Technical Information
Ti 013G/03/ae

Proservo NMS 53x series

Intelligent tank gauge with high accuracy performance






Applications

The Proservo NMS 53x series of intelligent tank gauges is designed for high accuracy liquid level measurement in storage and process applications.
It fulfills the exacting demands of tank inventory management, loss control, total cost saving and safe operation.
Typical areas of application include:

- Oil (fuels)
- LPG/LNG
- Chemicals
- Water / chemical interface measurement
- Liquid food

Tank mounted intelligence makes the Proservo NMS 53x series ideal for single or multi-task installations converting a wide range of measurement functions including:

- Liquid level
- Interface level
- Density

Features

- Measures liquid to an accuracy of +/- 0.03" (0.7 mm)
- Measures two clear interface levels and specific gravity of up to three liquid phases
- Latest microtechnology keeps the design simple, lightweight and compact
- Weted parts are completely separate from the electronic circuit
- Tank top mounting with 3" (76 mm) flange weighing only 26 lbs (12 kg) (aluminum version)
- Wide range of output signals including RS 485 and HART® protocol
- Material and pressure rating of the weted parts can be selected according to the application
- Suitable for atmospheric and high pressure application up to 363 psi (2500 kPa)
- Maintenance prediction of the instrument
- Direct connection of spot or average temperature probes
- Easy to program using the Endress+Hauser matrix system
- Robust IP 67 housing
- Built-in calibration window

Online
www.systems.endress.com

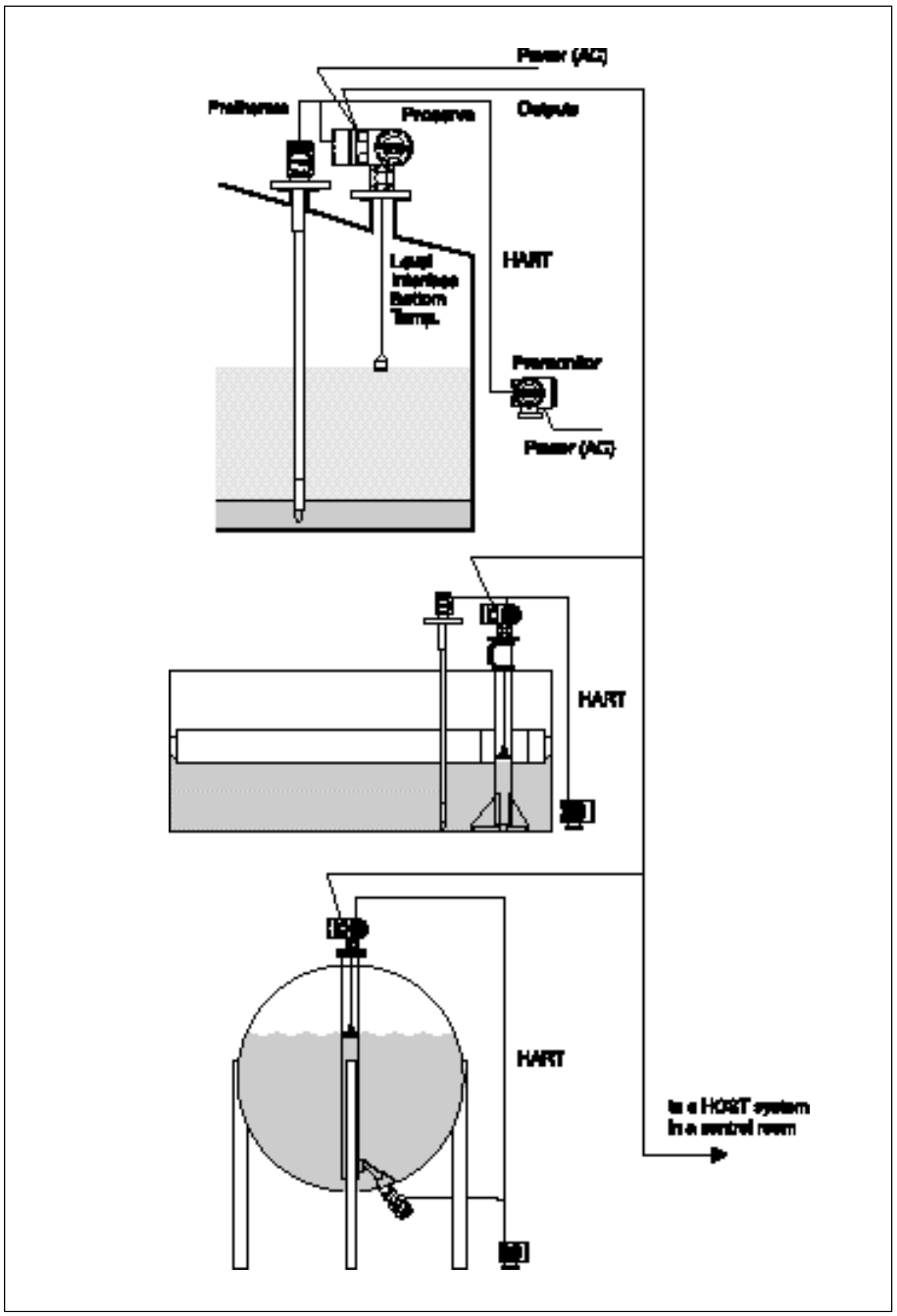
Endress+Hauser
Systems & Gauging

Measuring System

Proservo NMS 53x is an intelligent tank gauge for high accuracy liquid level measurement employing the latest microtechnology. As well as level measurement, Proservo NMS 53x can determine the interfaces between three liquids, specific gravity of these liquids and tank bottom. To enable accurate volume calculation or simply for indication, Proservo NMS 53x will accept an input from either an average temperature element NMT 535/6 series [via two core cables using HART® protocol or via one spot temperature element (Pt 100)].

