



Rosemount TankRadar® STaR

Tank Gauging, Alarm Handling and Cargo Control System

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Technical Description
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Abbreviation and Denomination

CCR	Cargo Control Room
CDU	Channel Display Unit
CPU	Central Processing Unit
FFT	Fast Fourier Transform
FMCW	Frequency Modulated Continuous Wave
IACS	International Association of Classification Societies
IOU	I/O Unit
LAN	Local Area Network
LED	Light Emitting Diode
PRS	Portable Readout System
PRU	Portable Readout Unit
PTFE	PolyTetraFluoroEthylene
RTD	Resistance Temperature Detectors
SCA	Supply and Communication Alarm Panel
SCB	Supply and Communication Interface Box
SCC	Supply and Communication Computer
SCD	Supply and Communication Display
SCE	Supply and Communication Ethernet Switch
SCM	Supply and Communication Modem
SCS	Supply and Communication Safety Barrier
SCT	Supply and Communication Tank Interface
SCU	Supply and Communication Unit
TCB	Tank Connection Box
TGD	Tank Gauge Display
TGE	Tank Gauge Electronics
TGU	Tank Gauge Unit
TMU	Temperature Measuring Unit
UPS	Uninterruptable Power Supply
VPS	Vapor Pressure Sensor
WSC	Workstation Computer
WSU	Workstation Unit
WSP	Workstation Printer

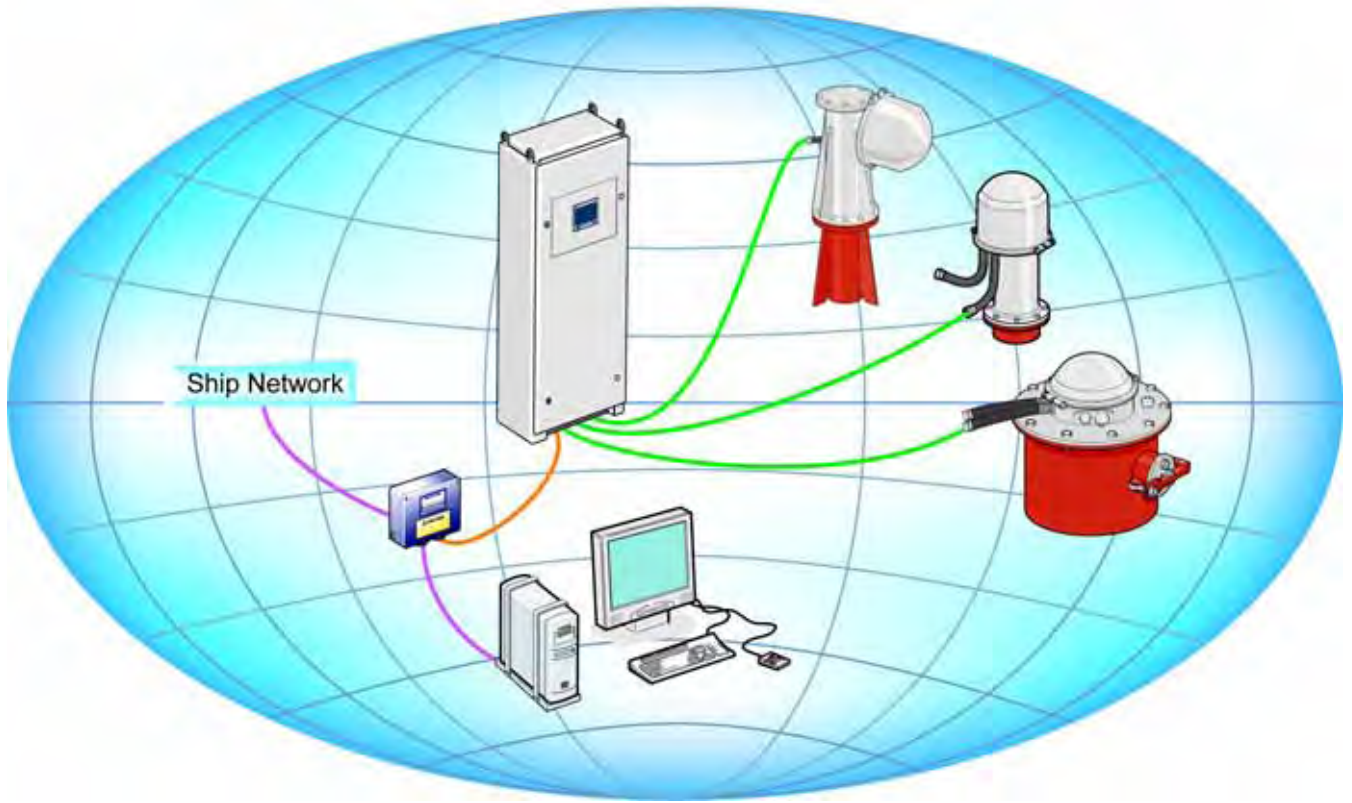
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TECHNICAL DESCRIPTION

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Rosemount TankRadar STaR

Overview of the Tank Gauging, Alarm Handling
and Cargo Control System
Rosemount TankRadar STaR



Rosemount TankRadar STaR main parts overview.

System Description

Rosemount TankRadar STaR is a Tank Gauging, Alarm Handling and Cargo Control System designed for marine use in the area of tank gauging.

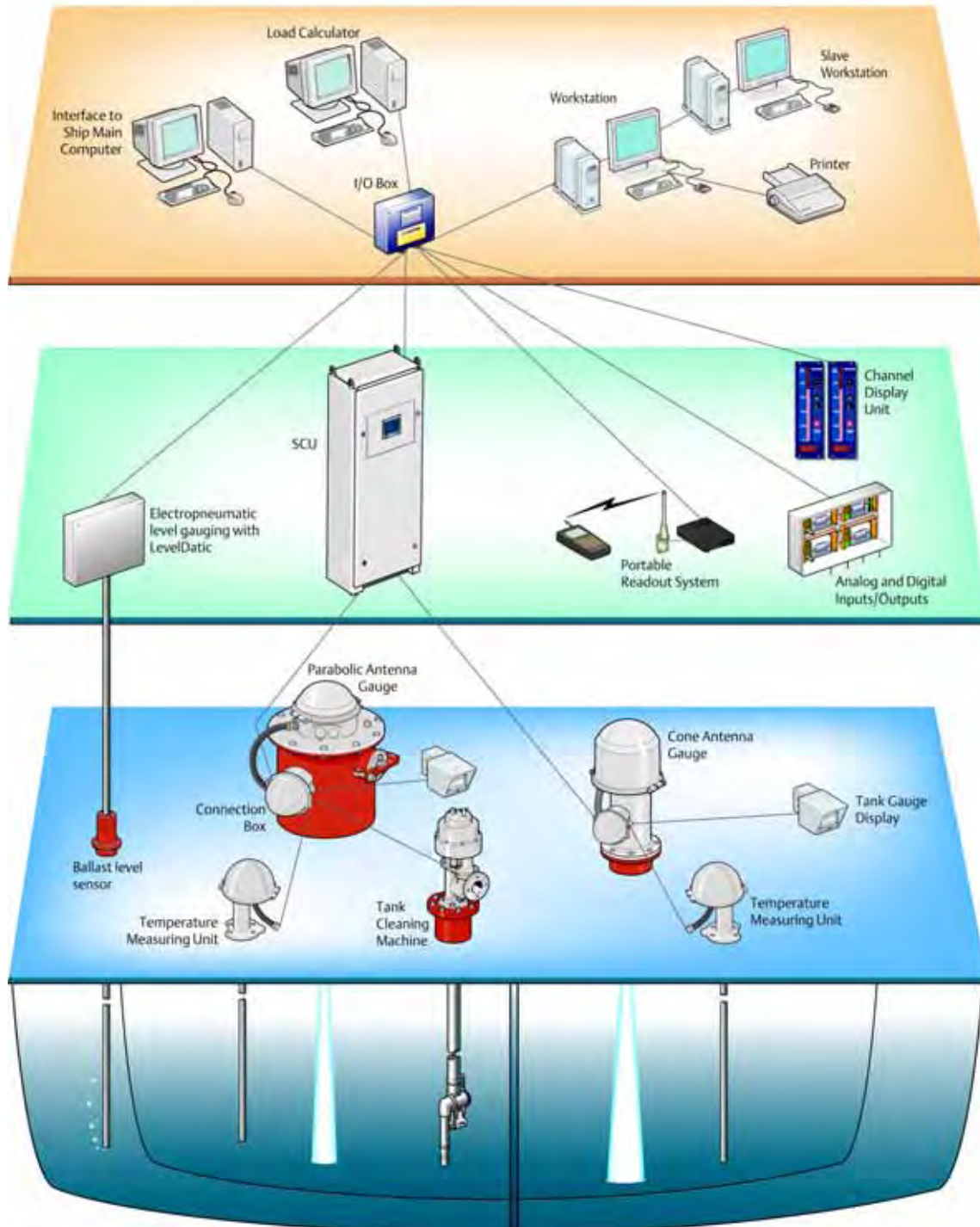
Rosemount TankRadar STaR comprehends several subsystems and a wide range of functions. By tradition Emerson Process Management Marine Solutions has measured cargo ullage on tankers since 1976. With all the knowledge and experience from over 30 years of radar tank gauging Emerson Process Management Marine Solutions has developed a new generation of Rosemount TankRadar. Rosemount TankRadar STaR is a highly integrated system for a reliable and accurate control of the cargo with functions such as cargo calculations, alarm monitoring, redundant communication and tank cleaning monitoring. The system is easily monitored and controlled from one or several Workstations.

The foundation of the system is the Tank Gauge Unit, the Supply and Communication Unit and the Workstation. The Tank Gauge Unit measures the distance to the cargo surface using a continuous radar signal. The intelligent and autonomous Tank Gauge Unit sends the processed data to the Supply and Communication Unit that communicates with the Workstation.

Rosemount TankRadar STaR has a high degree of safety built into the system. The Tank Gauge Unit is intrinsically safe, that is an electrical fault cannot induce an igniting spark.

Rosemount TankRadar STaR meets the requirements of all the major international marine classification societies. The system is type tested against the relevant sections of IACS Unified requirement E10 together with the relevant sections of IEC 60945.

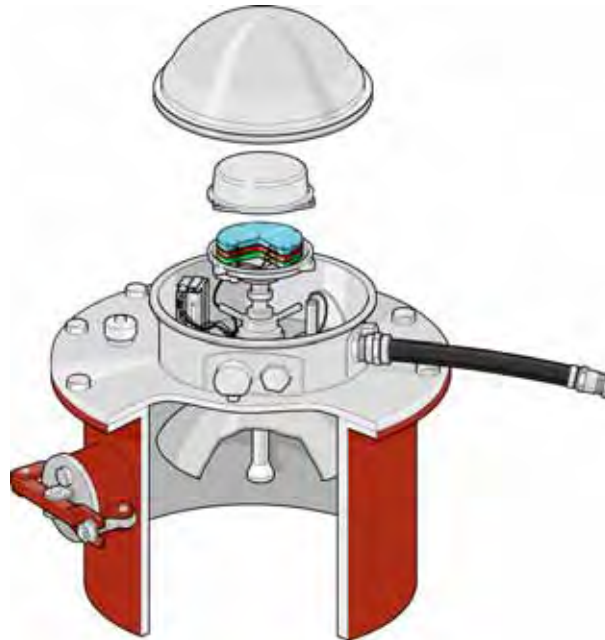
Rosemount TankRadar STaR



System Description ed 10.fm

System and configuration of a Rosemount TankRadar STaR level gauging system. The example shows a Parabolic Antenna Gauge and a Cone Antenna Gauge on different tanks. LevelDatic is an Electropneumatic Level Measurement System from SF Control.

Level Gauging, High Level and Overfill Alarm System STaR 3-in-1 Solution



The centerpiece of the STaR system is the Tank Gauge Unit (TGU). The intrinsically safe TGU comprises the antenna with sensor that transmit and receive radar signals, the electronic box (TGE) that processes the signals and auxiliary equipment such as vapor pressure sensor.

The TGE can be equipped with up to three channels. The electrical parts in each channel are galvanically isolated from each other. Each channel processes the signals independently from each other and hence the Level gauging, High Level and Overfill Alarm systems are integrated in one single unit, yet galvanically separated. This 3-in-1 solution will improve gauging performance and read-out reliability, it will need fewer deck penetrations and less cabling and it is more cost effective.

The High Level and Overfill Alarm systems follows the regulation set for alarm systems to prevent overflowing of tanks in different type of vessels. Alarms are indicated by annunciators such as horns, flashlights, buzzers, LEDs and external relays. Alarms can be silenced, acknowledged and blocked from the Alarm panel. There is also a test mode included in the Alarm panel to assure the functionality of the alarm output.

Automated extensive self test modes are continuously supervising processes and communication within the High Level and Overfill Alarm systems. Should any function failure an indication is immediately sent to the Alarm panel alerting the crew of the specific failure.

Functions and Equipment

Rosemount TankRadar STaR is a complete system for tank gauging that fits all types of marine carried liquid cargo applications. Rosemount TankRadar STaR is flexible to customer requirements and includes several functions and options.

Functions and equipment can be combined in a various number of ways. The following functions are available in the Rosemount TankRadar STaR system:

- **Cargo Ullage/Level**
The Cargo Ullage/Level is measured with the Tank Gauge Unit (TGU) using radar waves. The gauging method developed by Emerson Process Management Marine Solutions is a reliable, accurate and fast method to measure ullage/level of the cargo.
- **Cargo Temperature**
The temperature is measured with up to five different temperature sensors (Pt100) with three or four wire connection for each tank.
- **Vapor Pressure**
The Vapor pressure is measured through a sensor placed inside the Tank Gauge Unit.
- **Reports and Alarm Monitoring**
Several reports can be printed as well as alarm logs and warnings.
- **Workstation Redundancy**
Two Workstations connected in a network providing a degree of fault tolerance for PC failure.
- **Volume and Weight Calculation**
Volume and weight calculations are normally handled by a connected load calculator with information available on Workstation.
- **Trim and List Corrections**
The cargo level/ullage is corrected for trim/list from the available information (e.g. draft measuring system).
- **Service Display**
A display for service procedures and tank monitoring is mounted on the Supply and Communication Unit door.

Optional Features

Rosemount TankRadar STaR is one of many different types of Gauges used within the Rosemount TankRadar system. STaR also has the following optional features:

- **Cargo and Ballast Control**
Cargo and Ballast Control functions for safe and reliable handling of the cargo.
- **Ballast, Draft and Miscellaneous Tanks**
Level measurements on ballast-, draft- and miscellaneous tanks can be done using the Tank Gauge Unit (TGU) or LevelDatic™ (electropneumatic gauging system).
- **Cargo Report System**
Calculates cargo volumes based on tank tables. The calculation is corrected for trim and list and allows manual inputs of several measurement data.
- **Tank Cleaning Monitoring**
Monitoring of Scanjet tank cleaning machines.
- **Interface to Ship Main Computer**
Communication with other onboard systems is established over serial links with Master Slave, Modbus or other customer protocols.
- **High Level and Overfill Alarm System**
The Level, High Level and Overfill Alarm systems can be integrated in the same Tank Gauging Unit. The integrated systems can be installed as independent systems fulfilling the requirements set by international standards. For details, see Type Approval Certificate of respective class. The High Level and Overfill Alarm system can also be of a separate mechanical system.
- **Load Calculator**
Communication with onboard-NAPA (or other) loading computers is established over serial links with Master Slave or Modbus protocols.
- **Butterworth Filtering**
STaR measurement for operations offshore.

The Operator Interface

The Rosemount TankRadar STaR operator interface has a high degree of usability. A new user of the system can easily use the Workstation Unit to monitor data such as tank ullage, temperatures and vapor pressure. And also quickly understand how to manage other functions such as alarm handling.

Workstation Software

The overview mimic window displays all the tanks with necessary data and status. Simply click on the symbols or select the menus to access further information of the system. How to operate the software is described in the Operating Manual.

The Workstation database is modified during commissioning of the system or when updating the system. The configuration of the system data is password protected.

The software also contains a Service part that is password protected.

The Help function is based on the manuals for the Rosemount TankRadar STaR system.



System Description ed 10.fm

Installation of Rosemount TankRadar STaR

The installation of Rosemount TankRadar STaR is very convenient. The Tank Gauge Units (TGU) are placed on the deck according to a few requirements stated in the Installation Manual. The main requirement for the TGU is that the radar beam in the tank shall be unobstructed.

The Supply and Communication Unit (SCU) can be placed anywhere in safe area indoor onboard. It is bolted to a bulkhead and to the floor.

The Workstation can be placed on the bridge, in the cargo control room or wherever the cargo is monitored and controlled. It is possible to place a number of Workstations in various locations onboard. The Workstations are connected in a network that communicates with the SCU via the I/O Box.

Auxiliary equipment such as Temperature Measurement Unit and WashTrac are connected to the TGU which means less cables from deck to the SCU.

Associated systems, such as load calculator and electro pneumatic level gauging systems, can be connected to the Workstation via the I/O-box by serial interface.

Radar Principle and its Advantages

The main advantages for using radar for tank gauging are:

- Radar waves are extremely robust to any conditions in the tank.
- Radar waves are generally not affected by the atmosphere above the product in the tank
- The only part located inside the tank is the antenna without any moving parts
- High reliability
- High accuracy
- With Rosemount TankRadar STaR, the Tank Gauge Electronics can easily be serviced and replaced during closed tank conditions

With more than 30 years of research and experience in radar tank gauging, Emerson Process Management Marine Solutions has developed the Rosemount TankRadar STaR Gauges with narrow radar beams for easy location of the Gauges on deck.

What Happens if I'm Hit by the TankRadar Beam?

We sometimes get this question from our customers. There are no health hazards known in handling the Tank Gauge Units when they are powered. As the emitted power from each Tank Gauge Unit is so low, there is no known health hazard even when you are very close to the antenna. Some data below illustrates this.

