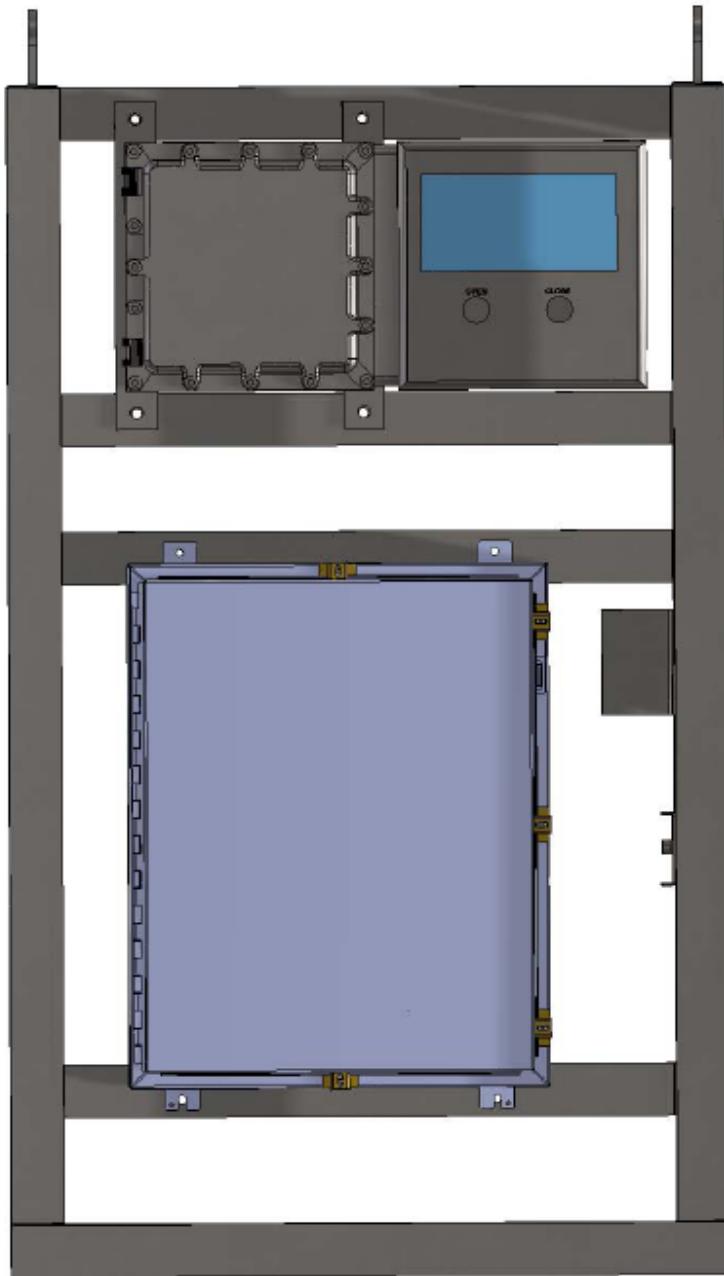




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Operation & Maintenance Manual
20381680 MPD Sentry Relief Valve Controls
Doc. #: T3-1283918 B

T3 Model 20381680





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NOTICE

The procedures herein are to be performed in conjunction with the requirements and recommendations outlined in API Specifications. An authorized T3 Energy Services representative should do any repairs to the equipment covered in this book. T3 Energy Services will not be responsible for loss or expenses resulting from any failure of equipment or any damage to any property or injury or death to any person resulting in whole or in part from actions or tasks on this document that are performed by other than authorized T3 Energy Services personnel. Such unauthorized repairs shall also serve to terminate any contractual or warranty, if any, on the equipment, and may also result in the equipment no longer meeting applicable requirements.

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Revisions and/or additions to this manual will be made as deemed necessary by T3 Energy Services. The drawings in this book, if any, are not drawn to scale, but the dimensions given are accurate. Refer to component part numbers in all communications concerning the equipment.

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List of Annexes

- Annex 1 – User Guide, Fluidwell F053-A Process Monitor
- Annex 2 – T3-1279090, Control Console Validation
- Annex 3 – T3-1283913, Relief Valve PLC Schematic
- Annex 4 – Bill of Material, Relief Valve Controls 20381680



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Operation & Maintenance Manual

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1 Safety Notice

When working on T3 products working safely is the most important job. Before commencing any work read this entire manual to plan your work activity safely. Clearly communicate your work plans with your entire team in a pre-job safety meeting to assure safe completion of the job. All personnel involved in job shall wear full PPE (Personal Protection Equipment) that includes safety glasses, steel toe boots, hardhat and hearing protection. When the equipment is on a well that produces Hydrogen Sulfide a respirator air pack shall also be employed.

NOTE: This is not a safety device!

2 Scope

This manual is specific to the MPD Sentry relief valve control system. It covers the operation, maintenance, installation, and commissioning of the controls as they apply to relief valve use.

3 Reference Documents

- T3-1279090, Control Console Validation Specification
- T3-1283913, Wiring Diagram, MPD Sentry Controls
- F053-A, User Guide, Loop Powered Indicator

4 System Description

The MPD Sentry relief valve system consists of the hydraulically actuated valve, the MPD Sentry electro-hydraulic control console, and a set of hoses and cables. This system is designed to be installed upstream of the MPD choke manifold. Its purpose is to help prevent formation pressure from exceeding values that could damage the formation in the event the MPD system loses control. A P&ID of this system is shown in Figure 1.

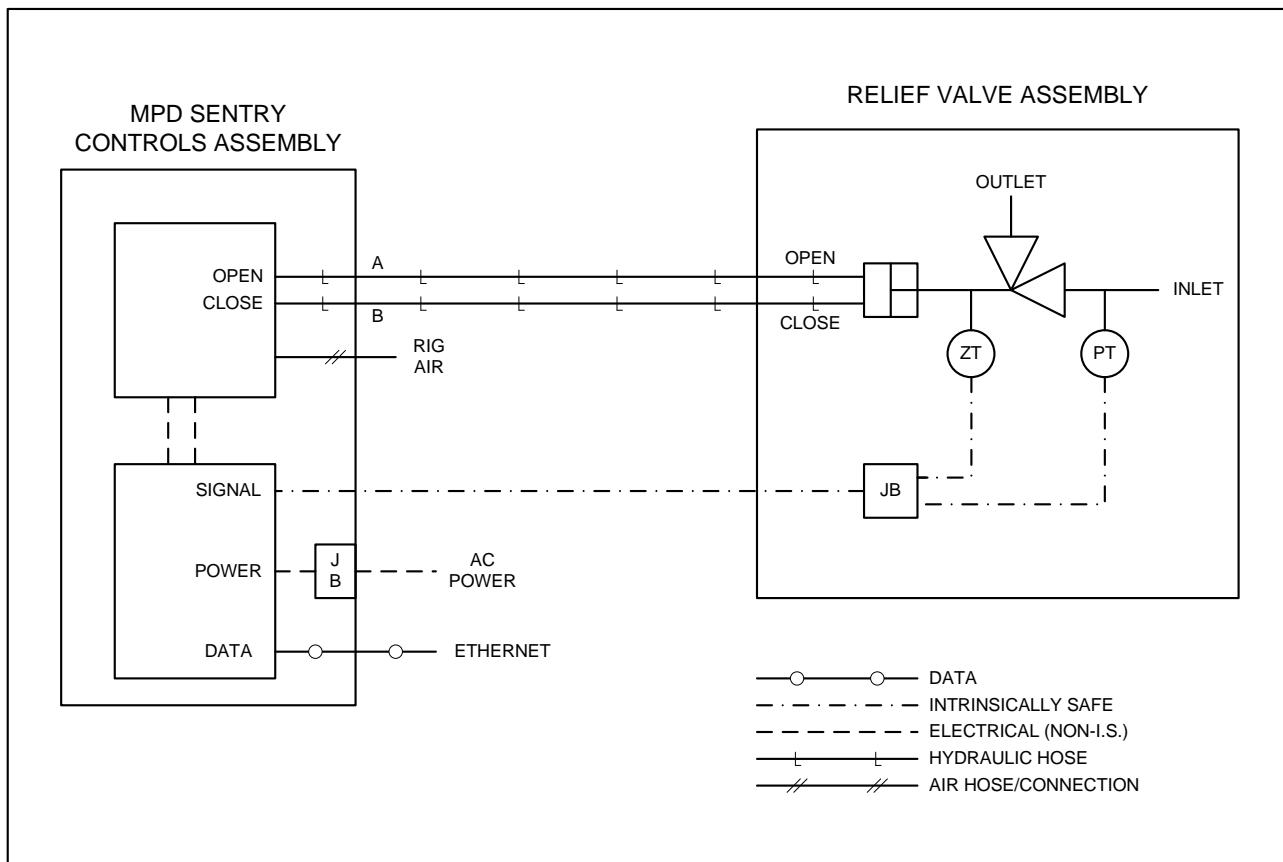


Figure 1 P&ID of MPD Relief Valve System

The MPD Sentry Controller works by continuously monitoring annular pressure and comparing it to two trip point pressures. A high limit trip point or “hard” trip point setting is controlled by the electronic gauge located in the control console. This trip point is typically set to the highest expected pressure. If the pressure ever exceeds the hard trip point the valve will open. A dynamic or “soft” trip point that originates from the customer supplied MPD system will also cause the valve to open if its trip pressure is ever exceeded. The soft trip point is typically lower than the hard trip point and is updated by the MPD system to follow the fracture pressure gradient. When either a hard or soft trip is encountered, the control system hydraulically opens the relief valve.

The relief valve assembly includes sensors that monitor pressure and valve position. The pressure and position signals are sent back to the MPD Sentry controller where they are used to control the valve and are made available

to customer-supplied equipment via MODBUS-TCP. The controller can be set remotely to use either the local valve-mounted pressure sensor or use a remotely delivered pressure reading for making the pressure comparison to the trip setting.

The “hard” trip point is controlled by a panel indicator with built in alarm. Programming buttons on the gauge allow the gauge and alarm parameters to be set. The “soft” trip point is controlled by a programmable bus coupler. The “soft” trip point is sent over the MODBUS-TCP link where the bus coupler compares it to the measured pressure and controls the valve.

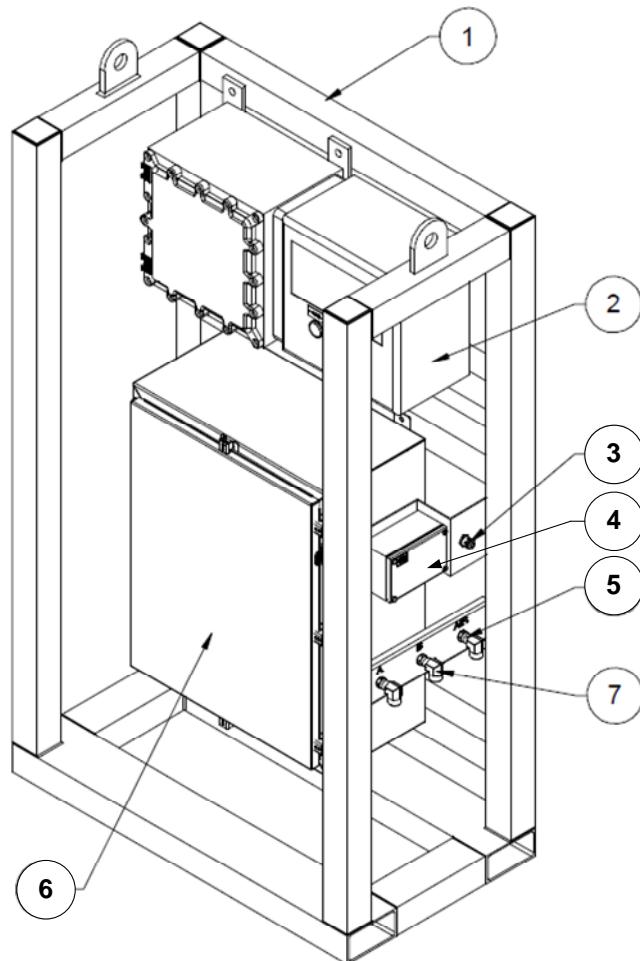
Also located on the control panel are two lighted pushbuttons: OPEN and CLOSE. These pushbuttons are used to manually open and close the valve during commissioning and maintenance. Note that the CLOSE pushbutton will not close the valve if an overpressure condition is detected by the MPD Sentry. The valve may always be manually opened regardless of pressure conditions. When the valve is closed, the green lamp is lit; the red lamp is lit when the valve opens. These lamps are tied to the position sensor on the valve.

The hydraulic power pack contains an air driven hydraulic pump, a reservoir, an accumulator, and some valves. A solenoid operated valve (SOV) controls hydraulic fluid to the relief valve under control of the electrical control panel.

The relief valve is attached to the MPD Sentry controller with a pair of hydraulic hoses and a signal cable. The position and pressure signals are conveyed through a single cable with connectors at both ends; additional cables may be connected together to increase the overall length as needed.

The following sketch illustrates the main components of the MPD Sentry control system.

1. Mounting frame with lifting eyes.
2. Electrical control panel
3. Valve signal connector
4. AC Power entry junction box
5. Rig air hose fitting
6. Hydraulic power pack
7. Hydraulic hose fittings

**Figure 2 Console and stand arrangement**

5 Unpacking

When shipped, the console is secured to a wooden pallet with banding straps and shrink wrap plastic film. Using a fork truck, move the console on its pallet to a clear and level area with at least two meters clearance around all four sides.

CAUTION

Steel bands can be dangerous when suddenly released under tension.
Wear appropriate PPE to protect against bodily injury.

Next, remove the steel bands by cutting with snips and discard. The plastic shrink film can then be cut and removed and the console removed from the pallet. Fork pockets in the console base and pad eyes in the top of the frame facilitate lifting from the pallet and into final location.

Once unpacked, open the HPU cover and inspect for any visible damage that might have occurred during shipping. Look for any loose mechanical components or tubing. If any damage is observed, DO NOT ATTEMPT TO POWER THE CONSOLE. Instead, call T3 Service for advice on repairing the console or dispatching a service tech to perform repairs.

Report any shipping damage to the shipper immediately.

6 Installation

6.1 Moving the Console

The console is designed to be transported and lifted using the fork pockets or the pad eyes designed into the frame. A fork truck or crane should be used to locate the console to its final location. Take into consideration the center of gravity when moving and locating the console. The CG points are shown in Figure 3.

6.2 Location Planning

When planning the location of the console, observe the following guidelines.

1. Mounting surface must be a flat and level deck surface
2. Since personnel could be operating the console manually, this must be taken into consideration when planning the location of the console
3. One meter of clearance minimum is required on the right side of the console to provide access to the cables and hoses; there is no clearance requirement for the left and rear sides
4. The front of the console must be accessible to personnel for both operation and servicing. A minimum clearance of two meters is recommended.

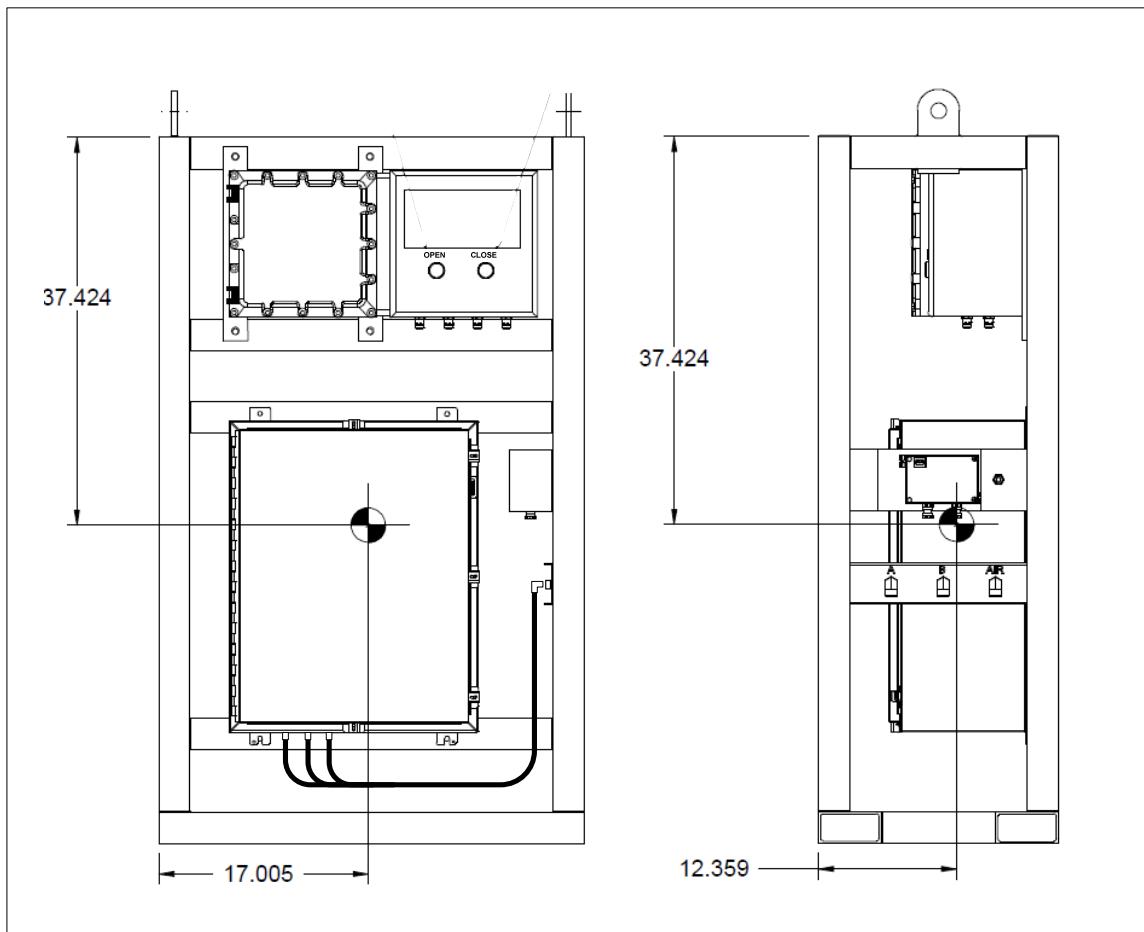


Figure 3 Center of Gravity points on console & stand

6.3 Preparation

Route all cables and hoses where they can be brought to the right side of the console for termination. For offshore use, the console should be secured to the structure. Plan the attachment method before moving the console into its final position.

6.4 Securing to the Deck or Bulkhead

The console is designed for temporary installation. If it must be secured to the deck or bulkhead, the user must devise the fastening method to suit the installation.

6.5 Hose Connections

There are three hoses that must be connected to the console. Two are hydraulic hoses that connect the console to the valve and the third is the rig air supply hose. Access to the inside of the power pack is required to install and commission the console.

6.5.1 Rig Air Connection

CAUTION

- Leaks in the Rig Air supply line can blow debris in eyes
- A loose hose on an energized air line can cause bodily harm
- Unchecked hoses should be secured with a lanyard per rig guidelines

The recommended Rig Air supply line size is $\frac{1}{2}$ inch minimum.

1. Close the main air supply valve inside the console
2. Attach the rig air supply line to the rig air port on the console
3. Verify that the quick connect fittings are securely mated and locked
4. Open the main valve that supplies the rig air line
5. Check for any leaks where the rig air line connects to the console
6. Verify presence of rig air by observing pressure registering on the rig air gage mounted inside the console

6.5.2 Hydraulic Hose Connections

CAUTION

Hoses may have trapped pressure from previous use. Use caution when mating the quick connects as fluid will typically escape, possibly under pressure. Catch any spills with a rag or absorbent towel.

1. Connect the hydraulic open and close hoses to the bulkhead ports on the console
2. Verify that the quick connect fittings are securely mated and locked
3. Mop up any spills with a rag or absorbent towel and dispose of according to local regulations

6.6 Electrical Connections

See figure 4. The electrical connections to the console are:

- Power
- Remote Ethernet cable
- Valve instrument signal cable (I.S.)

