Quantsen Intelligence System

SmartFlow

Coolant control and leak detection for robotic welding systems

PRODUCT USER MANUAL

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1 Overview

Introduction

This document provides comprehensive technical information about the Quantsen SmartFlow™ coolant monitor and flow controller with version of Digital IO, EtherNet/IP and ProfiNet/IP. The product features, specifications, and operating instructions described herein apply to standard SmartFlow products and may not be valid for customized versions.

Important Safety Information

Throughout these instructions, NOTE, CAUTION and WARNING statements are used to highlight important operational and safety information.

NOTE


NOTE statements provide additional information that is important to the successful operation of the device.

CAUTION!


CAUTION statements identify conditions or practices that could result in damage to equipment or other property.

WARNING!


WARNING statements identify conditions or practices that could result in personal injury or loss of life.

Taking proper precautions to avoid damage to your instrument's sensors during installation helps to ensure consistent, error-free operation, which lowers costs and assists on-time completion of your work.

NOTE	
	It is recommended that the installation of this product be performed by qualified service personnel only.

Technical Support

For technical or applications assistance, please contact:

Quantsen Intelligence System (Shanghai) company limited

No.9, Lane.98, Shunda Rd, Shanghai, China

TEL: +86 18192110628

E-mail: frank_hu@quantsen.com

Warranty

Quantsen SmartFlow products are manufactured under ISO 9001-certified processes and are warranted to be free from defects in materials and workmanship for two years from the date of shipment.

2 FEATURES AND FUNCTIONS

What it is and what it does

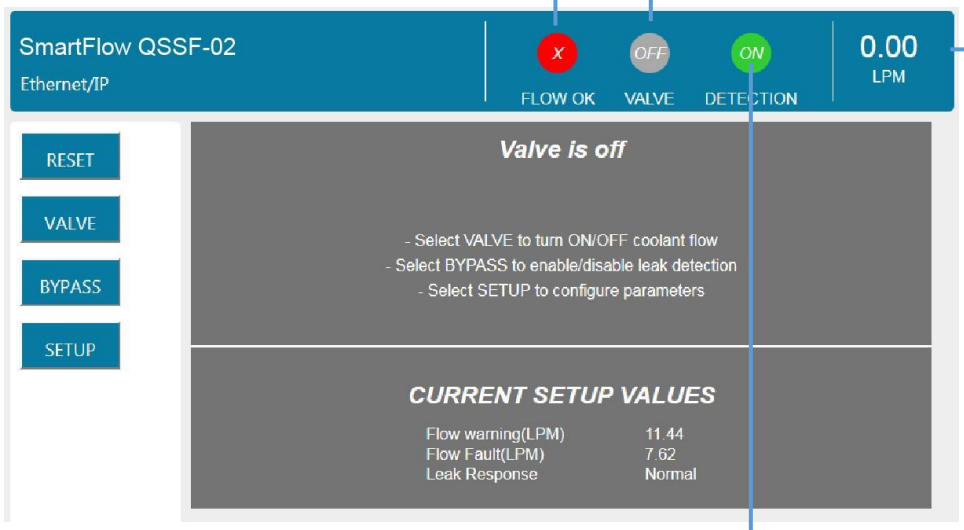
The Quantsen SmartFlow™ is a unique coolant control unit designed to provide multiple functions to monitor and control coolant flow.

It's a Flow Valve

Coolant flow to the weld cell can be turned ON and OFF through the browser interface using a mouse, keyboard or other input device, or remotely from the weld controller.

It's a Flow Meter

The web browser-based interface displays the actual flow rate through the system in Liters Per Minute (LPM).



It's a Flow Monitor

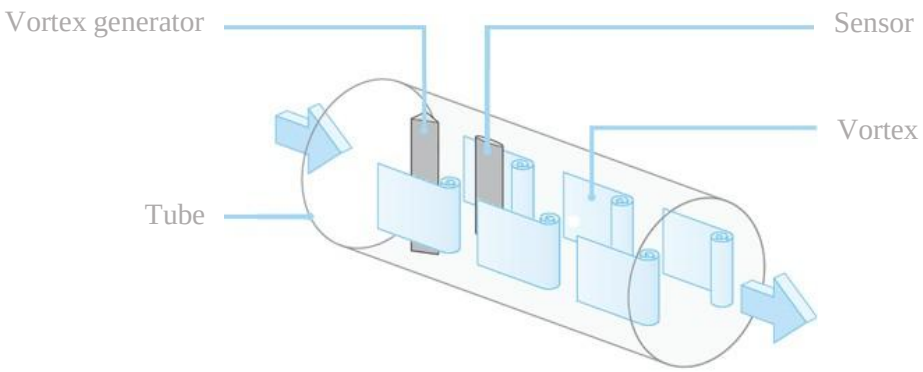
Flow status is clearly indicated on the interface at all times.
When flow to the weld cell is greater than the user-programmed flow warning rate, the FLOW OK status is displayed.
When flow to the weld cell is less than the Flow Warning rate, but higher than the Flow Fault rate, the FLOW WARNING status is displayed.
When flow to the weld cell is less than the Flow Fault rate, the FLOW FAULT status is displayed.

