SiloPatrol®
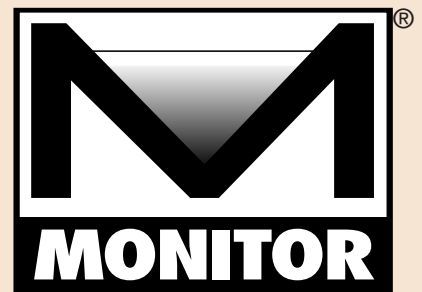
INVENTORY MONITORING SYSTEM

▼ *Leader in Cable-Based Smart Sensor Value, Technology and Systems*

▼ *Unprecedented and Unsurpassed Sensor Durability & Application Reliability*

▼ *Unique Durable Sensor Electronics Meet Stringent International Standards*

▼ *Unmatched Optical Sensing System Ensures Sensor Performance and Reliability*

▼ *Unparalleled Choice of Operator Interfaces*

▼ *Unique Network Capable PC-Based Inventory Management Software*

▼ *Affordable Wireless Sensor Interface Available*

▼ *Unmatched Remote Inventory Monitoring via LAN, Dial-up or Internet/WAN*

SiloPatrol®

MONITOR

"SETTING THE STANDARD FOR SUPPLIER EXCELLENCE"

▼ **Industry-First Robust Sensor Design**

▼ **Virtually Maintenance-Free**

▼ **Electrical Isolation for Reliable Operation**

▼ **Sensor Electronics Meet CE 1010 Standards**

▼ **Completely Sealed Sensor Optics System**

▼ **Optics Signal Amplified for Noise Immunity**

▼ **Industry-First Direct-Drive Motor**

▼ **Unsurpassed Motor/Cable Strength**

▼ **Full-Function HMI, PC-based System or ActiveX® Software**

▼ **Analog and/or Relay Outputs**

▼ **Wireless Sensor Communications Interface Available**

The **SiloPatrol®** Inventory Monitoring System is the first truly robust cable-based smart sensor system. It is a field-proven approach to reliably monitoring the level of material in bins, silos and tanks up to 150 ft (45.7 m) in height.

The heart of any inventory monitoring system is the sensor itself. The Silo Monitoring Unit (SMU) sensor requires no field adjustments and its robust design provides virtually maintenance-free operation. The SMU is suited for most any application and can be equipped with various mounting flanges and plumb bobs.

The **SiloPatrol** system also offers the most sensor interface choices. If a standalone sensor with analog output and no operator interface display is what you are looking for, the SMU is available in this type of configuration at the lowest cost in the industry. Alternatively, the multi-functional Human Machine Interface (HMI) connects with the standard "smart" communication output version of the SMU and incorporates a robust electronic design.

SiloPatrol®
Silo Monitoring Unit (SMU)

Remote and local monitoring of plastic storage at four facilities.

The **SiloPatrol** system also features software interfaces. The **SiloTrack™** PC-based Inventory Management Software provides a flexible graphical interface for up to 128 "smart" output sensors. Also available is an ActiveX® software package that can simplify the integration of the "smart" output SMUs into an existing PLC/PC control system.

PRINCIPLE OF OPERATION

Once a measurement cycle is initiated, the SMU's "smart" motor system controls the descent of a plumb bob, attached to a stainless steel cable, into the vessel. The SMU measures the amount of cable dispensed via its unique optical sensing system. The SMU's optics are completely sealed from the internal environment of the sensor as well as the conduit system to ensure long-term reliable operation.

The descent of the bob is maintained at an optimal speed by the "smart" motor control system, contributing to the elimination of cable slack and maximizing the motor life. In conjunction with the unique dual optical sensing system, the "smart" motor control system guarantees that the bob will stop when it contacts the material surface and eliminates the need for a mechanical brake. When the bob reaches the material surface, the SMU reverses the direction of the motor and transmits the distance value.

During the ascent of the bob, the SMU measures the amount of cable gathered and controls the speed of ascent. This ensures proper cable wrapping in the patented storage reel and tangle-free operation.