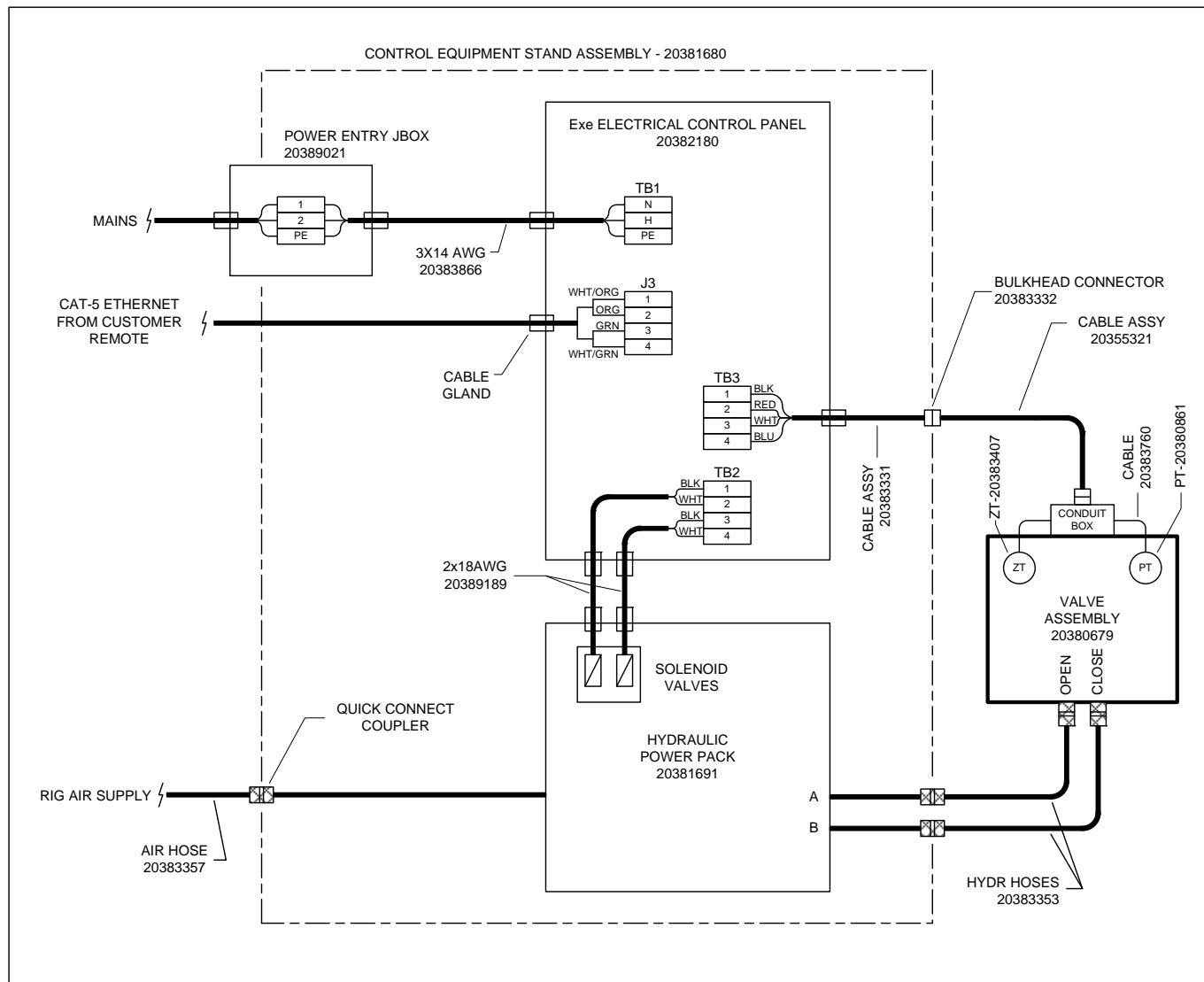


Figure 4 Console electrical connections

6.6.1 Power

Power to the console is supplied to an Increased Safety (EEx e) junction box on the right side of the console. A customer-supplied 3-core power cable and M20 cable gland must be installed in the junction box to supply AC power. Power requirements are 120/240 V (auto-selectable), 50/60 Hz, 3A. The customer must provide 10A branch circuit protection to the cable powering the console. It is up to the customer to select a cable gland that is appropriate for use with the cable he supplies.

After the power cable is installed in the junction box, terminate the individual cores at the terminal block. The terminals are labeled *L1,L2, PE*.

When installed on a metal deck such as an offshore platform, an earth/ground connection should be connected to one of the earthing terminals on the console electrical enclosure and connected to a suitable point on the deck or bulkhead. Consult local or rig requirements for the necessity of this as well and to size the wire gauge.

6.6.2 Remote Ethernet

Communication between the console and remote customer equipment is via Ethernet cable. An M20 entry is provided on the bottom of the console control enclosure for this purpose. The cable and gland are customer-supplied. The cable must CAT-5 and only two pairs are used in this installation.

The two pairs that are used are TX+/- and RX+/. When connecting each pair, maintain the twist of each pair up to the terminal block as close as possible. Refer to the figure below for wiring details.

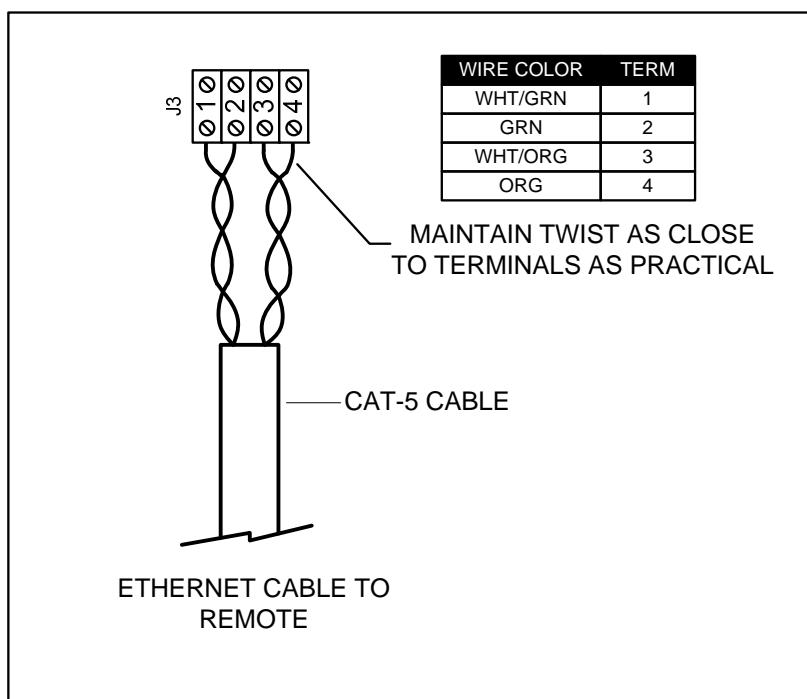


Figure 5 Ethernet wiring detail

6.6.3 Valve Instrument Cable

CAUTION

Intrinsic safety wiring techniques must be followed when routing the valve instrument cable between the console and the valve. Separate tray must be used and proper segregation observed in order to comply with local and international regulations and standards.

The valve instruments consist of the position sensor and the pressure transmitter, both intrinsically safe devices. These signals are conveyed to the console through a cable assembly with water tight (IP67) connectors on each end. The cable is made like an extension cord with a male connector on one end and a female connector on the other end. This allows multiple cables to be joined to extend the overall length as needed. The male connector plugs into the bulkhead connector on the side of the console. When mating the two connectors, verify that the locking ring is securely fastened. Refer to Figure 6 for details on valve sensor wiring.

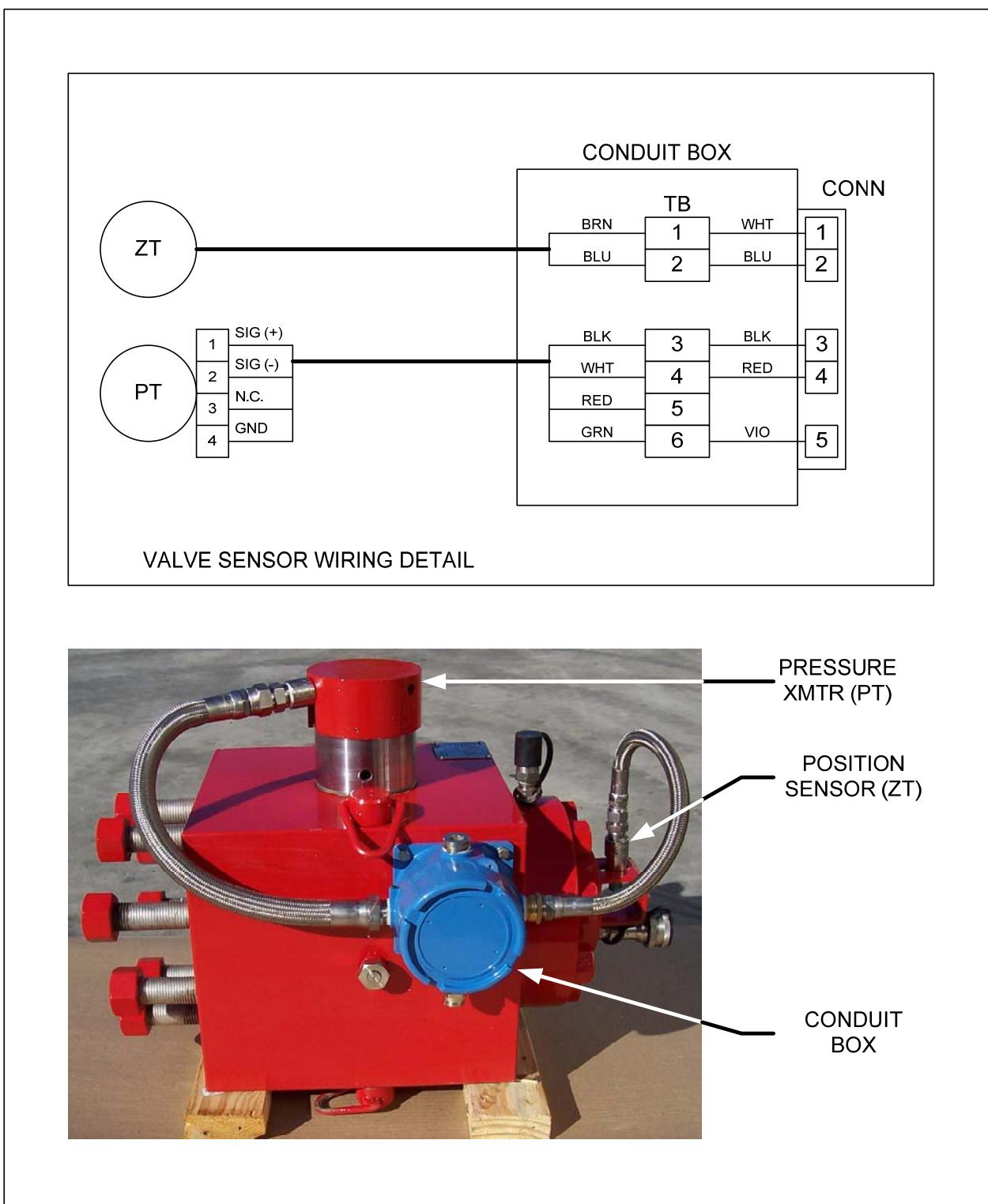


Figure 6 Valve wiring detail

7 Commissioning

Refer to figures 7-8 and to T3-1279090, Sections 6.1, 6.2, 9.0 for the following steps

1. Verify hydraulic reservoir is filled with operating fluid using the sight gauge on the reservoir.
 - a. Fill as required through the reservoir cap
 - b. Use AW 10 grade hydraulic fluid, however any light hydraulic fluid with flow properties acceptable for the expected ambient temperature is acceptable
2. If required, pre-charge the accumulator with nitrogen to 750 PSIG before pressurizing the system hydraulically.
3. Verify rig air supply is available in the range 80-125 PSIG
4. Close the main hydraulic dump valve located inside the HPU
5. Close the air driven hydraulic pump air supply valve located inside the HPU
6. Open the accumulator isolation valve located inside the HPU
7. Adjust the air regulator until hydraulic pressure output is 1500 PSIG

The console may now be inspected for hydraulic leaks. Look inside the console through the access door at all fittings for any signs of hydraulic leaks. Actuate the OPEN and CLOSE pushbuttons on the console panel multiple times to supply hydraulic fluid to the relief valve. If no leaks are detected, the console may be placed into service.

NOTE: Air must be purged from new hoses that do not yet have trapped fluid. To purge the hoses, remove the two hose ends from the valve and connect the two hose ends together. Repeatedly open and close using the front panel pushbuttons to circulate fluid through the hoses until the air is purged.

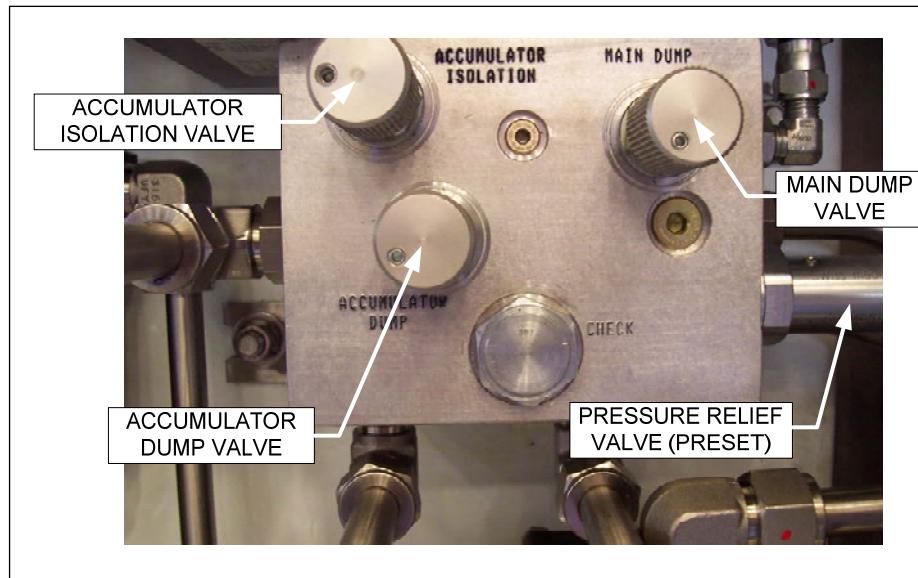


Figure 7 Hydraulic adjustment detail

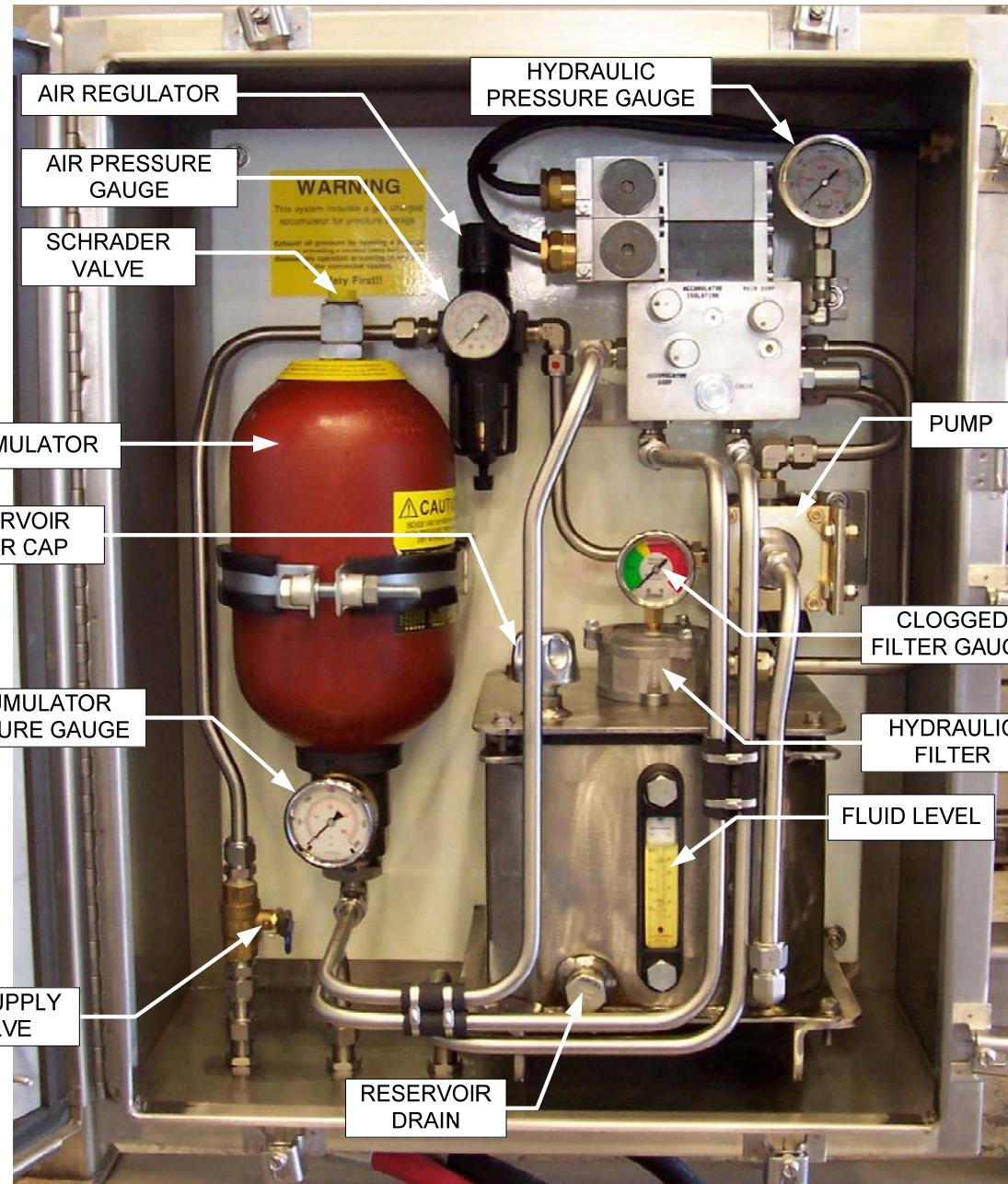


Figure 8 HPU Layout

8 Operation

To manually open or close the relief valve, press the pushbutton on the local control panel for the desired operation. Note: The valve cannot close if the measured pressure exceeds either the “soft” or “hard” trip point.

The MPD Sentry will cause the relief valve to open whenever the trip point is exceeded. Once the pressure drops below the trip point the relief valve will close. This cycle will continue as long as the conditions that caused the high pressure are present. The exception is once the pressure stored in the accumulator is depleted, the cycle will not resume until the hydraulic pump builds the accumulator pressure back up, causing the valve to dwell for up to several seconds in either the open or closed state while this takes place.

Soft trip settings are sent to the console via Ethernet connection and are determined by the customer’s drilling program.

If the remote connection is lost, such as from a cable break, the console will detect this condition and no longer trip using the soft setpoint. During this condition, only the hard trip point will be active. Upon restoration of the remote signal, the soft trip point will activate in the console.

The customer supplied external remote equipment can access status and pressure values from the MPD Sentry controller.

8.1 Hard Trip Setting

Refer to the attached user guide in Annex 1 for setting the panel display on the console. Follow the steps shown in the user guide to adjust the high trip setting on the display. For instance, if a hard trip setting of 2500 psi is desired, enter 2500 into the high trip on the display per the instructions in the user guide.

After the hard trip has been adjusted, verify proper operation with a test pump or other means of pressuring the valve. With the remote connection disabled or disconnected so that the soft trip is ignored, increase the pressure on the valve until the hard trip is reached. The valve should open once the valve pressure exceeds the hard trip setting. Immediately upon opening, the valve pressure will fall, causing the controls to close the valve.

The hard trip setting is typically configured for a specific well program and should not have to be changed during operation.

Note: The display is preconfigured at the factory to display pressure as 0-5000 psi. Refer to the user guide to scale the pressure reading in other units.

9 Maintenance

CAUTION

If equipment is located in a hazardous area, do not open electrical equipment covers while energized!

WARNING!