It's a Very Fast Leak Detector

In the event of a weld cap loss or other break in the coolant flow circuit, the leak is detected and water flow is shut off in less than 1 second.
A CAP OFF fault message is displayed and the system controller is advised of the alarm condition.

A sensitive and rugged flow sensor is located in both the supply and return coolant lines.

Water flows through the vortex generator in tube and create the vortex under cyclic pressure. A piezoelectric sensor can detect the pulse of each vibration by the vortex. By counting the pulse and frequency, MCU can calculate the actual flow rate of the water in tube.



Flow comparison

The SmartFlow's microcomputer compares the measured inlet flow rate with the Flow Warning and Flow Fault trip point values as selected by the operator.

- When the measured flow rate is greater than the Flow Warning and Flow Fault values, the microcomputer sends the digital message **diWS_OKtoWeld** and **diWS_MinFlow** to the weld controller.
- When the measured flow rate is less than the Flow Warning value, but greater than the Flow Fault value, the microcomputer sends only the **diWS_OKtoWeld** digital message to the weld controller.
- When the measured flow rate is less that the Flow Fault value, the microcomputer stops sending the **diWS_OKtoWeld** digital message.

The weld controller makes decision affecting weld operations based on the flow status reported by the SmartFlow.

FLOW STATUS	FLOW RATE CONDITION	SIGNAL(S) TO WELD CONTROLLER	
OK to Weld	Flow Rate > Flow Warning Value > Flow Fault Value	diWS_OKtoWeld	diWS_MinFlow
Flow Warning	Flow Warning Value ≥ Flow Rate > Flow Fault Value	diWS_OKtoWeld	
Flow Fault	Flow Warning Value > Flow Fault Value ≥ Flow Rate		

Cap Loss Detection

The SmartFlow's microcomputer uses a patented algorithm to continuously monitor the output frequencies of both the supply and return flow sensors. This algorithm is able to detect the loss of a weld cap or other catastrophic loss of flow continuity in less than 0.3 seconds.