The operator interface (HMI, **SiloTrack™** PC software or ActiveX® software) can perform calculations and conversions to display the data in the format selected. The system, if so equipped, will also generate remote mounted analog and/or relay outputs (not with ActiveX® software).
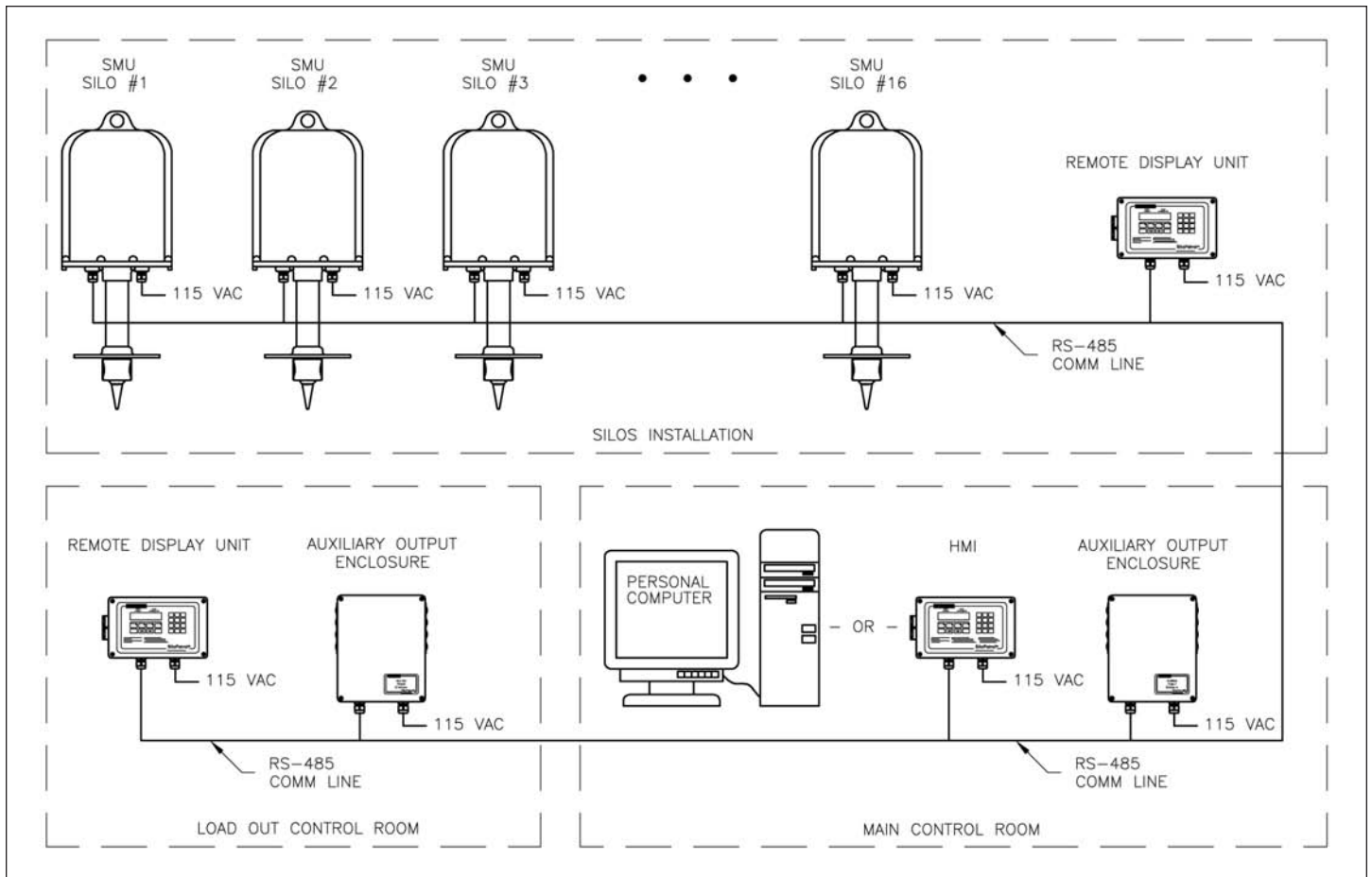
SiloPatrol® system with multiple silo monitoring units, human machine interface or PC, remote display units, and auxiliary output enclosures

APPLICATIONS

The **Silo**Patrol® Inventory Monitoring System can be used in a wide variety of applications, including coarse/fine granular solids, powders, liquids, foodstuffs and even some sticky or corrosive substances. The nature of the electronics also makes it ideal for environments with temperature extremes and where ambient temperature variations can result in condensation.