Once installed, all calibration and operating functions can be made via the user friendly Matrix program and touch sensitive keypad. Tank-side monitoring and operation can be performed by the Promonitor NRF 560.

Possible system configurations



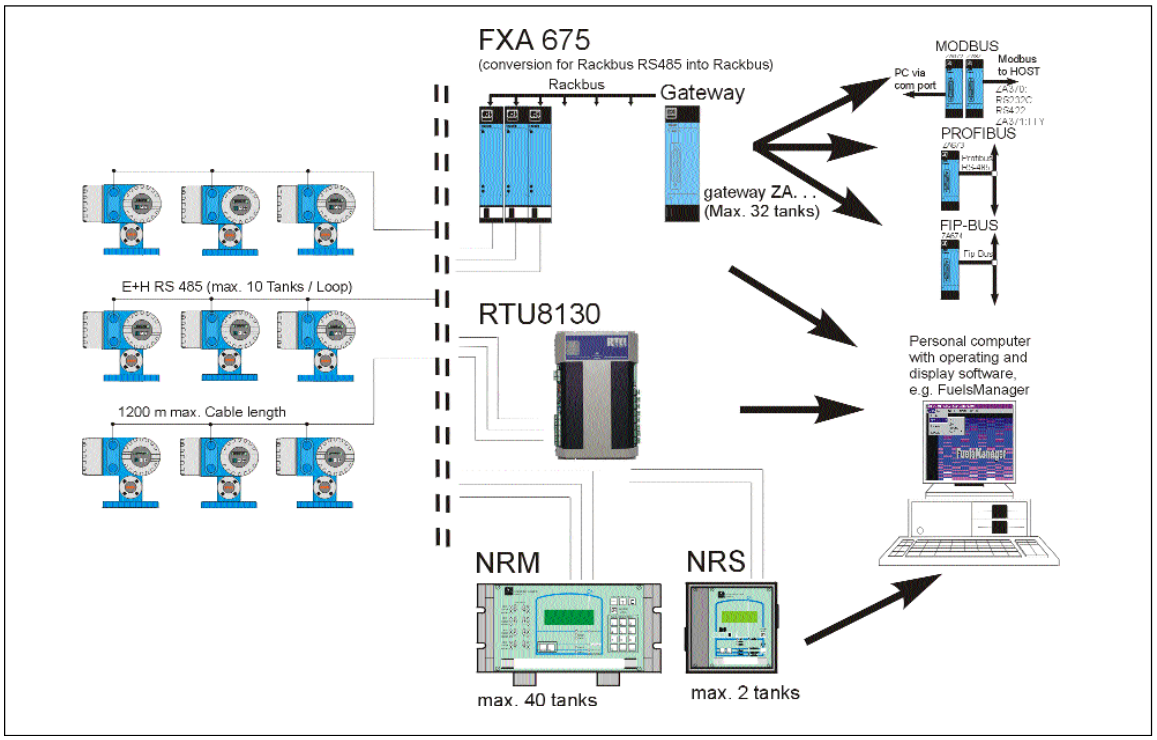
System Configuration

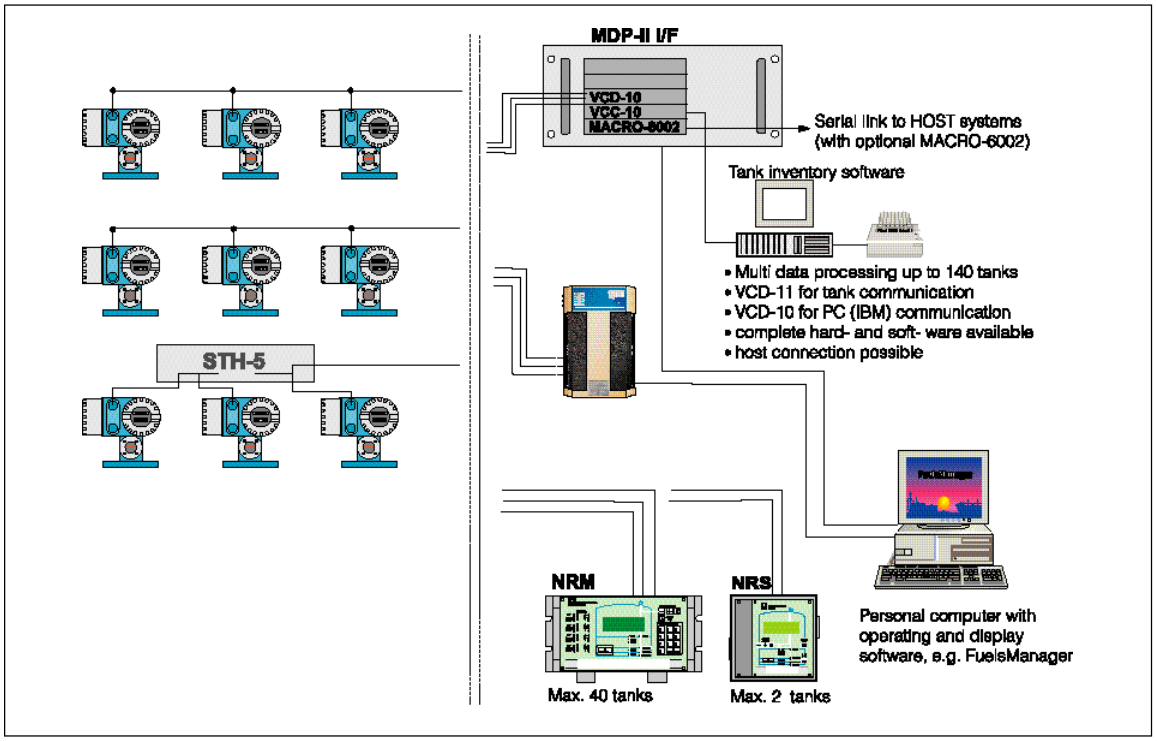
The versatility of Proservo NMS 53x allows the gauge to be effectively applied to tank applications as well as to small or large tank farms.