Most international standards state that a power density of up to 1 mW/cm^2 is considered safe for continuous exposure.

The power density close to the antenna is 0.001 mW/cm^2 and further down in the tank it is much lower. The transmitted microwave power is less than 1 mW .

As a comparison it might be interesting to know that in sunshine you are exposed to a power density of $100\text{-}150 \text{ mW/cm}^2$.



This photo shows the Tank Gauge Unit from inside the tank. It is perfectly safe to enter the tank while the Emerson Process Management Marine Solutions equipment is in operation. It is also safe to handle the Gauges while they are in operation, since the transmitted power is so low.


Intrinsic Safety

When connecting equipment in hazardous areas, certain requirements must be fulfilled to provide explosion protection. There are requirements both for the equipment in the hazardous area on deck and for the associated equipment in nonhazardous area.


Rosemount TankRadar STaR is CE, (Europe) declared see “EC Declaration of Conformity” on page 19, and approved according to the ATEX directive. Rosemount TankRadar STaR has also been scrutinized by CSA (Canada) according to IEC.

Classification

All parts of Rosemount TankRadar STaR that are placed in the hazardous area (such as the TGU) are intrinsically safe. They have the following classification:

- ATEX  II 1 G, EEx ia IIC T4
- Ex ia IIC T4 (scrutinized by CSA according to IEC)

The Supply and Communication Tank interface (SCT) which is placed in the non hazardous area has the following classification:

- ATEX  II (1) G, [EEx ia] IIC
- [Ex ia] IIC (scrutinized by CSA according to IEC)

Standards

The following standards have been used to achieve the ATEX approval:

- EN50014:1997, Electrical apparatus for potentially explosive gas atmospheres-General requirements.
- EN50020:1994, Electrical apparatus for potentially explosive gas atmospheres-Intrinsic safety “i”.

The following standards have been used for the CSA scrutinization:

- CAN/CSA-E79-0-95, Electrical apparatus for explosive gas atmospheres - Part 0: General requirements.
- CAN/CSA-E79-11-95, Electrical apparatus for explosive gas atmospheres - Part 11: Intrinsic safety “i”.

The Intrinsic Safety Principle

Intrinsic safety is based on the principle of restricting electrical energy available in hazardous-area circuits, so that any sparks or hot surfaces, that may occur as a result of electrical faults in components, are too low to cause ignition.

Intrinsic safety is the only technique accepted for Zone 0 hazardous areas. It is also safe for the crew or the service personnel and it allows the deck units to be maintained while the system is in operation.

The Intrinsic Safety Design of Rosemount TankRadar STaR

Supply and Communication Tank Interface (SCT)

The Supply and Communication Tank interface (SCT) is the intrinsically safe interface between units in the hazardous area and the non hazardous area. It is placed in the cabinet for the Supply and Communication Unit (SCU). The units in the hazardous area are connected to the Supply and Communication Safety Barrier boards (SCS) in the SCT. The SCS boards use three separate shunt diode barriers for voltage and current limiting.

Deck Cable

Cables are laid out on deck to connect the Tank Gauge Unit (TGU) with the Supply and Communication Tank interface (SCT) boards and also the auxiliary equipment on deck. The deck cables are to be multi core and have at least a common shield. Cable data must comply with IEC 79-11, item 6.2.9 and also the Rosemount TankRadar STaR ATEX certificate.

Tank Gauge Unit (TGU)

The Tank Gauge Units (TGU) are placed on each tank. Each Intrinsically safe circuit is equipped with a voltage limiter.

Intrinsically Safe Galvanic Isolation

The Supply and Communication Safety Barrier boards (SCS) does not need to be connected to the system safety earth in order to be intrinsically safe. The board does not use conventional grounded type zener barriers, i.e. an Intrinsic Safety Earth is not defined. It has transformers, blocking capacitors and optocouplers. This achieves an approved high integrity isolation that prevents electrical surges and overloads.

The cable shields should however be connected to earth (Protective Earth) for EMC protection.



WARNING!

For trouble shooting and repair work of intrinsically safe equipment or associated equipment, the following rules need to be strictly followed:

Use only original spare parts from Emerson Process Management Marine Solutions. Any replacement with non-recognized spare parts can jeopardize the intrinsic safety and the function of the product.

Use only certified instruments and tools appropriate for the area classification.

Before disconnection of units in the hazardous area the Tank Gauge Unit wiring has to be disconnected in the safe area. Main power in the SCU (Supply and Communication Unit) does not have to be turned off.

Intrinsically safe and non-intrinsically safe cabling must be separated from each other according to the requirements in IEC 79-11, item 6.9.

CAUTION!

Do not test insulation of this system using a megger, etc. Violating this can destroy protective electronic components. Always disconnect the mains to this system before testing related distribution lines.

EC Declaration of Conformity

The current issue of the declaration can always be found on
www.emersonprocess.com/marine

EC DECLARATION OF CONFORMITY



TYPE OF EQUIPMENT:

Tank Gauging Equipment, Level, High Level, Overfill, Temperature and Pressure and Cargo Monitoring and Control and Alarm System

BRAND NAME OR TRADE MARK:

ROSEMOUNT TANKRADAR STaR

TYPE DESIGNATION:

SCU SCC 5211, SCC 5210, SCP 5110, SCH 5110, SCH 5120, SCY 5110, SCT 5110,
SCN 5110, SCM 5110, SCS 5110, SCB 5110, SCE 5110, SCA 5110, SCD 5110

I/O modules IOT5110, IOT5120, IOT5130, IOT5140, IOT5150, IOP5110, IOP5120, IO-Box,

TGU TGE 51xx, TGU 51xx, TGU 52xx, TGU 53xx, TGU 55xx, TGU 56xx, TGU 57xx

Auxillary Equipment VPS 51xx, VPS 53xx, VPS 54xx, TMU 51xx TMU 53xx, TMB 51xx, TMB 52xx,
TCB 5110, TGD 5110, WTU 5110

MANUFACTURER:

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Box 13045
S-402 51 Göteborg, Sweden
Tel +46 31 3370 000
Fax +46 31 25 30 22

WE HEREBY DECLARE THAT THE ABOVE LISTED EQUIPMENT IS IN CONFORMITY WITH THE PROVISIONS OF:

EMC directive (89/336/EEC) incl. latest amendments with the application of the harmonised standards: IEC 60945

Declaration is originally based at report from notified body SP, No **P104582-1, F120574, F117281, P403092 and P504329**

Atmosphere Explosive Directive (94/9/EC) incl. latest amendments with the application of the harmonised standards:

EN 50 014:1997
EN 50 020:1994
IEC 60079-0: 1998
IEC 60079-11: 1999

Declaration is based at EC type examination report NEMKO **01ATEX338x**

2007-05-28
Date

Signature

Technical Product Manager STaR
Position

a division of Emerson Process Management

TGU, TANK GAUGE UNIT

Description of the Tank Gauge Unit
and its Components



Parabolic Antenna Gauge
TGU 51



Cone Antenna Gauge
TGU 52



Parabolic Antenna Gauge
TGU 57



Still Pipe Antenna Gauge
TGU 55

Example of Tank Gauge Units.

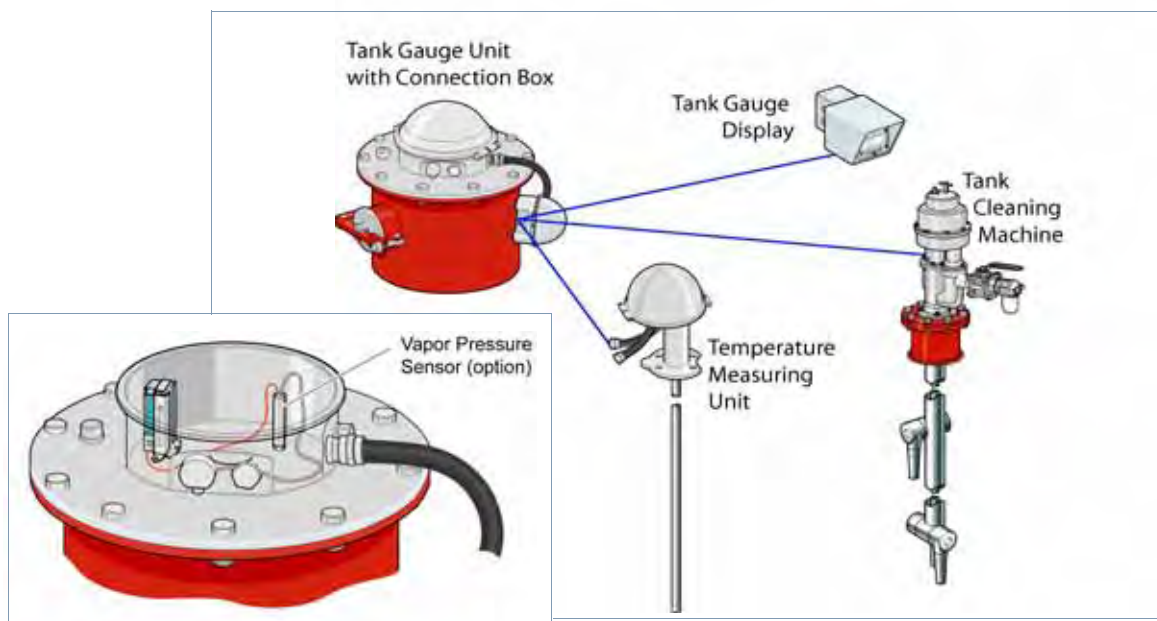
Description

The Tank Gauge Unit (TGU) is an intrinsically safe FMCW based radar transmitter/receiver mounted on deck. The intelligent TGU processes the signals using up to three independent channels in the Tank Gauge Electronics (TGE) mounted in the Tank Gauge Housing.

The TGU consists of a 10 GHz radar transmitter/receiver. Depending on the design of the tank onto which the TGU is mounted, it will come in different antenna designs:

- Parabolic Antenna Gauge
- Cone Antenna Gauge
- Still Pipe Antenna Gauge
- Still Pipe Antenna Gauge for Draft
- Parabolic Antenna Gauge for Bitumen

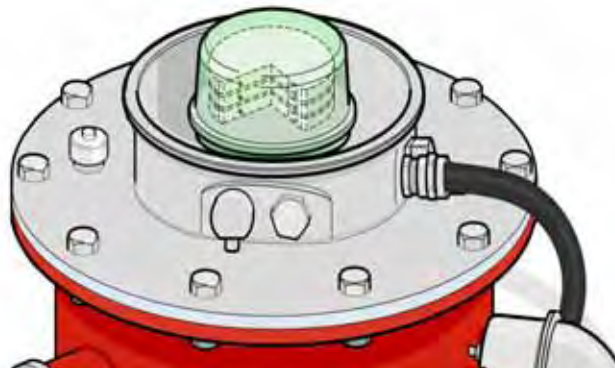
The Gauges are prepared for vapor pressure measurement and connection to local readouts, WashTrac and up to five Resistance Temperature Detector (RTD) sensors. All auxiliary equipment are connected to a serial sensor bus. Depending on the configuration of the system a Tank Connection Box (TCB) might be required (see picture below).



The TGU with the Tank Connection Box for communication with auxiliary deck mounted equipment. The Vapor Pressure Sensor is located inside the Tank Gauge Housing.

Tank Gauge Electronics

The Tank Gauge Electronics (TGE) is the box mounted in the Tank Gauge Housing. The TGE processes the signals/data from the radar and from sensors. The result of the processed measurements is sent directly to the Supply and Communication Unit (SCU). The measured values can be monitored on the Workstation, the Supply and Communication Display, the Tank Gauge Display, the Channel Display or on the Portable Readout System.



The TGU with the Tank Gauge Cover removed showing the Tank Gauge Electronics.

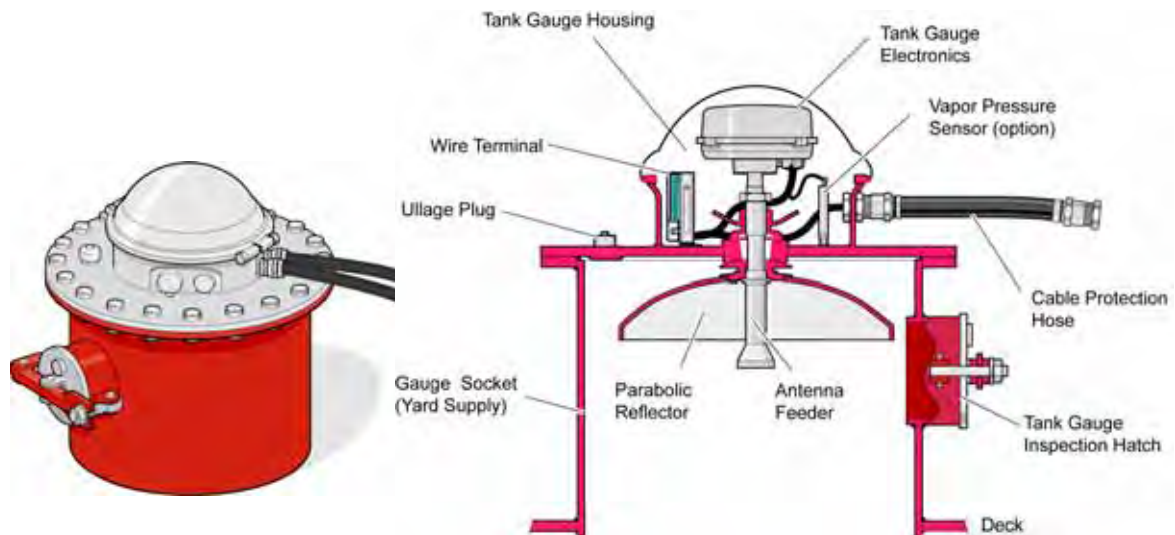
STaR 3-in-1 Solution

Rosemount TankRadar STaR provides up to three built in independent measuring channels using the same antenna. The TGE can hold up to three electronic boards depending on the system configuration. One channel for Level Gauging, two channels for High Level or Overfill Alarm system and three channels if all three systems are to be included. All three channels can be made galvanically isolated and independent from each other. The channels are intrinsically safe and approved by all major classes (see “Intrinsic Safety” on page 23).

This provides the opportunity to have a radar based independent overfill alarm system integrated in one single unit. The High Level and Overfill Alarm systems are described in the chapter “High Level and Overfill Alarm” on page 67.

Contact your Classification society and Emerson Process Management Marine Solutions for more information about how to apply an high level and/or overfill alarm system versus your vessels notification.

TGU 5140 and 5150, Tank Gauge Unit (parabolic antenna)



TGU 5140 and 5150.

The Parabolic Antenna Gauges TGU 51 (TGU 5140 and TGU 5150) are the standard Tank Gauge Units (TGU) used on all types of tanks. Due to its large antenna diameter, the radar beam from the Parabolic Antenna is very narrow. This makes it easy to find a good location so that the radar beam may pass unobstructed in complicated tanks with a lot of internal structures, as well as in deep and/or narrow tanks. In these cases a smaller antenna with a wider radar beam will find disturbing echoes or will not receive a strong enough echo from the surface of the cargo.


The Parabolic Antenna Gauge is placed on a socket. The socket is in compliance with Load Line Convention. The only part of the TGU within the tank is the antenna consisting of a stainless steel parabolic reflector and the antenna feeder with PTFE sealing. Adjustment of the direction of the antenna beam can be done within $\pm 2^\circ$. The optional vapor pressure sensor is placed within the TGU housing.

The Tank Gauge Antenna can be cleaned during tank operation using a brush that is entered via a check valve in the inspection hatch on the socket.

There is an ullage plug for hand dipping and for taking samples. When the ullage cap is removed, there is a clear reference point that can be used for hand dipping. Equipment for collecting samples up to 1.5" standard size, under closed tank conditions, can be connected to the threaded connection.

Technical Specification

TGU 5140/5150

Operating accuracy	±5 mm
Instrument accuracy	±3 mm
FMCW Center frequency	10 GHz
Measuring range	0 to 40 m
Operating temperature	-40 to 80 °C Full accuracy in the temperature range -25 to 70 °C.
Number of independent channels	Up to 3 (e.g. Level, High Level and Overfill Alarm).
Cable to control room	Up to three cables with two or three twisted pairs with common shield. Max. length is 400 m.
Number of cable inlets	Up to 4 inlets.
Antenna diameter	440 mm
Free space requirement	5.0° (angle from antenna axis).
Ullage reference plug	Free inner diameter 42 mm.
Socket height (Yard supply)	500 mm
Sealing	IP66
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

TGU 5140

Flange	Ø 670 m, 20 holes, Rosemount std (Inside socket diameter 525 to 553 mm).
Material facing tank atmosphere	Stainless steel 316L, PTFE. Other materials optional.
Material facing deck	Stainless steel 316 L
Weight	55 kg (deck socket excluded)

TGU 5150

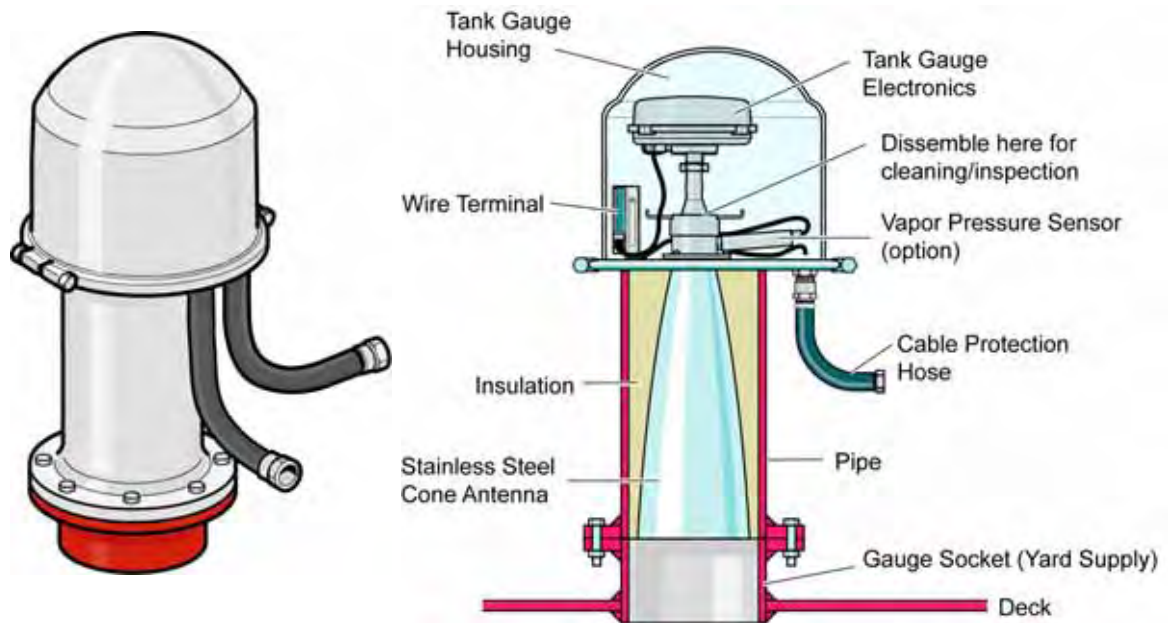
Flange	Ø 670 m, 20 holes, Rosemount std (Inside socket diameter 525 to 553 mm).
Material facing tank atmosphere	Stainless steel 316L, Mo >2.7%, PTFE. Other materials optional.
Material facing deck	Stainless steel 316 L
Weight	80 kg (deck socket excluded)

TANK GAUGE UNIT

TGU 5140 and 5150, Tank Gauge Unit

TGU 51 ed 08.fm

TGU 5210, Tank Gauge Unit (Cone Antenna)




The Cone Antenna Gauge, TGU 5210, is designed for use in shallow tanks. It has a small DN200-flange and is easily installed on a deck with closely spaced frames or longitudinals.