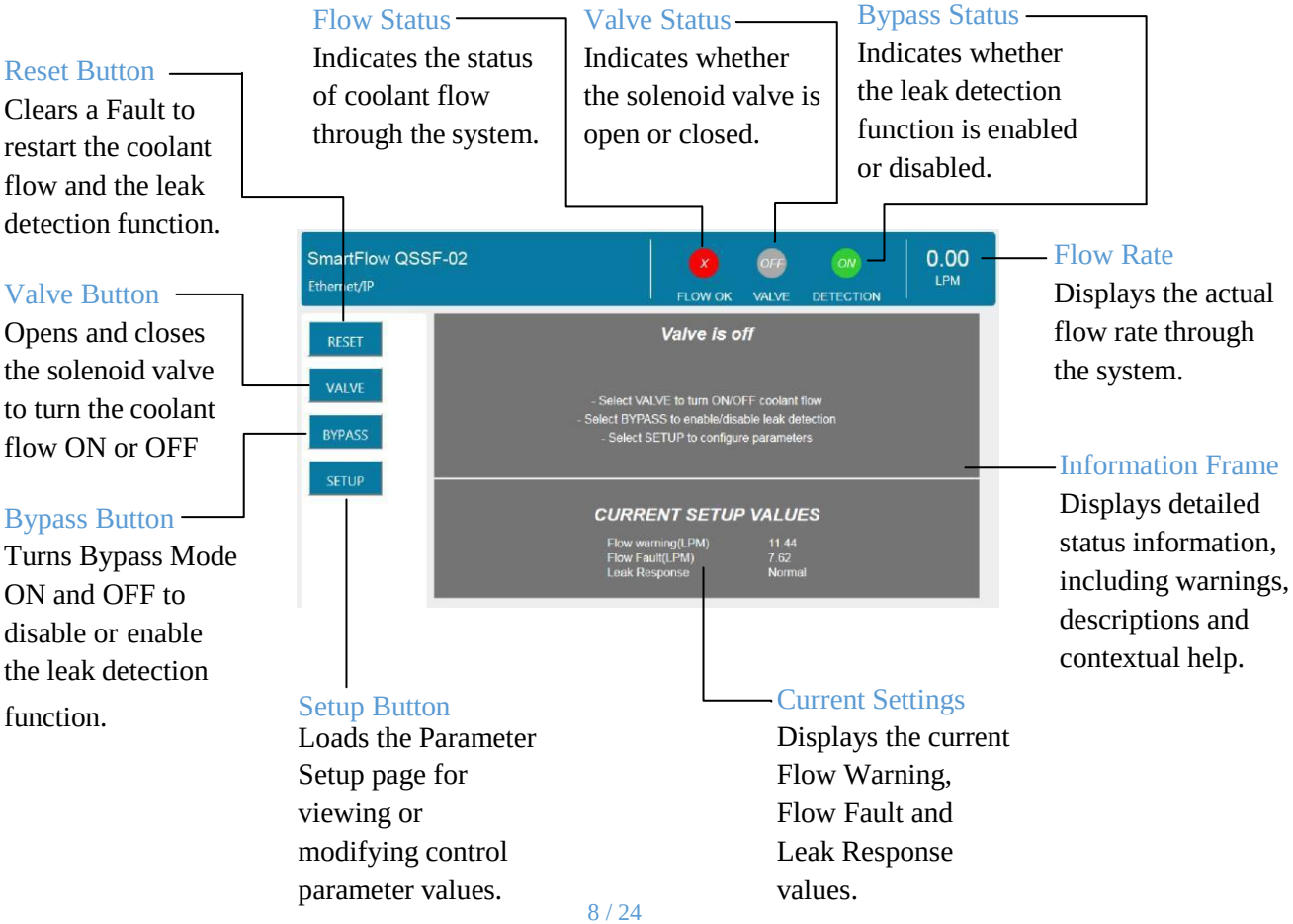
- When a cap loss event is detected, the microcomputer shuts off coolant flow in both the supply and return lines and sends the digital message **diWS_CapLoss** to the weld controller.

The weld controller makes a decision to shut down weld operations.

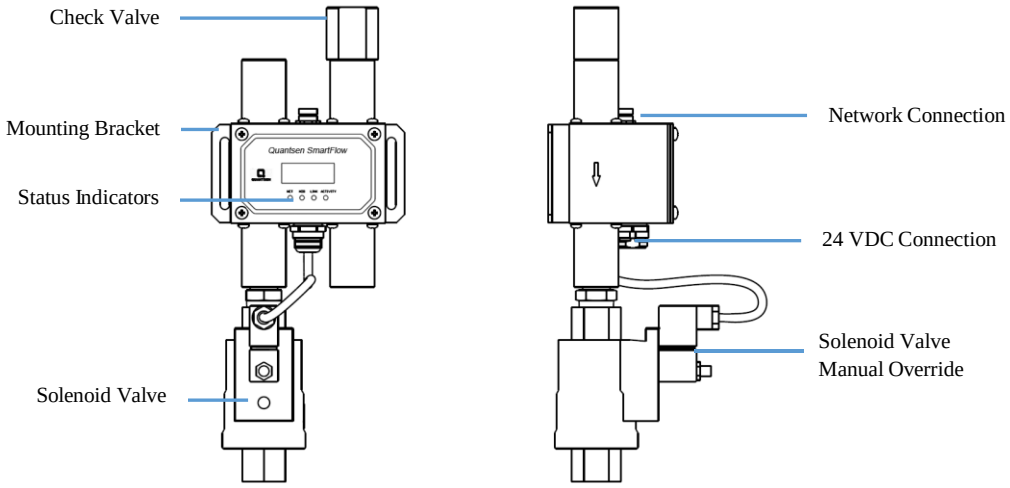
User Interface

The SmartFlow graphical user interface provide information on device status in real time, with clear visual indicators and descriptions. The interface can be accessed over a network using most JavaScript™ -enabled web browsers by entering the working IP address of the device.