TYPICAL APPLICATIONS INCLUDE, BUT ARE NOT LIMITED TO:

▼ Feeds
▼ Plastic Pellets
▼ Aggregates
▼ Limestone
▼ Powders

▼ Bulk Chemicals
▼ Rocks
▼ Liquids
▼ Plastic Regrind
▼ Grains

▼ Cement
▼ Coal
▼ Sand
▼ Oils

REMOTE INVENTORY MONITORING

If material levels need to be monitored at one or many locations (i.e. your facility, a location down the street, or a plant on the other side of the world) the **Silo**Patrol system can provide accurate and reliable measurements. Using **Silo**Track™ software, inventory monitoring from remote locations has never been easier.

WIRELESS SENSOR COMMUNICATIONS INTERFACE

While using the **Silo**Patrol "smart" sensor is the most economical approach available for inventory monitoring, using the available **Silo**Patrol Wireless Interface in your application may help you reduce the installed cost of the system even further.


The **Silo**Patrol wireless transceivers use frequency-hopping spread-spectrum wireless technology and operate in the FCC license-free 900MHz band. This provides the longest range and most reliable wireless communications available.

Working in conjunction with Monitor's **SiloTrack** PC-Based Inventory Management Software, the wireless **SiloPatrol** transceivers provide the most functional and economical inventory management system available today.

Refer to Bulletin 343D for additional information and call Monitor's technical support personnel today to see if your application can benefit from the **SiloPatrol** Wireless Communications Interface.

SMU FEATURES

▼ Industry-exclusive electronics certified to international CE 1010 standards ensure compliance in shock hazard protection, electromagnetic noise interference and generation

▼ Complete electrical isolation between inputs/outputs and earth ground eliminates ground loops and ensures proper long-term operation and data communication

SMU Electrical Side

▼ Industrial or Mil-Spec grade components guarantee operation in ambient temperatures down to –40˚F/ -40˚C

▼ Industry-exclusive compartment seals optical sensors from internal SMU environment to completely eliminate problems created by contamination

SMU Mechanical Side

▼ Unique optical measuring system uses an amplification circuit to maximize signal-to-noise performance

▼ Industry-first direct-drive motor and heavy-duty cable system deliver maximum pull strength

▼ Dual optical sensors ensure proper end-of-cable detection without using mechanical crimps or stops that can become jammed in cable pathway

▼ Patented storage reel incorporates a "step" to ensure nontangling cable wrap

▼ Cable pathway and storage reel are completely captive, eliminating cable-jump

▼ Unparalleled stainless steel cable provides a maximum of 270 lbs (123 kg) tensile strength
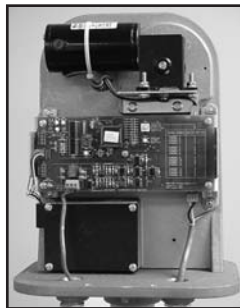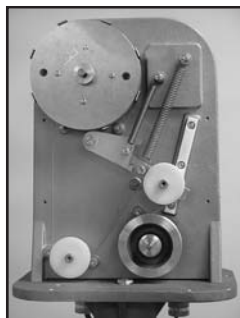
SMU MODEL SELECTIONS

OUTPUT TYPES   **Standard "Smart"** – The SMU communicates with the HMI, **SiloTrack**™ PC-based Inventory Management Software or ActiveX® software via a RS-485 proprietary protocol. This type of system can also be equipped with auxiliary relay and/or analog outputs (not with ActiveX® software) and remote displays.

Analog 4-20mA – This SMU sensor version provides a direct analog signal in response to a remotely activated contact closure. This is a standalone sensor and does not require any external box for generation of the 4-20mA output.

Pulse (retrofit) – An SMU version that is used to integrate into an older Monitor Technologies CM console replacing the old CM-3A or CM-4 sensors. The SMU provides only a 1/10' or dm pulse output. Contact Monitor if you want to use this sensor version to provide direct input into a PLC (modification may be required).

APPROVALS   The SMU is available certified for either Ordinary or Hazardous Class I and II locations by a North American agency. The SMU also carries the CE Mark.

MOUNTING FLANGES   SMUs can be provided with either the standard flat mounting flange or one of the angled flanges (5˚ and 10˚ available) for adapting to sloped roofs. Contact the factory for modified ANSI/DIN flanges.