The electrical equipment is certified by a Notified Body for use in ATEX Zone 1 hazardous areas. For this reason no components may be added to or substituted for those originally shipped with the equipment. Personnel performing repairs must be qualified to work on this equipment. **Failure to observe these requirements could cause equipment failure that could lead to fire or explosion.**

Perform the following checks:

- At installation
- Weekly during continued operation

9.1 Hydraulic Inspection

1. Check the level and add fluid if the reservoir is lower than 2/3 full.
2. Inspect the hydraulic fluid for contamination. Drain and replace the fluid if it appears cloudy, dirty, or water is present in the fluid. Replace the filter whenever the fluid is replaced.
3. Inspect the hydraulic unit for leaks and tighten/repair as needed.
4. Inspect the hydraulic unit internally for loose components and tighten if needed.
5. Inspect the rig air filter occlusion gauge and replace the filter if the gauge is in the “yellow” zone.
6. Clean up and properly dispose of any hydraulic fluid spills or accumulations inside the cabinet

9.2 Electrical Inspection

The following steps are limited to inspection of components outside the electrical equipment cabinets; the electrical equipment cabinets should not be opened under normal conditions, but only for detailed repair by qualified service technicians.

1. Inspect all cables for damage: cracked insulation, cables pulled free from glands, cuts, abrasions; replace or repair as needed.
2. Assure that all enclosure covers are properly closed and fastened
3. Inspect the protective glass cover over the pressure display; clean with glass cleaner or WD40; replace if cracked or broken
4. Inspect all external earth/ground connections for corrosion and correct as needed

9.3 TROUBLESHOOTING

Symptom	Action
Valve closes but will not open	Make sure the pressure signal is below the trip point; check hydraulic hose connections
Pump constantly runs	Check to make sure both dump valves are closed; if reservoir fluid level is also falling look for and repair any leaks in the cabinet, hoses, or relief valve; adjust to lower pressure and if problem stops, replace hydraulic relief valve inside the hydraulic power pack; continuous open-close cycles will cause the pump to run constantly
Accumulator not charging	Check to make sure isolation valve is open; check nitrogen precharge and perform precharge procedure outlined in Commissioning if needed
Pressure display appears dead	This is a loop powered indicator. An excitation source and transmitter must be present for the display to be powered. Check 4-20 mA signal connection and cable; check pressure transmitter and replace if needed; connect a 2-wire transmitter simulator in place of the pressure transmitter to rule out a defective transmitter
OPEN and CLOSE lamp states do not follow the valve state	Adjust position sensor to turn on when valve is fully open; check signal cable between sensor and junction box on the valve; check signal cable between valve and MPD Sentry controller
Pressure display reading inaccurate	Display indicator may require calibration – see calibration procedure in the user guide for the indicator; pressure transmitter defective – isolate sensor from display indicator and test or replace
External communication not functioning	Check Ethernet cable; verify IP address and subnet for compatibility with that of MPD Sentry

9.4 Recommended Spares

The following list shows the recommended spare parts for the control system. For convenience, the parts are grouped into kits; parts may be ordered separately or as part of a kit using the T3 part numbers shown.

T3 Part Number	Description	Recommended Quantity on Hand
20392347	Console spares kit, includes items and quantities listed below	
20367569	Power Supply, 24V, 5A	2
20392325	Relay, solid state, 3A, 24V	2
20356822	Digital input module (PLC)	1
20382358	Digital output module (PLC)	1
20382356	Analog input module (PLC)	1
20356820	CPU Module (PLC)	1
20392318	Isolator module, analog	1
20392321	Isolator module, digital	1
20392328	Gauge, digital process panel indicator	1
20392323	Transient suppressor	2
20392322	Display flip-up glass cover	1
20383332	Connector, 5 pin M/F bulkhead	1
20392346	Pushbutton, lighted, green	1
20392345	Pushbutton, lighted, red	1
20383331	Cable, console instrument	1
20392359	Hose & Cable spares kit, includes items and quantities listed below	
20355321	Cable, valve instrument extension, 15m long	2
20383353	Hose, hydraulic with M/F quick connects, 50 ft.	2
20383357	Hose, rig air supply, 50 ft.	1
20392360	Valve electrical spares kit, includes items and quantities listed below	
20383760	Cable, valve pressure sensor	2
20380861	Pressure sensor, 5000 psi, EEx ia	2
20383407	Proximity sensor, NAMUR, EEx ia	2
20392361	HPU spares kit, includes items and quantities listed below	
20387523	Filter, hydraulic	5
20388126	Pump, 1:21 air/hydraulic	1
20388270	Seal kit, liquid section, for pump	5
20388271	Seal kit, air section, for pump	2

10 Removing From Service

When demobilizing or taking the console out of service, follow the steps outlined below. Before beginning the process, have on hand absorbent pads, a 5 gal. bucket or pail, and a hose suitable for connecting to the reservoir drain .

PROCEDURE

1. De-energize the power feed to the console
2. Remove power, Ethernet, and signal cables
3. Close rig air valve and main rig air supply valve
4. Remove external air supply line from console. This must be done slowly to allow pressure trapped in line to bleed before completely removing.
5. Remove external choke hydraulic lines. With an absorbent pad under and around the connection, slowly loosen the connection and allow fluid with trapped pressure to escape slowly. Once pressure is relieved proceed with removal of that line.
6. Dump accumulator pressure by opening the accumulator dump valve
7. Dump main hydraulic pressure by opening the main dump valve
8. Drain reservoir by attaching user-supplied hose to reservoir drain
9. Discharge accumulator bladder pressure; remove protective cap at top of accumulator and release the charge pressure from the bladder using Schrader valve. The nitrogen charge may be safely vented to atmosphere.
10. If applicable, remove fasteners or other attachment method from console
11. Close and fasten all covers in preparation for shipping or storage
12. The console may now be removed
13. Clean up any spilled fluid with absorbent pads to assure the area is free of any oil
14. Dispose of drained fluid and absorbent towels per local environmental laws and company policy

11 SPECIFICATIONS

11.1 HPU	
Hydraulic Operating Pressure	1500 psi, nom.
System Test Pressure	3000 psi
Accumulators	1 gal.
Reservoir	2 gal.
Pumps	1:21, ATEX Zone 1 certified
Rig Air Requirements	80 – 120 psi, 25 scfm
Rig Air Control	Manual ball valve: Air Supply On-Off, located inside panel
Hydraulic Dump	Manual valve, located inside panel
Accumulator Dump	Manual valve, located inside panel
Accumulator Isolation	Manual valve, located inside panel
Directional Control Valve	Zero-leakage cartridge style poppet valve, (2) valves combine to form 4/2 arrangement, 24VDC, 12W, spring return
Gauges, HPU	Rig Air, Filter Occlusion, Hydraulic, all located inside panel
External Connections	
Hydraulic Valve	½ inch quick connect, male & female, mates with hose pair
Rig Air Supply	½ inch male quick connect, mates with air hose

11.2 Electrical

Power Supply	120/240 VAC, 100W max.; customer supplied 10A branch protection
External Signals	Connection via IP67 connector and molded cable assembly
Valve Status	Proximity sensor, NAMUR, Intrinsically Safe
Valve Pressure	4-20 mA, Intrinsically Safe
Remote Data Connection	Modbus/TCP, 10/100, direct connection inside Exe enclosure
Environmental	
Temperature	-20 – 45 degrees C
Humidity	20 – 100%
Area Classification	ATEX Zone 1
Cable Entries	Glanded, M20; power entry and Ethernet glands customer supplied
Certification	None on overall assembly; all individual components certified for use in ATEX Zone 1 area.

12 Register Map

WRITE REGISTER			
MODBUS REG. ADDR.	TYPE	DESCRIPTION	UNITS OF MEASURE
IW256	Word	Remote pressure trip value; when pressure exceeds this value the valve will open; when this value is zero the remote setpoint is ignored and operation is determined solely by the pressure gauge alarm setting	Raw A/D counts; 0-32767 represents 0-5000 psi
IX257.0	BIT	Remote Open command: unconditionally opens the valve remotely; same as pushing the local OPEN button on the panel	1=OPEN 0= don't care
IX257.1	BIT	Remote Close command: closes the valve remotely if the pressure is below the remote setpoint pressure value; same as pushing the local CLOSE button on the panel	1=CLOSE 0=don't care
IX257.2	BIT	Remote pressure measurement mode: instructs the PLC to use a remotely delivered pressure measurement or the valve (local) pressure sensor for comparing to the soft trip point	1=Remote 0=Local
IW258	WORD	Remote pressure measurement: remote delivery of the pressure measurement to compare against the soft trip point	0-32767 represents 0-5000 psi

READ HOLDING REGISTER

MODBUS REG. ADDR.	TYPE	DESCRIPTION	UNITS OF MEASURE
QW256	Word	Measured pressure as sensed by the pressure transmitter installed in the valve; resolution is 12 bits	Raw A/D counts; 0-32767 represents 0-5000 psi
QX257.0	BIT	Status of local OPEN pushbutton	1=OPEN pushbutton pressed 0=OPEN pushbutton not pressed
QX257.1	BIT	Status of local CLOSE pushbutton	1=CLOSE pushbutton pressed 0=CLOSE pushbutton not pressed
QX257.2	BIT	Valve position sensor	1=Valve is closed 0=Valve is open
QX257.3	BIT	Valve trip status flag	1=Valve tripped state (hydr. solenoid energized and relief valve should be open) 0=Valve state normal and should be closed; hydr. solenoid de-energized)
QX257.4	BIT	Hydraulic Solenoid Valve	1=energized 0=de-energized
QX257.5	BIT	Local Panel OPEN Indicator Lamp	1=OPEN indicator energized 0=OPEN indicator de-energized
QX257.6	BIT	Local Panel CLOSE Indicator Lamp	1=CLOSE indicator energized 0=CLOSE indicator de-energized
QW258	Word	Remote trip setting readback	32767 represents 0-5000 psi
QX259.0	BIT	Remote Open command readback	Readback of the remote open cmd
QX259.1	BIT	Remote Close command readback	Readback of the remote close cmd
QX260	USINT	Communication token sent back to Master to indicate Slave is still active and online	N/A; value continuously changed by Slave



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**Operation & Maintenance Manual
20381680 MPD Sentry Relief Valve Controls
Doc. #: T3-1283918 B**

Annex 1

User Guide, Fluidwell F053-A Process Monitor

F053-A

PRESSURE MONITOR
WITH HIGH / LOW PRESSURE ALARMS



Signal input sensor: (0)4-20mA.

Alarm output: one pressure alarm.

Options: Intrinsically Safe.



SAFETY INSTRUCTIONS



- Any responsibility is lapsed if the instructions and procedures as described in this manual are not followed.



- **LIFE SUPPORT APPLICATIONS:** The F053-A is not designed for use in life support appliances, devices, or systems where malfunction of the product can reasonably be expected to result in a personal injury. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify the manufacturer and supplier for any damages resulting from such improper use or sale.



- Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well-grounded object.



- This unit must be installed in accordance with the EMC guidelines (Electro Magnetic Compatibility).



- Do connect a proper grounding to the aluminum casing (option HA/HU) as indicated if the F053-A has been supplied with the 115-230V AC power-supply option PM. The green/yellow wire between the back-casing and removable terminal-block may never be removed.



- Intrinsically Safe applications: follow the instructions as mentioned in Chapter 5.

SAFETY RULES AND PRECAUTIONARY MEASURES

- The manufacturer accepts no responsibility whatsoever if the following safety rules and precautions instructions and the procedures as described in this manual are not followed.
- Modifications of the F053-A implemented without preceding written consent from the manufacturer, will result in the immediate termination of product liability and warranty period.
- Installation, use, maintenance and servicing of this equipment must be carried out by authorized technicians.
- Check the mains voltage and information on the manufacturer's plate before installing the unit.
- Check all connections, settings and technical specifications of the various peripheral devices with the F053-A supplied.
- Open the casing only if all leads are free of potential.
- Never touch the electronic components (ESD sensitivity).
- Never expose the system to heavier conditions than allowed according to the casing classification (see manufacture's plate and chapter 4.2.).
- If the operator detects errors or dangers, or disagrees with the safety precautions taken, then inform the owner or principal responsible.
- The local labor and safety laws and regulations must be adhered to.

ABOUT THE OPERATION MANUAL

This operation manual is divided into two main sections:

- The daily use of the unit is described in chapter 2 "Operation". These instructions are meant for users.
- The following chapters and appendices are exclusively meant for electricians/technicians. These provide a detailed description of all software settings and hardware installation guidance.

This operation manual describes the standard unit as well as most of the options available. For additional information, please contact your supplier.

A hazardous situation may occur if the F053-A is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information in this operating manual indicated by the pictograms:



A "warning" indicates actions or procedures which, if not performed correctly, may lead to personal injury, a safety hazard or damage of the F053-A or connected instruments.



Caution !

A "caution" indicates actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the F053-A or connected instruments.



Note !

A "note" indicates actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned.

Hardware version	:	FB03.03.xx
Software version	:	03.02.xx
Manual	:	HF053AEN_v0301_01.doc
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Information in this manual is subject to change without prior notice. The manufacturer is not responsible for mistakes in this material or for incidental damage caused as a direct or indirect result of the delivery, performance or use of this material.

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1. INTRODUCTION

1.1. SYSTEM DESCRIPTION OF THE F053-A

Functions and features

The pressure monitor model F053-A is a microprocessor driven instrument designed to display pressure as well as the monitoring of the pressure for high / low values.

This product has been designed with a focus on:

- ultra-low power consumption to allow long-life battery powered applications (type PB / PC),
- intrinsic safety for use in hazardous applications (type XI),
- several mounting possibilities with ABS or aluminum enclosures for industrial surroundings,
- ability to process all types of sensor signals,
- transmitting possibilities with one configurable output.

Sensor input

This manual describes the unit with an analog (0)4-20mA input type from the sensor "-A version".

Other versions are available to process a 0-10V sensor signal.

One sensor with a passive or active (0)4-20mA signal output can be connected to the F053-A. To power the sensor, several options are available.

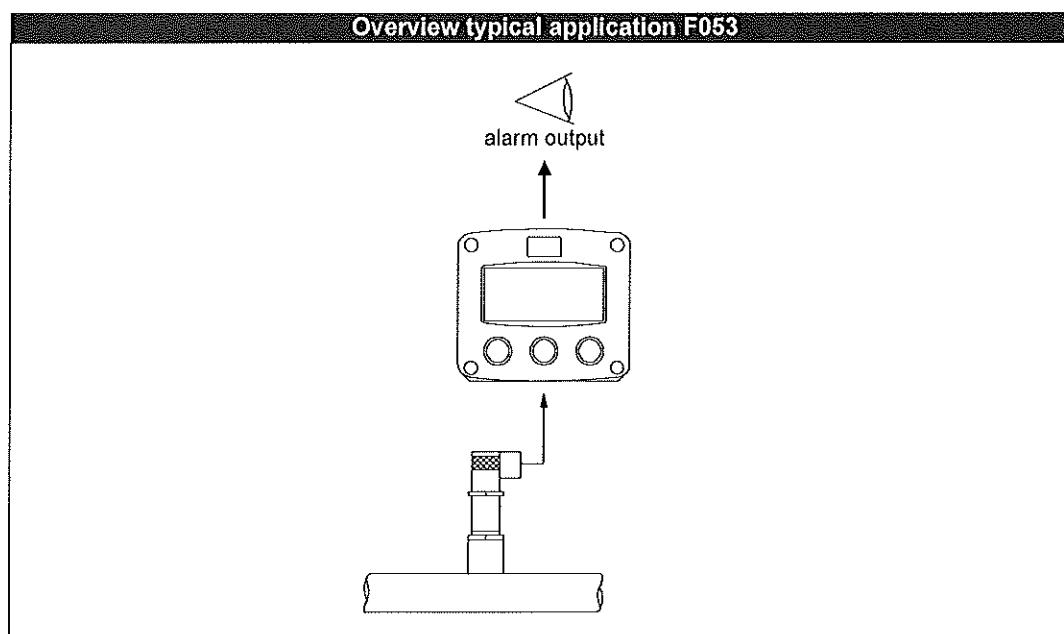


Fig. 1: Typical application for the F053-A.

Configuration of the unit

The F053-A has been designed to be implemented in many types of applications. For that reason, a SETUP-level is available to configure your F053-A according to your specific requirements.

It includes several important features, such as Span, measurement units, display options etc. All setting are stored in EEPROM memory and will not be lost in the event of power failure. To extend the battery-life time, please use of the power-management functions as described in chapter 3.2.3.

Display information

The unit has a large transreflective LCD with all kinds of symbols and digits to display measuring units, status information, trend-indication and key-word messages.

Pressure and alarm values are displayed with the large 17mm digits while the smaller 8mm digits display the measuring unit and alarm messages.

Options

The following options are available: intrinsic safety, mechanical relay or active outputs, power- and sensor-supply options, panel-mount, wall-mount and weather-proof enclosures, flame proof enclosure and LED backlight.

2. OPERATIONAL

2.1. GENERAL



- **The F053-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.**
- **Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.**

This chapter describes the daily use of the F053-A. This instruction is meant for users / operators.

2.2. CONTROL PANEL

The following keys are available:



Fig. 2: Control Panel.

Functions of the keys



This key is used to program and save new values or settings.
It is also used to gain access to SETUP-level; please read chapter 3.



This key is used to SELECT the pressure alarm values.
The arrow-key ▲ is used to increase a value after PROG has been pressed
or to configure the unit; please read chapter 3.



The arrow-key ▶ is used to select a digit after PROG has been pressed or to
configure the unit; please read chapter 3.

2.3. OPERATOR INFORMATION AND FUNCTIONS

In general, the F053-A will always function at Operator level. The information displayed is dependant upon the SETUP-settings. The signal generated by the connected sensor is measured by the F053-A in the background, whichever screen refresh rate setting is chosen. After pressing a key, the display will be updated very quickly during a 30 second period, after which it will slow-down again.



Fig. 3: Example of display information during process.

For the Operator, the following functions are available:

- **Display pressure**

This is the main display information of the F053-A. After selecting any other information, it will always return to this main display automatically.
Pressure is displayed on the upper-line of the display and the measuring unit and alarm messages on the bottom line.
When "-----" is shown, then the value is too high to be displayed. The arrows \blacktriangleleft indicate the increase/decrease of the pressure trend.

- **Programming the pressure alarm values**



Note!

Note: This function might not be accessible due to a configuration setting.

When the SELECT-key is pressed a few times, following pressure alarm values are displayed:

- low pressure alarm: enter here 40 Bar for example,
- high pressure alarm: enter here 300 Bar for example,

To change the alarm value, the following procedure must be executed:

- 1) press PROG: the word "PROGRAM" will flash or a pass code will be requested,
- 2) use \rightarrow to select the digits and \blacktriangleup to increase that value,
- 3) confirm the new alarm value by pressing ENTER.



Fig. 4: Example of display information during programming minimum pressure.

When data is altered but ENTER has not been pressed yet, then the alteration can still be cancelled by waiting for 20 seconds or by pressing ENTER during three seconds: the former value will be reinstated.

- **Pressure alarm**

When the actual pressure is outside the allowed range, an alarm message will be displayed indicating the type of alarm: "LO PRESSURE", "HI PRESSURE".

The alarm is terminated automatically as soon as the pressure is within its range again.

- **Low-battery alarm**

When the battery voltage drops, it must be replaced. At first "low-battery" will flash, but as soon as it is displayed continuously, the battery MUST be replaced shortly after!

Only official batteries may be used, or else the guarantee will be terminated. The remaining lifetime after the first moment of indication is generally several days up to some weeks.



Fig. 5: Example of low-battery alarm.

- **Alarm 01-03**

When "alarm" is displayed, please consult Appendix B: problem solving.

3. CONFIGURATION

3.1. INTRODUCTION

This and the following chapters are exclusively meant for electricians and non-operators. In these, an extensive description of all software settings and hardware connections are provided.



Caution!

- *Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.*
- *The F053-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.*
- *Ensure that the measuring system is correctly wired up according to the wiring diagrams. The housing may only be opened by trained personnel.*
- *Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.*

3.2. PROGRAMMING SETUP-LEVEL

3.2.1. GENERAL

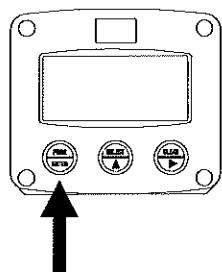
Configuration of the F053-A is done at SETUP-level. SETUP-level is reached by pressing the PROG/ENTER key for 7 seconds; at which time, both arrows \blacktriangleleft will be displayed. In order to return to the operator level, PROG will have to be pressed for three seconds. Alternatively, if no keys are pressed for 2 minutes, the unit will exit SETUP automatically.