By using the RS 485 output, a maximum 4000 ft (1200 m) long bus link can be made allowing all RACKBUS RS 485 compatible instrumentation to be connected to either a personal computer or interface unit. For larger transmission distances of up to 20000 ft (6000 m), Proservo NMS 53x can be provided with a serial bus output.

Control room interrogation and operation are facilitated by the dual channel NRS 571 or the 40-channel NRM 571. Both units supply the necessary information for tank inventory control and can be used to provide an Endress+Hauser RACKBUS or RS 232C output to a personal or host computer. 19" (483 mm) rack or panel mounted options are available.

Possible system configurations





Major Application

The number of measuring functions and output options as well as the lightweight compact design enables Proservo NMS 53x to be installed in a wide range of applications at minimal cost.

Petroleum Industry
From the production of oil through to storage at an oil depot, there is a need to measure and manage a wide variety of products. A remote tank gauging and inventory management system combined with Proservo NMS 53x and a receiving computer is an ideal way to measure and control the contents of the tanks.

Chemical Industry
For this industry, a wide choice of materials is available for the construction of the weted parts, to ensure chemical compatibility and long life.

Food Industry
In the brewing and beverage industries, where large volumes of water or water-based products are being handled, it is essential to obtain a precise level measurement to establish low cost production. Proservo NMS 53x can be supplied with a built in CIP nozzle if required.

Power Plant
Fuel, oil and boiler water levels are major applications where precise measurement is required to ensure safe operation.

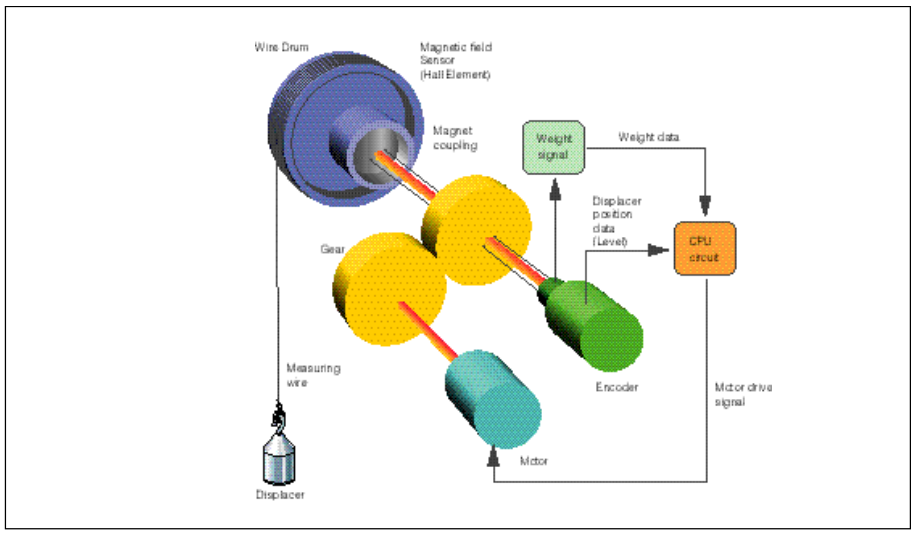
Operating Principle

The Proservo NMS 53x tank gauging system is based on the principle of displacement measurement.

A small displacer is accurately positioned in the liquid medium using a servo motor. The displacer is suspended on a measuring wire which is wound onto a finely grooved drum housed within the instrument.

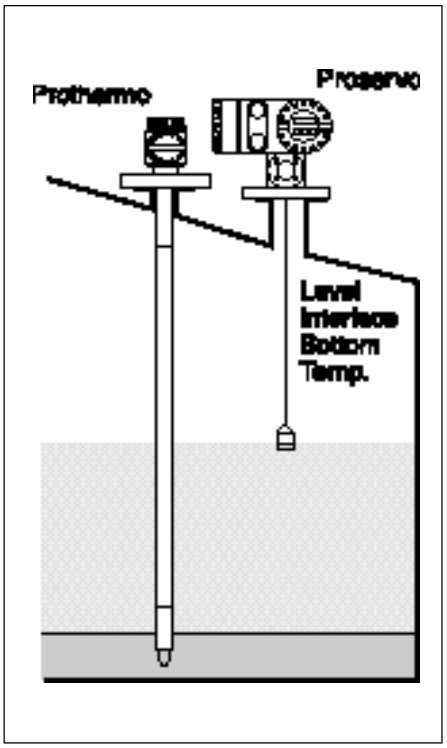
The drum is driven via coupling magnets which are completely separated by the drum housing. Outer magnets are connected to the wire drum while the inner magnets are connected to the drive motor. As the magnets turn, its magnetic attraction causes the outer magnets to turn as well, thus turning the entire drum assembly. The weight of the displacer on the wire creates torque on the outer magnets generating the change of magnetic flux. These changes generated between the drum assembly are detected by a unique electromagnetic transducer on the inner magnet. The drive motor is actuated to balance the voltage generated by the variations of magnetic flux to equal the reference voltage defined by the operating command.