SMU ACCESSORIES

PLUMB BOBS
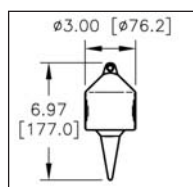
Standard Cast Aluminum – Most SMUs are shipped with this plumb bob assembled to the unit. For use with bulk solids with a bulk density greater than 20lbs./ft^3 (320kg/m^3). Teflon®-coated version is also available for sticky materials.
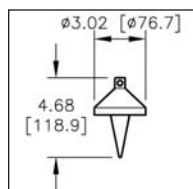

316 Stainless Steel – For use with corrosive solids and foodstuffs with bulk densities greater than 20lbs./ft.^{3} (320kg/m^3). This plumb bob is typically shipped as a separate item, but can be assembled to the SMU at the factory upon request.
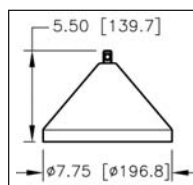
316 SS Inverted Cone – For use with light bulk solids and foodstuffs with bulk densities greater than 5lbs./ft.^{3} (80kg/m^3). Teflon®-coated also available for corrosive or sticky materials. This is shipped as a separate line item and must be attached to the cable in the field.

DIMENSIONS ARE SHOWN IN INCHES WITH MILLIMETER EQUIVALENT IN BRACKETS
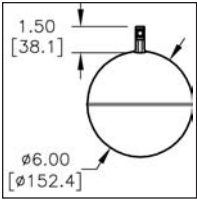
6 in. (152 mm) Diameter 316 SS Ball Float
For use with liquids with a minimum specific gravity of 0.85. Teflon®-coated also available for corrosive or sticky materials. This plumb bob is shipped as a separate line item and must be attached to the cable in the field.

HMI FEATURES

▼ Multi-functional HMI controls SMU operation, auxiliary output activation (if equipped), displays measured and calculated data and performs/displays system and sensor diagnostic messages

▼ Industry-exclusive electronics certified to stringent international CE 1010 standards to ensure worldwide compliance in shock hazard protection, electromagnetic noise interference and generation

▼ Unique back-lit display ensures visibility in any environment

▼ Environmentally hardened NEMA 4 enclosure with ambient temperature limits down to –4˚F/-20˚C

▼ Automatic, Manual or Auto/Manual operating modes

▼ With data input from the user, HMI calculates and displays values for level, volume, weight and percent (See "Use of Volume/Weight Calculations")

▼ Flexible display of data in English or Metric units including feet, meters, pounds, kilograms, cubic feet, cubic meters, U.S./British bushels, gallons, liters, tons, metric tonnes

▼ Displays 12-character alphanumeric name for vessel contents

HMI OPERATING MODES

MANUAL MODE The HMI is easily programmed to display calculated level, volume, weight or percent in addition to the basic distance measurement. Manual readings are taken by depressing the MEAS button, followed by the channel number, followed by ENTER.

AUTOMATIC MODE The HMI can also be programmed to operate the SMUs automatically. Menu options allow the user to select days of operation (such as Mon.-Fri.), time window (such as 7 a.m.-3 p.m.) and measurement interval (minimum 30 minutes).

HMI MODEL SELECTIONS

**APPROVALS** The HMI is designed for Ordinary Locations. The HMI also carries the CE Mark.

NUMBER OF CHANNELS The HMI is available in 2-, 8- or 16-channel configurations. The individually addressable SMU's are wired to the HMI using a single RS-485 network cable (daisy-chained).

PC-BASED INVENTORY MANAGEMENT SOFTWARE

SiloTrack™ Inventory Management Software Version 3.0 provides users with an unsurpassed, flexible graphical interface for **SiloPatrol®** "smart" sensors. Together, **SiloTrack** Server and Client Software can provide inventory monitoring and management to a virtually unlimited number of users, both internal and external to your facility. This allows easy implementation of remote monitoring and vendor managed inventory programs.