SETUP can be reached at all times while the F053-A remains fully operational.



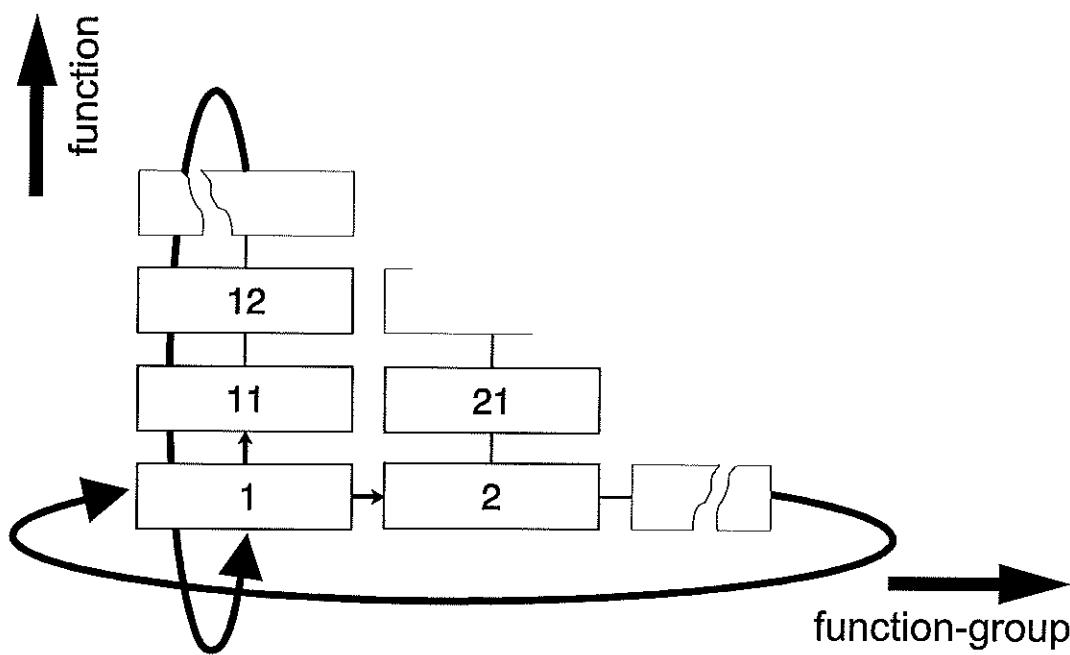
Note: A pass code may be required to enter SETUP. Without this pass code access to SETUP is denied.

To enter SETUP-level:



Press  for 7 seconds

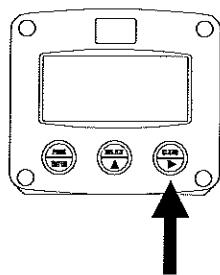
Matrix structure SETUP-level:



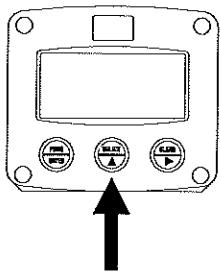
SCROLLING THROUGH SETUP-LEVEL

Selection of function-group and function:

SETUP is divided into several function groups and functions.



Select function-group with

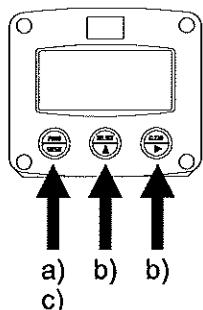


Select function with

Each function has a unique number, which is displayed below the word "SETUP" at the bottom of the display. The number is a combination of two figures. The first figure indicates the function-group and the second figure the sub-function. Additionally, each function is expressed with a keyword.

After selecting a sub-function, the next main function is selected by scrolling through all "active" sub-functions (e.g. 1▲, 11▲, 12▲, 13▲, 14▲, 1▼, 2▼, 3▼, 31 etc.). The "CLEAR" button can be used to jump a step back if you missed the desired function.

To change or select a value:



- a) press briefly; **PROGRAM** will start flash
- b) select or enter value with and / or
- c) press to confirm the value / selection.

To change a value, use **▼** to select the digits and **▲** to increase that value.
If the new value is invalid, the increase sign **▲** or decrease-sign **▼** will be displayed while you are programming.

To select a setting, **▲** is used to select in one direction and **▼** can be used to select in the other direction.

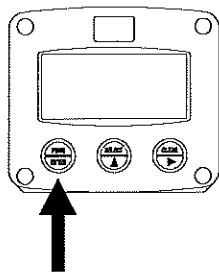
When data is altered but ENTER is not pressed, then the alteration can still be cancelled by waiting for 20 seconds or by pressing ENTER for three seconds: the PROG-procedure will be left automatically and the former value reinstated.



Note: alterations will only be set after ENTER has been pressed!

Note !

To return to OPERATOR-level:



Press for 3 seconds

In order to return to the operator level, PROG will have to be pressed for three seconds. Also, when no keys are pressed for 2 minutes, SETUP will be left automatically.

3.2.2. OVERVIEW FUNCTIONS SETUP LEVEL

SETUP FUNCTIONS AND VARIABLES		
1	PRESSURE	
11	UNIT	mbar - bar - PSI - no unit
12	DECIMALS	0 - 1 - 2 - 3 (Ref: displayed value)
13	SPAN	0.000001 - 999,999 unit
14	DECIMALS SPAN	0 - 6
15	OFFSET	-999,999 to +999,999 unit
2	ALARM	
21	PRESSURE ZERO	default - no relays - ignore
22	ALARM LOW	000.000 - 999,999 unit
23	ALARM HIGH	000.000 - 999,999 unit
24	DELAY ALARM LOW	0.1 - 999.9 seconds
25	DELAY ALARM HIGH	0.1 - 999.9 seconds
26	ALARM OUTPUT	high - low - both
3	DISPLAY	
31	SET ALARM	operator - setup
32	BACKLIGHT (optional)	off - green - amber
33	BACKLIGHT ALARM	off - on - flash
34	BL. BRIGHTNESS	1 - 5
4	POWER MANAGEMENT	
41	LCD UPDATE	fast - 1 sec - 3 sec - 15 sec - 30 sec - off
42	BATTERY MODE	operational - shelf
5	SENSOR	
51	FORMULA	interpolation, square root
52	FILTER	00 - 99
53	CUT-OFF	0.0 - 99.9%
54	CALIBRATE LOW	(0)4mA
55	CALIBRATE HIGH	20mA
6	OTHERS	
61	TYPE / MODEL	F053-A
62	SOFTWARE VERSION	03.xx.xx
63	SERIAL NO.	xxxxxx
64	PASS CODE	0000 - 9999
65	TAGNUMBER	0000000 - 9999999

3.2.3. EXPLANATION OF SETUP-FUNCTIONS

1 - PRESSURE	
MEASUREMENT UNIT 11	SETUP - 11 determines the measurement unit for the displayed pressure and alarm values. The following units can be selected: mbar - bar - PSI - _ (no unit). Alteration of the measurement unit will have consequences for operator and SETUP-level values. Please note that the Span has to be adapted as well; the calculation is not done automatically.
DECIMALS 12	This setting determines for pressure and the alarm values the number of digits following the decimal point. The following can be selected: 00000 - 1111.1 - 2222.22 - 3333.333
SPAN 13	With the span, the sensor signal is converted to a quantity. The <u>span for pressure</u> is determined on the basis of the <u>selected measurement unit</u> at 20mA. Enter the span in whole numbers (decimals are set with SETUP 14). The more accurate the span, the more accurate the functioning of the system will be. Example Calculating the span for pressure <i>Let us assume that the sensor generates 20mA at a pressure of 18.95 Bar and the selected unit is "mbar". The span is 18,950 mbar, Enter for SETUP - 23: "18950" and for SETUP - 24 - decimals span "0".</i>
DECIMALS SPAN 14	This setting determines the number of decimals for Span (SETUP 13). The following can be selected: 0 - 1 - 2 - 3 - 4 - 5 - 6
OFFSET 15	Enter here the "not measured" pressure from where there the sensor starts to generate a signal, in many cases 0 or 1 Bar. Also, a negative offset can be entered: do press the middle and right button simultaneously.



Note 1

2 - ALARM

With these settings, it is determined how the pressure will be monitored and the functionality of the transistor / relay output (terminals 7-8) be determined.

PRESSURE ZERO 21	When the signal is the minimum value, then it is possible to ignore or disable the pressure monitoring. The following settings can be selected: DEFAULT: in case of a low-pressure alarm and zero pressure, it will switch the alarm output and indicate the alarm on the display. NO RELAY: in case of a low-pressure alarm and zero pressure, it won't switch the alarm output but will indicate the alarm on the display only. IGNORE: in case of a low-pressure alarm and zero pressure, it won't switch the alarm output and nothing will be indicated on the display.
ALARM VALUE LOW PRESSURE 22	The low alarm is set with this setting. An alarm will be generated as long as the pressure lower than this value. With value 0.0 this function is disabled.
ALARM VALUE HIGH PRESSURE 23	The high alarm is set with this setting. An alarm will be generated as long as the pressure higher than this value. With value 0.0 this function is disabled.
DELAY TIME ALARM LOW PRESSURE 24	An alarm generated by SETUP 22 "low" can be ignored during X-time period. If the actual pressure is still incorrect after this delay time, then an alarm will be generated.
DELAY TIME ALARM HIGH PRESSURE 25	An alarm generated by SETUP 23 "high" can be ignored during X-time period. If the actual pressure is still incorrect after this delay time, then an alarm will be generated.
ALARM OUTPUT TRANSISTOR / RELAY 26	One transistor or relay output is available to transmit the alarm condition. Assign with this function the type of alarm to be transmitted: low pressure alarm, high pressure alarm or both alarms.

3 - DISPLAY

SET ALARM 31	This function determines if the pressure alarm values can be set at both Operator level and SETUP-level or SETUP-level only. If SETUP has been selected, the alarm values are still visible for the Operator but can not be changed.
BACKLIGHT (OPTION) 32	If a LED backlight has been supplied, the color can be selected. Following selections are available: OFF - GREEN - AMBER
BACKLIGHT ALARM (OPTION) 33	In case the F053-A generates a pressure alarm, the backlight can be set to change to red. Following selections are available: OFF: during pressure alarm the color is according to setting 32 ON: during pressure alarm the color is red. FLASH: during pressure alarm the color flashes red and the color as set with SETUP 43.
BRIGHTNESS (OPTION) 34	The density of the backlight can be set in following range: 1 - 5 One is minimum and five is maximum brightness.

4 - POWER MANAGEMENT

When used with the internal battery option, the user can expect reliable measurement over a long period of time. The F053-A has several smart power management functions to extend the battery life time significantly. Two of these functions can be set:



LCD NEW 41	<p>The calculation of the display-information influences the power consumption significantly. When the application does not require a fast display update, it is strongly advised to select a slow refresh rate. Please understand that NO information will be lost; the input signal will be processed and the output signal will be generated in the normal way. The following can be selected:</p> <p style="margin-left: 40px;">Fast - 1 sec - 3 sec - 15 sec - 30 sec - off.</p> <p>Example battery life-time:</p> <p style="margin-left: 40px;">battery life-time with a FAST update: about 3 years. battery life-time with a 1 sec update: about 5 years.</p> <p>Note: after a button has been pressed by the operator - the display refresh rate will always switch to FAST for 30 seconds. When "OFF" is selected, the display will be switched off after 30 seconds and will be switched on as soon as a button has been pressed.</p>
BATTERY-MODE 42	<p>The unit has two modes: operational or shelf. After "shelf" has been selected, the unit can be stored for several years; it will not process the sensor signal; the display is switched off but all settings are stored. In this mode, power consumption is extremely low. To wake up the unit again, press the SELECT-key twice.</p>

5 - SENSOR

SIGNAL 51	<p>The F053-A can process the analog signal of the sensor in two ways:</p> <ul style="list-style-type: none"> ▪ Interpolation: the signal is processed linear $P = S \times I$ ▪ Square root: for differential pressure $P = S \sqrt{I}$ <p>where: P = Pressure: the calculated pressure S = Span: the maximum pressure at 20mA. The span is programmed with setting 13 for pressure I = Input: the scaled analog value; in these formulas value 0 (zero) for (0)4mA and value 1 (one) for 20mA.</p>																																																																
FILTER 52	<p>The analog output signal of a sensor does mirror the actual pressure. This signal is measured several times a second by the F053-A. The value measured is a "snap-shot" of the real pressure as it will be fluctuating. With the help of this digital filter a stable and accurate reading can be obtained while the filter level can be set to a desired value.</p> <p>The filter principal is based on three input values: the filter level (01-99), the last measured analog value and the last average value. The higher the filter level, the longer the response time on a value change will be. Below, several filter levels with there response times are indicated:</p>																																																																
FILTER VALUE	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th rowspan="2"></th> <th colspan="4">RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE.</th> </tr> <tr> <th colspan="4">TIME IN SECONDS</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>50% INFLUENCE</td> <td>75% INFLUENCE</td> <td>90% INFLUENCE</td> <td>99% INFLUENCE</td> </tr> <tr> <td>02</td> <td>filter disabled</td> <td>filter disabled</td> <td>filter disabled</td> <td>filter disabled</td> </tr> <tr> <td>03</td> <td>0.3 seconds</td> <td>0.5 seconds</td> <td>1.0 seconds</td> <td>1.8 seconds</td> </tr> <tr> <td>05</td> <td>0.5 seconds</td> <td>1.0 seconds</td> <td>1.5 seconds</td> <td>3 seconds</td> </tr> <tr> <td>10</td> <td>1.0 seconds</td> <td>1.8 seconds</td> <td>2.8 seconds</td> <td>5.3 seconds</td> </tr> <tr> <td>20</td> <td>1.8 seconds</td> <td>3.5 seconds</td> <td>5.6 seconds</td> <td>11 seconds</td> </tr> <tr> <td>30</td> <td>3.5 seconds</td> <td>7.0 seconds</td> <td>11 seconds</td> <td>23 seconds</td> </tr> <tr> <td>50</td> <td>5.3 seconds</td> <td>10 seconds</td> <td>17 seconds</td> <td>34 seconds</td> </tr> <tr> <td>75</td> <td>8.8 seconds</td> <td>17 seconds</td> <td>29 seconds</td> <td>57 seconds</td> </tr> <tr> <td>99</td> <td>13 seconds</td> <td>26 seconds</td> <td>43 seconds</td> <td>86 seconds</td> </tr> <tr> <td></td> <td>17 seconds</td> <td>34 seconds</td> <td>57 seconds</td> <td>114 seconds</td> </tr> </tbody> </table>		RESPONSE TIME ON STEP CHANGE OF ANALOG VALUE.				TIME IN SECONDS				01	50% INFLUENCE	75% INFLUENCE	90% INFLUENCE	99% INFLUENCE	02	filter disabled	filter disabled	filter disabled	filter disabled	03	0.3 seconds	0.5 seconds	1.0 seconds	1.8 seconds	05	0.5 seconds	1.0 seconds	1.5 seconds	3 seconds	10	1.0 seconds	1.8 seconds	2.8 seconds	5.3 seconds	20	1.8 seconds	3.5 seconds	5.6 seconds	11 seconds	30	3.5 seconds	7.0 seconds	11 seconds	23 seconds	50	5.3 seconds	10 seconds	17 seconds	34 seconds	75	8.8 seconds	17 seconds	29 seconds	57 seconds	99	13 seconds	26 seconds	43 seconds	86 seconds		17 seconds	34 seconds	57 seconds	114 seconds
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CUT-OFF 53	<p>To ignore e.g. vibration due to an empty tank, a low-level cut-off can be set as percentage over the full range of 16mA (or 20mA). When the analog value is less then required with this setting, the signal will be ignored.</p> <p>The cut-off value can be programmed is the range 0.0 - 99.9%.</p> <p>Examples:</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>SPAN (setup 13)</th> <th>REQUIRED CUT-OFF</th> <th>CUT-OFF (setup 53)</th> <th>REQUIRED OUTPUT</th> </tr> </thead> <tbody> <tr> <td></td> <td>450 L</td> <td>25 L</td> <td>25/450 x 100% = 5.5%</td> <td>16mA x 5.5% + 4mA = 4.88mA</td> </tr> </tbody> </table>		SPAN (setup 13)	REQUIRED CUT-OFF	CUT-OFF (setup 53)	REQUIRED OUTPUT		450 L	25 L	25/450 x 100% = 5.5%	16mA x 5.5% + 4mA = 4.88mA																																																						
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Continued next page >>>

5 - SENSOR (CONTINUED)

TUNE MIN / 4MA 54	<p>With this setting it is possible to calibrate the input value for (0)4mA as the signal from the sensor might not be exact 4.0 mA (or 0.0 mA) at pressure zero.</p> <p>This function will measure the real output value at pressure zero.</p> <p><i>Please note: the input loop powered version - type A-PL - requires a signal from 4mA and not lower!</i></p> <ul style="list-style-type: none"> ▪ Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system! <p>After pressing PROG, three settings can be selected:</p> <ul style="list-style-type: none"> ▪ CALIBRATE: with this setting, the input will be calibrated with the actual "(0)4mA" value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be more than the calibrated value before the signal will be processed. ▪ DEFAULT: with this setting, the manufactures value is re-installed. ▪ CAL SET: to select the last calibrated value.
TUNE MAX / 20MA 55	<p>With this setting it is possible to calibrate the input value for 20mA as the signal from the sensor might not be exact 20.0 mA at maximum pressure. This function will measure the real output value at maximum pressure.</p> <p><i>Warning: be very sure that the offered signal is correct before the calibration is executed as this function has major influences on the accuracy of the system!</i></p> <p>After pressing PROG, three settings can be selected:</p> <ul style="list-style-type: none"> ▪ CALIBRATE: with this setting, the input will be calibrated with the actual "20mA" value. After pressing enter, CAL SET will be displayed as soon as the calibration is completed. From that moment, the analog value must be less than the calibrated value for a reliable measurement. ▪ DEFAULT: with this setting, the manufactures value is re-installed. ▪ CAL SET: to select the last calibrated value.



6 - OTHERS

TYPE OF MODEL 61	<p>For support and maintenance it is important to have information about the characteristics of the F053-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.</p>
VERSION SOFTWARE 62	<p>For support and maintenance it is important to have information about the characteristics of the F053-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.</p>
SERIAL NUMBER 63	<p>For support and maintenance it is important to have information about the characteristics of the F053-A. Your supplier will ask for this information in the case of a serious breakdown or to assess the suitability of your model for upgrade considerations.</p>
PASS CODE 64	<p>All SETUP-values can be pass code protected. This protection is disabled with value 0000 (zero). Up to and including 4 digits can be programmed, for example 1234.</p>
TAGNUMBER 65	<p>For identification of the unit and communication purposes, a unique tag number of maximum 7 digits can be entered.</p>

4. INSTALLATION

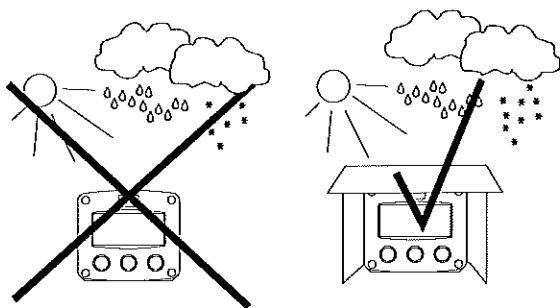
4.1. GENERAL DIRECTIONS

- Mounting, electrical installation, start-up and maintenance of this instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.
- The F053-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained personnel.
- Take careful notice of the " Safety rules, instructions and precautionary measures " at the front of this manual.



Caution!