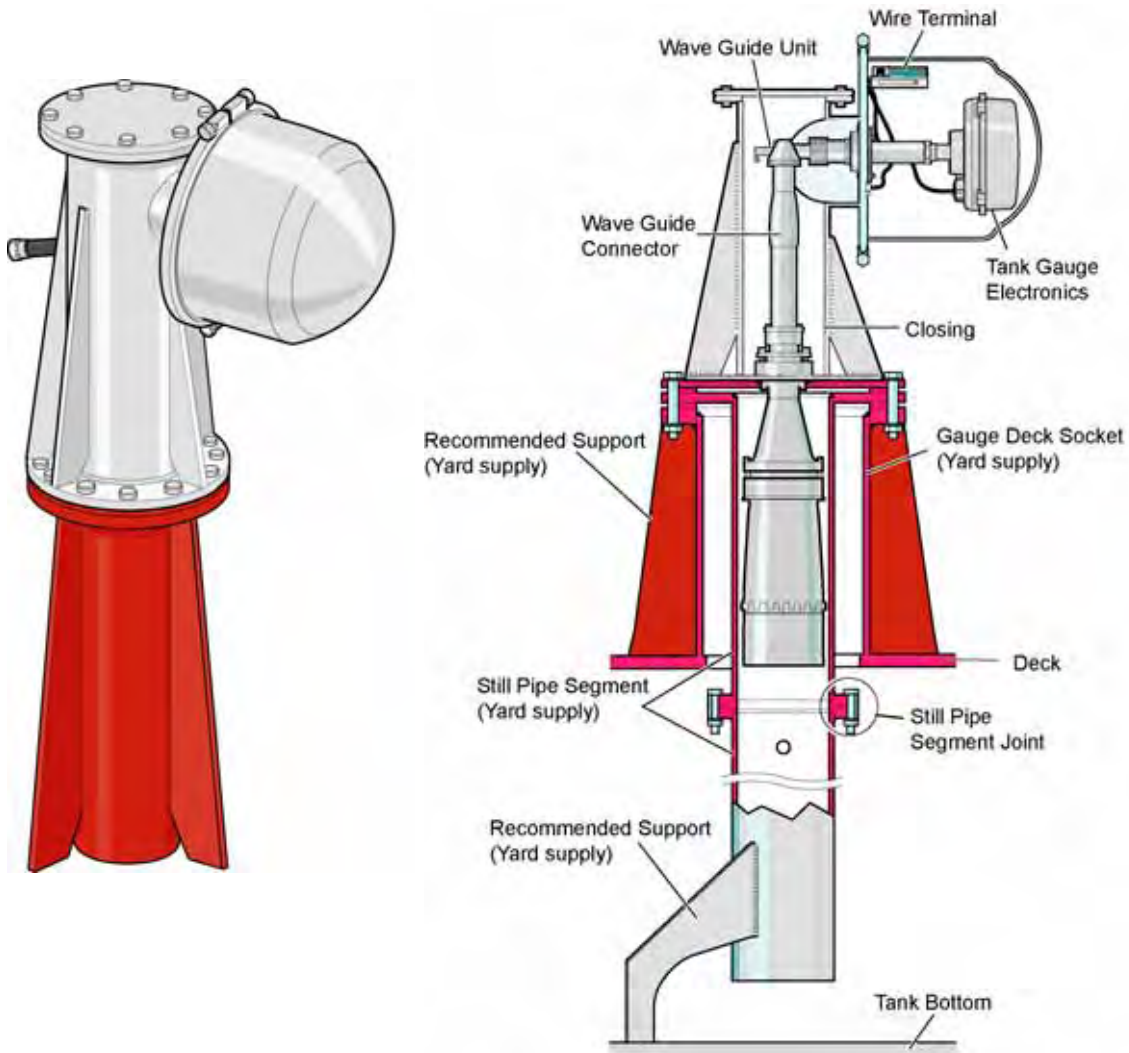
A cleaning facility is available so that the Cone Antenna Gauge can be inspected and cleaned from above.

Technical Specification

TGU 5210

Operating accuracy	±5 mm
Instrument accuracy	±3 mm
FMCW Centerfrequency	10 GHz
Measuring range	0 to 14 m
Operating temperature	-40 to 80 °C Full accuracy in the temperature range -25 to 70 °C.
No. of independent channels	Up to 3 (e.g. Level, High Level and Overfill Alarm).
Cable to control room	Up to three twisted pairs with common shield. Max. length is 400 m.
Number of cable inlets	Up to 4 inlets.
Free space requirement	7.5° (angle from antenna axis).
Flange	DN200 (Flange outer diameter 320 mm, pipe outer diameter 219 mm).
Material facing tank atmosphere	Stainless steel 316L, Mo >2.5%, PTFE. Other materials optional
Material facing deck:	Gauge housing and Pipe: Stainless steel 316L.
Socket height (Yard supply)	Standard 150 mm Max 1.5 m
Weight	45 kg (deck socket excluded).
Sealing	IP66
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

TGU 5510, Tank Gauge Unit (Still Pipe Antenna for Tanks)




TGU 5510 is designed for measuring levels in narrow tanks such as ballast tanks and slop tanks with products such as heavy fuel oil.

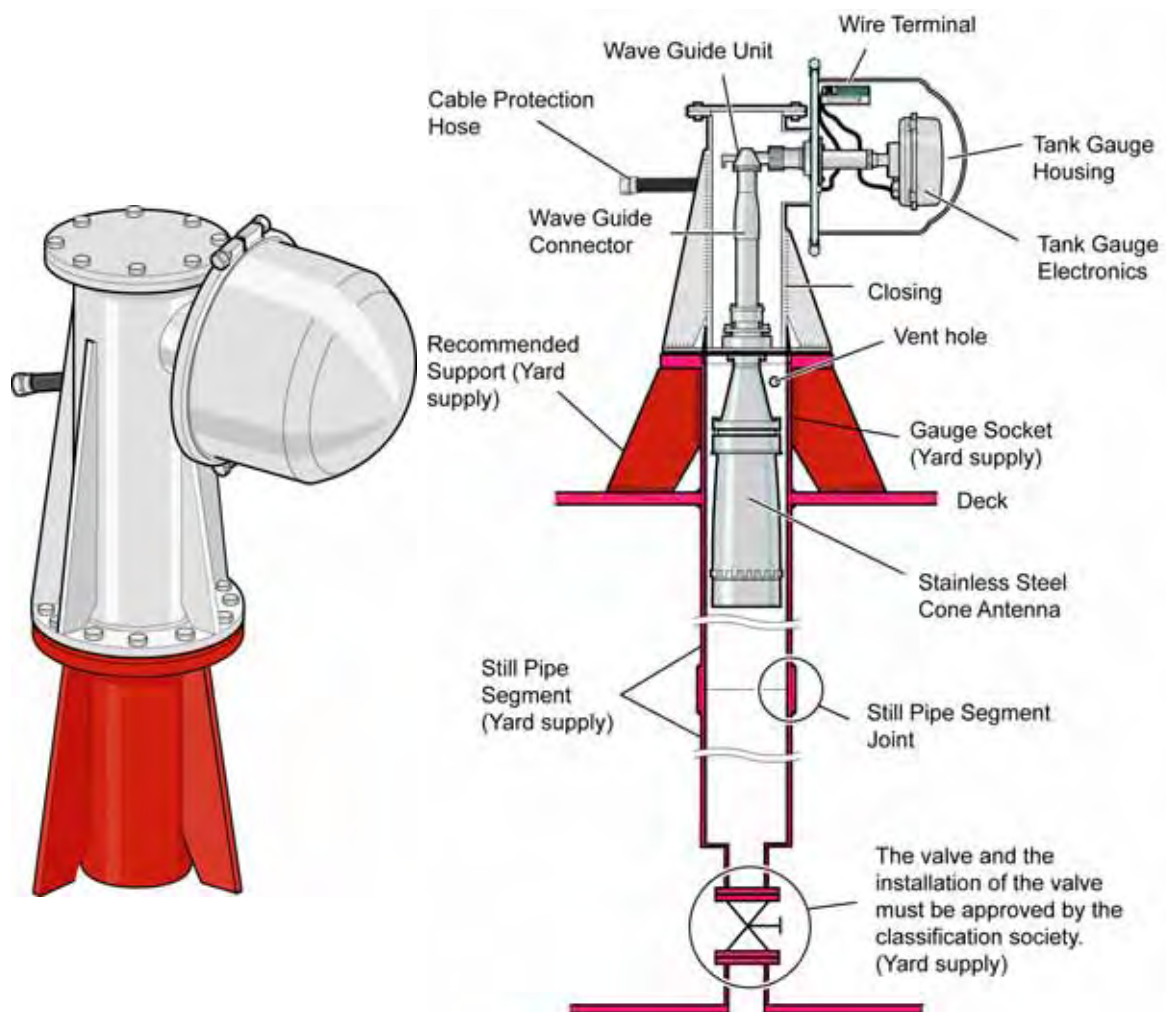
The Still Pipe Antenna Gauge, TGU 5510, and its cone antenna are mounted on top of a still pipe reaching through a tank penetration into the tank and reaching below the surface of the liquid. The Gauge measures the distance to the surface level of the liquid inside the pipe. The still pipe and antenna configuration are optimized to tolerate build-up of deposits inside the still pipe. The still pipe is equipped with a number of vent holes to equalize the level in the still pipe with the tank level.

Technical Specification

TGU 5510

Operating accuracy	±10 mm
Instrument accuracy	±3 mm
FMCW Center frequency	10 GHz
Measuring range	0 to 30 m
Operating temperature	-40 to 80 °C Full accuracy in the temperature range -25 to 70 °C.
No. of independent channels	Up to two (e.g. Level, High Level or Overfill).
Cable to control room	Up to two twisted pairs with common shield. Max. length is 400 m.
Number of cable inlets	Up to 4 inlets.
Still Pipe (yard supply)	165.2 x 4.85 mm (JIS) 168.3 x 6.3 mm (DIN) (Outer diameter x Wall thickness). Tolerance: The inner diameter MUST be within 154.0 to 158.0 mm.
Still Pipe material (yard supply)	Stainless or carbon steel with surface treatment.
Material facing deck:	Stainless steel 316L.
Material facing tank atmosphere	Stainless steel 316L, PTFE. Other materials optional
Tank Gauge Socket (yard supply)	Carbon Steel, welded to deck penetration.
Weight including TGU socket	52 kg
Sealing	IP66
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

TGU 5610, Tank Gauge Unit (Still Pipe Antenna for Draft)




TGU 5610 is designed for Draft measuring.

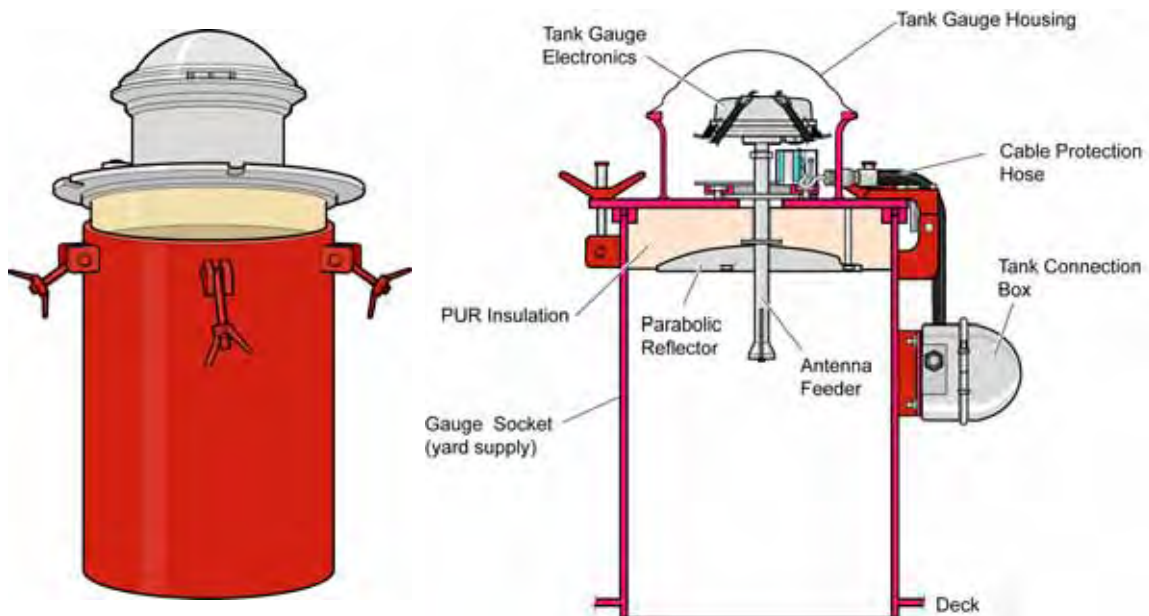
The Still Pipe Antenna Gauge, TGU 5610 is designed for measuring draft. The Gauge and its cone antenna is mounted on top of a still pipe reaching through a tank deck penetration and penetrating the ships hull (draft measuring). The Gauge measures the distance to the surface level of the sea water inside the pipe. The still pipe and the antenna configuration are optimized to tolerate build-up of deposits inside the still pipe. The gauge socket is equipped with a vent hole to equalize the level in the still pipe with the sea water level.

Technical Specification

TGU 5610

Operating accuracy	±10 mm
Instrument accuracy	±3 mm
FMCW Center frequency	10 GHz
Measuring range	0 to 30 m
Operating temperature	-40 to 80 °C Full accuracy in the temperature range -25 to 70 °C.
Number of independent channels	Up to two (e.g. Level, High Level or Overfill).
Cable to control room	Up to two twisted pairs with common shield. Max. length is 400 m.
Number of cable inlets	Up to 4 inlets.
Still Pipe (yard supply)	165.2 x 4.85 mm (JIS) 168.3 x 6.3 mm (DIN) (Outer diameter x Wall thickness). Tolerance: The inner diameter MUST be within 154.0 to 158.0 mm.
Still Pipe material (yard supply)	Stainless or carbon steel with surface treatment.
Material facing deck	Stainless steel 316L.
Material facing tank atmosphere	Stainless steel 316L, PTFE. Other materials optional.
Tank Gauge Socket (yard supply)	Stainless or carbon steel with surface treatment, welded to deck penetration.
Weight including TGU socket	52 kg
Sealing	IP66
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

TGU 5710, Tank Gauge Unit (bitumen)




The Parabolic Antenna Gauge, TGU 5710, is designed for measuring levels on bitumen and other cargos with high temperatures. This fast opening gauge is suitable on tanks where easy access to the antenna for inspection and cleaning is necessary.

TGU 5710 and its parabolic antenna is mounted on top of a fast opening hatch socket. The Gauge measures the distance to the surface level of the liquid inside the tank. The antenna configuration is optimized to tolerate high temperature of the cargo, up to +230°C at the highest load level in tank.

When used with heated cargos, it is essential for the proper function of the Tank Gauge to keep deck ambient temperature (around the Gauge) not higher than +60°C.