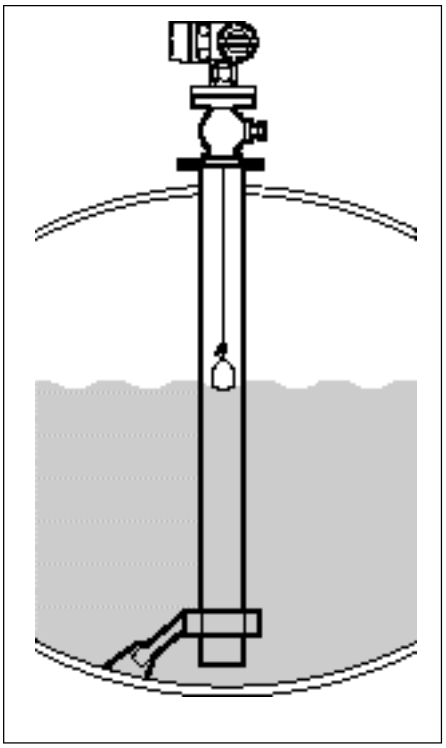
When the displacer is lowered and it touches the liquid, the weight of the displacer is reduced because of the buoyant force of the liquid. As a result, the torque in the magnetic coupling is changed and this change is measured by two Hall detector (US patent) chips which are temperature compensated. The signal, an indication of the position of the displacer, is sent to the motor control circuit. As the liquid level rises and falls, the position of the displacer is adjusted by the drive motor. The rotation of the wire drum is precisely evaluated to determine the level value which is accurate to an outstanding +/- 0.03” (0.7 mm).



Direct Torque Detection

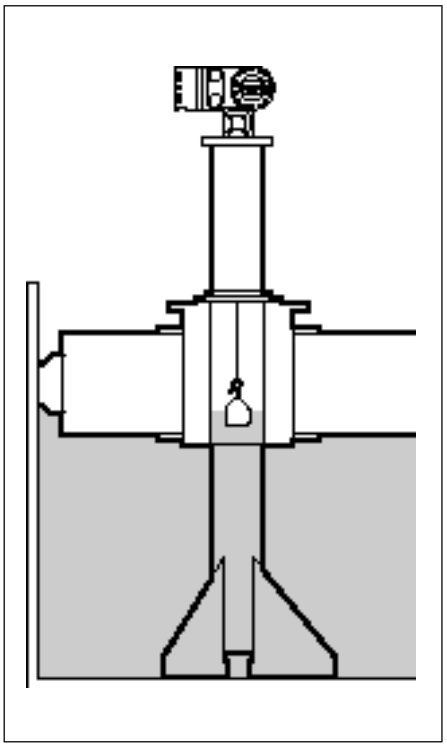
Installation

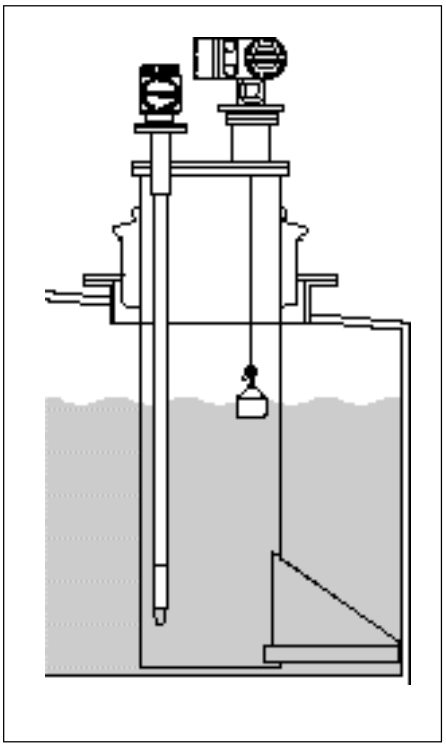




Left:
Fixed roof tank without guiding system

Right:
High pressure tank with stilling well and ball valve



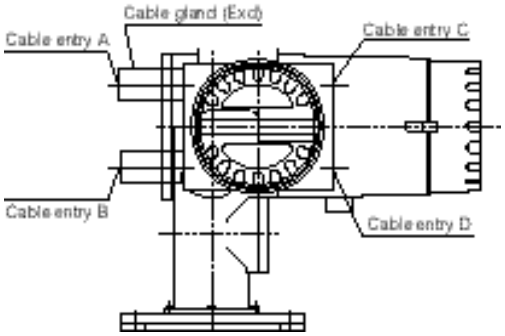


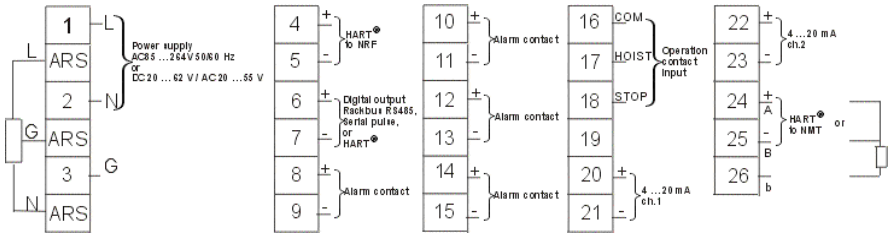
Left:
Floating roof tank and/or covered floating roof tank

Right:
Stilling well application; Proservo NMS 53x and Prothermo NMT 535/6 in the same stilling well

Electrical

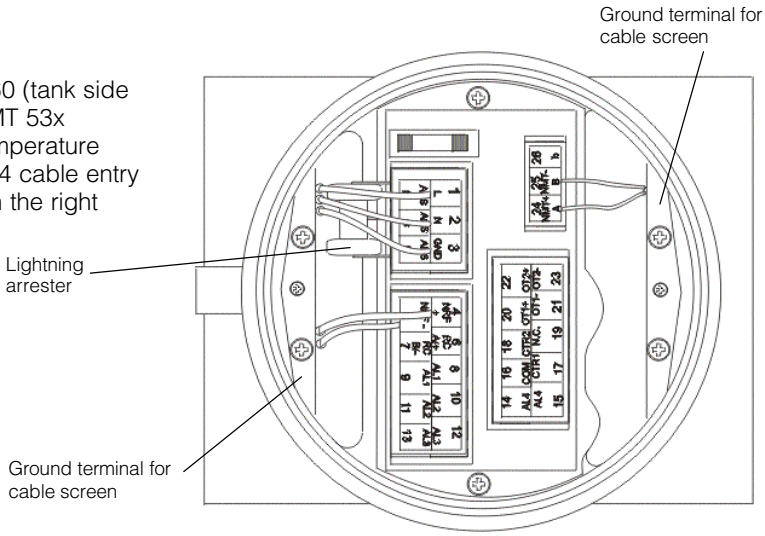
The cable being used for HART® and/or RS 485 transmission must be those specified accordingly