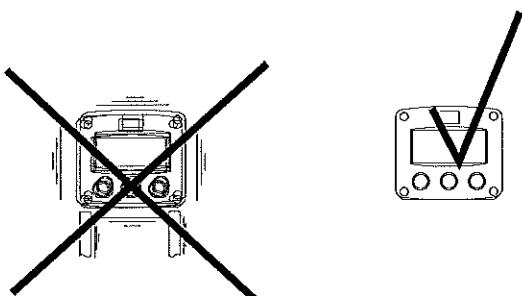
4.2. INSTALLATION / SURROUNDING CONDITIONS



Take the relevant IP classification of the casing into account (see manufacturer's plate). Even an IP67 (NEMA 4X) casing should NEVER be exposed to strongly varying (weather) conditions.

When panel-mounted, the unit is IP65 (NEMA 4)!

When used in very cold surroundings or varying climatic conditions, take the necessary precautions against moisture by placing a dry sachet of silica gel, for example, inside the instrument case.



Mount the F053-A on a solid structure to avoid vibrations.

4.3. DIMENSIONS- ENCLOSURE

Type HC: IP65 (NEMA 4) ABS panel-mount enclosure:

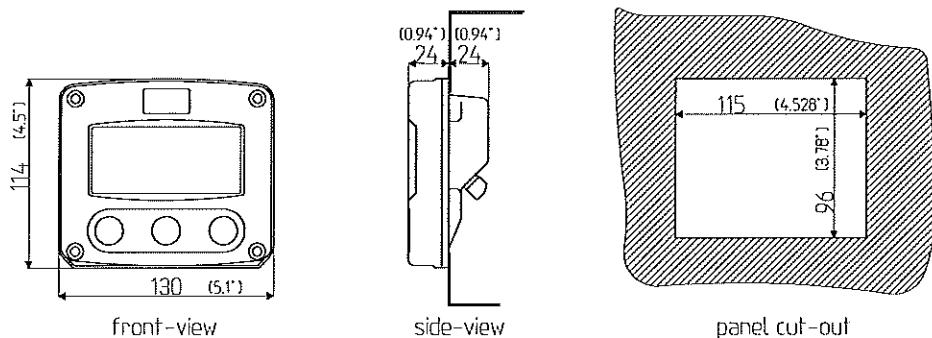


Fig. 6: Dimensions of type HC - IP65 ABS Panel-mount casing / panel cut-out.

Type HD: IP67 (NEMA 4X) ABS Wall-mount enclosure:

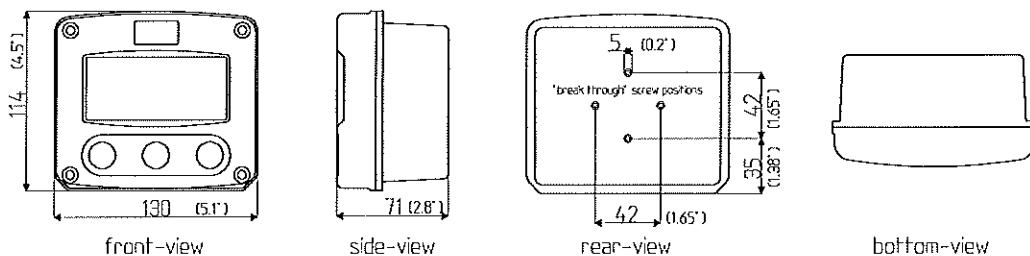


Fig. 7: Dimensions of type HD - IP67 ABS Wall-mount enclosure.

Type HA: IP67 Aluminum Field enclosure with 2xPG9 and 1xM20 Tapped holes:

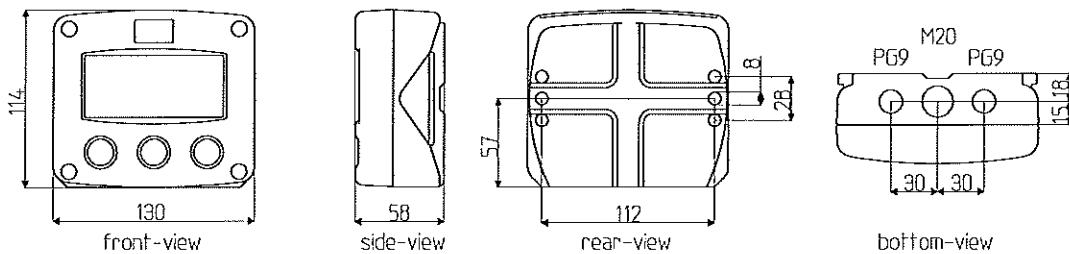


Fig. 8: Dimensions of type HA - IP67 Aluminum Field enclosure with 2xPG9 and 1xM20 drilling.

Type HU: NEMA 4X Aluminum Field enclosure with 3x 1/2" NPT Tapped holes:

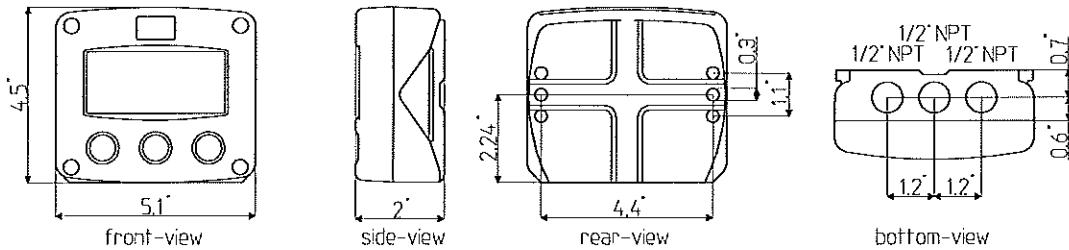


Fig. 9: Dimensions of type HU - NEMA 4X Aluminum Field enclosure with 3x 1/2"NPT drilling.

4.4. INSTALLING THE HARDWARE

4.4.1. INTRODUCTION



- *Electro static discharge does inflict irreparable damage to electronics! Before installing or opening the unit, the installer has to discharge himself by touching a well-grounded object.*



- *This unit must be installed in accordance with the EMC guidelines (Electro Magnetic Compatibility).*



- *Do ground the aluminum casing properly (option HA / HU) as indicated, If the F053-A has been supplied with the 115-230V AC power-supply option PM. The green / yellow wire between the back-casing and removable terminal-block may never be removed.*

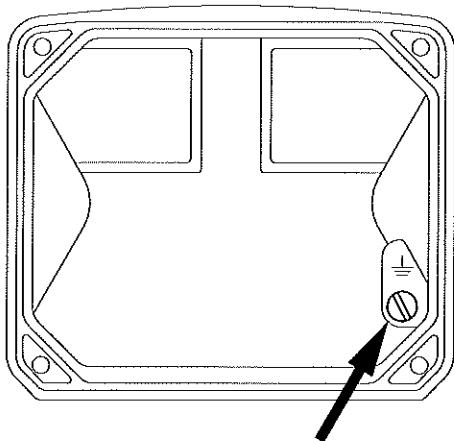


Fig. 10: Grounding aluminum enclosure with option PM 115-230V AC.

FOR INSTALLATION, PAY EMPHATIC ATTENTION TO:

- Separate cable glands with effective IP67 (NEMA4X) seals for all wires.
- Unused cable entries: ensure that you fit IP67 (NEMA4X) plugs to maintain rating.
- A reliable ground connection for both the sensor, and if applicable, for the metal casing. (above)
- An effective screened cable for the input signal, and grounding of its screen to the "L" terminal or at the sensor itself, whichever is appropriate to the application.

4.4.2. TERMINAL CONNECTORS WITH POWER SUPPLY - TYPE : PB / PD / PL / PX

For Intrinsically Safe applications: read chapter 5.

The following terminal connectors are available:

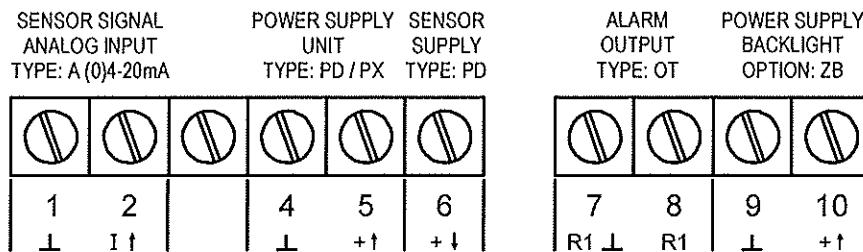


Fig. 11: Overview of terminal connectors F053-A-(PB / PD / PL / PX)-OT and options.

SENSOR SUPPLY

Type PD - terminal 6: sensor supply - input voltage:

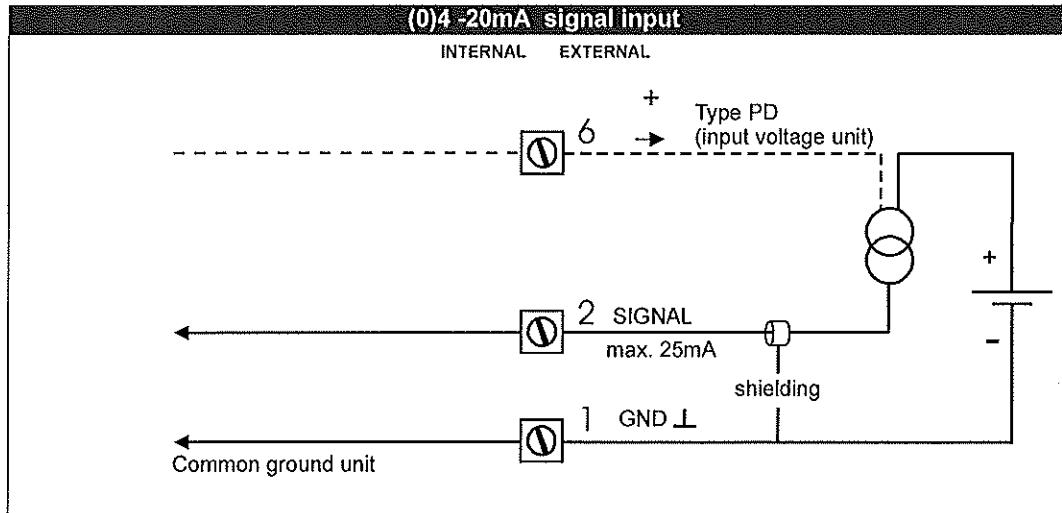
With this option, the input voltage as connected to terminal 5 is available. This terminal is internally linked to terminal 5.

REMARKS: TERMINAL CONNECTORS:

Terminals 1-2; Sensor input:

The F053-A requires a (0)4-20mA sensor signal which will be processed 4 times a second with a 16 bits accuracy. The input is not isolated.

The screen of the signal wire must be connected to the common ground terminal



Terminals 1-2; sensor INPUT LOOP POWERED - type A-PL:

Model F014-A-PL is powered from the 4-20mA sensor signal. In the mean time, the unit will process the signal four times a second with a 16 bit accuracy. The input is not isolated.

The screen of the signal wire must be connected to the common ground terminal 1.

Terminal 4-5: POWER SUPPLY UNIT - TYPE PD / PX:

To power the unit an internal battery can be used (type PB) and / or an external DC power supply of 8-30V DC (type PX) or 16-30V DC (type PD).

Connect the "-" to terminal 4 and the "+" to terminal 5. When power is applied to these terminals, the optional internal battery will be disabled / enabled automatically to extend the battery life time.

The input loop powered model - type A-PL - does not have this power supply option.

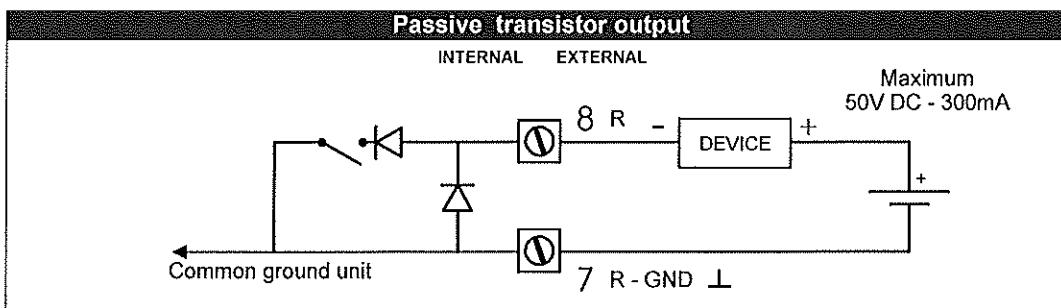
Terminal 6: Power supply type PD: sensor supply voltage.

With this option, a sensor supply terminal comes available which offers the same voltage as connected to terminal 5 (internally linked).

Remark: this terminal is only available if option PD has been ordered.

Terminal 7-8; transistor or relay output:

With SETUP 26, the function of this output is set to a low and / or high pressure alarm.



Terminal 9-10: power supply backlight (optional):

To power the backlight, a voltage in the range 20-30V DC has to be connected.

Connect the "-" to terminal 9 and the "+" to terminal 10.

4.4.3. TERMINAL CONNECTORS WITH POWER SUPPLY - TYPE : PF / PM

For Intrinsically Safe applications: read chapter 5.

The following terminal connectors are available:

POWER SUPPLY TYPE: PF / PM			ALARM OUTPUT TYPE: OA-OR-OT		SENSOR SIGNAL TYPE: A ANALOG (0)4-20mA		
GND	1	2	3	4	5	6	7
⊥ N	L1	R⊥	R	⊥	I↑	+↓	

Fig. 12: Overview of terminal connectors F053-A-(PF-PM)-OA-OR-OT and options.

SENSOR SUPPLY

Type PF-PM: Sensor supply: 3.2V, 8.2V, 12V or 24 V:

With this option, a real power supply for the sensor is available. The sensor can be powered with 3.2, 8.2, 12 or 24 V DC (max. 400mA@24V).

The voltage is selected with the three switches inside the enclosure.



- **Warning: be sure that all the leads to the terminals are disconnected from the unit when the internal plastic protection cover has been removed !**
- **HIGH VOLTAGE 400V !! NEVER connect the mains power supply to the unit when the plastic protection cover has been removed !!!**

First, remove the terminal strip(s) after which the internal plastic cover can be removed. The switches are located on the right hand side as indicated:

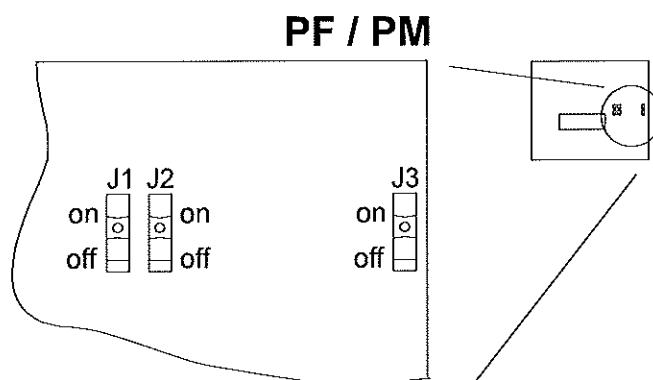


Fig. 13: switch position voltage selection (type PF and PM).

Switch positions / sensor supply voltage:

SWITCH	VOLTAGE SELECTION			
	3.2V DC	8.2V DC	12V DC	24V DC
J1	on	off	off	off
J2	on or off	on	on	off
J3	on or off	on	off	on or off

REMARKS: TERMINAL CONNECTORS:

Terminal GND- 01- 02; POWER SUPPLY only available with type PF / PM:

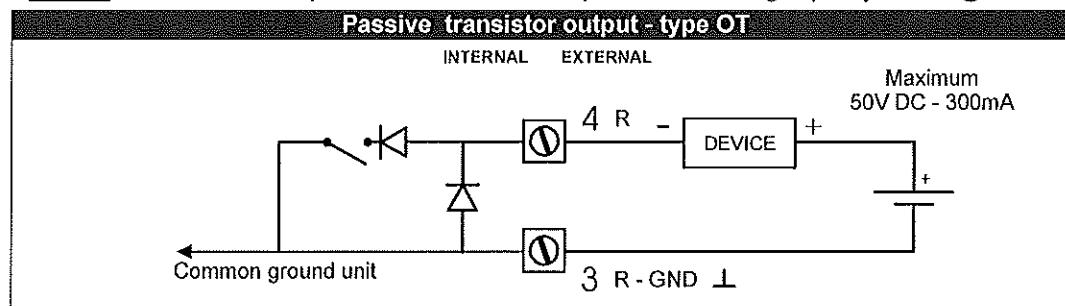
OPTION	SENSOR SUPPLY	Terminal		
		GND	01	02
PF 24V AC ± 10%	3.2, 8.2, 12, 24V max. 400mA@24V DC		AC	AC
PF 24V DC ± 10%	3.2, 8.2, 12, 24V max. 400mA@24V DC	L-	L+	
PM 115-230V AC ± 10%	3.2, 8.2, 12, 24V max. 400mA@24V DC	EARTH	AC	AC
Note PF / PM	The total consumption of the sensor, transistor output type OA and backlight type ZB may not exceed 400mA@24V DC.			

Terminal 3-4; transistor or relay output:

With SETUP 26, the function of this output is set to a low and / or high pressure alarm output.

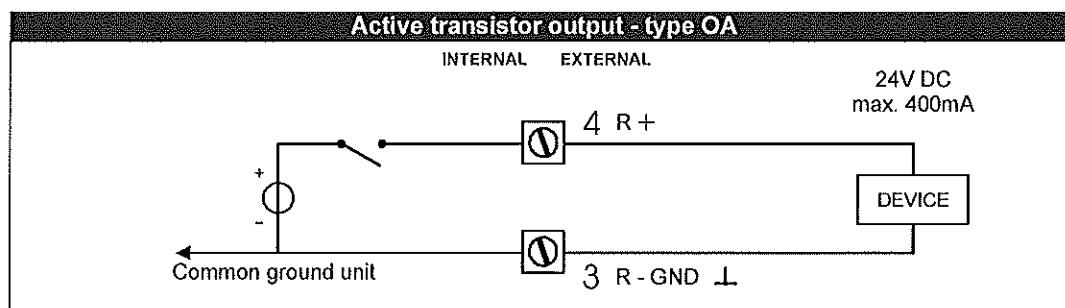
Type OT:

A passive flowrate alarm output is available with this option. Max. driving capacity 300mA@50V DC.

**Type OA:**

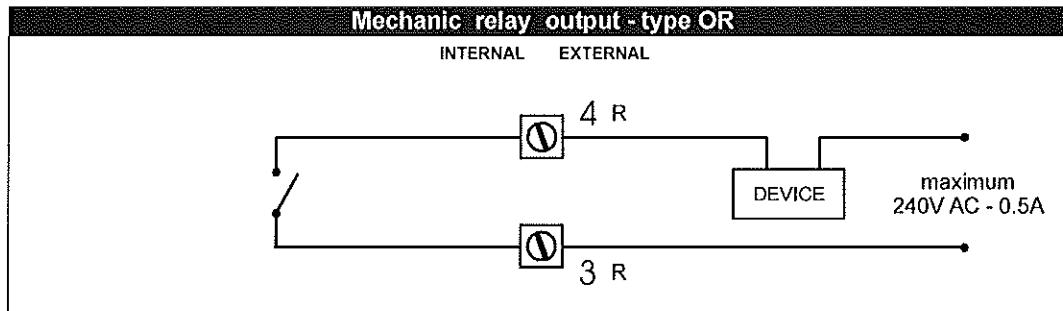
An active 24V DC signal flowrate alarm output is available with this option.

Max. driving capacity 400mA@24V DC. (Requires power supply type PF / PM).



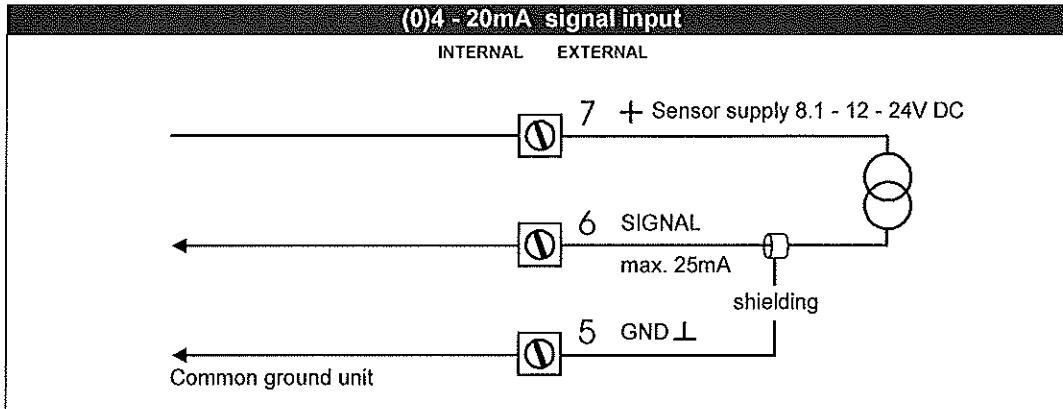
Type OR:

An isolated mechanical relay alarm output is available with this option.
Max. switch power 240V 0,5A. (Requires power supply PF / PM).