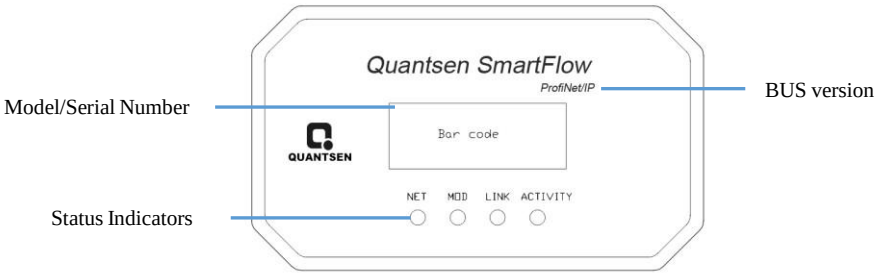
NOTE	
ⓘ	Standard SmartFlow products are programmed with a default IP address of 192.168.125.67. The IP address is only available for Digital IO and EtherNet/IP version, for ProfiNet/IP version, customer should use configuration tool to set the access IP address. For details, please refer to Chapter 6.



Function Components



Front Panel



Electric Solenoid Valve

Standard SmartFlow products are equipped with a solenoid valve featuring a manual override function.

- Normal Operation

  The solenoid valve is functional when the slot in the knob is in a horizontal position. During normal operation, the valve enables the control of flow through the system, either locally using the SmartFlow keypad or remotely from the weld controller.

- Manual Override

  The solenoid valve can be bypassed by depressing the knob and turning it 90˚ clockwise to a vertical position. In the manual override state, water can flow through the system to allow leak testing without engaging 24VDC electrical power.

3 SPECIFICATIONS AND PERFORMANCE

Performance Characteristics

Flow Range	1.0-50.0 LPM	
Connections	G1/2"(BSPP)	3/4"FNPT
Pressure Drop	< 15 kPa	
Coolant Supply Pressure	83-620 kPa	
Coolant Return Pressure	70-350 kPa	
Differential Pressure	14-415 kPa	
Coolant Temperature	4.0-110 ℃	
Leak Response Time	< 0.3 sec	
Low Flow Response	< 0.2 sec	
Reset/Override Response	< 0.1 sec	
Leak Detection	0.3-0.5 sec	
Accuracy	±3% of flow range	
Repeatability	±1% of flow range	
Operating Environment	Indoor use only	
Ambient Temperature	4.0-50 ℃	
Max Relative Humidity	80%	
Enclosure Protection	IP67	

CAUTION !	
	Do NOT exceed the maximum rated flow of your instrument. Extended operation above the rated maximum flow rate of the instrument will reduce its usable life.

WARNING !	
	Do NOT exceed the temperature limit of your instrument. Operation above the rated temperature can cause failure and create a hazard to operators and equipment.

WARNING !	
	Do NOT exceed the pressure limit of your instrument. Operation above the rated pressure can cause failure and create a hazard to operators and equipment.

Electrical Requirements

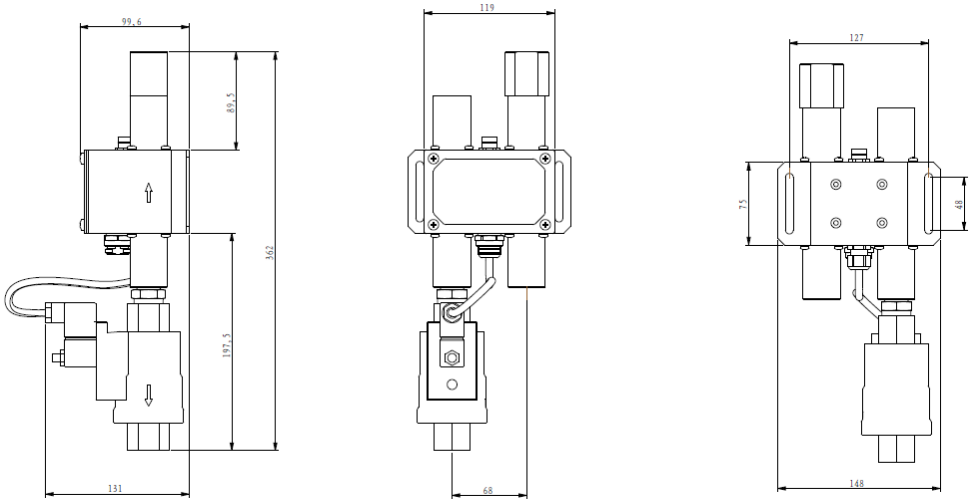
Input Power Voltage	+24VDC±10%
Input Power Consumption	<16VA at normal flow; <8VA with solenoid valve closed
Max Rated Input Current	O.75A