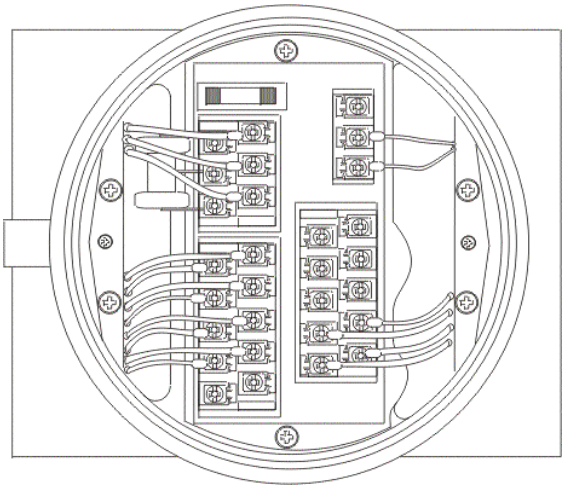


Note!
Terminal connection for Whessoe Matic 550 (WM550), please refer to specification drawing!

With NRF 560 (tank side monitor), NMT 53x (average temperature probe), use 4 cable entry as shown on the right



In reference to NRF 560, NMT 53x, digital output, contact output and analogue output, use 4 cable entry as shown on the right



Electrical connections of the Proservo NMS 53x

Bus Installation

The initial bus voltage is provided by the PC plug-in board or the interface adapter. If an adapter is being used, then the bus plug must be configured accordingly.

Termination Resistors
Termination resistors must be present on both ends of the measuring circuit (i.e. at the PC plug-in board and at the last transmitter on the bus link). The PC RS 485 plug-in board is delivered in a ready-to-use condition. When using the interface adapter, the plug must be configured. If the last transmitter on the bus link has no switch for adjusting a termination resistor then a 150 ohm resistor must be soldered between Terminal A and B. All other transmitters retain standard settings.

Bus Address
Each transmitter has an individual bus address. Depending on the type of transmitter, this is either defined by the address switches or by the software of the transmitter itself.

Linking to a Personal Computer
A personal computer is connected using either a RS 485 PC board or an RS 232C/RS 485 external converter (both with electrical isolation).

Bus Cabling
The bus cabling is galvanically isolated from the transmitter and from the PC plug-in board or the interface adapter. The screening must be grounded and have electrical continuity throughout. EMC tests indicate that grounding at both ends and at each transmitter allows the best results. If there is a difference in potential between the grounds, measures must be taken to equalize while observing a relevant hazardous area.

Bus Topology
When planning the system, attention should be paid to the possible segmentation of the bus according to individual plant sections. Suitable topologies are:

- Serial, max. 4000 ft (1200 m)
- Tree of total length 4000 ft (1200 m)

The bus screening is to be connected at various points.

RS 485 PC Board
The board is configured for use as a COM 3 interface port. Also supplied for the bus connection is a 25-pin plug with screw terminals:
Terminal 1: Bus screening

Terminal 17: Data A (RxD/TxD-P)

Terminal 16: Data B (RxD/TxD-N)

Proservo NMS 53x can be configured by Filechanger software from PC.

RS 232C/RS 485 Converter
The bus connector is supplied with a 9-pin plug with screw terminals.

Bus Installation (Serial Pulse Output)

The bus is connected to an MDP-II interface or to a receiver. The interface or receiver must be configured accordingly.

Termination Resistors
It is not necessary to set any termination resistors for serial pulse output.

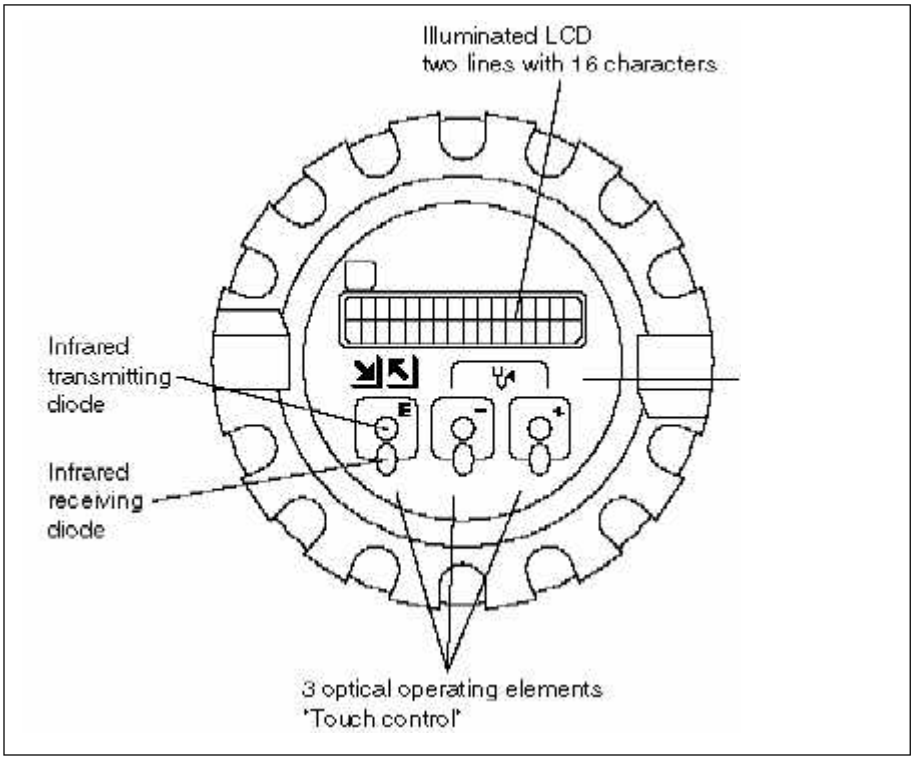
Bus Address
Each transmitter on a signal loop has an individual bus address. This is defined within the transmitter software.