SiloTrack capabilities include:

▼ Monitor up to 128 sensors/with up to 5 sensors per vessel

▼ Easy to setup and use

▼ Network ready

▼ Remote monitoring via LAN, Internet/WAN or dial-up

▼ Available in English ONLY and English/Spanish language

▼ Automatic and manual measurement initiation

▼ Curve-fit weight table

▼ Enhanced 3-D type silo graphics

▼ Export silo history and alarm data

▼ Automatic Reports and Scheduling

▼ Set up four alarms per silo

▼ Alarm notification via e-mail, fax, and/or pager
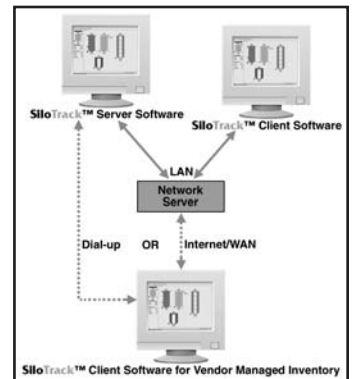
**Example configuration of a SiloTrack system with a LAN and remote users.**

Please refer to Bulletin 343B for additional information.

ACTIVEX® SOFTWARE PACKAGE

The ActiveX® software package is offered as an alternative for interfacing with the industry leading "smart" sensors equipped with RS-485 communication output and replaces either the HMI or **SiloTrack™** software. The **SiloPatrol®** ActiveX® software

package can be used to integrate with PLC/PC-based control systems utilizing ActiveX® containers for operating systems. The system and software will work with commonly available software such as Wonderware®, RSView®, Intellution® and Cimplicty®.
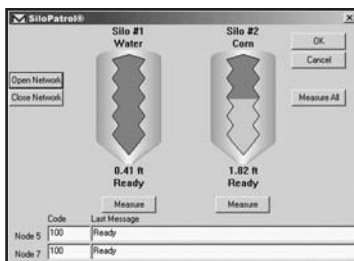
The ActiveX® software package allows the user to integrate these **SiloPatrol** sensors through the control system's standard serial port. This eliminates the need for analog and digital I/O normally required to integrate analog outputs, saving money and time. Refer to Bulletin 343C for more information.

## USE OF VOLUME/WEIGHT CALCULATIONS

The **SiloPatrol®** Model SMU sensor makes a direct measurement of the distance between the sensor and the material surface. This equipment does not measure the volume or weight of the material within the vessel. The HMI, **SiloTrack**™ PC-based software and ActiveX® software may be able to perform calculations to display the volume and weight of the material. These calculations are based upon the distance measurement and the vessel dimensions and material bulk density entered by the user during setup.

Note: The calculated volume and weight values should be considered "estimates". Monitor Technologies LLC accepts no responsibility for the accuracy of the calculated and displayed volume and weight values. The accuracy (not stated or warranted) of the volume/weight calculations are effected by the fluctuation and accuracy of various factors. These factors include, but may not be limited to, actual vessel dimensions, sensor mounting location, angle of repose (negative and positive), material bulk density, material flow properties (ratholes, bridging, etc.), material inlet/discharge locations and material packing. Please consult the factory to discuss applications where volume/weight is of critical importance.

SYSTEM ACCESSORIES

AUXILIARY OUTPUT ENCLOSURES

A unique feature of the **SiloPatrol®** Inventory Monitoring System is the ability to incorporate both relay and analog outputs with the standard "smart" output SMU system. These auxiliary relay and/or analog outputs are provided in Auxiliary Output Enclosures (AOE) and are programmed and controlled by either the HMI or **SiloTrack**™ PC-based Inventory Management Software.
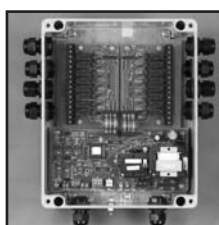
2-Card AOE

One analog and up to four relays (two for HMI; four for **SiloTrack**) can be assigned to each sensor. These can be used to tie the Inventory Monitoring System into remote control systems, sound alarms and for local control functions.

Up to 16 analog outputs or 32 relays can be provided within a single enclosure. Up to four AOEs can be connected on a single network. The AOE can be located close to the point of hardwiring termination minimizing wiring and installation costs.