Technical Specification

TGU 5710

Operating accuracy	±5 mm (±10 mm from deck and down to 0.6 m).
Instrument accuracy	±3 mm
FMCW Center frequency	10 GHz
Operating temperature on deck with heated cargo	Max 60 °C
Max temperature of product	230 °C at highest load level.
Measuring range	0 to 30 m
Number of independent channels	Up to two (e.g. Level, High Level or Overfill).
Cable to control room	Up to two twisted pairs with common shield. Max. length is 400 m.
Number of cable inlets	Up to 4 inlets.
Antenna diameter	390 mm
Free space requirement	5.0° (angle from antenna axis).
Ullage reference plug	Free inner diameter 42 mm
Material facing deck	Stainless steel 316 L
Material facing tank atmosphere	Stainless steel 316 L, Glass fibre reinforced PUR (insulation).
Gauge Socket (yard supply):	
Height	800 mm
Inner diameter	Ø512 mm
Wall thickness	12 ±1 mm
Weight	80 kg (deck socket excluded).
Sealing	IP66
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

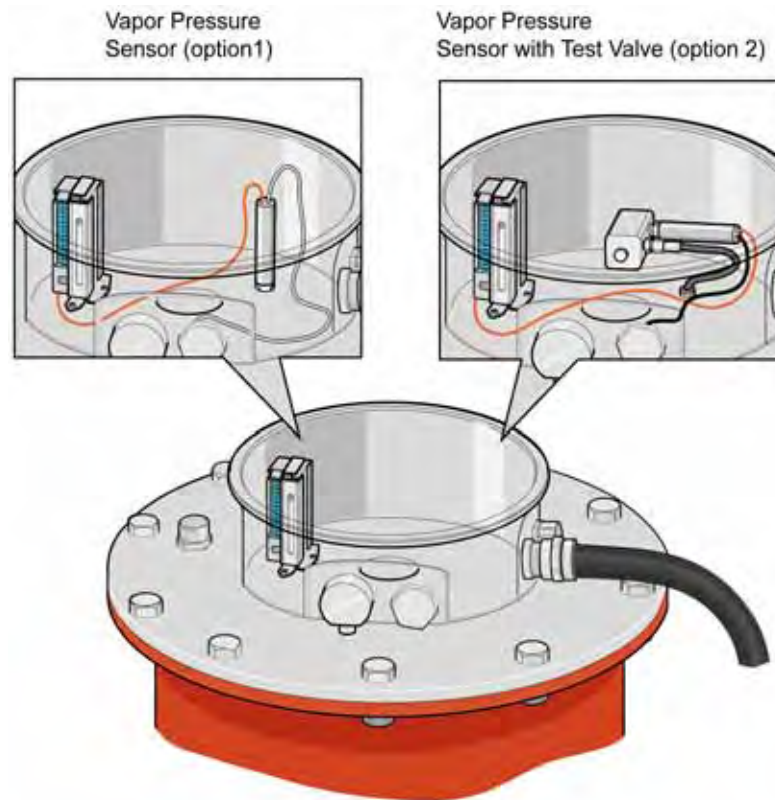
AUXILIARY EQUIPMENT

This Chapter Describes the Auxiliary Equipment
on Deck that can be Connected to the TGU

AUXILIARY EQUIPMENT



VPS, Vapor Pressure Sensor



Vapor Pressure Sensor with and without the Vapor Pressure Test Valve installed in a Parabolic Antenna Gauge.

The vapor pressure can be measured with an intrinsically safe sensor mounted inside the Tank Gauge Unit (TGU). The signals from the sensor are processed by the Tank Gauge Electronics (TGE) in the TGU and the measured pressure is then sent to the Supply and Communication Unit with the same interval as the ullage.

Depending upon the application, the pressure sensor can be chosen vented (gauge) or absolute type (common in gas application).


Normal high and low pressure alarm handling is done in the Workstation.

A system with Vapor Pressure Sensor (VPS) meets SOLAS “secondary means” requirement.

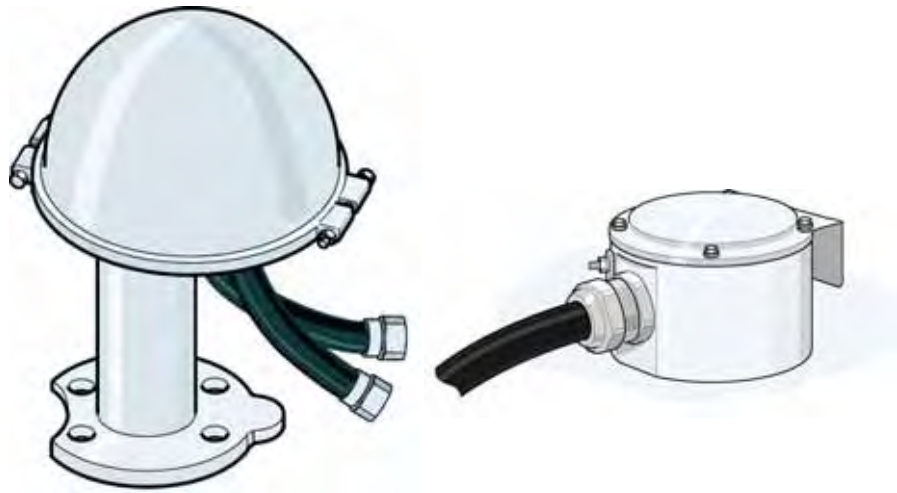
The VPS can be installed with a Vapor Pressure Test Valve (VPT) that enables a verification of the VPS without having to open the tank and thereby risking leakage.

Technical Specification

VPS

Operating pressure range:	
Vented gauge	-100 to 300 mBar (VPS 5111) -100 to 900 mBar (VPS 5130)
Absolute gauge	0.8 to 1.4 Bar (VPS 5310) 0.8 to 8.0 Bar (VPS 5410)
Operating temperature range	-40 to 80 °C
Accuracy	±0.25% FS (Full Scale) in temperature range -20 to 70 °C.
Mounting	Integrated in TGU.
Signal interface	1 (RS-485 for communication with TGU).
Material facing tank atmosphere	Stainless steel 316L Haste alloy C276
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

TMU, Temperature Measuring Unit



Example of a TMU 51 (left) and a TMU53 (right).

The temperature of the cargo and vapor in the tank can be measured with up to five sensors for the tank deck mounted TMU 51 and three sensors for the pump mounted TMU 53. The temperature sensors (TMS) are distributed over the tank height with three or four wire connections.


The temperature data is processed by the Tank Gauge Unit (TGU) and sent to the Supply and Communication Unit (SCU). The temperature can be monitored from the Workstation, the Tank Gauge Display, Channel Display Unit, Supply and Communication Display or on the Portable Readout System.

The TMS shall be located in a thermowell extended through the tank below the TMU.

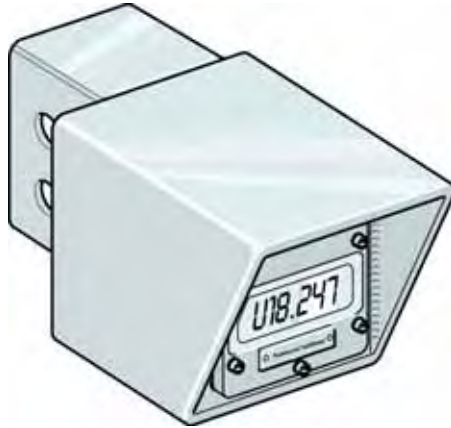
The TMS is a Pt100 element with a three (standard) or four (high accuracy) wire connection. The TMS are connected to the Tank Measuring Block (TMB) inside the TMU. The TMB communicates with the TGU through a sensor bus.

Technical Specification

TMU

Accuracy, excl. sensor	±0.15 °C
Sensor accuracy, standard	±0.3 °C + 0.005 ΔT for Pt100. Class B sensor (ex. ±0.3 °C at 0 °C and ±0.55 °C at 50 °C).
Measuring range with PT100	-170 to 250 °C
Operating range	-40 to 80 °C
Max no. of sensors	5 (TMU 51) 3 (TMU 53)
Cable to Tank Gauge Unit	Two twisted pairs with common shield.
Material facing deck	Stainless steel 316L
Weight TMU	5.4 kg (TMU 51) 3.0 kg (TMU 53)
Sealing	IP66
Signal interface	RS-485 for communication with TGU.
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4


TGD, Tank Gauge Display



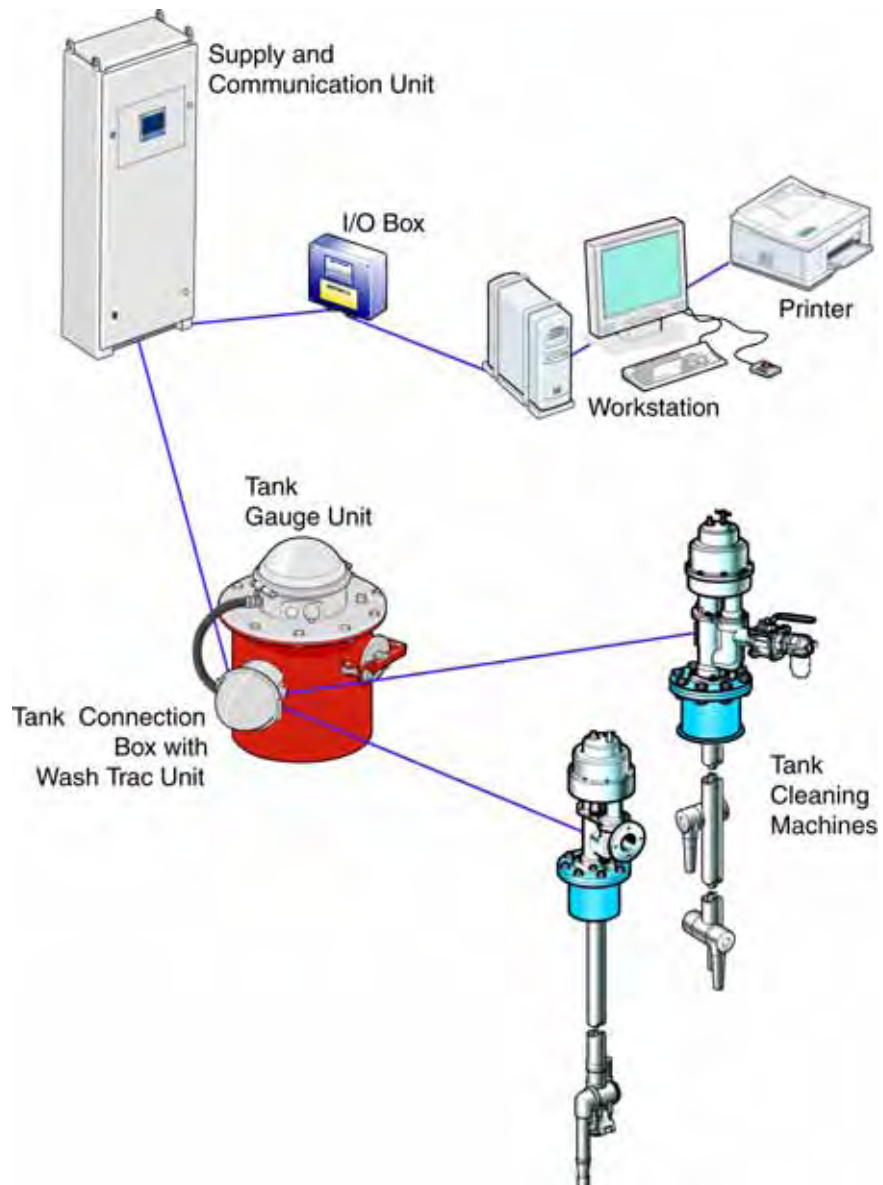
The Tank Gauge Display (TGD) is an intrinsically safe six-character display which is mounted on deck. The TGD is connected to the Tank Gauge Unit. Its purpose is to indicate measurements such as the tank's ullage, temperature and vapor pressure. It can be set to show one specific parameter or automatically toggle between these values. The design of the TGD allows it to be bolted, clamped or welded to any suitable structure on deck.

Technical Specification

TGD

Display	7 segments with 6 digits.
Resolution	1 mm, 0.1 °C, 1 mBar
Operating temperature	-25 to 80 °C
Dimensions	120 x 195 x 126 mm (Width x Height x Depth)
Cable to Tank Gauge Unit	Two twisted pairs with common shield.
Weight	6 kg
Material	Stainless steel 316L
Sealing	IP66
Signal interface	1 (RS-485 for communication with TGU).
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

WTU, WashTrac™ UNIT



WashTrac™ is a tank cleaning monitoring system that indicates the status of the tank cleaning operation that uses the ScanJet tank cleaning machines. The status is updated every thirty second and is presented on the Workstation.

Each Scanjet Tank Cleaning Machine can be equipped with a magnetic sensor that detects when the machine is running. The sensors are connected, via the WashTrac Unit (WTU), to the Tank Gauge Unit (TGU) situated on that particular tank. The WTU is a terminal block housed in the Tank Connection Box and as many as eight tank cleaning machines can be connected per tank.

The WTU monitors the cleaning machine rotation and sends a signal when the set rotation speed is reached. The information is processed in the TGU and the result is sent to the Workstation via the Supply and Communication Unit (SCU).


On the Workstation the following information will be available for each tank:

- Operating status of Tank Cleaning machines
- Start/Stop Alarm of Tank Cleaning machines
- Operation and Prewash Data Logging on printer
- Accumulated Running Time of Tank Cleaning machines
- Tank Cleaning Machine Service Intervals

With WashTrac™ it is also possible to print out a complete report from the tank cleaning operation. With such a record in hand there will be no discussion on whether the prewash has been performed correctly or not.

Technical Specification

WashTrac™

Max no. of machines/tank	8 cleaning machines
Cable to Tank Gauge Unit	Two twisted pairs with common shield.
Max cable length	The maximum allowed total length between the Cleaning Machines and the Gauge is 75 m. The total length includes both the cable from the Cleaning Machines to the WTU and the cable from the WTU to the Gauge.
Max polltime for machine status	30 s
Operating temperature	-40 to 80 °C
Signal interface	1 (RS-485 for communication with TGU).
Explosion Protection	Intrinsically safe. ATEX  II 1 G, EEx ia IIC T4 CSA (IEC) Ex ia IIC T4

Wash Trac ed 04.fm

SCU, SUPPLY AND COMMUNICATION UNIT

Description of the Supply and Communication Unit,
Cabinet and Enclosed Components

SCU for TD ed 10.fm

SUPPLY AND COMMUNICATIONS UNIT



The Supply and Communication Unit.

SCU for TD ed 10.fm

Description

The Supply and Communication Unit (SCU) is the connection hub for the Rosemount TankRadar STaR Tank Gauge Units. The SCU is a self-contained unit with provisions for intrinsically safe connection to external units.

The Supply and Communication Unit provides the following main functions:

- supply intrinsically safe power to the Tank Gauge Units and auxiliary equipment
- store configuration data of the connected devices
- collect and store data from gauges and sensors
- serve clients with requested data
- service display for diagnostics

The server program continuously scans all devices defined by the configuration database and stores input data (measured and calculated values and status information) in a process database. All data is stored in SI units.

The SCU is normally located in the cargo control room or in the instrumentation room of the ship. Up to 68 tank measuring channels can be handled by the SCU. The measuring channels are either for Tank Gauge (level, pressure, temperature, etc.), High Level Alarm (HL) or Overfill Alarm (OF) Functions. The system implicates one SCU for each function (Gauge, HL and OF).

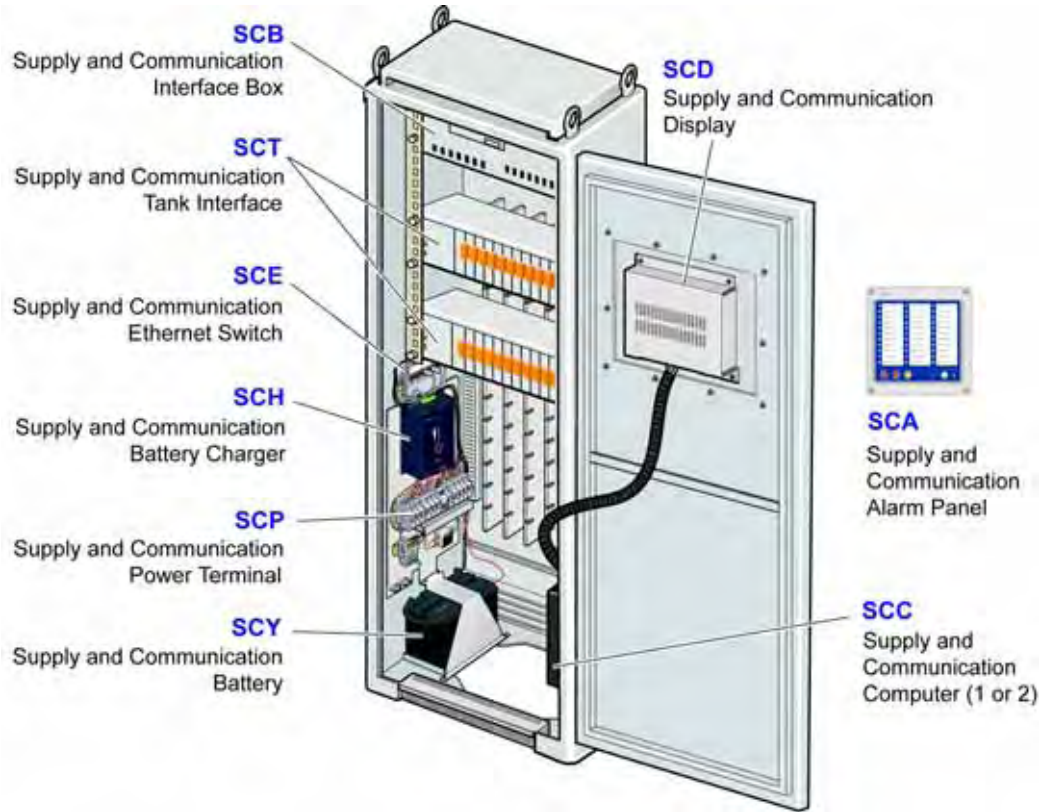
The SCU uses 115/230 VAC or 24 VDC supply voltage. The input power is connected to a terminal block (SCP) and is distributed from there to each consumer inside the cabinet.

Long-life Guideline

To maximise the life time of your equipment and minimise service costs, we recommend that you keep the SCU in a ventilated (air-conditioned) area. The air-inlet and ventilation area around and inside the SCU serves as a free air circulating space and are **not** to be blocked. Furthermore electrical components should **not** be exposed to extreme heat and direct moisture, this will make equipment age faster.

Following these requirements will keep your system up and going for a durable time. See “Technical Specification” on page 60 for recommended operational temperature.