Bus Cabling
The bus cabling is electrically isolated from the transmitter and from the interface receiver. Standard communication cable can be used for the data transmission.

Bus Topology
The suitable topologies for the serial pulse output are:

- Serial max. 20000 ft (6000 m)
- Tree of total length 20000 ft (6000 m)

Operation



Proservo NMS 53x is furnished with a two line illuminated liquid crystal display. With the Endress+Hauser matrix driven operation, configuration is simple. Using only three keypads, all parameters can be selected and modified. For example:

- Operation - level; interface; specific gravity tank bottom
- Current output
- Relay output
- Custody transfer
- Maintenance prediction
- Calibration, etc.

The display can be configured to be read in either English or Japanese. Help functions are available during programming to ensure trouble-free calibration and operation.

Operational Security
The programming information can be protected by software access codes that disable all programmable parameters or by a hardware switch to prevent changes from remote transmission or the touch control keypad. A self diagnosis function checks for any operational failures.

Advanced Maintenance

Maintenance Prediction
Proservo NMS 53x will provide advance warning of maintenance requirements such as replacement of worn wire etc. The operating lifespan of electrical and mechanical parts of the Proservo NMS 53x are factory set within the instrument's memory. This information is checked against the built-in clock and compared and registered in the instrument.

Automatic Displacer Weight Compensation
The displacer can be checked for build-up or corrosion by comparing the measured weight of the displacer in air with the pre-programmed displacer weight. Proservo NMS 53x can be set to periodically check the displacer weight, and any deviations in the weight will then be corrected and an alarm or memo initiated.

Automatic Compensation of Wire Length
When the displacer is moved from the level position to the reference point (mechanical stop within the instrument), the calibration can be checked. If there is any deviation outside the tolerance, then the instrument will sound an alarm. If the deviation is within the tolerance (set by the customer), then an automatic recalibration is done. This function can be working manually or automatically in preset time intervals.

Maintenance Record
The maintenance record can be accessed via the matrix and will provide alarm data information (e.g. date, time, alarm type). A memo function allows the user an Endress+Hauser Service Engineer to enter maintenance data manually.

Technical Data

General Specification

Manufacturer	Endress+Hauser Systems & Gauging, Inc.
Designation	Proservo NMS 531/2/4/5/6
Function	Level, interface level, density, tank bottom measurement

Input Characteristics

Input for local devices

Signal	Multi drop local HART® protocol max. 4 devices
Power supply	DC 24 V
Additional units	NMT 535/6/7 average temperature sensor NRF 560 field data processor Others – compatible HART® devices Spot temperature Pt 100 Ohm ISO standard three wire connection

Output Characteristics

RACKBUS RS485

No. of units	Maximum 10 instruments per loop
Baud rate	19,200 bit/s, fixed
Cable	Two wire, twisted cable with screening (DGND is connected to the ground cable)
Topology	Serial bus, electrically isolated, tree structure
Transmission distance	Max. 4000 ft (1200 m) including limbs or branches [negligible with branches under 10 ft (3 m)]
Instrument address	Accessed via touch control
Isolation	Bus inputs are electrically isolated from the other electronics

Bidirectional serial pulse

No. of units	Maximum 10 instruments per loop
Baud rate	3,300 bps
Cable	Two wire (twisted pair) unscreened cable
Topology	Serial bus, tree structure
Transmission distance	Max. 20000 ft (6000 m) max.
Instrument address	Accessed via touch control
Isolation	Serial pulse circuit isolated from other circuits

HART® protocol

No. of units	Maximum 15 instruments per loop
Baud rate	1,200 BPS
Cable	Two wire, twisted pair screened cable Minimum core Ø 0.006” (0.15 mm) (24AWG)
Transmission distance	Max. 4000 ft (1200 m)
Instrument address	Accessed via touch control
Isolation	Bus inputs are electrically isolated from the other electronics

Analog output

Output	4 to 20 mA, two channels freely assignable value
On alarm	Switchable +110%, -10% or hold last measured value
Electrical isolation	Analog output isolated from other circuits
Adjustable damping	0 to 99 sec
Maximum load	500 ohm
Load effect	Negligible

Relay

Version	4 relays with potential free change-over contacts, freely assignable to measured value
Hysteresis	Switch points and switching hysteresis freely adjustable, residual current fail-safe mode: minimum or maximum, selectable
Switching capacity	AC max. 2 A max. 250 V max. 62.5 VA DC max. 2 A max. 220V max. 60 W For FM / CSA: DC max. 2 A 30 V max. 60 W

Display/programming

Display (LCD)	Two line 16 digit illuminated display English, Japanese selectable
Programming	Three optical keys (touch control) for selection of matrix functions
Memo function	Memo of maintenance information

Certification

Explosion proof	EEx d IIB T6 EEx d IIB T6 Zone 0 (PTB, Germany) Ex d IIB T4 (TIIS, Japan) Class I, Div. 1, Gp. CD (FM, USA) Class I, Div. 1, Gp. CD (CSA, Canada) EEx d [ia] IIB T6 Zone 0 (PTB, Germany, pending)
Custody Transfer	PTB; Germany and NMi; Netherland
Overspill protection	TÜV; Germany