REMOTE DISPLAY UNIT

SiloPatrol systems using the standard "smart" SMU can be provided with Remote Display Units (RDU). These units have the same display capability as the HMI. They, however, can not be used to initiate any measurements. They are identical to the HMI in specification and appearance. User setup is required in order to view the data in the desired units of measure. A maximum combination of four AOEs and RDUs can be connected on each network.
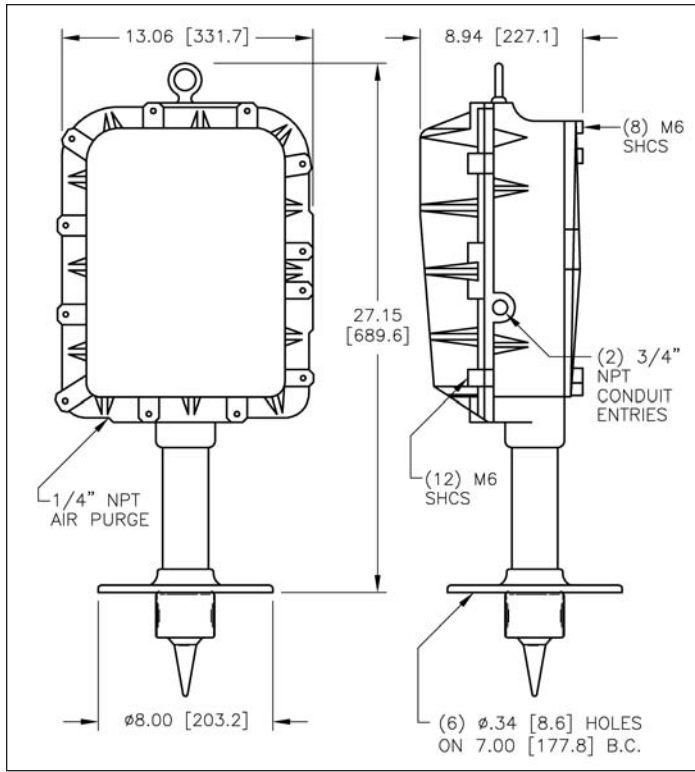

MECHANICALS

DIMENSIONS ARE SHOWN IN INCHES WITH MILLIMETER EQUIVALENT IN BRACKETS
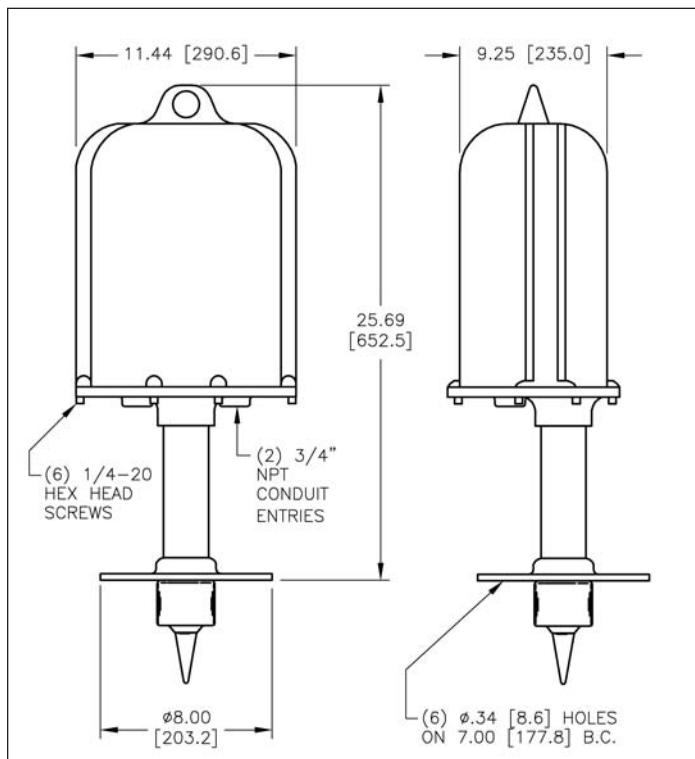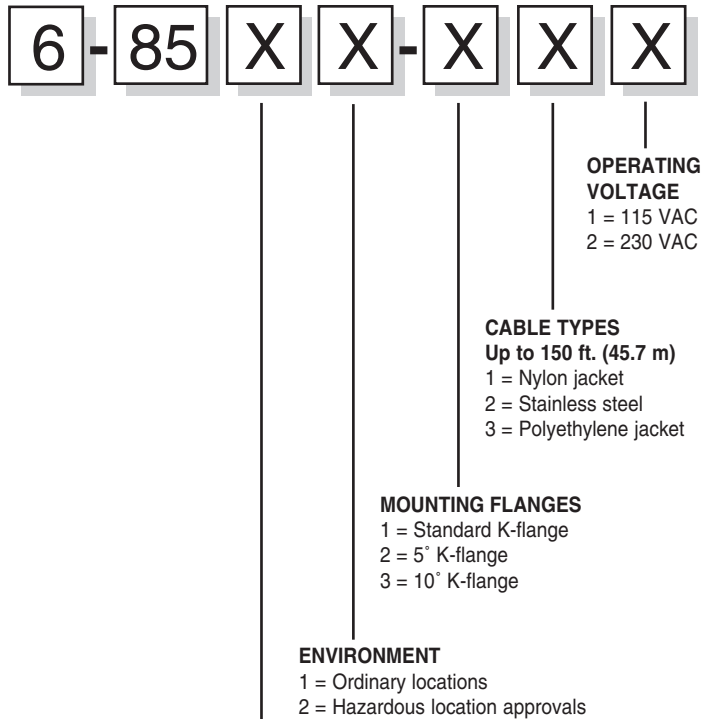