SCU Main Parts

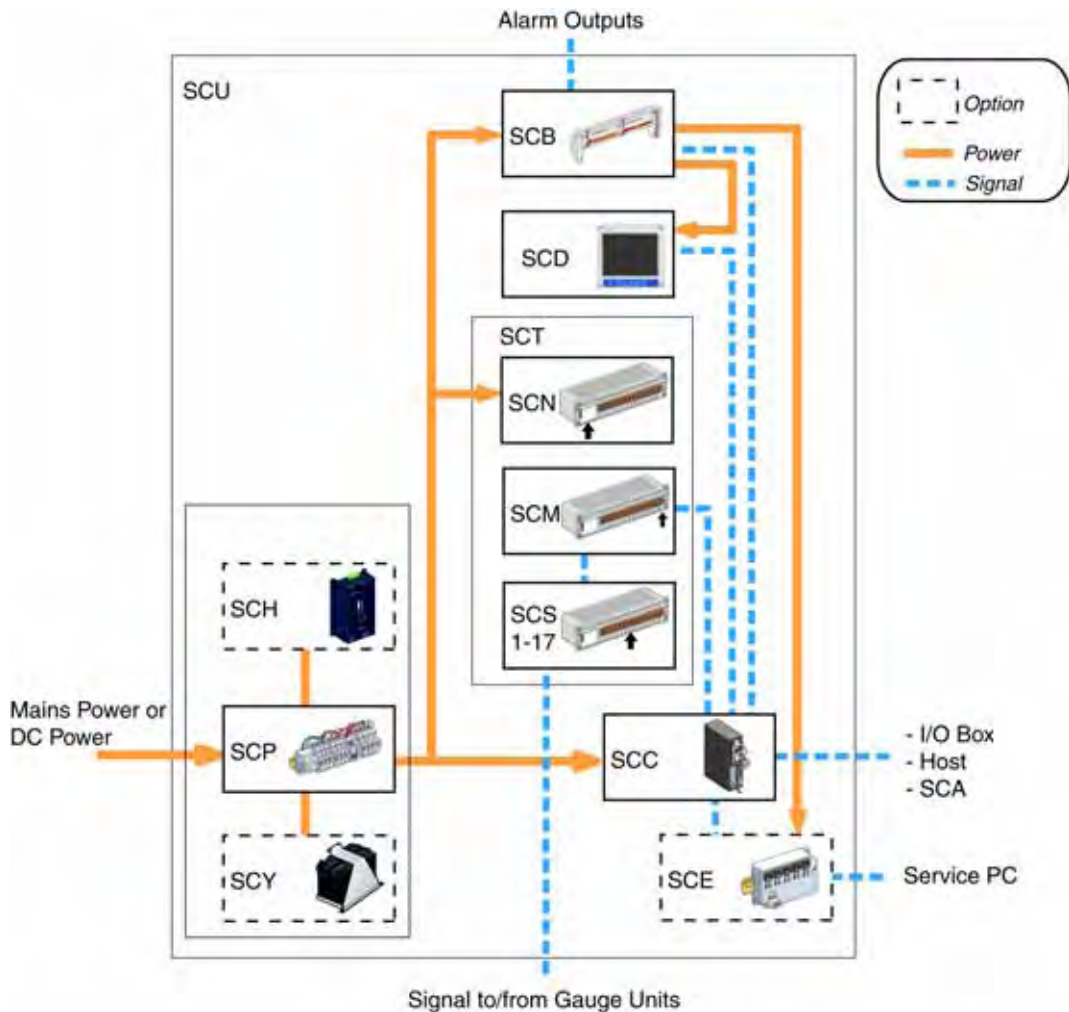


Supply and Communication Unit with Supply and Communication Alarm Panel.

The SCU main parts are mounted inside one or two standard 19" cabinet with the cables from external units entering through the bottom of the cabinet. The entire cabinet has been verified to comply with EMC requirements (electromagnetic compatibility). The SCU consists of the following parts:

- Cabinet
- Supply and Communication Computer, SCC
- Supply and Communication Tank Interface, SCT
- Supply and Communication Interface Box, SCB
- Supply and Communication Power Terminal, SCP
- Supply and Communication Ethernet Switch, SCE (option)
- Supply and Communication Battery, SCY (option)
- Supply and Communication Charger, SCH (option)
- Supply and Communication Alarm Panel, SCA (option)
- Supply and Communication Display, SCD

Power and Signal Flow



SCU block diagram for a small system.

The signals from the Tank Gauge Unit (TGU) enter the Supply and Communication Unit (SCU) through the tank interface (SCT). The signal passes the safety barrier (SCS) and enter the Supply and Communication Computer (SCC) via the modem (SCM). In the SCC the signals are processed and sent to the Host via an RS-485 serial communications port.

The Supply and Communication Power (SCP) is the power distribution terminal in the SCU. As an option a battery (SCY) and a battery charger (SCH) can be connected to form an Uninterrupted Power Supply (UPS). The SCH converts the 115/230 VAC mains input to 24 VDC output. The SCN is the DC/DC converter module for intrinsic safety power supply in the SCT.

The SCU can also be fed with 24 VDC but that leaves out the possibility to form an UPS.

SCU for TD ed 10.fm

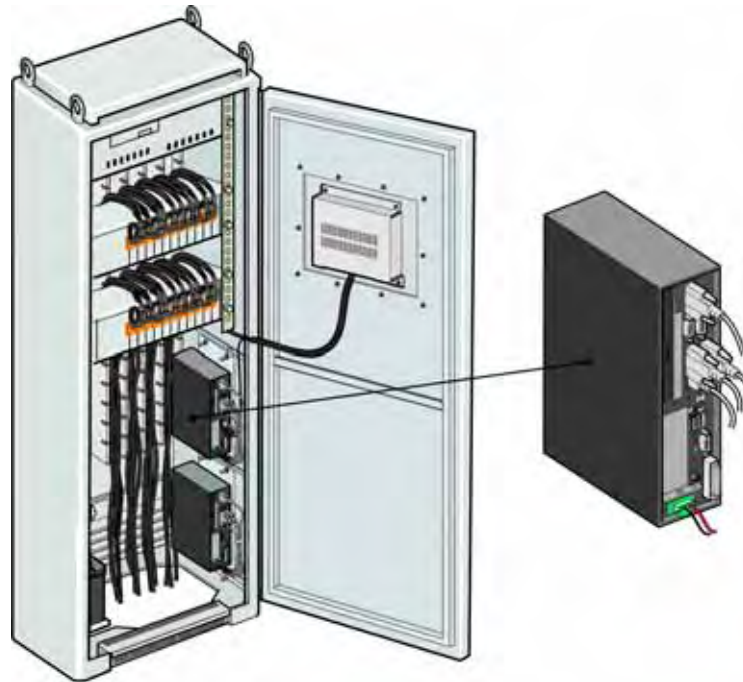
SUPPLY AND COMMUNICATIONS UNIT

Description

The SCA is the alarm panel for High Level and/or Overfill Alarm functions. The signals to/from the SCA are directed via a modbus communication port in the Supply and Communication Computer (SCC).

The Supply and Communication Display (SCD) is connected to the SCC with USB and VGA cables. It is powered from the SCB (Supply and Communication Interface Box).

SCC, Supply and Communication Computer



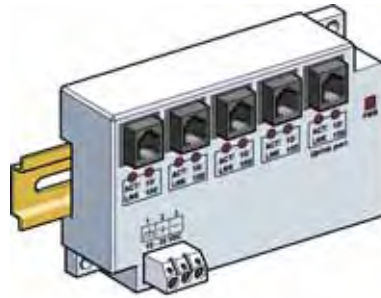
The SCC and its location in the SCU.

The Supply and Communication Computer (SCC) is a complete industrial computer with an integrated DC power supply and a hard disk with anti-vibration suspension. There is a Power On indicator on top of the SCC. The SCC is located inside the Supply and Communication Unit.

The SCC acts as a server and manages a process database for storing input data, such as measured and calculated values and status information, from the Tank Gauge Units and auxiliary equipment. The result is presented on the Workstation or a separate display.

Systems dual functions (e.g. independent Tank Gauge and High Level or Overfill Alarm units) are equipped with two SCC. The SCA is then connected to the applicable SCC.

SCE, Supply and Communication Ethernet Switch

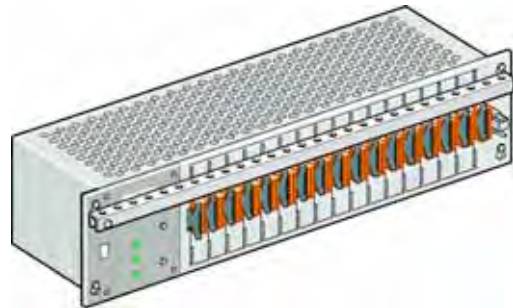


The Supply and Communication Ethernet Switch (SCE) is the switch for communication between the SCU and service PC. The SCE is optional and not included as standard.

SCT, Supply and Communication Tank Interface

The Supply and Communication Tank Interface (SCT) comprises a backplane with socket connectors for nineteen plug-in circuit boards as follows:

- One Supply and Communication Converter (SCN) for intrinsic safety power supply
- One Supply and Communication Modem (SCM) for communication with the Supply and Communication Computer
- Up to 17 Supply and Communication Safety Barrier (SCS) for connection to intrinsically safe Tank Gauge Units.



The backplane distributes communication and power buses to the Supply and Communication Safety Barrier (SCS) and to the Supply and Communication Modem (SCM). No cables are connected to the backplane.

SCN, Supply and Communication Converter

The Supply and Communication Converter (SCN) is the DC/DC converter module in the Tank Interface Unit. The SCN provides three isolated outputs.

SCM, Supply and Communication Modem

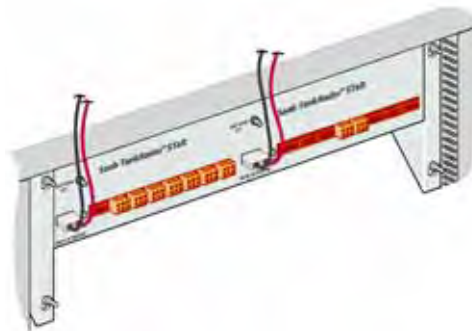
The Supply and Communication Modem (SCM) acts as a converter between an RS-232 connection and the fieldbus. The RS-232 interface provides galvanic insulation from the Supply and Communication Computer.

An additional function located on the SCM is a ground insulation monitor. It enables the detection of ground errors in the Tank Units and indicates ground error with a LED on the SCM board and also sends a ground failure signal to the Work Station Unit (WSU).

SCS, Supply and Communication Safety Barrier

The Supply and Communication Safety Barrier (SCS) in the Supply and Communication Tank Interface limits the available voltage and current to the Tank Units to intrinsically safe levels. Each SCS has two supply barriers and one combined fieldbus/supply barrier. The outputs are short-circuit protected.

SCB, Supply and Communication Interface Box



The Supply and Communication Interface Box (SCB) is an I/O Unit for the Supply and Communication Computer (SCC). It controls relays that can be connected to for example alarm devices.

The SCB is equipped with one or two independent electronic boards. This enables a configuration with a second independent measuring channel in the same cabinet. This type of configuration can be used for independent High Level or Overfill Alarm units

Each electronic board has eight relay control outputs, a power supply and a system failure watchdog/relay control circuit.

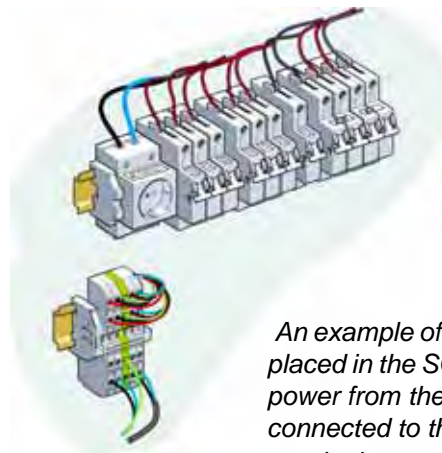
If the communication with the SCC is interrupted, the watchdog will activate the System Failure Alarm. The first relay is used as System Failure Alarm output, the remaining relays are for general purpose alarm and control.

SCP, Supply and Communication Power Terminal

The Supply and Communication Power Terminal (SCP) is the circuit breaker terminal mounted inside the Supply and Communication Unit cabinet. It distributes power to the different consumers inside the cabinet.

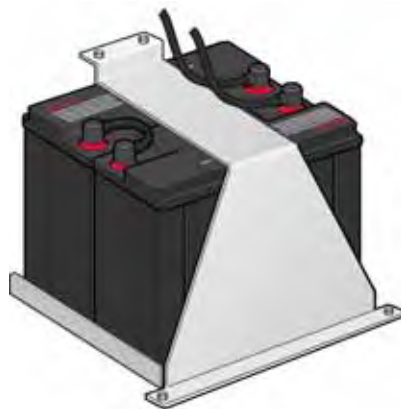
When the SCU is fed with AC Voltage, a battery and a battery charger are connected to form an Uninterrupted Power Supply (UPS).

The SCP is also equipped with a power outlet for connection of a lamp or a service instrument.



An example of an SCP placed in the SCU. The power from the ship is connected to the lower terminal

SCY, Supply and Communication Battery



The Supply and Communication Battery (SCY) is always used when the SCU is fed with AC voltage. It is mounted inside the Supply and Communication Unit cabinet. The SCY is optional and not included as standard.

The SCY is connected to the battery charger (SCH) and forms an Uninterrupted Power Supply (UPS). The charging voltage is temperature compensated by means of a sensor mounted on the battery.

Keep battery from being continuously exposed to high temperatures. Long term exposure to high temperatures in an ambient room temperature above 45°C could decrease battery performance permanently. The SCU cabinet should be placed in an air-conditioned room.

CAUTION!

Keep battery from being continuously exposed to high temperatures. Long term exposure to high temperatures in an ambient room temperature above 25°C will decrease battery performance permanently and above 45°C damage the battery permanently. The SCU cabinet should be placed in an air-conditioned room.

SCH, Supply and Communication Battery Charger

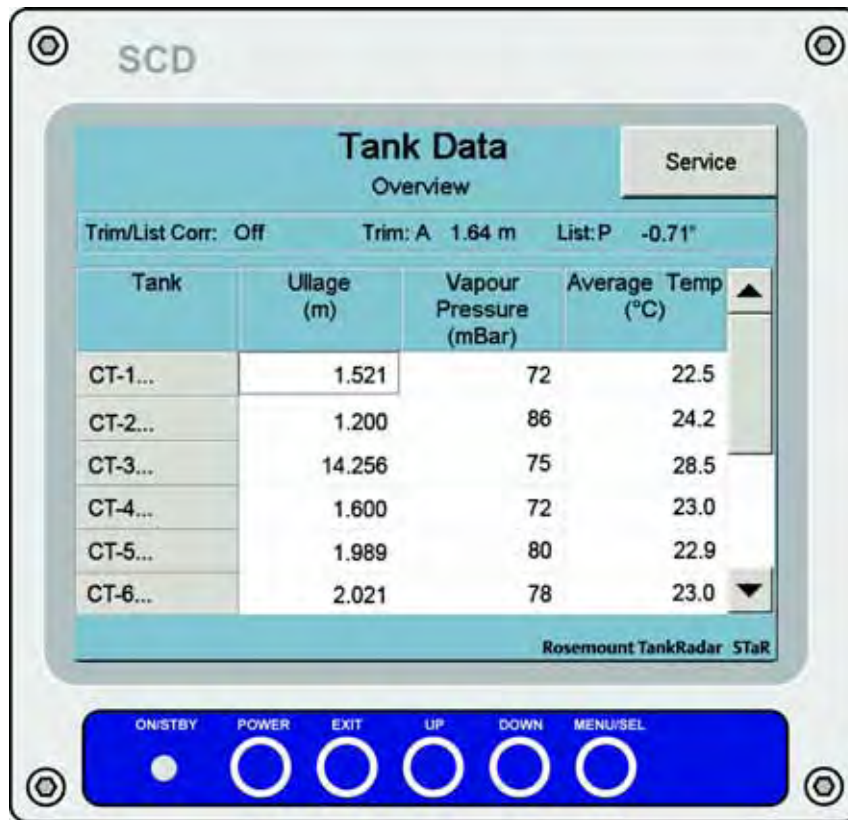


The Supply and Communication Battery Charger (SCH) is a power supply/battery charger that converts the 115/230 VAC mains input to 24 VDC output.

The SCH is optional and not included as standard. However, when the SCU is fed with AC voltage the SCH is normally included.

It is connected to a battery (SCY) to form an Uninterrupted Power Supply (UPS). The charging voltage is temperature compensated by means of a sensor mounted on the battery.

SCD, Supply and Communication Display



The SCD (Supply and Communication Display) in the Tank Data mode.

The SCD (Supply and Communication Display) provides diagnostics, service and Tank Data monitoring functions to the operator.

The Tank Data monitoring mode presents either an overview picture with basic data for all tanks or detailed data for one tank at a time. Presented data are for example: ullage, spot- and average temperature and vapor pressure.

If a problem occurs the operator can use the diagnostics and service functions to locate the cause and take corrective actions to resolve the situation.

	Level	High Level	Overfill	
Power	OK	OK	OK	▲
Host...	OK	OK	OK	
SCC...	OK	OK	OK	
SCB	OK	OK	OK	
SCM	OK	OK	OK	
TGE...	Clean Antenna	Clean Antenna	Clean Antenna	▼

Exit

Rosemount TankRadar STaR

The Diagnostics function presents status information to the operator.


The SCD has a resistive 6.5" touch screen mounted in front of a TFT display. This enables the user to operate the SCD by touching the screen with his fingers. No external input devices are needed.

It is mounted on the SCU (Supply and Communication Unit) cabinet door.

Five push buttons on the front of the SCD are used for the on-screen display menus for adjustment of for example brightness and contrast.