Wetted Materials

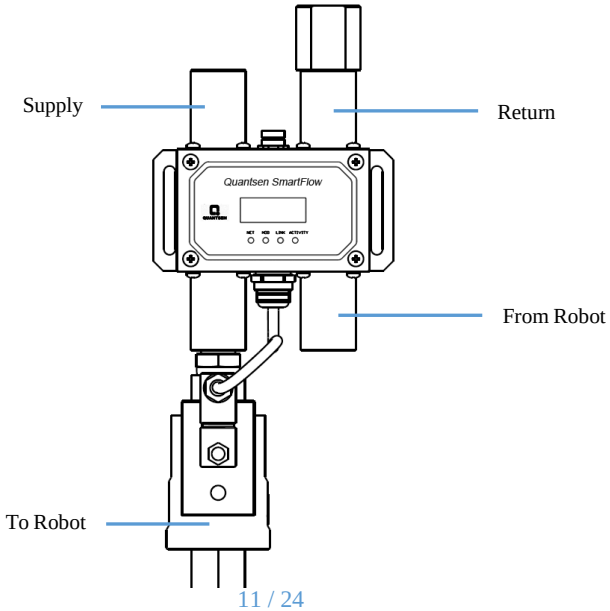
COMPONENT	MATERIAL
Flow Body, Solenoid Valve, Check Valve, Fittings	Alu
Flow sensor	Kynar®
O-Ring	Huba®

Dimensional Drawing

Product dimensions for standard SmartFlow (Digital IO, EtherNet/IP, and ProfiNet/IP) models are indicated below. Three-dimensional drawings are accessible on the Quantsen Intelligence System (Shanghai) company limited. Solid models are available upon request; please contact Quantsen Industries Technical Support.



Plumbing Connections



4 INSTALLATION

Tools Required

- Adjustable wrenches
- Pipe wrenches
- Teflon®-based pipe sealant
- 2 ×M5 ×12 screws for mounting bracket

Plumbing Connections

1. Flush the inlet piping

CAUTION !	
	Flush contaminants and other accumulated construction debris from the upstream pipe BEFORE connecting the SmartFlow. Failure to flush coolant lines may result in the fouling of the SmartFlow's supply flow sensor and the clogging of smaller orifices in the system supply lines, manifolds and the weld gun.

CAUTION !	
	Flush contaminants and other debris from water lines connecting the system， manifold， transformer， SCR and any other water-cooled components BEFORE connecting them to the SmartFlow. Failure to flush these lines may result in the fouling of the SmartFlow's return flow sensor and the clogging of smaller orifices in the system supply lines， manifolds, transformer, SCR, weld gun and any other water-cooled components.

2. Lubricate all pipe threads using a non-hardening pipe sealant, such as Teflon® paste, to help simplify installation and seal plumbing connections.

CAUTION !	
	Do NOT allow excess pipe sealant to enter the flow sensor! Excess material may foul the sensors and cause the clogging of smaller orifices in the system's supply lines, manifold, transformer, SCR, weld gun and any other water-cooled components.

3. Refer to page 11 of this document to identify the SmartFlow plumbing connections.

4. Make plumbing connection to the Supply, Return, and To-Robot connection port on the SmartFlow using appropriate pipe fittings and sealing washers.

CAUTION !
Ensure that the correct hoses have been connected to the SmartFlow To-Robot and From-Robot connections. Check hose labels or trace water flow to confirm that the SmartFlow is connected to include the water circuit cooling the weld gun. If the hose connections are not correct, the SmartFlow may NOT be able to detect the loss of a weld cap or other loss of flow continuity.

5. Adjust pipe connections as required for proper alignment of the SmartFlow.

6. Depress the solenoid valve manual override knob and turn it 90˚ clockwise to a vertical position to enable flow. (Refer to Electric Solenoid Valve section on page 6 for more information.)

7. Turn water ON slowly.

WARNING !
The SmartFlow body is NOT insulated! When using the SmartFlow with hot liquids, use personal protective equipment.

8. Check for leaks at all connections to the SmartFlow.

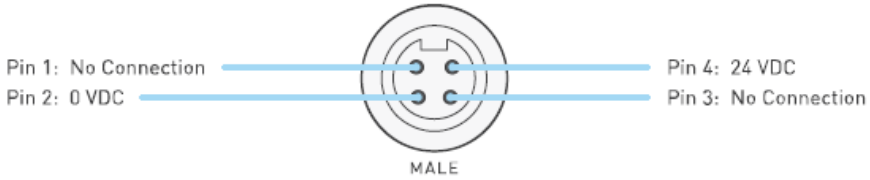
9. Eliminate all leaks before proceeding.