**Terminals 5-7; Sensor input:**

The F053-A requires a (0)4-20mA sensor signal which will be processed 4 times a second with a 16 bits accuracy. The input is not isolated.

The screen of the signal wire must be connected to the common ground terminal 5.



5. INTRINSICALLY SAFE APPLICATIONS

5.1. GENERAL INFORMATION AND INSTRUCTIONS:

- Mounting, electrical installation, start-up and maintenance of this device may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.
- This device may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.
- Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the cabinet has been opened (danger of electric shock). The housing may only be opened by trained personnel.
- Take careful notice of the " Safety rules, instructions and precautionary measures " in the front of this manual.



Caution!



Safety Instructions

- For European Community: the installation of this intrinsically safe device must be in accordance with the Atex directive 94/9/EC.
- This device has to be installed in accordance with the product certificate KEMA 05ATEX1168 X
- Exchange of Intrinsically Safe battery - certified KEMA 03ATEX1071 U - is allowed in Hazardous Area.

Please note



Note!

- Special conditions for safe use mentioned in both the certificate and the installation instructions must be observed for the connection of power to both input and / or output circuits.
- When installing this device in hazardous areas, the wiring and installation must comply with the appropriate installation standards for your industry.
- Study the following pages with wiring diagrams per classification.

Serial number and year of production
This information can be looked-up on the display:
setup function (par. 3.2.2.).

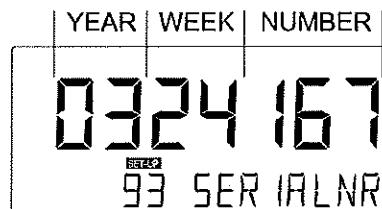


Fig. 14: Example serial number.

Label information analog input type - A (inside and outside the enclosure)

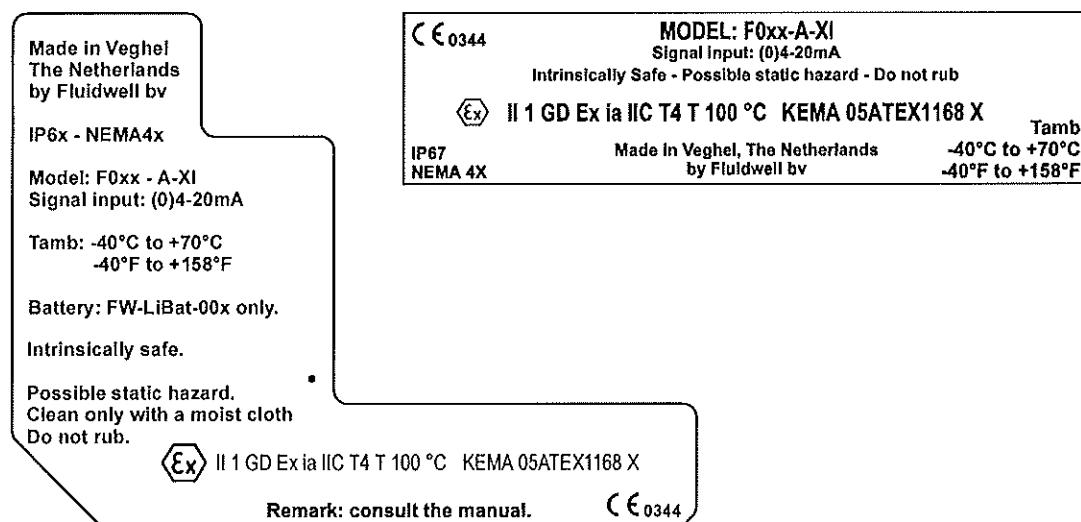


Fig. 15: Label information Intrinsically Safe application.

Label information analog input - loop powered - type A-PL (inside and outside the enclosure)

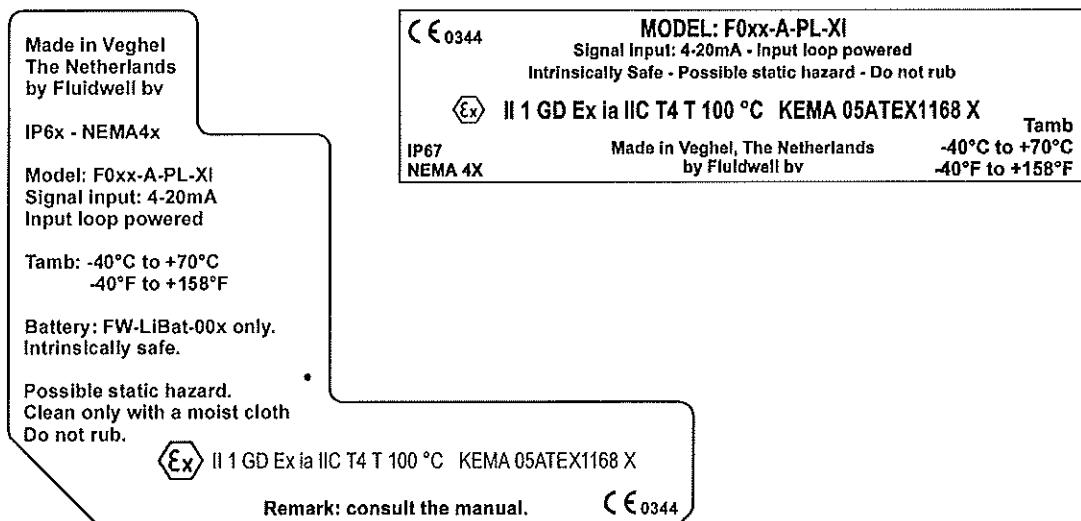


Fig. 16: Label information Intrinsically Safe application.

5.2. TERMINAL CONNECTORS INTRINSICALLY SAFE APPLICATIONS:

Terminal connectors F053-A-(PC / PD / PX)-OT-XI-(ZB):

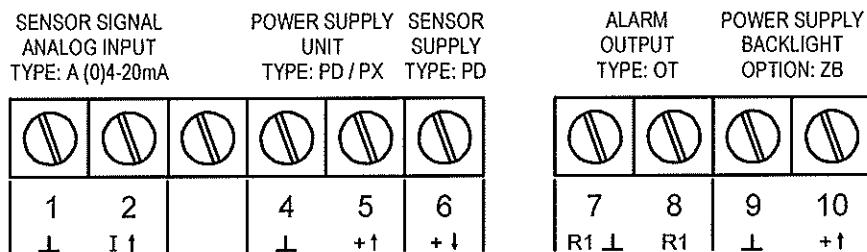


Fig. 17: Overview terminal connectors XI - Intrinsicely Safe applications.

Remarks power supply options:

Type PX: as standard, all intrinsically product are supplied with terminal 4 and 5 to power the product externally.

Type PD: offers - additional to type PX - a sensor supply terminal (terminal 6) which offers the same voltage as connected to terminal 5 (internally linked).

Type PC: offers - additional to type PX - an internal Intrinsicely Safe lithium battery. This ATEX certified battery (FW-LIBATT-xxx) may be changed in hazardous area.

5.3. CONFIGURATION EXAMPLES INTRINSICALLY SAFE APPLICATIONS:

Configuration example no. 1

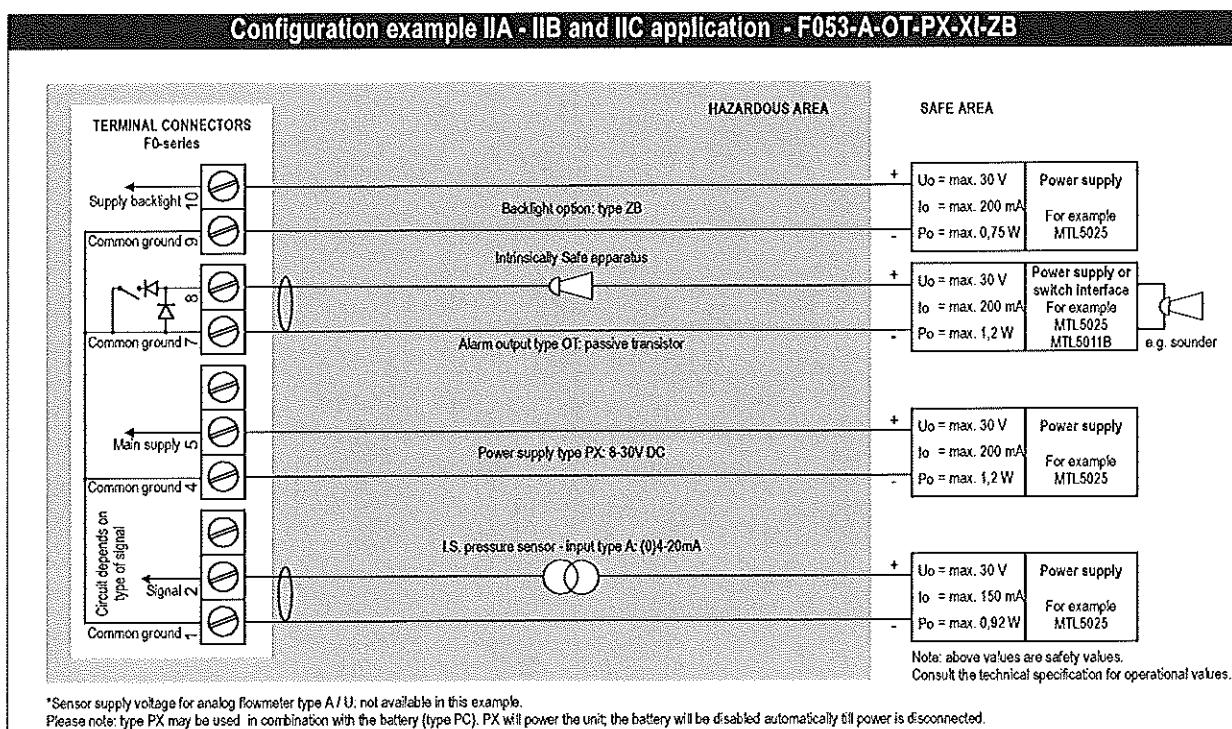


Fig. 18: Configuration example Intrinsicely Safe.

Configuration example no. 2

Configuration example IIA - IIB and IIC application - F053-A-OT-PD-XI-ZB

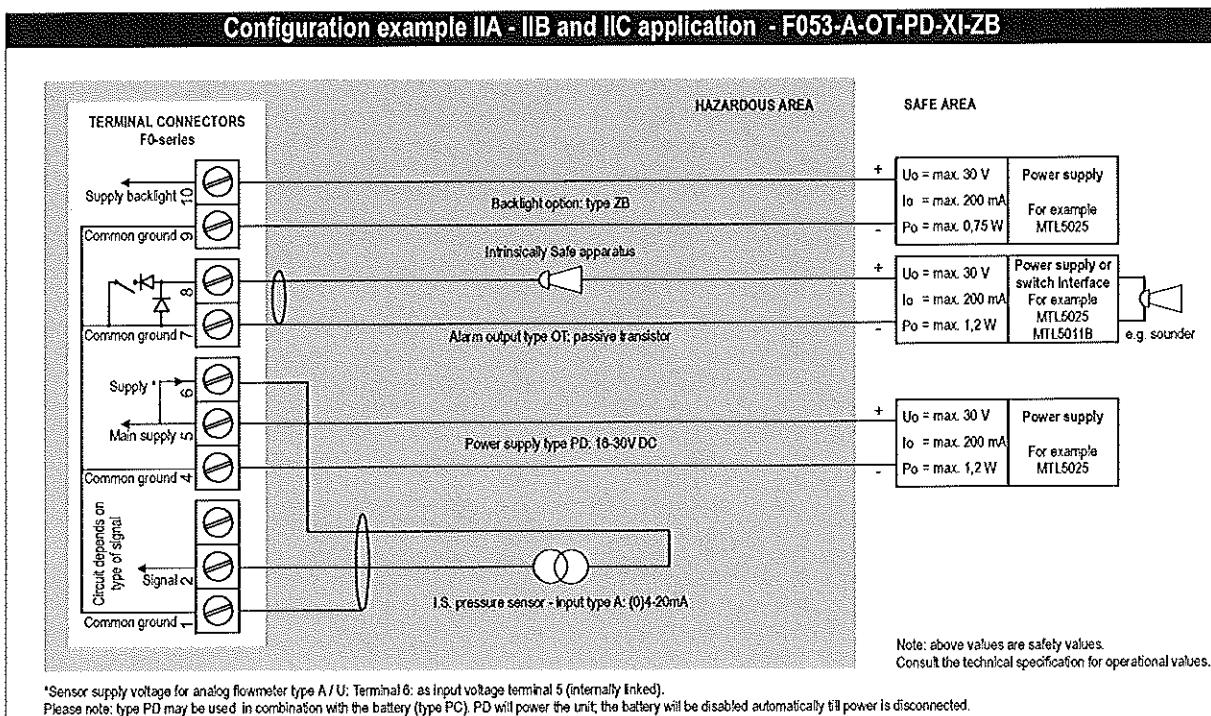


Fig. 19: Configuration example Intrinsically Safe.

Configuration example no. 3

Configuration example IIA - IIB and IIC application - F053-A-OT-PL-XI-ZB

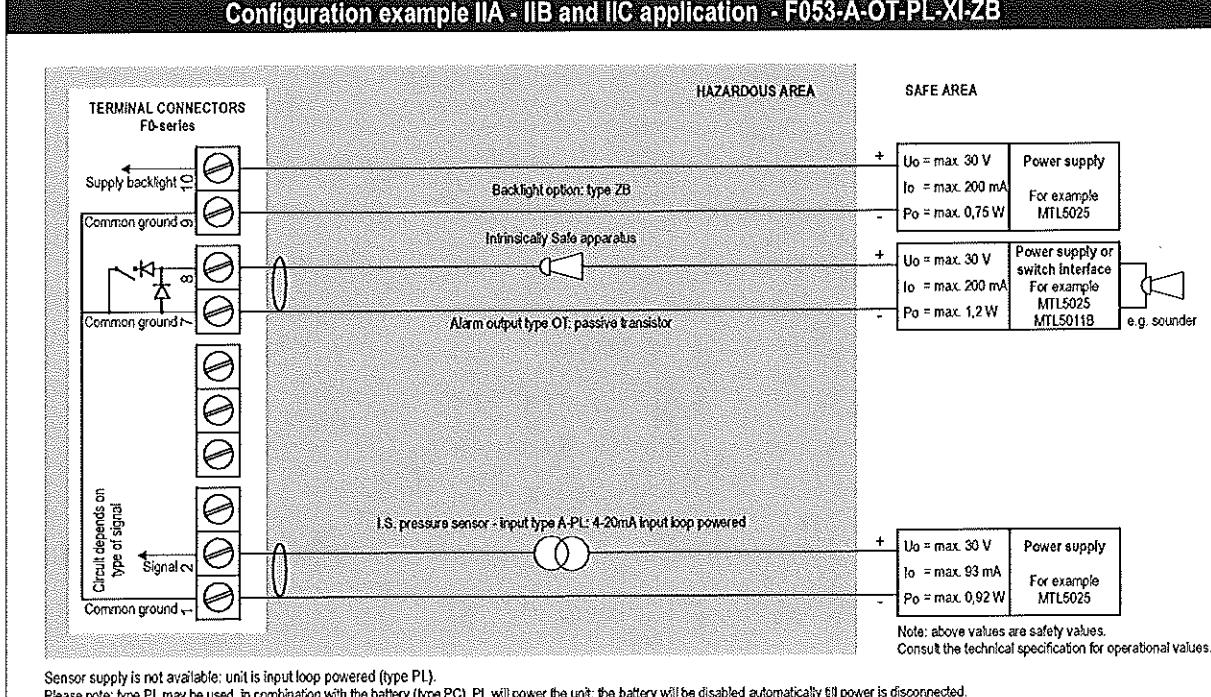


Fig. 20: Configuration example Intrinsically Safe.

6. MAINTENANCE

6.1. GENERAL DIRECTIONS

- *Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorized by the operator of the facility. Personnel must read and understand this Operating Manual before carrying out its instructions.*
- *The F053-A may only be operated by personnel who are authorized and trained by the operator of the facility. All instructions in this manual are to be observed.*
- *Ensure that the measuring system is correctly wired up according to the wiring diagrams. Protection against accidental contact is no longer assured when the housing cover is removed or the panel cabinet has been opened (danger from electrical shock). The housing may only be opened by trained personnel.*
- *Take careful notice of the "Safety rules, instructions and precautionary measures" in the front of this manual.*



Caution !

The F053-A does not require special maintenance unless it is used in low-temperature applications or surroundings with high humidity (above 90% annual mean). It is the users responsibility to take all precautions to dehumidify the internal atmosphere of the F053-A in such a way that no condensation will occur, for example by placing dry silica-gel sachet in the casing just before closing it. Furthermore, it is required to replace or dry the silica gel periodically as advised by the silica gel supplier.

Battery life-time:

It is influenced by several issues :

- Display update: fast display update uses significantly more power.
- Alarm output.
- Low temperatures; the available power will be less due to battery chemistry.



Note !

Check periodically:

- The condition of the casing, cable glands and front panel.
- The input/output wiring for reliability and aging symptoms.
- The process accuracy. As a result of wear and tear, re-calibration of the sensor might be necessary. Do not forget to re-enter any subsequent span alterations.
- The indication for low-battery.
- Clean the casing with soapy-water. Do not use any aggressive solvents as these might damage the polyester coating.

APPENDIX A: TECHNICAL SPECIFICATION

GENERAL

Display	
Type	High intensity reflective numeric and alphanumeric LCD, UV-resistant.
Digits	Seven 17mm (0.67") and eleven 8mm (0.31"). Various symbols and measuring units.
Refresh rate	User definable: 8 times/sec - 30 secs.
Option type ZB	Tri-color configurable LED-backlight - green, amber with red flashing during alarm. Intensity adjustable from the keyboard.

Casing	
General	Polycarbonate window, EPDM and PE gaskets.
Control keys	Three industrial micro-switch keys. UV-resistant polyester keypad.
Type HC	ABS - IP65 / NEMA 4 panel mount enclosure, UV-resistant and flameproof. 130 x 114 x 52mm (5.1" x 4.5" x 2.05") - LxHxD. 115 x 96mm (4.53" x 3.78") LxH.
Type HA / HT / HU / HZ	Die-cast aluminum IP67 / NEMA 4 with 2-component UV-resistant coating. 130 x 114 x 58mm (5.1" x 4.5" x 2.28") - LxHxD.
Dimensions	Mounting Panel cut-out
Type HD / HF	Wall-mount, sensor head-mount, panel-mount, horizontal/vertical pipes. HA: 2xPG9 and 1xM20. HT: 1x 1/2"NPT tapped hole in the center. HU: 3x 1/2"NPT tapped hole. HZ: None, user defined
Dimensions	
Cable Entry	ABS IP67 / NEMA 4X wall-mount casing, UV-resistant and flameproof. 130 x 114 x 71mm (5.1" x 4.5" x 2.8") - LxHxD.
	HD: None, user defined. HF: 1x 22mm in the center.

Operating temperature	
Operational	-40°C to +80°C (-40°F to +178°F).
Intrinsically Safe	-40°C to +70°C (-40°F to +158°F).

Power requirements	
Type PB	Lithium battery - life-time depends upon settings - up to 5 years.
Type PC	Intrinsically Safe lithium battery - life-time depends upon settings - up to 5 years.
Type PD	16-30 V DC. Power consumption max. 1 Watt.
Type PF	24V AC/DC ±10%. Power consumption max. 15 Watt.
Type PM	115-230V AC ±10%. Power consumption max. 15 Watt.
Type PX	8-30 V DC (also available with PB / PC). Power consumption max. 0.3 Watt.
Type ZB	20-30V DC. Power consumption max. 1 Watt. Note: with type PF / PM: internally powered.
Note PF / PM	The total consumption of the sensor, active output type OA and backlight type ZB may not exceed 400mA@24V DC.
Note I.S. application	for intrinsically safe applications, consult the safety values in the certificate.