Technical Specification

SCU, Supply and Communication Unit

Dimension	600 x 1795 x 400 mm (Width x Height x Depth)
Weight (typical)	Max 125 kg
External uninterrupted DC supply	24 V, +30%, -25% Max 16 A (with 2 SCT) Max 10 A (with 1 SCT)
AC Mains supply	115 V or 230 V \pm 10% 50 or 60 Hz Max 650 VA Continuous 450 VA
Operating environment:	
Temperature	0 to 35 °C
Humidity	20% to 80% (non-condensing)
Painting	RAL 7032
Sealing	IP22
Additional interface	2 RS-485/RS-422 (Opto isolated) 2 RS-422
Interface, service connection	10 BaseT/100 BaseTx
Relays:	
No. of relay control outputs	8 (incl. System Failure Alarm)
No. of terminals/output	3 (Normally Closed – Common – Normally Open)
Contact rating	250 VAC, 5 A max (resistive load)
Cable length to Tank Gauge Units	Max 400 m
LED indicators	Power on/off
Explosion Protection	Associated apparatus. ATEX  II (1) G, CENELEC [EEx ia] IIC CSA (IEC) [Ex ia] IIC

SCU for TD ed 10.fm

SCY, Supply and Communication Battery

Type	Gel filled sealed lead battery, hence spill proof.
Capacity	2x12 V 16 Ah
Operating Time	> 20 minutes
Battery life	Up to 8 years at 25 °C impaired to 3 years at 35 °C See Service Manual for maintenance.

SUPPLY AND COMMUNICATIONS UNIT

Description

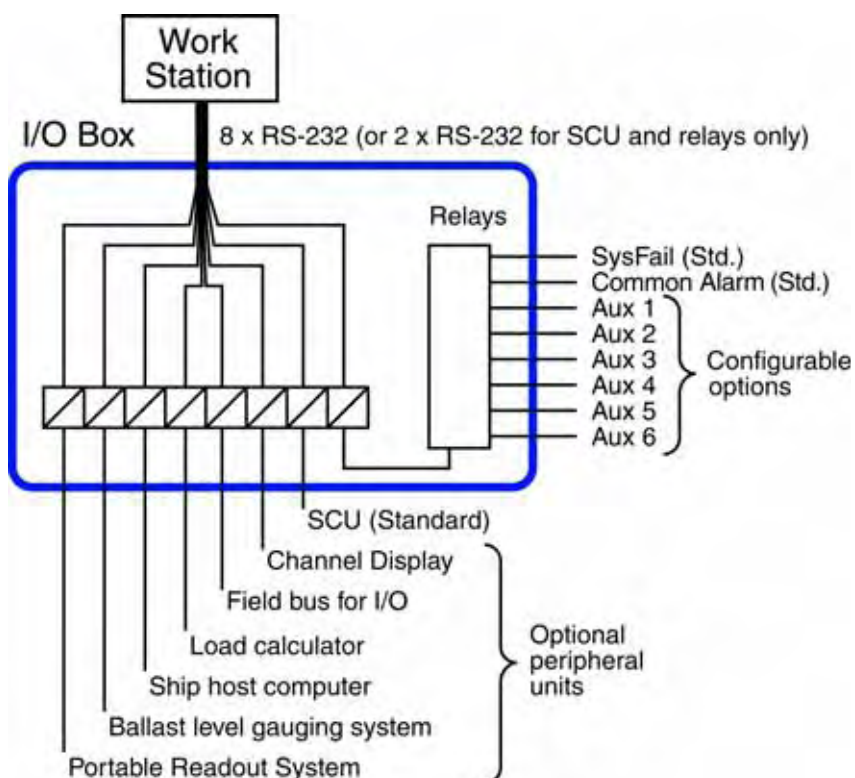
SCU for TD ed 10.fm

I/O Box



The I/O Box (IOB) connects the Workstation Unit with the Supply and Communication Unit (SCU) as well as other equipment such as ship main computer, load calculator and a wide range of analog/digital inputs and outputs. Distributed I/O modules are connected to the IOB via a serial interface.

The IOB consists of an electronic board with power supply, relays and connectors for seven serial interface boards. The IOB provides galvanic isolation between the Workstation Unit and other equipment. When required it also provides interface conversion, for example RS-232 and RS-485.



The I/O box with possible connections.

IO Box ed 04.fm

The IOB is connected to the Workstation Unit with an 8-channel serial interface board or with the COM1 and COM2 (only for connections of SCU and relays) ports.

One of the IOB's 8 channels is used for relay output control and the other seven are wired to the interface board connectors on the motherboard. Of these seven channels one is dedicated for connection of the SCU.

The channel that is used for relay output controls eight relays. One of them is a system failure relay (controlled by a watchdog circuit), another is a common alarm and the other six can be used for alarms or for general output signals.

The interface board connectors are used to connect equipment such as ship main computer and load calculator.

Technical Specification

IOB

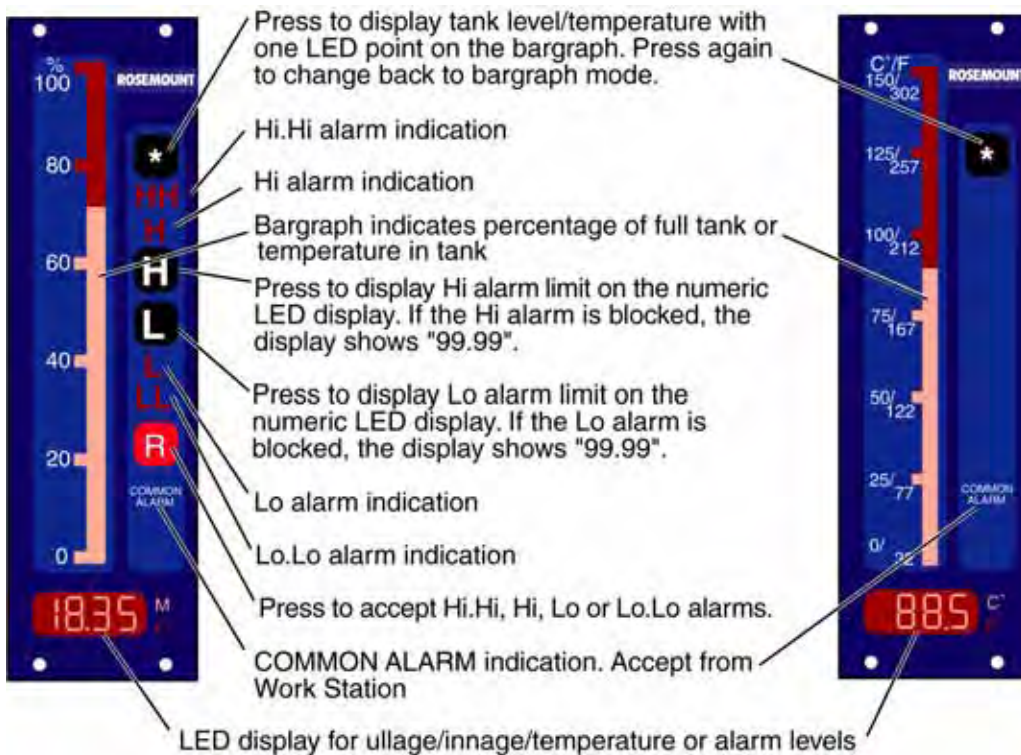
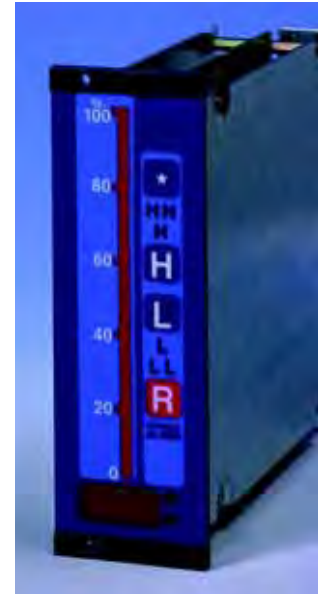
Dimensions	280 x 230 x 110 mm (Width x Height x Depth)
Weight	5 kg
Serial communication interfaces	Up to seven galvanically isolated RS-232 (max 15 m) or RS-485/RS-422 (max 400 m) of which one is dedicated for the SCU communication.
Communication protocol	Rosemount Master/Slave protocol, Modbus protocol.
Relays	System failure, common alarm and up to six configurable relays for alarms or general output signals. Rated 250 VAC, 8 A.
Connection to Workstation	RS-232 max 15 m Cable supplied by Emerson Process Management Marine Solutions.
Power supply	115 VAC +10% to -15%, 47-63 Hz or 230 VAC +10% to -15%, 47-63 Hz
Power consumption	Max 15 VA
Sealing	IP22

CDU, CHANNEL DISPLAY UNIT

One Channel Display Unit (CDU) for each tank installed in a common control room panel gives a clear view of tank contents (ullage or innage); drafts or temperatures. The standard Channel Display Unit has a four digit numeric display and a bargraph of light emitting diodes (LEDs) indicating tank filling as a percentage of the tank height or temperature in °C. The display also indicates alarm levels (Hi, Hi.Hi, Lo and Lo.Lo alarms). Values can be displayed in either metric or imperial units, which is preset at delivery.

The CDU's are powered by a separate power supply unit. Up to 30 Channel Display Units can be supplied by one power supply unit.

There is an optional thumb wheel selector switch that can be used together with a single CDU. The thumb wheel is used to select the tank to be displayed at the moment.



CDU.ed.03.fm

Technical Specification

CDU

Resolution	50 LEDs in bargraph represent full tank height. Numeric display shows ullage in cm.
Operating temperature	0 to 55 °C
Dimensions	48 x 168 x 200 mm (Width x Height x Depth)
Signal interface	RS-485, 3 twisted pairs with common shield. Area: 0.5 to 1.5 mm ²
Cable to Power supply	2 x 1.5 mm ² (max 10 Display Units / cable pair).
Weight	0.7 kg

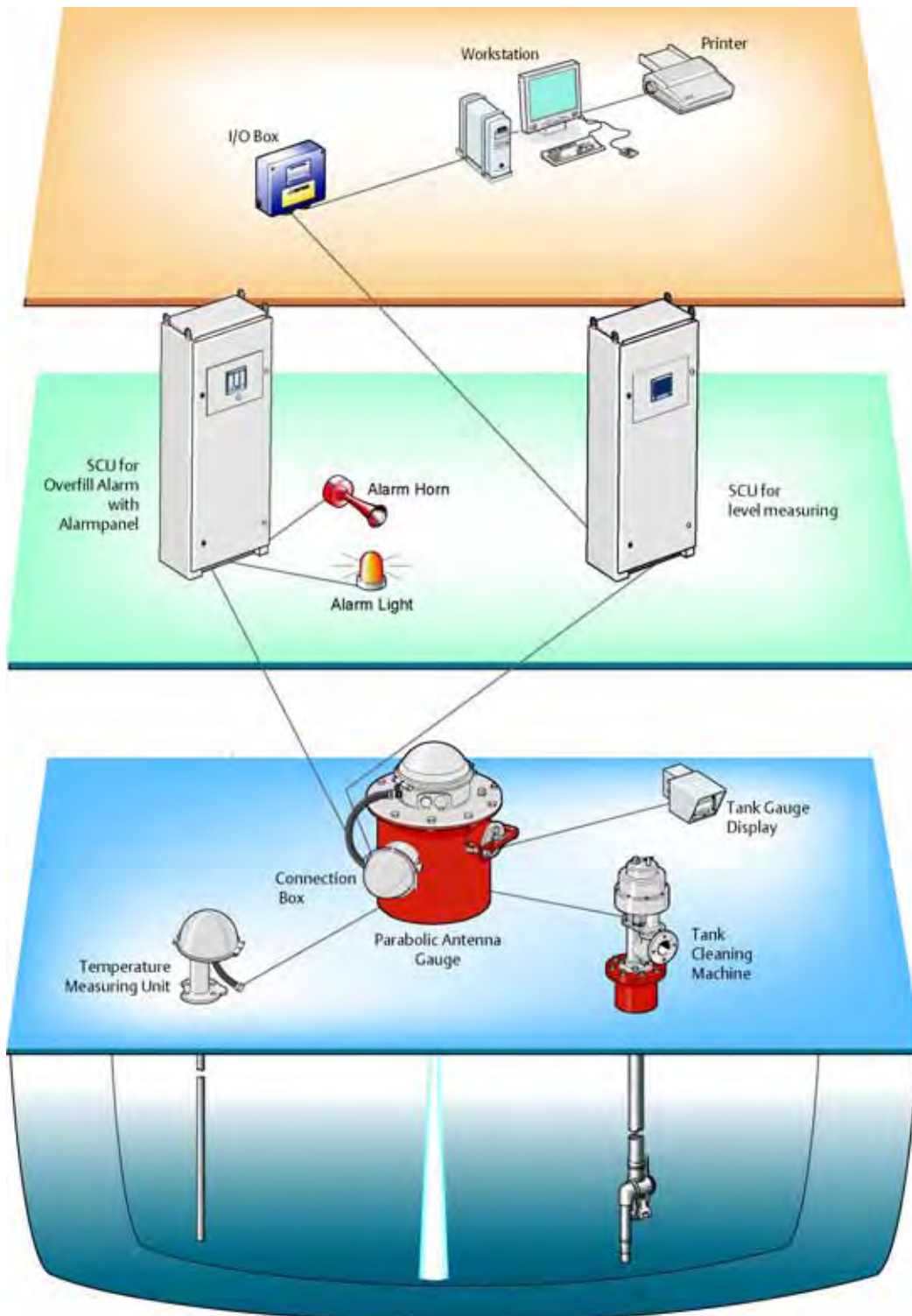
CDP, Channel Display Power

Power supply for 1-30 Units	115 VAC +10 to -15%, 47-63 Hz or 230 VAC +10 to -15%, 47-63 Hz
Power consumption	Max 100 VA
Dimensions	285 x 325 x 100 mm (Width x Height x Depth)
Weight	10 kg

HIGH LEVEL AND OVERFILL ALARM

This chapter describes the High Level and Overfill Alarm Systems

HIGH LEVEL AND OVERFILL ALARM SYSTEM



An example of a system configuration with level measurement and overfill alarm. The number of SCU cabinets depends on the system configuration.

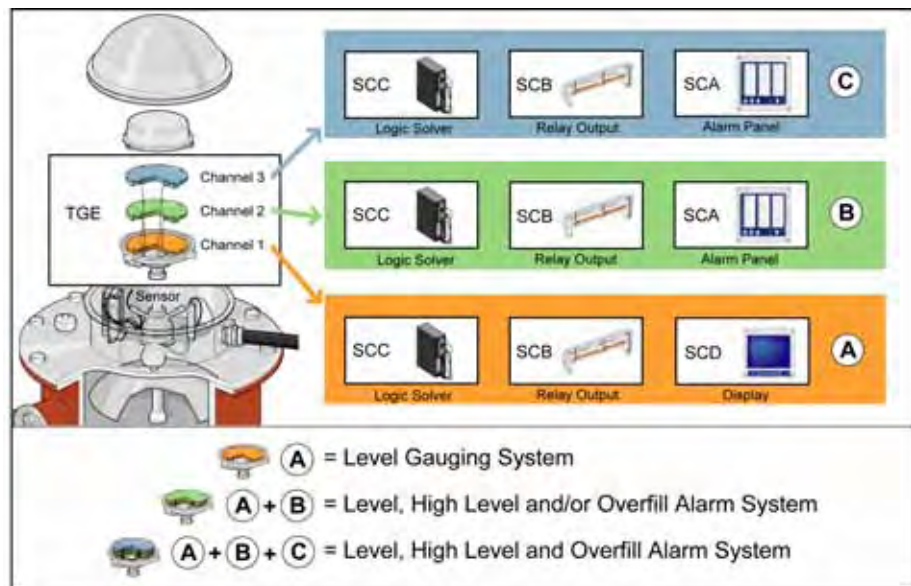
Alarm system ed 05.fm

General Description

The High Level and Overfill Alarm systems can be used as stand-alone independent systems or as integrated, but still independent, systems. The level alarm systems can be configured to meet individual class interpretations of IMO rules for independent sensors.

The integrated system is mounted in the same intrinsically safe Tank Gauge Unit (TGU) with the High Level and Overfill Alarm electrically separated from each other and from the level/ullage gauging system (see chapter Tank Gauge Unit for more information).

The Supply and Communication Unit (SCU) is the connection hub within the STaR system. All the processed data from the TGU is transferred to the SCU. The SCU cabinet can contain several different numbers of equipment as described in the SCU chapter. If independent systems are to be used the SCU cabinet can be equipped with sets of independent equipment, such as relay outputs and logic solvers. This implies that in some cases it is not necessary to use a second SCU cabinet. Depending on the configuration of the system it might be possible to fit the High Level or Overfill Alarm SCU equipment into the SCU Level Cabinet. The SCU cabinet is then equipped with independent SCU equipment together with the Supply and Communication Alarm panel (SCA). There can be one SCA each for the High Level and Overfill Alarm systems.



The system has a self checking function to ensure that correct indication and communication is carried out (see “Automated Self-Testing” on page 71).

The High Level and Overfill Alarm corresponds to the configured ullage limits (typically 95% and 98%) of tank volume for all types of cargo tanks.

The system is powered separately.

System Description



The alarm handling for High Level and Overfill Alarm systems includes activation of outputs for visible and audible deck alarm annunciators. The audible and visible alarms are accepted and silenced from the Supply and Communication Alarm panel (SCA). The alarm handling includes:

- High Level and/or Overfill Alarm
- Failure detection
- Sea mode function

Alarms are displayed on the SCA that is placed separately in the control room or on the Supply and Communication Unit (SCU). All alarms are accepted from the SCA.

To ensure system function at all time an automated extensive self-testing is continuously running in the background. The user is immediately alerted if a fault is detected. The failure detection includes sensor failure alarm, system failure alarm and power failure alarm. The Supply and Communication interface Box (SCB) has a failure relay that is activated in case of power or system failure. This relay is preferable connected to a supervising system.