10. Turn the solenoid valve bypass knob 90˚ counterclockwise to return it to a horizontal position for normal operation.

Electrical Connections

NOTE
The SmartFlow must be connected to 24VDC auxiliary power to perform correctly. Proteus highly recommends connecting the SmartFlow to certified DC power supplies only.

1. Refer to the wiring diagram below for the 24VDC power connector on the bottom of the SmartFlow body.



2. Confirm that the power cable has 24VDC present between 2 and 4.

CAUTION !

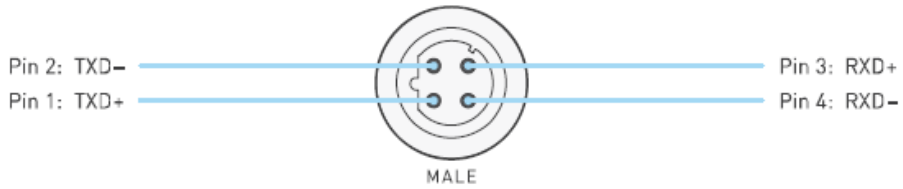
	Connect the power cable to the 24VDC power source BEFORE connecting to the SmartFlow.

3. Connect the power cable to the 4-pin connector on the bottom of the SmartFlow body.

Network Connections

NOTE	
	The SmartFlow must be connected to an Ethernet network to perform correctly.

1. Refer to the wiring diagram below for the network connection on the top of the SmartFlow body.



2. Connect the RJ-45end of the Ethernet cable to an Ethernet LAN port or broadband modem port on a computer.

3. Connect the other end of the Ethernet cable to the 4-pin connector on the top of the SmartFlow body.

5 FUNCTIONAL TESTING

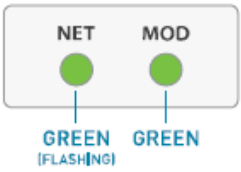
Power and Network Connectivity

NOTE	
ⓘ	A valid Ethernet connection and a JavaScript™-enabled web browser are required to operate the SmartFlow. If operating the SmartFlow using a Welding robot pendant, refer to the robot manufacturer's pendant operating manual for instructions on accessing network devices. If connecting to the SmartFlow from a personal computer, it may be necessary to disable or Standard SmartFlow products are programmed with a default IP address of 192.168.125.67.

NOTE	
ⓘ	A Configuration Guide describing the procedure for configuring the SmartFlow EtherNet/IP network setting is available on the product delivered disc.

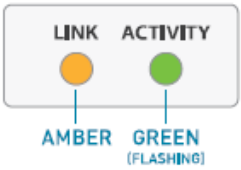
1. Turn 24VDC power ON.

   - The NET status indicator will turn GREEN and flash.
   - The MOD status indicator will turn GREEN.



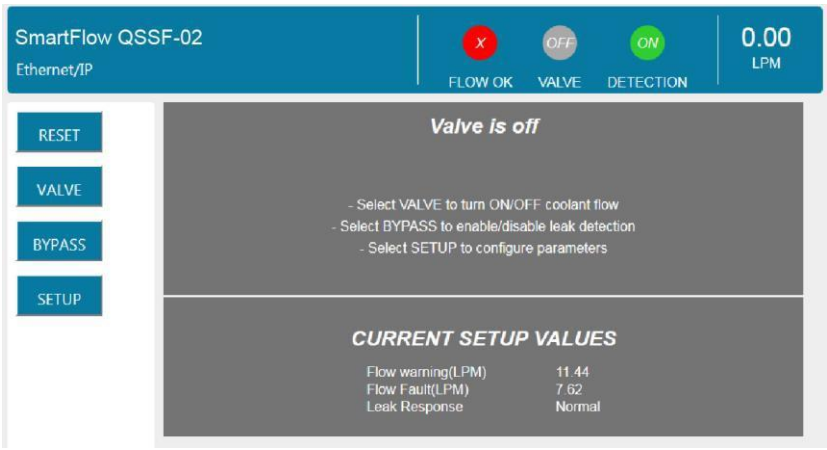
2. Confirm that the SmartFlow has established a valid Ethernet connection.

   - The LINK status indicator will be AMBER.
   - The ACTIVITY status indicator will be GREEN and flashing.



3. Open the web browser and access the IP address of the SmartFlow.

   - The SmartFlow interface will display in the browser window.
   - The status information indicated on the screen will depend on the measured flow rate through the device.



