
- HTTP (server), FTP (server & client), E-mail (SMTP and POP3), ICMP (ping; server & client), DHCP (server & client), DNS, DDNS

### Cellular:
- **1** 4G LTE:
  - [8x-5x91] 700(B13)/AWS1700(B4)/1900(B2) (Verizon)
  - [8x-5x92] 700(B12/B13)/850(B5)/AWS1700(B4)/1900(B2) (AT&T, T-Mobile, International)

#### SCADA Protocols:
- Modbus TCP & UDP (master/slave), MQTT

#### Internet Protocols:
- HTTP (server), FTP (server & client), E-mail (SMTP and POP3), ICMP (ping; server and client), DNS, DDNS

### Serial:
- **1** RS-232, RS-485, RS-422, SDI-12 (for general purpose communications)

#### Baud Rates (all ports):

#### Protocols:
- Modbus RTU (master/slave), DF1 (slave), SDI-12 (general purpose port only)

## HMIs

### Local:
- 128x32 graphical, wide temperature range yellow OLED and single pushbutton

### Graphical:
- Web based, graphic library included. Compatible with most browsers, including Internet Explorer, Firefox, Chrome, Safari, Android

### Mobile:
- Web based, text only, up to 50 registers. Compatible with most browsers, including Internet Explorer, Firefox, Chrome, Safari, Android

## PROGRAMMING

### Languages:
- Ladder Logic, Function Block, Text—built-in web based graphical and text editor and debugger

### Capacity:
- 64KB logic, 2MB source code, 32-bit integer and floating point math

## STORAGE

### Registers:
- 504 Numeric registers, 504 Boolean registers

### Internal Flash disk:
- 32MB

### Removable disk:
- Micro SD Card (up to 256GB, supplied by customer)

## CLOCK

### Real Time Clock:
- Temperature compensated with lithium battery backup power

### Stability:
- +/- 3ppm from –30°C to 70°C

## GENERAL

### Input Power:
- 10Vdc to 30Vdc

### Power Consumption:
- (not including analog output current)
  - Not using Ethernet: 68mA @ 12Vdc / 40mA @ 24Vdc (Ethernet power saver enabled)
  - Using Ethernet: 108mA @ 12Vdc / 60mA @ 24Vdc
  - Add current per on relay: 10mA @ 12Vdc / 5mA @ 24Vdc

### Field Wiring Terminations:
- [81-5x9x] screw terminal blocks, [B2-5x9x] lever terminal blocks, 3.5mm, 22 to 14GA wires

### Antenna Connector:
- SMA female (pin center conductor)

### Temperature:
- -40°C to 70°C (operating), -40°C to 85°C (storage)

### Humidity:
- <95% RH (non-condensing)

### Enclosure:
- Polyamide, light gray (RAL 7035)

### Mounting:
- 35mm DIN rail with bus connector block

Specifications subject to change without notice. Consult factory to ensure that you are working with current information.
Most cellular based systems typically have less costly and complex antenna system requirements. The choice of antenna components depends on the type of enclosure housing the enclosure (metallic or non-metallic) and the proximity to the nearest cellular tower.

**Non-metallic Enclosure**

When installed in a non-metallic enclosure, the simplest and lowest cost antenna solution is a whip antenna screwed directly into the SMA antenna connector on the module. The part number is 98-3411.

**Metallic enclosure—standard.**

If the module is installed in a metallic enclosure, many applications can use a low-cost “salt-shaker” style antenna (part number 98-3402), mounted on the enclosure. The antenna is connected to the communications module with a short internal antenna cable (part number 98-6136).

**Metallic enclosure—difficult reception areas.**

Sometimes, the site location may not be close to the carrier’s cellular tower. This may require a higher performance antenna system using a Yagi directional antenna elevated on a support pole or structure. You will need to aim the antenna towards the desired cellular tower (the carrier can help you identify the tower location). A lightning arrestor is generally recommended since the antenna is elevated, making it a better “target” for a lightning strike. Use a dedicated grounding rod and bonding as shown for the lightning arrestor.

**Antenna System BOM:**

- 98-6136 36” Internal Antenna Cable
- 98-8011 Lightning Arrestor
- 98-42xx Low-loss Antenna Cable (xx= length in feet)
- 98-3409 Cellular Yagi Antenna w/ weather radome
- 98-9002 Weatherproofing Kit (for external antenna connections)
Refer to the installation manual for additional installation details and precautions.

### Discrete Input DI1, Discrete Output DO1 & Analog Inputs — TB1

The field wiring may be connected directly to the TB1 terminal block, or through a field Wiring Panel as shown in the diagrams below. All discrete inputs/outputs and analog inputs are referenced to the ground terminal (5). This terminal is connected internally to the power supply ground.

The Discrete Input accepts a contact closure or open-collector (“NPN” style) input signal. An external pull-up resistor is not required.

The Discrete Output sources current by switching the module input power to the output terminal.

The 8x-519x models have analog Inputs that accept 20mA current signals. Loop powered (Figure A) and self-powered (Figure C) devices are supported. In power conserving applications, the analog sensors may be powered from the Discrete Output (Figure B), configured to switch power to the sensors only when needed to take an analog reading (with configurable “warmup” time).

The 8x-529x models have analog Inputs that support voltage sensors (+/-5v, +/-10v and 30v) while the 8x-539x models support resistance sensors including thermistor type temperature sensors. The wiring for these sensors is shown in Figure D below.

Note that for loop powered devices, model 82-01xx Field Wiring Panels should be used. For self-powered devices, either model 82-00xx or 82-01xx Field Wiring Panels may be used.

#### 8x-519x (20mA Analog Inputs)

**FIGURE A**
20mA Loop Powered Sensors
External Loop Supply

**FIGURE B**
Sensor Power from Discrete Output

**FIGURE C**
Self-powered 20mA Sensors

**FIGURE D**
Voltage and Resistance Sensor Wiring

**Optional Field Wiring Panel**

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Note: Resistance sensors do not have a polarity.
Extended I/O Field Wiring Panel 8x-5x9x

Discrete Outputs Wiring

Discrete Inputs Wiring

Analog Inputs Wiring
Loop Powered Devices

Analog Inputs Wiring
Self Powered Devices

Analog Outputs Wiring

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Refer to the installation manual for additional installation details and precautions.