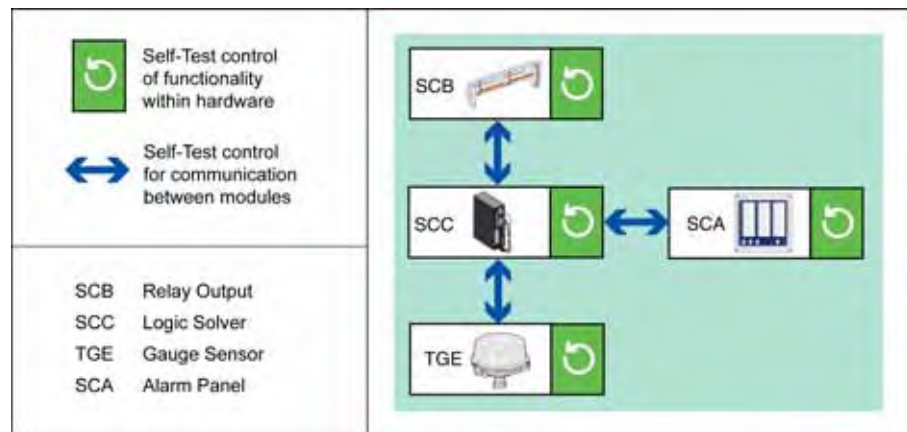
Sea Mode Function

A sea mode function for blocking alarms can prevent unnecessary level alarms when the vessel is sea going. The sea mode function only silences the level alarms, all other alarms, such as system failure, are announced if failure should occur.

Failure Detection

Automated Self-Testing

To ensure system function at all time the Rosemount TankRadar STaR High Level and Overfill Alarm systems contains an automated extensive self-testing function.



The automated extensive self-testing function consists of different test modes that continuously supervises the functionality within the hardware and the communication between the modules. Processes within the hardware such as the Tank Gauge Electronics (TGE), the Supply and Communication Computer (SCC), the Supply and Communication interface Box (SCB) and the Supply and Communication Alarm panel (SCA) are continuously checked for its current functionality. Should any of these processes be interrupted there will immediately be an indication on the SCA.

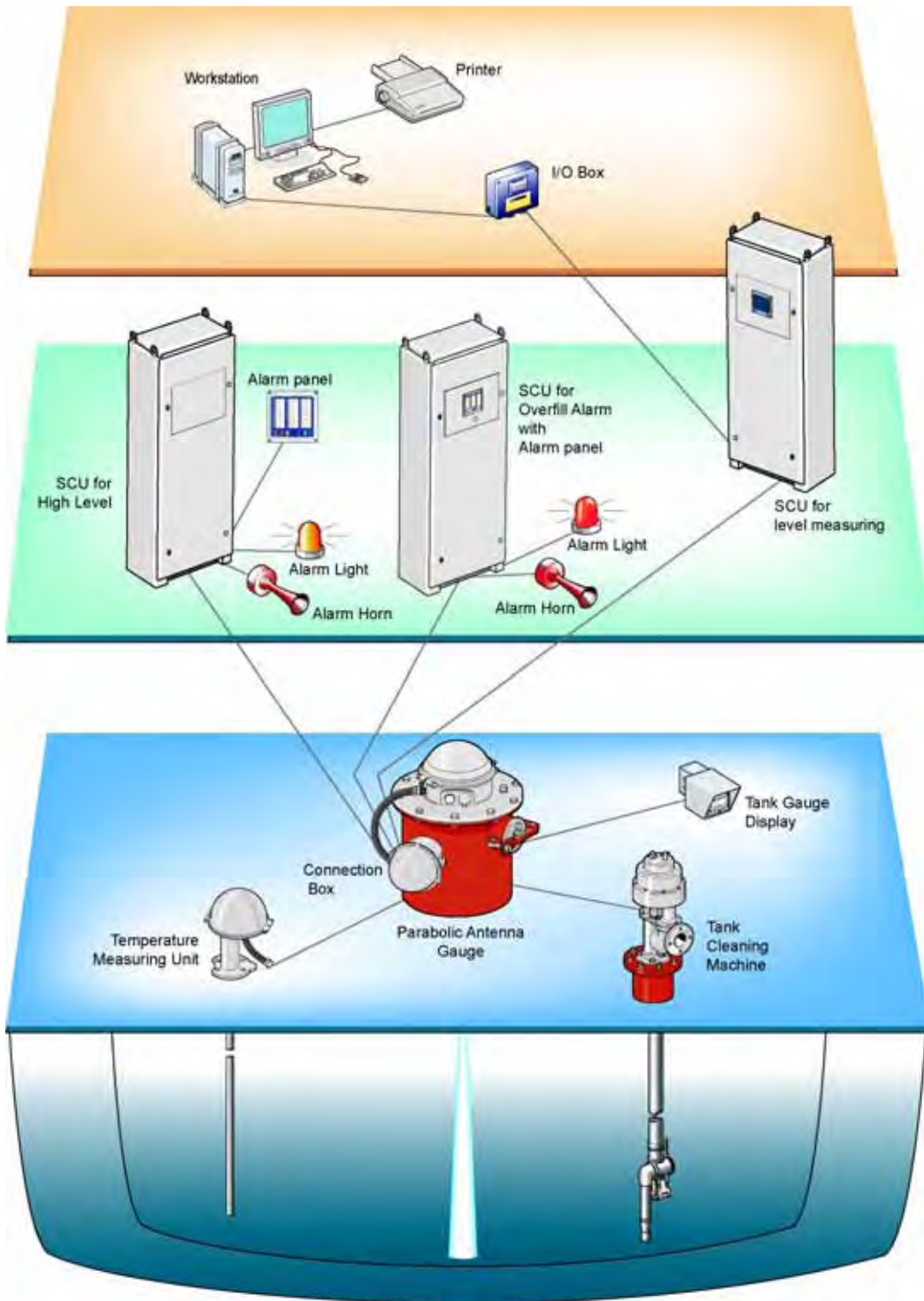
The communication between modules are continuously checked so that the data transferred is valid and consistent. Should invalid measurements or interrupted communication occur there will immediately be an indication on the SCA. These checks are performed at least once every second.

System Test

The Supply and Communication Alarm panel (SCA) has a System Test button to ensure proper function of the visible and audible alarms. Pressing this button will turn all the LEDs, buzzer, horn and flashlight on. To release the test mode press the button again. This test procedure is recommended to be done at least before each loading of cargo.

HIGH LEVEL AND OVERFILL ALARM SYSTEM

Failure Detection

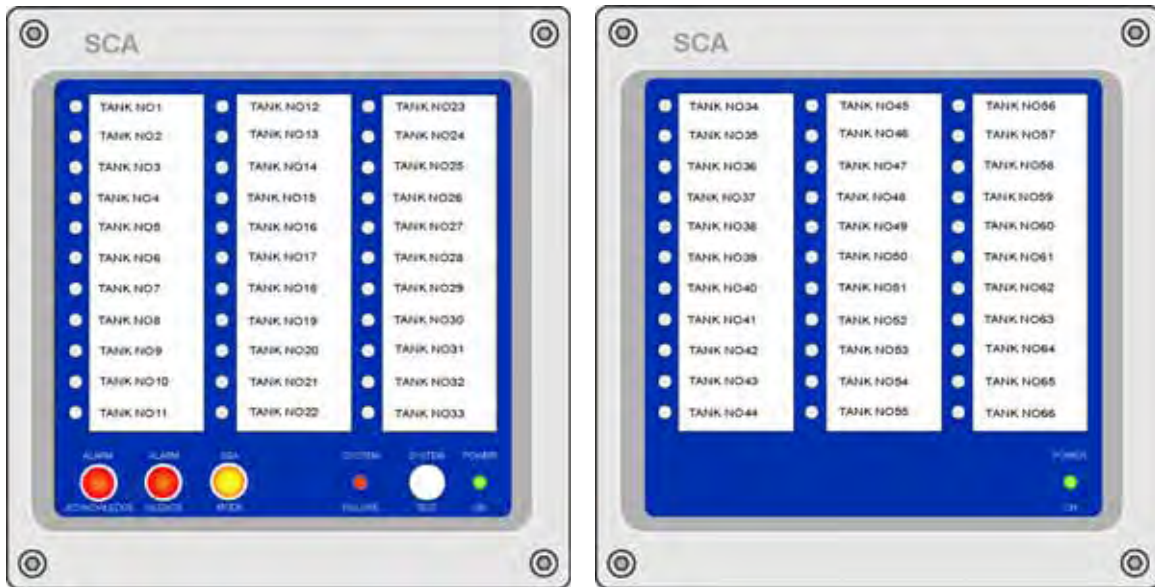


An example of a system configuration with level measurement, overfill alarm and High Level Alarm integrated in the TGU. The number of SCU cabinets depends on the system configuration.

Alarm system ed 05.fm

User Interface

Supply and Communication Alarm Panel



An example of an alarm panel for Overfill Alarm system with a slave panel (right).

The Supply and Communication Alarm panel (SCA) displays the High Level or Overfill Alarms independently of the level gauging system.

The SCA can be mounted on the Supply and Communication Unit (SCU) cabinet or elsewhere (e.g. the bridge).

The SCA features one LED indicator per Level Alarm channel that indicates when the level limit is exceeded in a tank. There are also indicators for common alarms. One slave panel can be added to double the number of individual channel indicators. Alarm indication is both visible and audible. Outputs for Alarm light and Alarm horn are available from the Supply and Communication Interface Box (SCB). The audible alarms can be silenced without accepting the alarm. The unaccepted alarms are indicated with a red flashing light. All alarms are monitored and accepted from the SCA. (For more information see the Operating Manual.)

Alarm Horn

Two types of alarm horns are used with the STaR system. One with high frequency for the high level alarm limit and one with low frequency for the overfill alarm limit. The recommended alarm horns are driven by compressed air for the best output.

Alarm Light

There are two types of alarm lights within the STaR system. One with red strobe light to indicate the overfill alarm limit and one with amber light to indicate the high level alarm limit.

Technical Specification

Master SCA

Dimension	149 x 155 mm
Power supply	24 VDC +30 to -25%
Signal interface	RS-485
Data rate	38.4 kb/s
Alarm Channels	33
LED indicators	33+5 (4 common,1 Power)
Buzzer	built in

Slave SCA

Dimension	149 x 155 mm
Power supply	from Master SCA
Alarm Channels	33
LED indicators	33 + 1 (1 Power)

OAH 5110, Alarm Horn

Frequency	400 Hz
Sound pressure level at 1m	120 to 135 dB
Working pressure	0.5 to 1.2 MPa
Weight	1.5 kg
Power Supply	24 VDC

OAH 5120, Alarm Horn

Frequency	800 Hz
Sound pressure level at 1m	>130 dB
Working pressure	0.5 to 1.2 MPa
Weight	2 kg
Power Supply	24 VDC

OAL 5110, Alarm Light

Color	amber
Sealing	IP56
Light Source	strobe light
Weight	1.3 Kg
Safety certification	EEx de II CT6
Power Supply	24 VDC

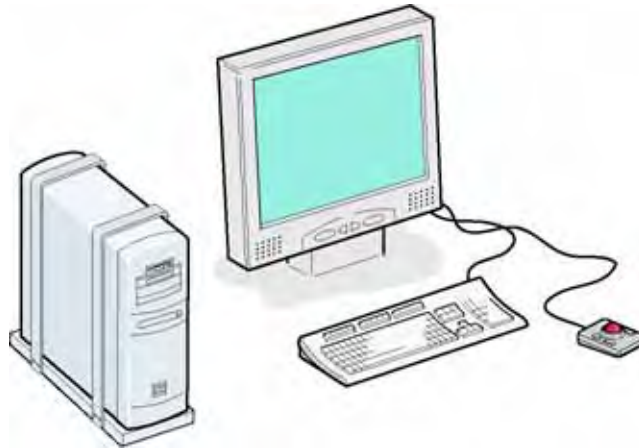
OAL 5120, Alarm Light

Color	red
Sealing	IP56
Light Source	strobe light
Weight	1.3 Kg
Safety certification	EEx de II CT6
Power Supply	24 VDC

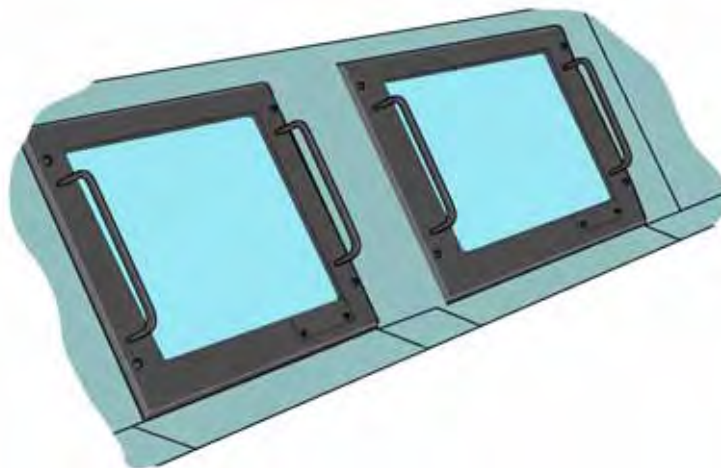
WSU, WORKSTATION UNIT

Describes the Workstation Computer
and Software

Description



The Workstation Unit (WSU) consists of the Workstation Computer (WSC) and the Workstation Monitor (WSM)



Two Workstation Monitors (WSM) mounted in a console

The Workstation Unit (WSU) consists of the Workstation Computer (WSC) and the Workstation Monitor (WSM). The WSU is used by the operator to monitor tank ullage, temperatures, tank pressures and all other data handled by Rosemount TankRadar STaR. It is also used during configuration of the system and for service purposes.

The WSU is designed for easy understanding and use. It features all-graphic presentation on a personal computer. There is an easy access to the frequently used screen views and alarm functions. An on-line Help-function provides direct access to on-screen help texts from the Operating Manual.

The WSU acts as a client and communicates with the Supply and Communication Computer (SCC) in the Supply and Communication Unit (SCU). The SCU is also used for configuration of the Workstation database.

WORKSTATION UNIT

Description

The WSU also communicates with other systems, such as a load calculator or a ship host computer system.

The WSU can be operated with a pointer device. For input of, for example alarm limits and text messages, a keyboard is included as standard.

The WSC and the WSM are marine class Type Approved hardware.



Example of a Cargo mimic.

Software Functions

The Rosemount TankRadar STaR provides a broad presentation of required information and historical trend parameters. Mimic diagrams including piping diagrams, symbols for controlled items and presentation of values in figures and bargraphs are available in the Workstation software. The information can be presented in customized text groups as well as interactive graphic.

Depending on the system configuration the following functions are available:

- Presentation of information including:
 - cargo/slop ullages, temperatures and tank pressures
 - loading and discharge rate (m/h) per tank
 - ballast, fuel oil and fresh water tank levels
 - Ship's draft measurement
 - trim and list indication from measured drafts
 - Volume and weight (as calculated by online Load Calculator)
 - indication of fixed and adjustable alarms (Hi Hi, Hi, Lo and Lo Lo for all process values)
 - Trends
- Automatic trim and list compensation of ullages
- Control of pumps, valves and other items
- Alarm handling by Workstation for controlled items and measured values
- Cargo labels
- Logging
- Notepad
- Help
- Printed reports
- Communication with external units
- Protection against unauthorized use

Technical Specification

WSU, Workstation Unit

Computer	Type approved PC
Monitor Rosemount TankRadar STaR	19" TFT monitor.
Pointer device	Mouse and/or trackball.
Operating system	Real time operating system QNX.
Power supply	115 VAC +10/-15%, 47-63 Hz or 230 VAC +10/ -15%, 47-63 Hz
Power consumption	Max 300 VA
Connection of associated equipment	Via I/O box to Supply and Communication Unit.
Dimension (including mounting kit): WSC	185 x 495 x 450 mm (PC)
WSM	430 x 410 x 193 mm (19" monitor). (Width x Height x Depth)
Weight (PC with installation kit)	18 kg
Screen update time	Max 2 seconds

WSP, WORKSTATION PRINTER



Two alternative printers that can be connected to the Workstation Unit. The laser printer (left) and the dot matrix printer (right)

A printer (WSP) can be supplied with the Rosemount TankRadar STaR system for printing reports and logs of alarms and warnings.

Alarm logs are useful for keeping track of alarms or warnings. The Printer prints one row for each alarm with the following information:

- Date and time for the alarm as well as the time when the alarm went out.
- Alarm parameter
- Alarm value
- Alarm limit value
- Unit of measurement

Information groups can also be created and printed. The information can either be printed at your command or it can be automatically printed at certain intervals, for example each week or month.

One printer alternative is the dot matrix type. It is suitable for alarm logs since it prints one row at a time in a continuous process.

Another printer alternative is the laser type. This printer is suitable for printing screen copies or reports.

Technical Specification

WSP

Dot Matrix Printer

Dimensions	430 x 140 x 312 mm (Width x Height x Depth)
Weight	5.2 kg
Power supply	115 VAC +10 to -15%, 47-63 Hz or 230 VAC +10 to -15%, 47-63 Hz
Power consumption	15 W
Connection	Parallel port on Workstation Unit

Laser Printer

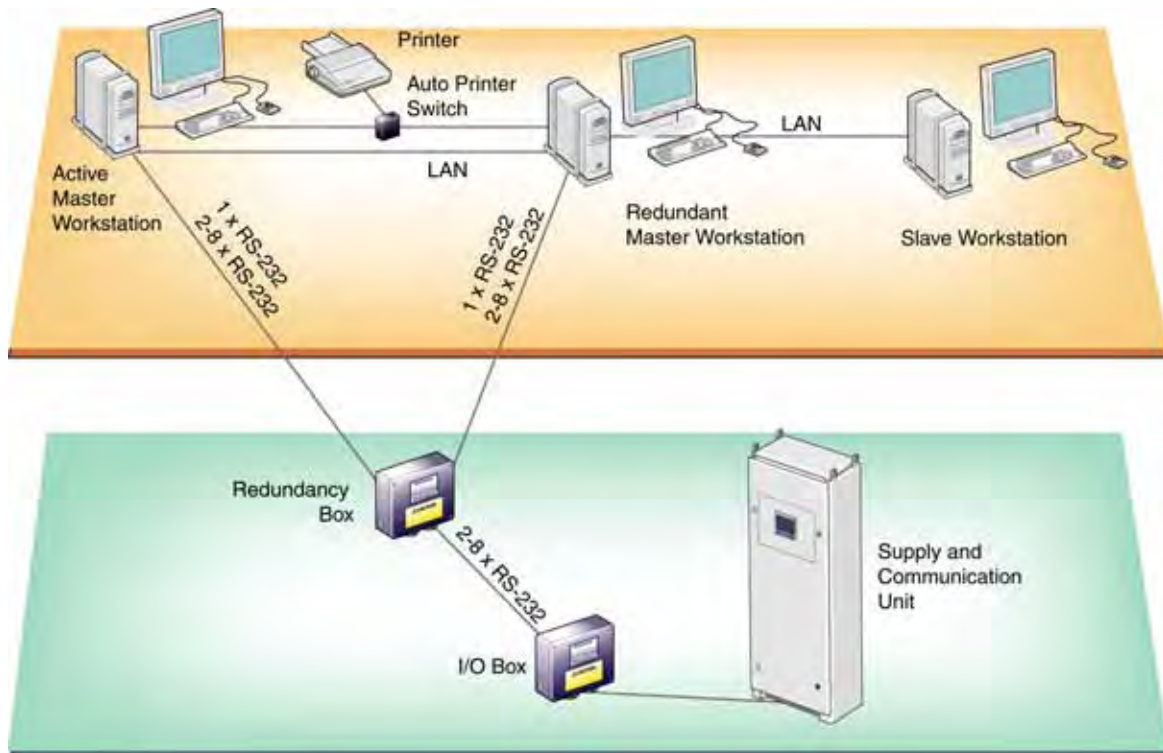
Contact Emerson Process Management Marine Solutions for data sheet.