Flow Detection

1. Confirm that 24VDC power is ON.

- If the coolant flow is OFF or if the flow rate the Flow Fault value, the display will indicate a FLOW FAULT condition.
- The indicated flow rate will be 0.00(if the flow is OFF) or the actual flow rate.

2. Turn the coolant flow ON or increase it until it reaches the optimum system flow rate.

- The display will indicate the OK TO WELD condition.

Valve Shut-Off

1. Select the VALVE button.

- The coolant flow will turn OFF and the display will indicate the VALVE CLOSED condition.

2. Select the VALVE button again.

- The coolant flow will turn ON and the display will indicate the OK TO WELD condition and the actual flow rate.

Bypass Mode

1. Select the BYPASS button.

- The leak detection function will turn OFF and the display will indicate the BYPASSED condition.

2. Select the BYPASS button again.

- The leak detection function will turn ON and the display will return to the OK TO WELD condition.

Cap Off Detection

1. Remove a weld cap to create a leak in the system.

- The SmartFlow will turn the coolant flow OFF and the display will indicate the CAP OFF condition.

2. Reinstall the weld cap and confirm that it is properly secured to the weld gun.

3. Select the RESET button

- The SmartFlow will restore the coolant flow and the display will indicate the OK TO WELD condition and the actual flow rate.

6 PARAMETER SETUP

Network configuration

- **Ethernet/IP version**

  If you know current IP address

  SmartFlow's IP address could be configured in Webserver. You can connect to SmartFlow via its present IP address and change it as shown in the following pictures.

  If you forget or don't know SmartFlow's current IP address

  In this case, please use the the following procedure to reset its IP address back to **192.168.125.67**. This also the default IP address out of factory.

1. Connect 24V+ to DI3 ande 24VGND to DI_COM.
2. Make sure this 24V signal to DI3 last at least 5 seconds.
3. Turn off and turn on the power to SmartFlow again. Try to connect to webserver via 192.168.125.67 to check the network connectivity.

Notes: always make sure your PC is in the same IP section when trying to connecto to webserver.