Sensor excitation	
Type PB / PC / PX	Analog sensors type A / U: sensor supply not available.
Type PD	As connected power supply voltage (internally linked)
Type PF / PM	Sensor supply voltage 3.2, 8.2, 12 and 24V DC - max. 400mA@24V DC

Terminal connections	
Type:	Removable plug-in terminal strip. Wire max. 1.5mm ² and 2.5mm ²

Data protection	
Type	EEPROM backup of all setting. Data retention at least 10 years.
Pass code	Configuration settings can be pass code protected.

Hazardous area (option)	
Intrinsically safe	ATEX approval ref.: <EX> II 1 GD EEx ia IIC T4 T100°C IECEx, CSA and FM approval is expected to be available May 2006.
Type XI	
Explosion proof	ATEX approval ref.: <EX> II 2 GD EEx d IIB T5. Weight appr. 15kg. Dimensions of enclosure: 350 x 250 x 200mm (13.7" x 9.9" x 7.9") LxHxD.
Type XD/XF	

Environment	
Electromagnetic compatibility	Compliant ref: EN 61326 (1997), EN 61010-1 (1993)
Low voltage directive	Compliant ref: EN60950.

INPUTS

Sensor	
Type A	(0)4-20mA - with signal calibration feature.
Type U	0-10 V - with signal calibration feature.
Accuracy	Resolution: 16 bit.. Error < 0.01mA / ±0.05% FS. Low level cut-off programmable.
Span	0.000010 - 9,999,999 with variable decimal position.
Update time	Four times a second.
Voltage drop	2.6 Volt.
Load impedance	3kOhm
Relationship	Linear or square root calculation.
Note	For signal type A and U: external power to sensor is required; e.g. type PD / PF / PM.

OUTPUTS

Transistor output	
Function	high, low or high and low pressure alarm.
Type OT	One passive transistor output - not isolated. Max. load 50V DC - 300mA
Type OA	One active 24V DC transistor output; max. 400mA per output (requires type PF or PM).
Type OR	Electro-mechanical relay output; max. switch power 230V AC - 0,5A (requires type PF or PM).

OPERATIONAL

Operator functions	
Displayed functions	<ul style="list-style-type: none"> • pressure. • alarm value's low - high pressure. • alarm value's can be entered (this function can be disabled).

Pressure	
Digits	6 digits.
Units	mBar - Bar - PSI - no unit.
Decimals	0 - 1 - 2 or 3.
Offset	-999.999 - +999.999 units

Alarm values	
Digits	6 digits.
Units	According to selection for pressure.
Decimals	According to selection for pressure.
Type of alarm	low and high pressure alarm. Includes delay time alarm and configurable alarm output.

APPENDIX B: PROBLEM SOLVING

In this appendix, several problems are included that can occur when the F053-A is going to be installed or while it is in operation.

Pressure displays "0 / zero" while a higher signal is available:

Check:

- SETUP 13 / 14: is the span correct?

The pass code is unknown:

If the pass code is not 1234, there is only one possibility left: call your supplier.

ALARM

When the alarm flag starts to blink an internal alarm condition has occurred. Press the "select button" several times to display the 5-digit error code. The codes are:

- 0001: irrecoverable display-data error: data on the display might be corrupted.
- 0002: irrecoverable data-storage error: the programming cycle might have gone wrong: check programmed values.
- 0003: error 1 and error 2 occurred simultaneously

The alarm condition will almost certainly be handled internally and if all mentioned values still appear correct, no intervention by the operator is needed. If the alarm occurs more often or stays active for a longer time, please contact your supplier.

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NOTES

LIST OF CONFIGURATION SETTINGS			
SETTING	DEFAULT	DATE :	DATE :
1 - PRESSURE	Enter your settings here		
11 unit	Bar		
12 decimals	000000		
13 span	0000001 Bar		
14 decimals span	0		
15 offset	000000 Bar		
2 - ALARM	Enter your settings here		
21 pressure zero	default		
22 alarm value low	0		
23 alarm value high	0		
24 delay time alarm low	0.0 sec		
25 delay time alarm high	0.0 sec		
26 alarm output	all		
3 - DISPLAY	Enter your settings here		
31 set alarm	operator level		
32 backlight	off		
33 backlight alarm	off		
34 brightness	5		
4 - POWER MANAGEMENT	Enter your settings here		
41 LCD-new	1 sec.		
42 mode	operational		
5 - SENSOR	Enter your settings here		
51 formula	interpolation		
52 filter	01 (off)		
53 cut-off %	00.0%		
54 calibrat. low-(0)4mA	default		
55 calibrat. high-20mA	default		
6 - OTHERS	Enter your settings here		
61 model	F053-A	F053-A	F053-A
62 software version	03.____	03.____	03.____
63 serial number	-----	-----	-----
64 pass code	0000		
65 tagnumber	0000000		



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**Operation & Maintenance Manual
20381680 MPD Sentry Relief Valve Controls
Doc. #: T3-1283918 B**

Annex 2

T3-1279090, Control Console Validation

T3 Energy Services	CONTROL CONSOLE VALIDATION SPECIFICATION	DOC. NO: T3-1279090
VALIDATION FOR CONTROL PANELS AND MAY INCLUDE CUSTOM CONTROL CONSOLES WITH SEPARATE HYD. POWER UNITS (HPU)		DATE: 11 March 2009
		REV. A
PREPARED BY: MARVIN G. PIWONKA	REVIEWED BY: Daniel Guerrero	PAGE: 1 OF 12

1.0 SCOPE

This specification defines instructions how to set pressures, purge, charge and perform functional performance acceptance tests required for the Control System. The Control System includes the choke control panel, separate HPU (when supplied), operator hoses, position indicator hoses or cables, well control gauge transducers, pump-stroke counter switch assembly and will all be tested in this document.

Note: may also include the drilling choke or other equipment controlled by this system to replicate the operation of control unit but not as requirement for acceptance criteria.

2.0 OBJECTIVE

This specification has fundamental objectives.

- a) Define the test levels to be imposed at both the component and assembly level.
- b) Specify the acceptable performance characteristics of the device.
- c) Define a suitable acceptance criteria.
- d) Record verified data.

3.0 GENERAL

The tests shall be performed in the order indicated unless otherwise specified. Failure to meet the pass/fail criteria shall be cause for rejection. Rejected parts may be reworked in accordance with appropriate drawings.

4.0 VERIFYING MAXIMUM RIG AIR SUPPLY TO CONTROL PANEL

Verify the maximum air supply pressure allowed for the following units: Air Filter(s), Air Lubricator, Air Regulator(s), Air driven Pump(s), and any other air devise install in the air circuit. The maximum air pressure should be noted on a tag found on air devise. If not refer to manufactures part specification sheet for that devise.

As verified above record the lesser of all maximum pressures in the air supply circuit up to and including air driven pumps. Data Sheet Record can be found in section 14.0

CAUTION DO NOT CONNECT AIR SUPPLY TO UNIT OVER MAXIMUM RATED AIR PRESSURE IN DOING SO COULD EXPLODE FILTER CAUSING SERIOUS INJURY TO TECHNICIAN AND OR PEOPLE IN THE IMMEDIATE AREA.



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5.0 VERIFYING MINIMUM RIG AIR SUPPLY TO CONTROL PANEL

Verify the minimum rig air supply pressure to operate each Air driven Pump(s) efficiently at the maximum actuator pressure To find minimum air pressure you must calculate maximum actuator pressure requirement divided by the pump ratio or if pump ratio matches maximum actuator pressure chart in **TABLE 1** it maybe used.

As verified above record the greater of all minimum pressures calculated from pump ratios. Data Sheet Record can be found in section 14.0

TABLE 1

**THE FOLLOWING TABLE IS A CHART FOR IDENTIFYING PRESSURES FOR CONTROL PANEL
SETTINGS TO BE USED IN CONJUNCTION WITH THIS TEST PROCEDURE**

ACTUATOR TYPE	ACTUATOR MINIMUM WORKING PRESSURE	ACTUATOR MAXIMUM WORKING PRESSURE	RECOMMENDED AIR DRIVEN PUMP RATIO	RIG AIR SUPPLY MINIMUM PRESSURE BASED ON RECOMMENDED PUMP RATIO
E-S 1-9/16" MAX Orifice	1,000 PSI	1,500 PSI	21:1 RATIO	71 PSI
E-C 1-3/4" MAX Orifice	250 PSI	300 PSI	4:1 RATIO	75 PSI
E-C 3" MAX Orifice	300 PSI	500 PSI	4:1 RATIO	125 PSI
XC & XC2	300 PSI	500 PSI	4:1 RATIO	125 PSI
HXE 15K 1-1/2", 2", 3" MAX Orifices	1,000 PSI	1,500 PSI	15:1 RATIO	100 PSI
HXE 20K 1", 1-1/2", 2" MAX Orifice	1,400 PSI	1,800 PSI	25:1 RATIO	72 PSI
E-FC Hyd. Gate Valve	1,000 PSI	1,500 PSI	35:1 RATIO	43 PSI
HPT Hyd. Gate Valve	1,500 PSI	3,000 PSI	35:1 RATIO	86 PSI

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6.0 PURGING THE HYDRAULIC SYSTEM

Purging the hydraulic system consists of:

- a) Filling the reservoir.
- b) Displacing air from all hydraulic lines and gauges.

Perform the following procedure in order specified:

6.1 Fill HYDRAULIC RESERVOIR

- a) Fill hydraulic reservoir with AW10 hydraulic fluid or equivalent to full mark on sight glass. Be sure fluid is clean and free from debris larger than 10 microns or filter through 10 micron filter before adding to reservoir.

CAUTION DO NOT FILL RESERVOIR BEFORE ENSURING STORED HYDRAULIC FLUID IS DUMPED FROM ANY AND ALL ACCUMULATORS, FAILURE TO FOLLOW THIS RULE MAY RESULT IN OVER FLOW OF FLUID IN RESERVOIR SPILLING INTO WORK AREA CAUSING A HAZARDOUS WORK AREA.

6.2 Purge Control Valve, Tubing and or Hoses with in panel assembly.

- a) Completely back off Air Regulator, counter clockwise, before air is connected to system. Connect shop air to system and open air valve to hydraulic pump.

CAUTION DO NOT CONNECT AIR SUPPLY TO UNIT OVER MAXIMUM RATED AIR PRESSURE IN DOING SO COULD EXPLODE FILTER CAUSING SERIOUS INJURY TO TECHNICIAN AND OR PEOPLE IN THE IMMEDIATE AREA.

- b) Rotate regulator clockwise until pump starts to oscillate and then stall at about 10% of system minimum operating pressure on hydraulic pressure gauge.
- c) Operate control valve in each direction "OPEN" and "CLOSE" for each control valve installed in system for a minimum of three times in all positions.
- d) Connect hydraulic operator hoses shipping with Panel to each connection at manifold plate.
- e) Install open end quick disconnect fitting and 5 gallon bucket at actuator end of hose. Purging one at time, operate control valve for that hose until all air is displaced and clean hydraulic fluid is flowing from open end. Repeat this step for each operator hose. Refill reservoir with clean fluid as in Fill hydraulic reservoir step above.
- f) Disconnect all hoses from manifold plate.
- g) Turn Air ball valve to "OFF" position, if valve not installed disconnect air supply from rear of panel.
- h) Again operate control valve in centered position to open position several times until Zero pressure is read on system pressure gauge.

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6.3 Purge Drill Pipe and Casing Pressure Gauges, Transducer and its transmitting hoses by using the manual hand operated purge pump.

- a) Remove check valve cap from manifold plate at gauge connection and install manual operated purge pump.
- b) Loosen hex on dampening screw at gauge.
- c) Fill purge bowl with AW10 hydraulic fluid or equivalent and stroke pump until no visible air bubbles emerge from bleed port.
- d) Remove check valve cap from Transducer and install purge pump.
- e) Fill purge bowl with AW10 hydraulic fluid or equivalent and stroke pump until no visible air bubbles emerge from bleed port in transducer and piston on transducer is fully extended to its retaining ring then push piston away from retainer ring about 1/8". Install purge pump to Transducer hose, fill bowl with same hydraulic fluid used in Transducer. Pre-purge may be preformed on hoses using the hydraulic pump installed in panel before using hand operated purge pump.
- f) Remove hand pump and install transducer and transmitter hose.

7.0 SETTING HYDRAULIC SYSTEM RELIEF VALVE

Set hydraulic system Relief Valve to not less than .7 but not more than 1.2 atmospheres per 100 PSI maximum system working pressure. Max pressure can be found in **TABLE 1**. The Max. Operating Pressure may also be found on assembly diagram, or equipment to be operated by this control panel. To calculate take maximum operating pressure and divide by 100 then multiply answer by .7 atmospheres (1PSI = 14.7 atmospheres then .7 atmospheres = 10.29 PSI) (Example if 1,500 PSI is found to be the maximum operating pressure then 1,500 / 100 = 15 multiplied by 10.29 = 154.35 plus max. operating pressure equals 1,654 PSI this is the relief valve pressure setting)

- a) Use the air driven hydraulic pump or manual recovery hand pump installed within the panel assembly to build pressure for adjusting relief valve.
- b) To increase relief pressure, rotate adjustment screw clockwise.
- c) To decrease relief pressure, rotate adjustment screw counter clockwise.
- d) Record relief valve setting. Data Sheet Record can be found in section 14.0

8.0 SETTING PRE-CHARGE FOR ACCUMULATOR

If accumulators are installed into hydraulic system for quick actuator response, the following procedure must be followed:

- a) Calculate the correct Accumulator Nitrogen Pre-Charge in PSI. Pre-Charge should be set at 90% of minimum system operating pressure (min. system pressure is equal to minimum actuator operating pressure found in **Table 1** or specified in assembly diagram, or equipment to be operated by this control panel. To calculate take minimum operating pressure and

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multiply by .900 (Example if 1,200 PSI is found to be the minimum operating pressure then 1,200 x .9 = 1,080 PSI is the accumulator nitrogen pre-charge pressure)

- b) Connect pre-charging system to dry nitrogen gas bottles. Caution: never use shop air or oxygen as pre-charge gas.
- c) Remove protective cap and gas valve cap, attach pre-charging system to accumulator gas valve.
- d) With Nitrogen supply valve still shut off, open accumulator valve on pre-charge unit. Note pressure on pre-charging gauge should be between 0-35 PSI.
- e) Pump small amount of systems fluid (approximately 10% of accumulator's capacity) using manual recovery hand pump or air driven hydraulic pump installed in system at a low pressure. Do not exceed 50 PSI on pre-charge gauge.
- f) Bleed all hydraulic pressure from accumulators.
- g) Slowly open valve from nitrogen bottle and begin charging.

CAUTION NOT TO OPEN NITROGEN VALVE AT A FAST RATE, GAS REGULATOR OR BLADDER CAN BE DAMAGED.

- h) Close nitrogen bottle valve and check reading on pre-charge gauge. Pre-charge amount should be approximately within +/- 5% of calculated pre-charge pressure.
- i) Record pre-charge pressure. Data Sheet Record can be found in section 14.0
- j) When nitrogen pre-charge is maintained remove charging system and replace protective caps.

9.0 SETTING HYDRAULIC SYSTEM OPERATING PRESSURE

Connect air supply line and open air ball valve to air driven hydraulic pump(s).

CAUTION DO NOT CONNECT AIR SUPPLY TO UNIT OVER MAXIMUM RATED AIR PRESSURE IN DOING SO COULD EXPLODE FILTER CAUSING SERIOUS INJURY TO TECHNICIAN AND OR PEOPLE IN THE IMMEDIATE AREA.

- a) Rotate regulator clockwise until the correct pressure is read on system hydraulic pressure gauge.
- b) Record system operating pressure. Data Sheet Record can be found in section 14.0

10.0 FUNCTIONAL TESTING

(Testing with actuator and recorded info can only be performed if Customer requires Actuator to be tested with panel. Technician shall omit testing with actuator if not requested by customer.)

- a) Connect all operator hoses from manifold to hydraulic actuators. If actuator not supplied leave this end blanked.
- b) Start pump(s) Once operating pressure is reached do not toggle control valve instead hold for a minimum of 5 minutes. During this time look for any visible leaks.

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- c) Still maintaining operating pressure operate control valve in each direction "OPEN" and "CLOSE" for each control valve installed in system and hold in that position for a minimum of 3 minutes. Again look for any visible leaks and record time to reach end of cycle for each valve installed in control system.
- d) Disconnect air from system and reduce hydraulic system to Zero PSI. At this time operate valve in both open and closed position by means of Manual Recovery Hand Pump and record number of strokes in each direction.
- e) Acceptance criteria:
 - Smooth operation of components operated, No sticking or jerky movements.
 - No visible leaks allowed before, during, and after functional testing.
 - Choke cycle time to be no longer than 30 seconds.
 - Hydraulic Gate Valves actuators assisted with accumulator install in panel, cycle times shall be no more than 7 seconds unless otherwise noted by customer request.
 - (1 cycle = fully open to fully closed) or (1 cycle = fully close to fully open)
- f) Record verified data. Data Sheet Record can be found in section 14.0

11.0 PNEUMATIC POSITION INDICATOR GAUGE CALIBRATION

(Testing with actuator and recorded info shall only be preformed if customer requires actuator to be tested with panel. Technician shall omit testing with actuator if not requested by customer.)

PNEUMATIC POSITION INDICATOR SYSTEM

- a) Actuate Choke to fully closed position.
Acceptance Criteria - Needle on CHOKE POSITION gauge should be within the wide black mark on the CLOSE side of the dial +/- 1/16".
- b) Actuate Choke to fully open" position.
Acceptance Criteria - Needle on CHOKE POSITION gauge should be within the wide black mark on the OPEN side of the dial +/- 1/16".
- c) Record verified data. Data Sheet Record can be found in section 14.0

DIGITAL POSITION INDICATOR SYSTEM

- a) Actuate Choke to fully closed position.
Acceptance Criteria – Depress the "Zero" button on back of Gauge, Gauge shall read 0.0 % open.
- b) Actuate Choke to fully open" position.
Acceptance Criteria – Depress the "Span" button on back of Gauge, Gauge shall read 100.0 % open.
- c) Record verified data. Data Sheet Record can be found in section 14.0

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Jason Beck**12.0 PUMP STROKE RATE METER AND LIMIT SWITCH INDICATION**

- a) With limit switch connected to rate meter move POWER switch on rate meter to the "ON" position. Wait 15 seconds minimum.
- b) Next set PUMP SELECT switch to "TEST" position.
- c) Acceptance Criteria - STROKES PER MINUTE display shall read "60" and nothing else.
- d) Place PUMP SELECT switch in P1 position. Manually actuate pump 1 limit switch.
- e) Acceptance Criteria - Each stroke shall be indicated in TOTAL STROKES display and colon symbol shall wink with each stroke. Stroke rate shall be indicated on STROKES PER MINUTE display.
- f) Place PUMP SELECT switch in P2 position. Manually actuate pump 2 limit switch.
- g) Acceptance Criteria - Each stroke shall be indicated in TOTAL STROKES display and colon symbol shall wink with each stroke. Stroke rate shall be indicated on STROKES PER MINUTE display.
- h) If panel is equipped with 3 pump system place PUMP SELECT switch in P3 position. Manually actuate pump 3 limit switch.
- i) Acceptance Criteria - Each stroke shall be indicated in TOTAL STROKES display and colon symbol shall wink with each stroke. Stroke rate shall be indicated on STROKES PER MINUTE display.
- j) Place POWER switch in RESET position and hold for a minimum of 1 second.

Acceptance Criteria - Both displays shall indicate zero.

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13.0 WELL CONTROL PRESSURE GAUGE PROOF PRESSURE TEST

Mount pressure de-booster or transducer on test sub and pressurize system test pressure from Table 2. Maintain pressure for 5 minutes.