WORKSTATION REDUNDANCY

Information on Workstation
Redundancy Option

Redundancy WSU ed 03.fm

REDUNDANCY



*An example of a Workstation redundant system.
If the Master Workstation fails, the Redundant Master Workstation becomes the active master.*

Description

A redundant Workstation system can be established with two Workstations in a network. They are configured as masters and connected to a Redundancy Switch Box in the system. One of the Workstations is the active master with the control over the Redundancy Switch Box. If the master Workstation fails the redundant Workstation will detect this and become the active master. The Redundancy Switch Box will then switch the control to the active master.

In order to become the active master the redundant master has to restart its software. It takes about 1 minute after the active master Workstation fails, until the redundant master Workstation controls the system.

The redundant master Workstation works like any slave Workstation until it detects that the active master has failed.



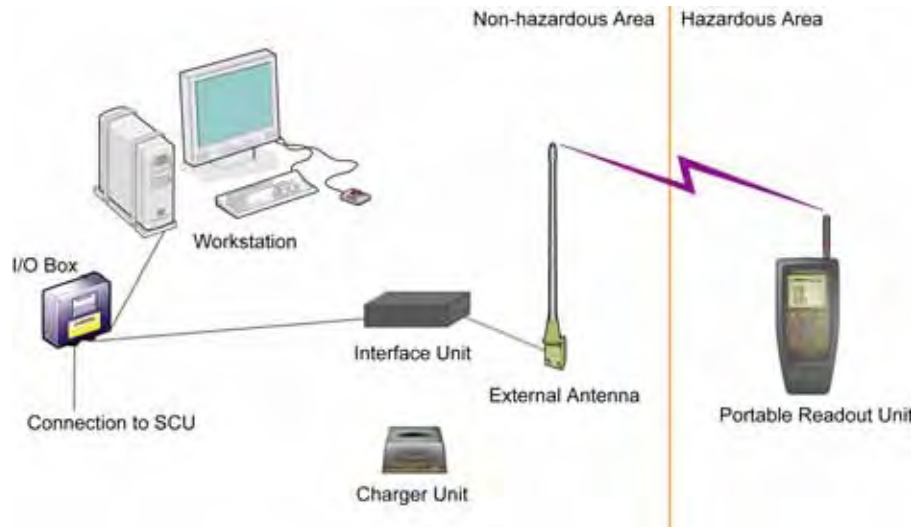
The Redundancy Switch Box.

Technical Specification

Redundancy Switch Box

Dimensions	280 x 230 x 110 mm (Width x Height x Depth)
Weight	5 kg
Connection to Workstation	RS-232 max 3 m Cables supplied by Emerson Process Management Marine Solutions.
Power supply	115 VAC +10% to -15%, 47-63 Hz or 230 VAC +10% to -15%, 47-63 Hz
Power consumption	Max 15 VA
Sealing	IP22

PRS, PORTABLE READOUT SYSTEM



The Portable Readout System allows the crew within radio coverage to monitor the contents in the tanks during loading and discharging of the cargo. The system consists of a number of Portable Readout Units (PRU) and an Interface Unit mounted on the bridge or in the Cargo Control Room. The system is wireless using a free frequency band, which does not disturb or can be disturbed by other electronic devices such as walkie-talkies and radars.

The Portable Readout Unit shows tank group and number, ullage for cargo tanks, innage for ballast and miscellaneous tanks, average liquid temperature, vapor pressure and alarms on the PRU display. The alarms are indicated with a buzzer, and the tank name with the text ALARM is shown on the display. When the PRU is not in use it should be placed in the Charger Unit for recharging.

The Workstation communicates with the PRU using the Interface Unit connected to an I/O Box. The information to the system from the Workstation is automatically updated.

As the Portable Readout Unit is intrinsically safe it can be used anywhere onboard. The Interface Unit and Charger Unit must however be mounted in a nonhazardous area.

Technical Specification

PRU, Portable Readout Unit

Number of units	Minimum 2 (one to be kept in the Charger Unit)
Dimensions	120x80x45 mm (WidthxHeightxDepth)
Weight	0.2 kg
Ambient temperature	-20 to 55 °C
Power Supply	Rechargeable battery via Charger Unit. No other charger/power must be used.
Use time (after charging)	Up to 6 hours
Battery life	Up to 10 years / 1000 charging cycles
LCD Display	Graphic w/backlight Updated 2 times per minute
Light Emitting Diodes	Red for Alarm Yellow for Battery Low
Antenna	Integrated
Sealing	IP65
Explosion Protection	Intrinsically safe EEx ib IIC T3
Frequency band	433.050 to 434.790 MHz 64 channels software selected
RF Power	Maximum 10mW

Charger Unit

Dimension	100x100x60 mm (WidthxHeightxDepth)
Weight	0.5 kg
Ambient temperature	-20 to 55 °C
Light Emitting Diodes	Red for Charging Yellow for Power On Green for Charge done
Sealing	IP22

Interface Unit

Dimensions	136x296x95 mm (WidthxHeightxDepth)
Weight	1.5 kg
Ambient temperature	-20 to 55 °C
Antenna	Full-wave, externally mounted
Contact Outputs	Power failure
Communication type	RS-232 and RS-485
Communication protocol	TankRadar Modbus protocol
Sealing	IP22

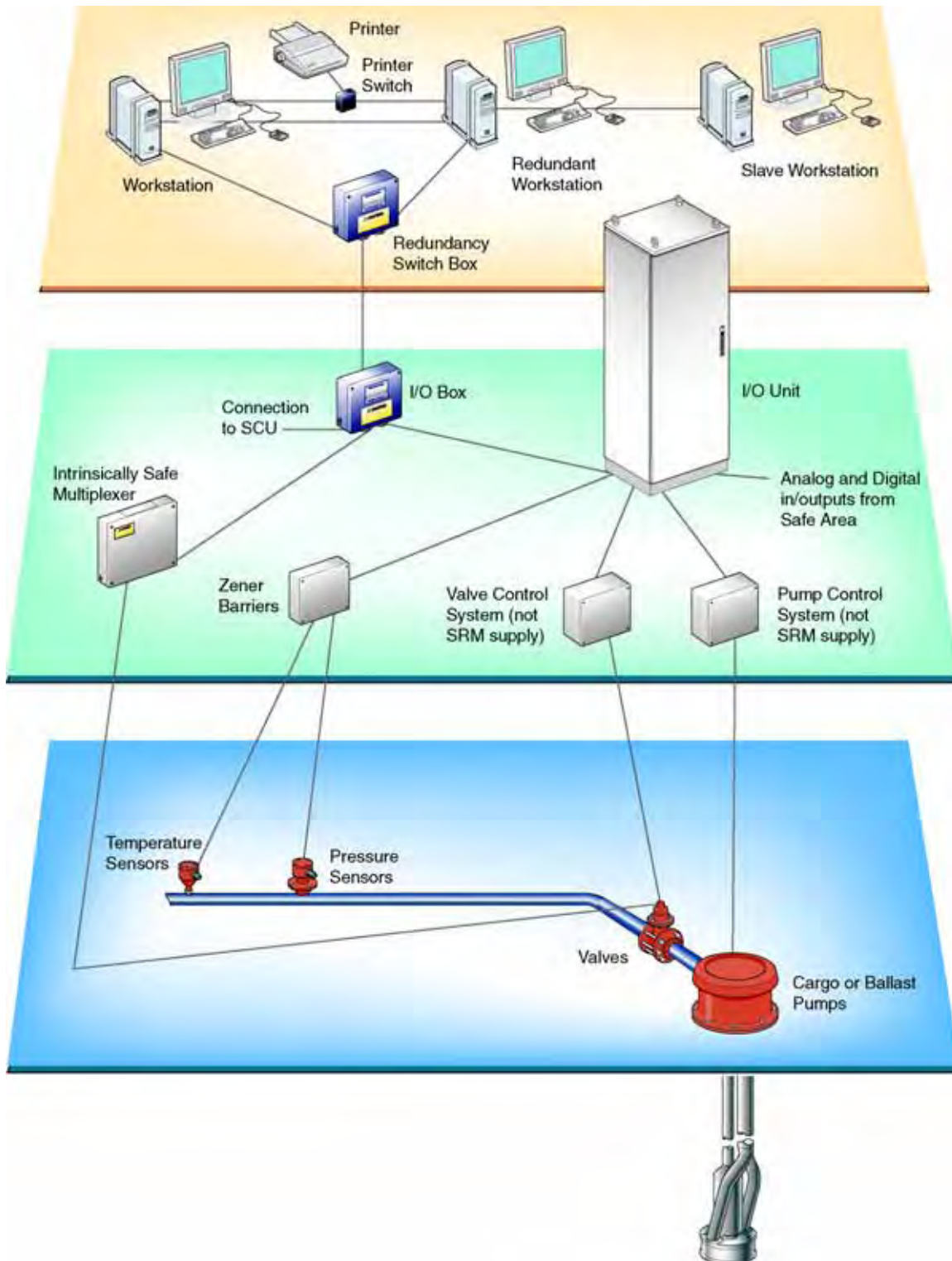
Power Supply for Interface Unit and Charger Unit

Weight	0.165 kg
Input voltage	90 to 264 VAC
Output voltage	24 VDC

Cargo and Ballast Control

Information on the Cargo and Ballast Control
in Rosemount TankRadar STaR

CARGO AND BALLAST CONTROL



Mac ed 03.fm

An example of a system configuration for Cargo and Ballast Control.

Description

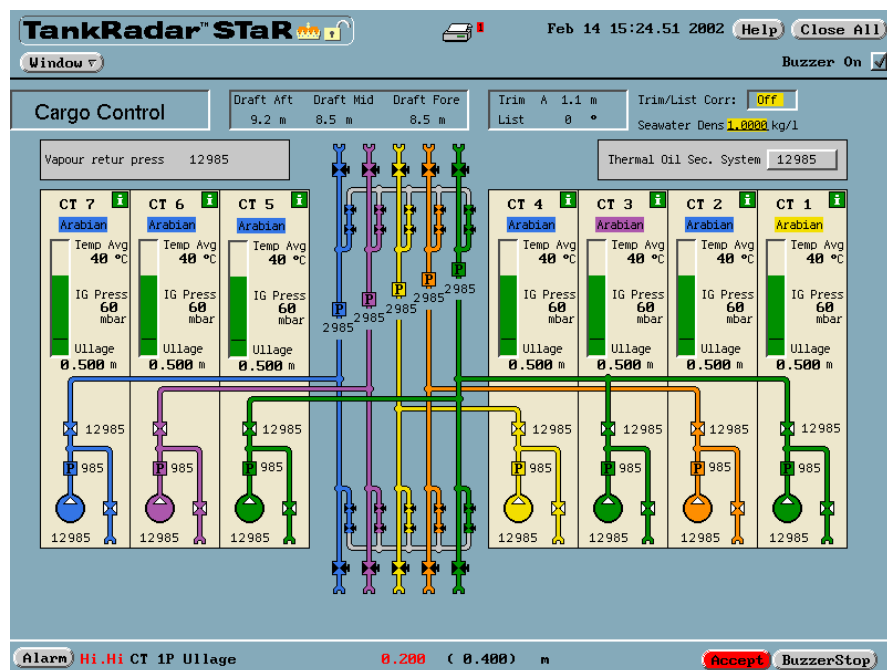
The Cargo and Ballast Control is the integrated cargo control function of Rosemount TankRadar STaR. This function provides complete overview and control of the loading and discharging of tanks. Pumps, valves and other equipment are easily controlled from the Workstation. Several tanks can be loaded/discharged at a time as well as topped up quickly and with full confidence.

Signals from devices such as valve positions, pressure sensors and temperature sensors are handled by the I/O Unit (IOU). The signals are processed and sent to the Workstation Unit for presentation. The operator can control on/off switches, pumps and valves from the Workstation that communicates with the IOU.

A number of Workstation Units can be placed in a network at various locations onboard. Redundancy can be achieved by connecting an optional Redundancy Switch Box.

The software is designed with standard symbols and layout giving the user a fast and easy interaction of all the required functions included in the Cargo and Ballast Control.

The system includes feedback signals, self test functions and alarms in case values are not within limits or if anything is abnormal in the system.



Example of a Cargo and Ballast Control mimic.

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I/O Unit

The I/O Units (IOU) contains electronics and wire terminals for input signals as well as control signals. The main function of the IOU is to handle the signals between the Workstation and the connected control equipment.

Each IOU can handle input/output signals to and from:

- Valves and pumps (actuators and feedbacks)
- Temperature and pressure sensors
- On/Off switches
- Workstation
- Other types of sensors and equipment

All communication with the Workstation and the IOU is transmitted over one or more high speed RS-485 data links.

4-20 mA feedback signals from sensors in hazardous areas pass through conventional zener barriers. Potentiometer or digital signals pass through the Intrinsically Safe Multiplexer (IOU 5410), which can handle up to 15 intrinsically safe signals. The IOU 5410 is a stand-alone box.

The IOU can contain the following I/O Terminals:

- IOT 5110, Analog In
- IOT 5120 Analog Out
- IOT 5130, Digital In
- IOT 5140, Digital Out
- IOT 5150, Multiplexer

The IOU cabinets come in different sizes depending on the number of I/O Terminals in the system.



Examples of IOU5310 (above) and IOU 5410 (below) (Intrinsically Safe Multiplexer).



Technical Specification

I/O Unit Cabinets

General

AC Mains supply	115 V or 230 V \pm 10% 50 or 60 Hz
External DC supply	24 V
Ambient Operating Temperature	0 to 55 °C
Painting	RAL 7032
Sealing	IP22

IOU 5110 Cabinet A

Dimensions	480 x 360 x 151 mm (Width x Height x Depth)
Weight	10 kg

IOU 5110 Cabinet B

Dimensions	360 x 240 x 151 mm (Width x Height x Depth)
Weight	5 kg

IOU 5310 Cabinet

Dimensions	620 x 1962 x 520 mm (Width x Height x Depth)
Weight	180 kg

IOU 5410 Cabinet (for IOT 5150 only)

Dimensions	480 x 360 x 151 mm (Width x Height x Depth)
Weight	10 kg
Power Supply	24 VDC only

I/O Terminals**General**

Supply Voltage	24 VDC
Ambient operating temperature	0 to 55 °C
Communication Type	RS-485
Isolation	Optocoupled (in I/O Box)
Mounting Method	DIN rail (35 mm) clip
Communication Speed	115 kb/s

IOT 5110, analog in

Channels	16 single ended
Input Load	50 Ω (curr.), 10 kΩ (voltage)
Accuracy (current)	Max ±0.5% of full range
Temp Drift (current)	Accuracy valid for 0 to 55 °C
Accuracy (voltage)	Max ±0.5% of full range
Temp Drift (voltage)	Accuracy valid for 0 to 55 °C
Dimensions	160 x 100 x 80 mm (Width x Height x Depth)
Power Consumption	8.5 W
Signal input	0(4)-20 mA 0-10 V

IOT 5120 analog out

Channels	16 single ended
Load Impedance	50 Ω / max 500 Ω
Load Current	<5 mA for 0-10 VDC
Accuracy (current)	Max $\pm 0.5\%$ of full range
Temp Drift (current)	Accuracy valid for 0 to 55 $^{\circ}\text{C}$
Accuracy (voltage)	Max $\pm 0.2\%$ of full range
Temp Drift (voltage)	Accuracy valid for 0 to 55 $^{\circ}\text{C}$
Dimensions	160 x 100 x 80 mm (Width x Height x Depth)
Power Consumption	7 W
Signal output	0(4)-20 mA 0-10 V

IOT 5130, digital in

Channels	16 negative common
Voltage Range Input	0 to 35 VDC
Source Type	Potential free contact
Input Current	Max 0.6 mA
Dimensions	160 x 100 x 80 mm (Width x Height x Depth)
Power Consumption	1 W

IOT 5140, digital out

Channels	8 pot free Single Pole Double Throw (SPDT)
Capacity	Max 250 VAC, 2A
Dimensions	160 x 100 x 80 mm (Width x Height x Depth)
Power Consumption	1 W

IOT 5150, intrinsically safe multiplexer

Channels	15
Input Types	For 3-wire potentiometer
Resistance Range	1 k Ω to 10 k Ω
Limit Detection	0 Ω and ∞ (short/open)
Accuracy	Max $\pm 2\%$ of full range, typically $< 1\%$
Explosion Protection	Intrinsically safe [EEx ia] IIC
Dimensions	160 x 280 mm

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