Silo Monitoring Unit for Ordinary Locations

Silo Monitoring Unit for Hazardous Locations

ORDERING INFORMATION

SiloPatrol® AUXILIARY OUTPUT ENCLOSURES(AOE)

6 - 88 X X - X X X

Note: The total sum of analog and relay cards can not be greater than the packaging configuration selected

PACKAGING CONFIGURATION
2 = 2 card system
4 = 4 card system

RELAY CARDS
0 = None
1 = 1 card (8 relays)
2 = 2 cards (16 relays)
3 = 3 cards (24 relays)
4 = 4 cards (32 relays)

ENVIRONMENT
1 = Ordinary Locations

OPERATING VOLTAGE
1 = 115 VAC
2 = 230 VAC

ANALOG CARDS
0 = None
1 = 1 card (4 4-20mA loops)
2 = 2 cards (8 4-20mA loops)
3 = 3 cards (12 4-20mA loops)
4 = 4 cards (16 4-20mA loops)

ACCESSORIES
6-5133   Relay Board Kit (For field upgrade)
6-5134   Analog Board Kit (For field upgrade)
6-4011   Wall Mounting Bracket (Set of 4)

SiloPatrol® HUMAN MACHINE INTERFACE(HMI)

6-8611-21	2-Channel 115VAC
6-8621-21	2-Channel 230VAC
6-8611-81	8-Channel 115VAC
6-8621-81	8-Channel 230VAC
6-8611-61	16-Channel 115VAC
6-8621-61	16-Channel 230VAC

SiloPatrol® SILO MONITORING UNIT(SMU)

6 - 85 X X - X X X

OPERATING VOLTAGE
1 = 115 VAC
2 = 230 VAC

CABLE TYPES
Up to 150 ft. (45.7 m)
1 = Nylon jacket
2 = Stainless steel
3 = Polyethylene jacket

MOUNTING FLANGES
1 = Standard K-flange
2 = 5° K-flange
3 = 10° K-flange

ENVIRONMENT
1 = Ordinary locations
2 = Hazardous location approvals

OUTPUT TYPE
1 = Standard "smart" communications
2 = Pulse (retro) output
3 = 4-20mA analog output

OPTIONAL PLUMB BOBS & ACCESSORIES
6-2190	Digestible Plumb Bob
6-3123	Cast Aluminum with Teflon® Coating
6-3136	316 Stainless Steel
6-4106	316 Stainless Steel Inverted Cone
6-4126	Teflon®-Coated 316 Stainless Steel Inverted Cone
6-4108	316 Stainless Steel Ball Float
6-4128	Teflon®-Coated 316 Stainless Steel Ball Float
6-1121	Standpipe Heater
6-3125	5° Mounting Flange
6-3128	10° Mounting Flange

Note: 6-3103 cast aluminum plumb bob is included with each SMU.