Power Supply

Power supply	High voltage type: 85 to 264 V_{ac} 50/60 Hz Low voltage type: 20 to 60 V_{dc} / 20 to 55 V_{ac} 50/60Hz
Power consumption	Maximum 20 VA, 20W (cos j=0.5)
Safe electrical isolation	Between power supply and signal output, CPU, RS 485, relay and other electronics

Environmental Conditions

Temperature ranges	Ambient temperature: -4 to +140°F (-20 to + 60 °C) Liquid temperature: -328°F to +392°F (-200 to +200°C)
Protection	IP 67 with closed housing and cable glands of equal protection type

Measuring Wire

Range	33 ft (10 m), 51 ft (16 m), 93 ft (28 m) maximum
Material(standard)	Stainless steel 316, Ø 0.006" (0.15mm)
Material(optional)	Hastelloy C. Ø 0.008" (0.2 mm) [max. 51 ft (16 m) range] PTFE coated SS 316L, Ø 0.02" (0.4mm) [max 51 ft (16 m) range]
Wire protection	Without for calm conditions Turbulent conditions via stilling well or guide wire

Displacer

Diameter	1.2" to 2" (30 to 50 mm) dependent on application, optional 2.8" to 4.3" (70 to 110 mm)
Material(standard)	Stainless steel 316
Material(optional)	Hastelloy C; PTFE
Horizontal movement	0.05" (1.23 mm)/m with standard wire
Speed of movement	0 to 98" (2500 mm)/min.

Accuracy

Liquid level	±.03" (0.7 mm) for L=33 ft (10 m), Dr = 62 lb/ft^3 (1 g/cm^3) with 50 mm displacer
Interface level	±.11" (2.7 mm) for L = 33 ft (10 m), Dr = 12 lb/ft^3 (0.2 g/cm^3) with 2" (50 mm) displacer
Specific gravity	±.31 lb/ft^3 (0.005 g/cm^3)
Tank bottom	±.08" (2.1 mm)

Compensation

Wire	Compensation of wire expansion due to temperature and wire weight
Displacer	Automatic compensation of displacer weight
Tank roof	Compensation of depression and distortion

Mechanical Construction

Housing materials of construction	Electrical compartment: aluminum casting Drum chamber for NMS531/4: aluminum casting Drum chamber for NMS532/5/6: stainless steel 316 casting
Weights	NMS 531/534: 26 lbs (12 kg) NMS 532/535/536/537: 60 lbs (27 kg)
Flange type	ANSI, JIS, DIN 3" (76 mm) (standard) or equivalent. Refer to order code for full selection

Product Structure

NMS 5x Proservo

Pressure rating, drum chamber material
- 1 Drum housing: 0.2 bar g; Al casting
- 2 Drum housing: 0.2 bar g; SS casting
- 4 Drum housing: 6 bar g; Al casting
- 5 Drum housing: 6 bar g; SS casting
- 6 Drum housing: 25 bar g; SS casting
- 9 Special version

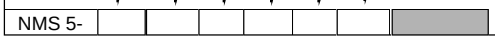
Protection class
- 0 Protection: Weather proof; IP67/NEMA4X/Type 4X
- 1 Flame proof; Ex d IIB T4 TIIS
- 2 Flame proof; EEx d IIB T6 CENELEC
- 3 Flame proof; EEx d IIB T6 PTB Zone 0 (only for stainless steel drum chamber)
- 5 XP Class I, Div. 1, Gp. CD (FM)
- 6 Class I, Div. 1, Gp. CD (CSA)
- 7 Flame proof; EEx d IIB T6 CENELEC with barrier box (EExi)
- 8 Flame proof; EEx d(ia) IIB T6 PTB (pending)
- F Flame proof; EEx d IIB T6, ATEX
- G Flame proof; EEx d IIB T6 ATEX Zone 0 (only for stainless steel drum chamber)
- H Flame proof; EEx d(ia) IIB T6, ATEX (pending)
- J Flame proof; EEx d(ia)IIB T6,ATEX Zone 0 (pending, only NMS5-2..,5..,6..)
- K Flame proof; EEx dem IIB T6 PTB ATEX (pending)
- L Flame proof; EEx dem IIB T6 PTB ATEX Zone 0 (pending, only NMS5-2..,5..,6..)
- M Flame pr.; EEx dem(ia) IIB T6 PTB ATEX (pending)
- N EEx dem (ia) IIB T6 PTB ATEX Zone 0 (pending, only NMS5-2..,5..,6..)
- 9 Special version

Measuring function
- A Level measuring function
- B Level measuring function, tax & weight PTB
- C Level measuring function, tax & weight NMi
- D Level, I/F level, bottom, density, multi-measurement
- E Level, I/F, bottom, density Tax & Weight PTB
- F Level, I/F, bottom, density Tax & Weight NMi
- Y Special version

Primary (Digital) output
- F Digital output not selected
- A Output-1: Serial pulse (Sakura V1/MDP)
- J Output-1: Serial pulse (Sakura MDP)
- B Output-1: Serial pulse (Sakura BBB)
- C Output-1: Serial pulse (Sakura MIC with RS232C)
- D Output-1: Serial pulse (Sakura MIC without RS232C)
- E Output-1: RS485 RACKBUS
- G Output-1: HART (active)
- H Output-1: HART (passive)
- L Output-1: Whessoe matic 550, with lightning protection
- K Output-1: Whessoe Matic 550, without lightning protection
- M Output-1: Mark Space
- Y Special version

Secondary output
- 0 Secondary output not selected
- 1 Output-2: Alarm contact output; 4SPST
- 2 Output-2: 4-20 mA, 2 chan. free assign
- 3 Output-2: 4 SPST and 4-20 mA, 2 chan.
- 4 Output-2: 2 SPST; Overspill protection TÜV
- 9 Special version

Signal input from field units
- 0 Input: HART protocol (e.g. NMT, NRF)
- 1 Input: HART and Pt100 Spot temp.
- 2 Input: HART and operation contact
- 3 Input: HART; Pt100 Spot temperature & operation contact
- 9 Special version



NMS 5x Proservo continued...