**CAUTION: DO NOT PRESSURIZE SYSTEM BY MEANS OTHER THAN THE SUPPLIED
PRESSURE DE-BOOSTER OR 1:1 TRANSDUCER DESIGNED FOR THIS SYSTEM.
DE-BOOSTERS HAVE 4:1 PRESSURE REDUCTION RATIO AND IF CONNECTED TO 1:1
RATIO TRANSDUCER MAY RESULT IN GAUGE DAMAGE.**

TABLE 2**WELL CONTROL GAUGES TO BE TESTED AT 25% AND 75% OF TOTAL GAUGE READING**

WELL CONTROL PRESSURE GAUGE	25% of total gauge reading	75% of total gauge reading
0-5,000 PSI / (340 Bar)	1,250 PSIG +/- 250 PSIG (85 Bar +/- 17 Bar)	3,750 PSIG +/- 250 PSIG (255 Bar +/- 17 Bar)
0-6,000 PSI / (413 Bar)	1,500 PSIG +/- 250 PSIG (103 Bar +/- 17 Bar)	4,500 PSIG +/- 250 PSIG (310 Bar +/- 17 Bar)
0-10,000 PSI / (680 Bar)	2,500 PSIG +/- 500 PSIG (170 Bar +/- 34 Bar)	7,500 PSIG +/- 500 PSIG (510 Bar +/- 34 Bar)
0-15,000 PSI / (1020 Bar)	3,750 PSIG +/- 500 PSIG (255 Bar +/- 34 Bar)	11,250 PSIG +/- 500 PSIG (765 Bar +/- 34 Bar)
0-20,000 PSI / (1360 Bar)	5,000 PSIG +/- 500 PSIG (340 Bar +/- 34 Bar)	15,000 PSIG +/- 500 PSIG (1020 Bar +/- 34 Bar)

Repeat for all Well Control Pressure Gauges.

Acceptance Criteria:

- Gauge pressures readings shall be +/- 50 PSI of calibrated gauge readings on test stand
- No evidence of leakage at any point during gauge test.

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14.0 VERIFIED TEST DATA DOCUMENTATION FOR CONTROL PANELS

Shop Order Number: _____ Delivery Date: _____

Control Part Number: _____ Serial Number: _____

HPU Part Number: _____ Serial Number: _____

Print Technicians Name: _____

Customers Witness

Print Name: _____ Title: _____

SERIAL NUMBERS OF MAIN COMPONENTS

Manual Recovery Hand Pump _____ MFG Date: _____

Air Driven Hydraulic Pump No.1 _____ MFG Date: _____

Air Driven Hydraulic Pump No.2 _____ MFG Date: _____

Air Driven Hydraulic Pump No.3 _____ MFG Date: _____

Maximum Rig Air has been verified in accordance with section 4.0

Record Maximum Rig Air Supply: _____ PSI

Minimum Rig Air has been verified in accordance with section 5.0

Calculated Minimum Rig Air Supply: _____ PSI

Purging the hydraulic system has been preformed and or witnessed in accordance with section 6.0

Initial showing this step has been preformed: _____

The hydraulic system relief valve has been set and or witnessed in accordance with section 7.0

Calculated Relief Valve Pressure: _____ PSI

Set Pressure Recorded at Time of Test: _____ PSI

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Daniel Guerrero**APPROVED BY:**
Jason Beck**The pre-charge for accumulators has been set and or witnessed in accordance with section 8.0**

Calculated Pre-Charge Pressure _____ PSI

Accumulator #1 SN _____
Set Pressure Recorded at Time of Test: _____ PSIAccumulator #2 SN _____
Set Pressure Recorded at Time of Test: _____ PS
IAccumulator #3 SN _____
Set Pressure Recorded at Time of Test: _____ PSIAccumulator #4 SN _____
Set Pressure Recorded at Time of Test: _____ PSIAccumulator #5 SN _____
Set Pressure Recorded at Time of Test: _____ PSIAccumulator #6 SN _____
Set Pressure Recorded at Time of Test: _____ PS**The hydraulic system operating pressure has been set and or witnessed in accordance with section 9.0**Operating from **Table 1** Pressure _____ PSI

Set and Recorded Hydraulic Operating Pressure at: _____ PSI

The hydraulic system been functionally, leak tested, and witnessed in accordance with section 10.0**Recorded Cycle Times:**Choke Control Valve
Fully open to fully closed _____ Seconds Fully closed to fully open _____ SecondsGate Valve Control Valve
Fully open to fully closed _____ Seconds Fully closed to fully open _____ SecondsManual Recovery Hand pump verification, record number of strokes to operate:
Choke cycle open to close _____ Choke cycle close to open _____
Gate Valve cycle open to close _____ Gate Valve cycle close to open _____

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Jason Beck

**The Position Indication Gauging system been functionally tested and witnessed in
accordance with section 11.0 POSITION INDICATION GAUGE CALIBRATION**

Place check by the appropriate position indication space to be within the acceptable range.

Position Indicator Gauge No.1

Serial No. _____ Open Position _____ Closed Position _____

Position Indicator Gauge No.2

Serial No. _____ Open Position _____ Closed Position _____

Position Indicator Gauge No.3

Serial No. _____ Open Position _____ Closed Position _____

Position Indicator Gauge No.4

Serial No. _____ Open Position _____ Closed Position _____

Position Indicator Gauge No.5

Serial No. _____ Open Position _____ Closed Position _____

Position Indicator Gauge No.6

Serial No. _____ Open Position _____ Closed Position _____

**Pump Stroke Rate Meter and it's limit switch has been tested and or witnessed in
accordance with section 12.0 PUMP STROKE RATE METER AND LIMIT SWITCH TESTING**

Recorded data from test:

Serial No. _____

Test position reading

Select Switch P1 Total Strokes _____ Strokes per Minute _____

Select Switch P2 Total Strokes _____ Strokes per Minute _____

Select Switch P3 Total Strokes _____ Strokes per Minute _____

Power Switch Reset Total Strokes _____ Strokes per Minute _____

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**Well control pressure gauges has been tested and or witnessed in accordance with section
13.0 WELL CONTROL PRESSURE GAUGES PROOF PRESSURE TESTING**

Recorded data from test:

GAUGE No.1 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

GAUGE No.2 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

GAUGE No.3 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

GAUGE No.4 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

GAUGE No.5 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

GAUGE No.6 Serial _____ Transducer Serial No. _____
Test Stand Pressure Reading at 25% _____ Panel Gauge Reading _____
Test Stand Pressure Reading at 75% _____ Panel Gauge Reading _____

15.0 REVIEW AND VERIFICATION

All the verifying data has been recorded and reviewed for it's validity.

Technicians Signature: _____ Date: _____

Reviewed for Validity Signature: _____ Date: _____

All the recorded verifying data has been witnessed and reviewed and accepted as recorded.

Customers Witness Signature: _____ Date: _____

Printed or downloaded copies of Quality Management System documentation shall be considered
"UNCONTROLLED" copies and are not subject to control and/or recall. The only controlled copy of a
Quality Management System document shall be located on the T3 Energy Services network server



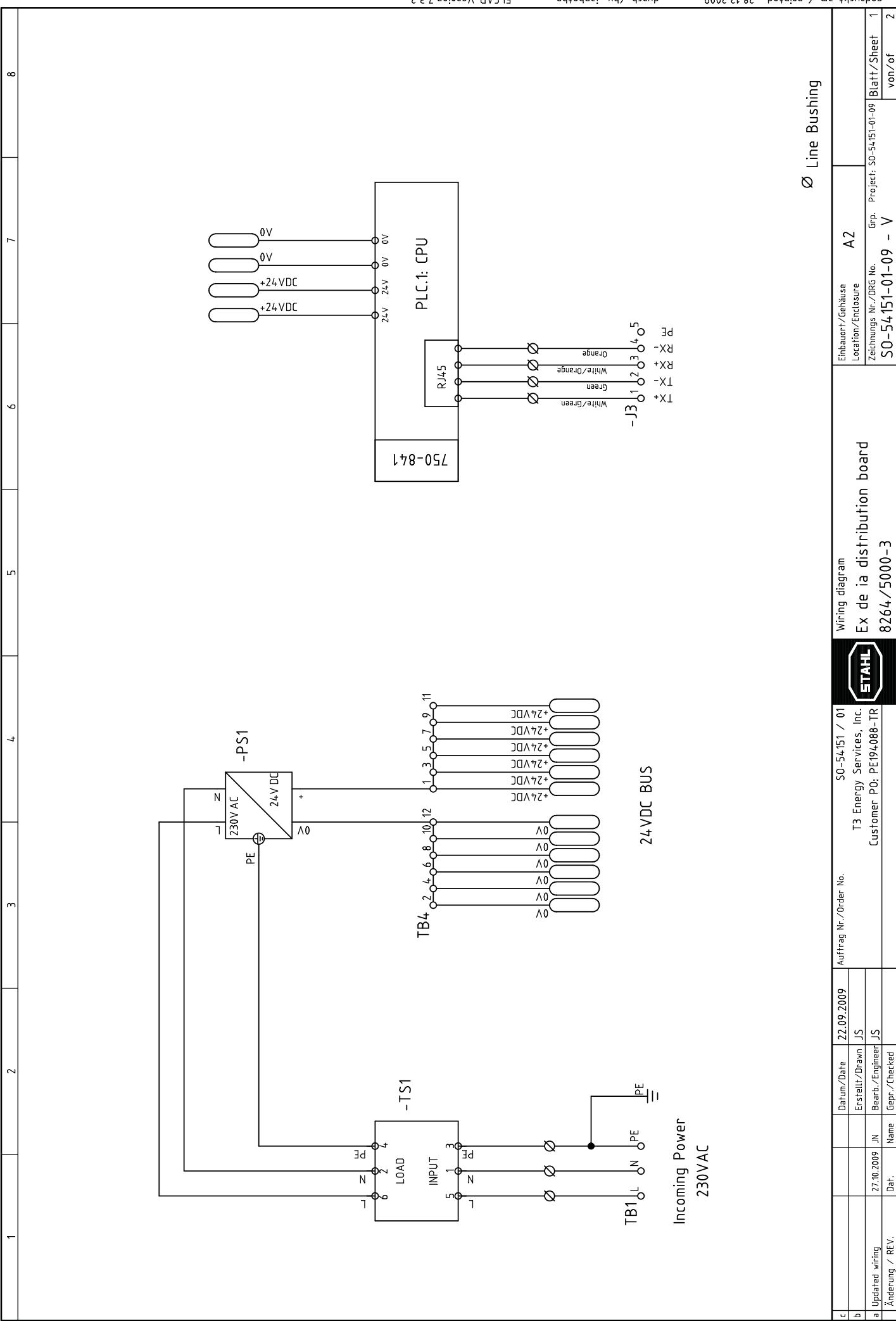
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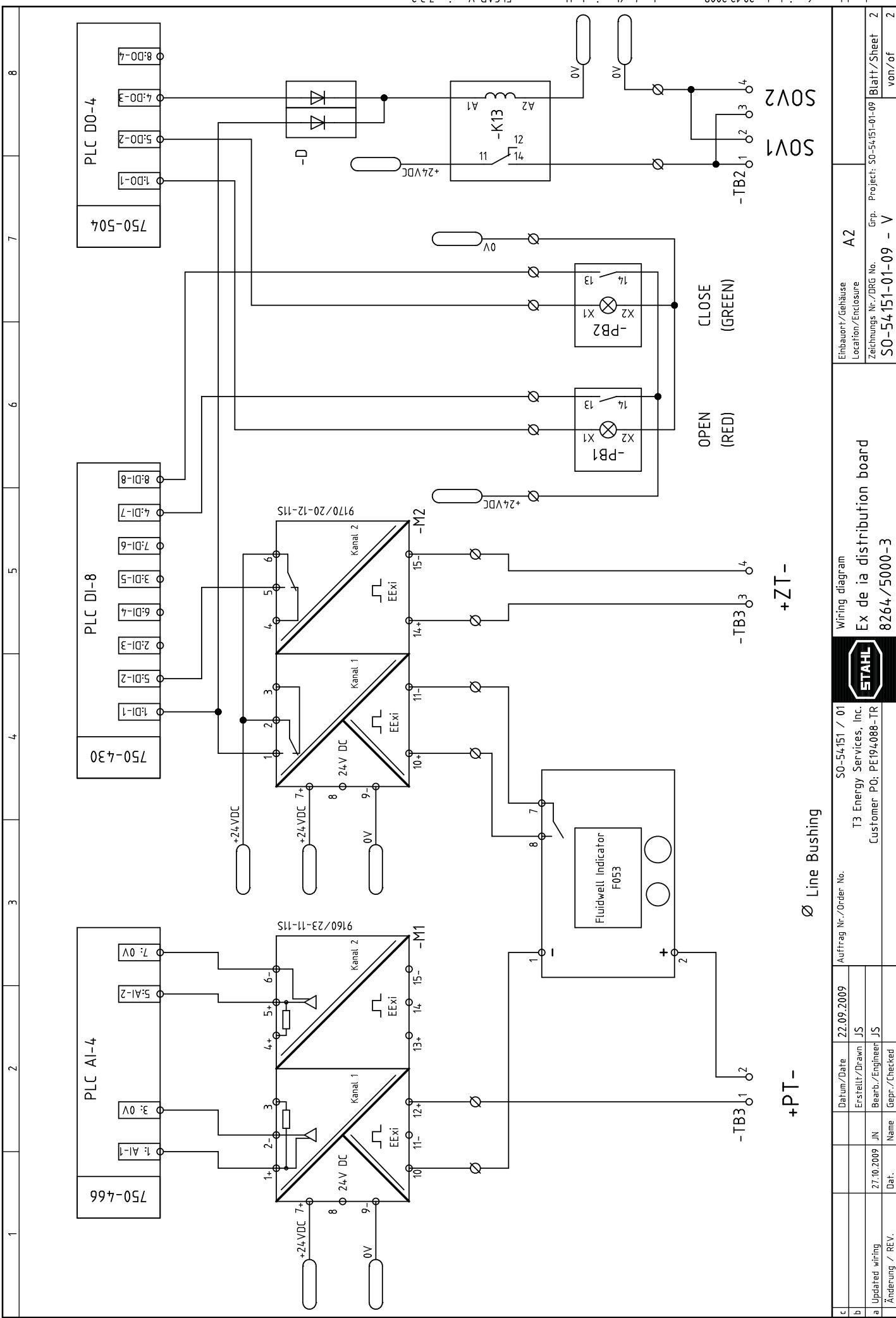
Operation & Maintenance Manual
20381680 MPD Sentry Relief Valve Controls
Doc. #: T3-1283918 B

Annex 3

Wiring Diagram, Relief Valve PLC Controller

T3-1283913







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Doc. #: T3-1283918 B

Annex 4

Bill of Material, Relief Valve Controls

Class: Engineered Component**Part Number: 20381680 Revision: B ECN:****Released: 9/22/2010****Weight: 1 Manufacturer's ID: T3 ENERGY SERVICES****Manufacturer's P/N: 20381680 Description:**

**ASSEMBLY~CONSOLE MPD30 CONTROLS PRESSURE
RELIEF VALVE SYSTEM, CONSISTING OF HYDRAULIC
ACTUATED VALVE, AIR POWERED HPU, PLC CONTROLLER,
HOSES, AND CABLES**

**Expand All Rows****Collapse All Rows**

Item Number	ID	Rev	Qty	U/M	Weight	Description
001	20383301A	1	EA	3000		FRAME~PANEL MPD30 CONTROLS RELEIF VALVE CONTROL SYSTEM
002	20382180 -	1	EA	50		ASSEMBLY~CONTROLLER CUSTOM DUAL ENCLOSURES/ELECTRICAL CONTROL PANEL STAHL QUOTE SQ-40751
003	20389021 -	1	EA	3		ENCLOSURE~ CONTROLS 176 X 116 X 91 MM STAINLESS STEEL ATEX EEX E WITH (6) UK 5N TERMINALS NO ENTRIES
004	20381691 -	1	EA	200		ASSEMBLY~HYDRAULIC POWER UNIT FOR USE WITH SINGLE MPD RELIEF VALVE, WITH 2 GAL RESERVOIR, ATEX M21 PUMP, 1 GAL DNV ACCUMULATOR, ZERO-LEAK VALVES, CE-MARKED RELIEF VALVE, ATEX ZONE 1 SOLENOIDS, 24X24X12 316SS ENCLOSURE, QC CONNECTORS FOR AIR AND HYDR
005	20383866 -	7	FT	.102		WIRE~CABLE ICP 3 CONDUCTOR 14 AWG GEXOL MARINE SHIPBOARD
006	20383331 -	1	EA	.7		WIRE~ ICP CORDSET DEVICENET LENGTH 2M TYPE 579 CABLE FEMALE MINIFAST CONNECTOR / UNTERMINATED PIGTAIL
007	20383332 -	1	EA	.24		CONNECTOR~ELECTRICAL CONTROLS BULKHEAD MOUNT SS MALE/FEMALE 5 PIN MINIFAST DEVICENET
008	20389230 -	16	EA	.1		WASHER~FLAT 1/2 MEDIUM DUTY, 304 S/S (.531 ID X 1.062 OD X .095 THK)
009	20389189 -	10	FT	.102		CABLE~MARINE SHIPBOARD CONTROLS 1 - 18 AWG TWISTED PAIR WITH INDIVIDUAL SHIELD GEXOL
010	20381360A	1	EA	.02		TAG~ CONTROLS RIG AIR SUPPLY 2" X 1" 304 SS 22GA
011	20383435A	1	EA	.02		TAG~ CONTROLS OPEN 2" X 1" 304 SS 22GA
012	20383436A	1	EA	.02		TAG~ CONTROLS CLOSE 2" X 1" 304 SS 22GA
013	20381765 -	9	EA	1		GLAND~CABLE ICP NON-ARMORED CABLE M20 FITS 7.5MM TO 11.9MM CABLE ATEX EEX D AND EEX E
014	20381266 -	9	EA	1		GLAND~WASHER ICP SEALING FOR M20 GLANDS
015	20384376 -	7	EA	.1		GLAND~ ICP LOCKWASHER M20 SERRATED 316SS
016	20384377 -	9	EA	.1		GLAND~ ICP LOCKNUT M20 BRASS
017	20389228 -	8	EA	.018		NUT~HEX .500-13 UNC-2B 304 S/S
018	20366110 -	8	EA	.01		WASHER~LOCK 1/2 SPLIT X .15 THK S/S
019	20383552 -	8	EA	.25		BOLT~HEX HEAD .500-13 UNC-2A X 4.500 LG 304SS HOSE~PNEUMATIC 1/2 250# PSI X 50FT. LONG NYLON BRAIDED RUBBER AIR HOSE FOR BARBED WITH 1/2 MALE NPT BRASS FITTINGS
020	20383357 -	1	EA	2		

					HOSE~HYDRAULIC 1/2 3K PSI X 50 FT LONG SAE-100R2AT BRAIDED RUBBER WITH 1/2 S/S HYDRAULIC QUICK DISCONNECTS 1 MALE 1 FEMALE C/W CAP AND PLUG
021	20383353 -	2	EA	2	WIRE~ ICP CORDSET 15M DEVICENET
023	20389291 -	4	EA	.1	MOUNT~CABLE TIE #10 SCREW .35 INCH SLOT BLACK POLYETHYLENE UV RESISTANT
024	20389293 -	4	EA	.1	TIE~CABLE 15 X .30 INCH BLACK POLYETHYLENE UV RESISTANT (MIL-S-23190 MS3367-3-0)
025	20389289 -	2	FT	.1	SLEEVE~SPIRAL WOUND WRAP 3/4 INCH OD BLACK POLYETHYLENE UV RESISTANT
L00	T3-1282294 B	-	-		ASSEMBLY~ CONSOLE RELIEF VALVE MPD RELIEF VALVE CONTROL
L01	T3-1287094 B	1	EA		V/S~FACTORY ACCEPTANCE TEST FOR RESET RELIEF VALVE SYSTEM MODEL MPD30
L02	T3-1283918 B	1	EA		O&M MANUAL~ CONTROL SYSTEM, MPD30 PRESSURE RELIEF VALVE, PDF FORMAT WITH ATTACHMENTS

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