SiloPatrol® REMOTE DISPLAY UNIT(RDU)

6-8711-61	16-Channel 115VAC
6-8721-61	16-Channel 230VAC

Silo Monitoring Unit (SMU)

Power Requirements:	115 VAC or 230 VAC, 50/60 Hz
Power Consumption:	6 VA continuous, 50 VA intermittent
Operating Temperature:	-40° F to 150° F (-40° C to 65° C)
Max. Internal Bin Temp.:	Up to 300°F (149°C) with use of bare stainless steel cable; Up to 200°F (93°C) with use of stainless steel jacketed cables
Measurement Range:	150 feet maximum (45.7 m)
Measurement Rate:	1.0 foot/second (typical) (0.3 m/s)
Accuracy:	< 0.5% of distance reading
Repeatability:	0.1 feet (30 mm)
Resolution:	1/100 foot (0.12 inch)
Mounting:	"K" flange, 8" dia. w/ 7" bolt circle
Conduit Entry:	(2) 3/4" NPT
Cable:	1/16" nylon-jacketed (270lb./123kg tensile strength) 3/64" SS unjacketed (270lb./123kg tensile strength) 1/16" polyethylene-jktd, (270lb/123 kg tensile strength)
Output Signal:	
Standard:	RS-485 half-duplex, isolated, proprietary protocol
Pulse:	1 pulse per 1/10' or dm, isolated
Analog:	4-20 mA, isolated; 500 Ohms max. loop resistance
Wiring Distance:	4,000 ft (1,220 m) maximum
Address Determination:	1-16 (switch selectable)
Shipping Weight:	40 lbs. (18.2 kg) ord. location (OL) 70 lbs. (31.8 kg) haz. location (HL)
Enclosure/Housing:	OL=Cast aluminum w/ Noryl® cover HL=Cast aluminum
Overall Dimensions: (Hght x Wdth x Dpth)	OL = 25.69 x 11.38 x 8.5 in (652 X 289 X 216 mm) HL = 27.56 x 13.1 x 8.8 in (700 X 333 X 224 mm)
Plumb Bob Weight:	2 lbs. (0.9 kg)
Air Purge Connection:	1/4" NPT; on HL version only,
Certifications/Protection:	NEMA 4; IP66; CE Mark
Approvals:	OL: CSA$_{C/US}$ HL: CSA$_{C/US}$ Class I, Div. 1 & 2; Grps C & D Class II, Div. 1 & 2; Groups E, F & G

Human Machine Interface (HMI)

Power Requirements:	115 VAC or 230 VAC, 50/60 Hz
Power Consumption:	10 VA max
Operating Temperature:	-4° F to 131° F (-20° C to 55° C)
Sensor Communication:	RS-485 half-duplex, non-isolated, proprietary protocol
Channels:	2, 8 or 16
Display:	2-lines by 20-characters .22" x .12" characters, LCD backlight
Keypad:	20 keys
Indicators:	8 LEDs (function, relay, error status)
Enclosure (HxWxD):	Pntd Alum.; 6.29 x 10.23 x 3.54 in (160 X 260 X 90 mm)
Certifications/Protection:	NEMA 4, IP66; CE Mark

Auxiliary Output Enclosure

Power Requirements:	115 VAC or 230 VAC, 50/60 Hz
Power Consumption:	25 VA Max
Operating Temperature:	-4° F to 131° F (-20° C to 55° C)
Communication w/HMI:	RS-485 half-duplex, isolated, proprietary protocol
Analog Outputs:	4-20mA, 16 max, 4 per card, non-isolated, 500 ohm, 10 bit resolution, zero/span set via HMI
Relay Outputs:	SPST, 5A @ 250 VAC, 32 max, 8 per card, visual LED per relay, assignment and action set via HMI
Enclosure:	Painted Aluminum
Overall Dimensions: (Hght x Wdth x Dpth)	2-Card: 11.02 x 9.05 x 4.33 in (280 X 230 X 110 mm) 4-Card:15.74 x 9.05 x 4.33 in (400 X 230 X 110 mm)
Certifications/Protection:	NEMA 4, IP66, CE Mark

Remote Display Unit (RDU)

Power Requirements:	115 VAC or 230 VAC, 50/60 Hz
Power Consumption:	10 VA max
Operating Temperature:	-4° F to 131° F (-20° C to 55° C)
Communication w/HMI:	RS-485 half-duplex, isolated, proprietary protocol
Channels:	16
Display:	2-lines by 20-characters
Keypad:	20 keys
Indicators:	8 LEDs (function, relay and error status)
Enclosure (HxWxD):	Pntd Alum.; 6.29 x 10.23 x 3.54 in (160 X 260 X 90 mm)
Certifications/Protection:	NEMA 4, IP66; CE Mark

M⦿ MONITOR®

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