Measuring range, Wire material
- A Range: 0...10m, AISI316 wire
- B Range: 0...16 m, AISI316 wire
- C Range: 0...28 m, AISI316 wire
- G Range: 0...10m, AISI316 PTFE cov. wire
- H Range: 0...16m, AISI316 PTFE cov. wire
- J Range: 0...10m, Hastelloy C wire
- K Range: 0...16m, Hastelloy C wire
- Y Special version

Cable entry
- E Cable entry: Four G(PF) 1/2" thread
- F Cable entry: Four G(PF) 3/4" thread
- G Cable entry: Four NPT 1/2" thread
- H Cable entry: Four NPT 3/4" thread
- J Cable entry: Four PG16 thread
- K Cable entry: Four PG21 thread
- L Cable entry: Four M20 thread
- M Cable entry: Four M25 thread
- Y Special version

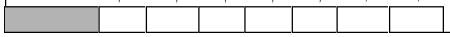
Process connection
- A JIS 10 K 80A RF flange
- C JIS 10 K 80A FF flange
- E JIS 20 K 80A RF flange (25 bar drum) (only for 25 bar Drum chamber)
- G ANSI 3" 150lbs RF flange
- J ANSI 3" 300lbs RF flange (25 bar drum) (only for 25 bar Drum chamber)
- L DIN DN80 PN10 RF flange
- N DIN DN80 PN25 RF flange (only for 25 bar Drum chamber)
- Q JPI 3" 150lbs RF flange
- S JPI 3" 300lbs RF flange (only for 25 bar Drum chamber)
- Y Special connection

Power supply
- 3 Power supply 85...264 V_{ac}, 50/60 Hz
- 4 Power supply 20...62 V_{dc}, 20W
  20...55 V_{ac}, 50/60 Hz, 20 VA
- 9 Special power supply

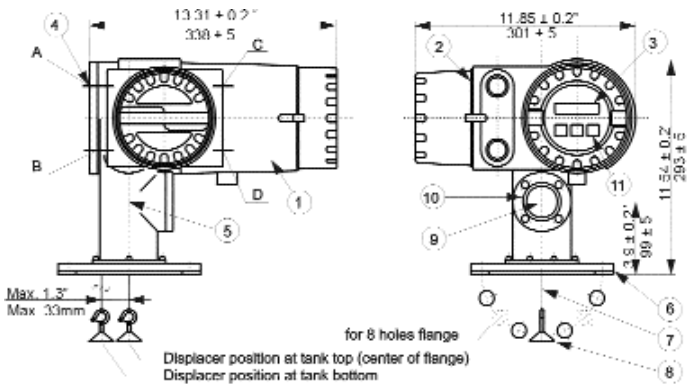
Displacer shape diameter; material
- A Displacer: Conical 50 mm; AISI316
- B Displacer: Conical 50 mm, PTFE
- D Displacer: Cyl. 50mm; AISI316 (stand.)
- K Displacer: Cylindrical 40 mm; AISI316
- N Displacer: Cylindrical 30 mm; AISI316
- R Displacer: 70 mm, W&M NMi
- S Displacer: 110 mm, W&M PTB
- T Displacer: Conical 50mm, Hastelloy C
- Y Special version

O-ring; chamber finishing
- 0 O-ring: NBR; Standard chamber
- 1 O-ring: Silicon rubber; Std. chamber
- 2 O-ring: Fluor rubber; Standard chamber
- 5 O-ring: Silicon rubber; PTFE coa.chamber
- 9 Special version

Options
- A Additional options not selected
- C With cleaning nozzle
- D With gas purging nozzle
- E With guide wires (AISI316 strand)
- F With external calibration chamber
- G With relief valve
- H With relief valve and pressure gauge
- J Vent plug assembly (pending)
- Y Special version



Dimensions



1. Electrical compartment
2. Terminal box
3. LCD
4. Cable entry (A,B,C,D)
5. Wire drum housing
6. Flange
7. Measuring wire
8. Displacer
9. Calibration window
10. Window cover
11. Touch control

Note!
Measurements are in inches and millimeters.

Welding process is specified for NMS537 flange assembly

Product Line	NMS	NRF	NMT
Description	Tank gauge, servo operated, high accuracy	Field data processor	Spot or average temperature sensor
Input	HART® Pt 100 Ohm		
Output	RS485, serial pulse, HART®, WM550, alarm contacts, analogue	HART®	HART®
Functions	Level, interface level, specific gravity, tank bottom measurement	Tank side monitor operation of NMS	Temperature measurement and average temperature measurement
Certificates	Ex: CENELEC, TIIS, PTB Zone 0, FM, CSA W&M: PTB, NMi	Ex: CENELEC, TIIS, FM, CSA W&M: PTB, NMi	Ex: CENELEC, TIIS, FM, CSA, PTB Zone 0 W&M: PTB
Protection	IP 67, NEMA 4X	IP 67, NEMA 4X	IP 67, NEMA 4X

Endress+Hauser
Systems & Gauging, Inc.
5834 Peachtree Corners East
Norcross (Atlanta), GA 30092
USA
Tel: +1 (770) 447-9202
Fax: +1 (770) 662-8939
http://www.systems.endress.com

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Systems & Gauging

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