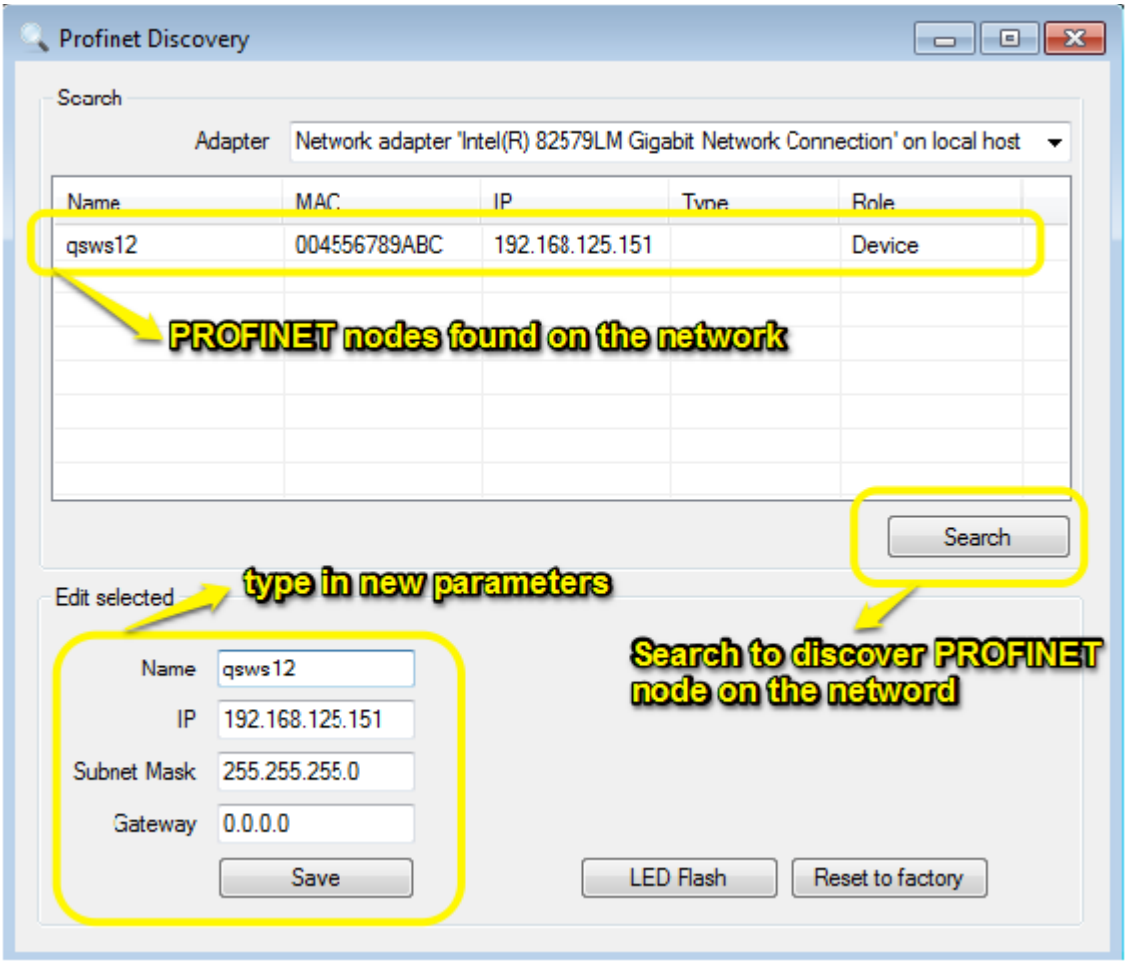
- **PROFINET version**

  We suggest to use the configuration tools from PROFINET technology supplier to configure PROFINET-based SmartFlow's IP address and other network parameters, such as NetNames+ from Phoenix Contact (former KW software). Actually this kind of software should be delivered as part of your PROFINET controller.

  PROFINET Explorer is also a good and free-of-charge alternative from personal developers.

  Due to PROFINET's DCP protocol, you don't need to keep your PC at the same IP section with SmartFlow. So feel freely to use those PROFINET configuration tools even if you forget or don't know SmartFlow's present IP address.

In some case, you need to close your PC's firewall to discover PROFINET node successfully.



SmartFlow Control Parameters

The SmartFlow features multiple control parameters that can be configured to achieve optimum performance within your system.

- Flow Warning Trip Point

  This is the flow rate at which the welding system should be operated, this flow rate provides sufficient cooling capacity to allow welds to be produced at the desired rate under all ambient temperature conditions.

- Flow Fault Trip Point

  This is the lowest flow rate at which the welding system should be operated. Coolant flow lower than this rate does not provide sufficient cooling capacity to allow satisfactory weld to be produced.

- Leak Response Sensitivity

This setting determines how quickly a leak will be detected. Slowing the response reduces sensitivity to false cap-loss events; speeding the response increase sensitivity.

- Startup Stabilization Delay Time

  This setting selects the amount of time required to purge air from the cooling system at startup that could otherwise cause false cap-loss events.

- Startup Leak Detection Threshold

  This setting checks whether the weld cap is properly in place and is not ejected from the weld shank when water pressure is applied. A low setting gives the most sensitive response to the loss of a weld cap at startup; a high setting gives the least sensitive response.

Factory Default Setup Values

CONTROL PARAMETER	SELECTABLE VALUES					DEFAULT
Flow Warning	0.0-11LPM					3.0LPM
Flow Fault	0.0-11LPM					1.5LPM
Leak Response	Slowest	Slow	Normal	Fast	Fastest	Normal
Startup Stabilization	1Sec.	2Sec.	4Sec.	8Sec.	16Sec.	2Sec.
Startup Leak	2.0LPM	4.0LPM	6.0LPM	8.0LPM	10LPM	2.0LPM

Adjusting Parameter Values

1. Select the SETUP button on the user interface.

- The Parameter setup page will display in the information Frame and show the current parameter settings.

NOTE	
ⓘ	The current parameter values are displayed at the bottom of the Parameter Setup page. The factory default parameter values can be viewed by selecting the Show Factory Settings button. To return to

the current parameter values view, click the Show Current Settings button.

2. Adjust the parameter values as desired.

- To change the Flow Warning or Flow Fault setting, enter a new flow limit value in the corresponding text field.

CAUTION !	
	Enter only NUMERIC characters in the Flow Warning and Flow Fault text fields. Any invalid characters entered into these fields will be ignored by the SmartFlow.

- To change the Leak Response, Stabilization Delay or Startup Leak Detection settings, select a new value from the corresponding pull-down menu.

3. Exit the Parameter Setup page.

- To save the new control parameter value(s) and return to normal operation, select the Submit button.
- To return to normal operation WITHOUT saving any changes, select the Cancel button.
- After either button is clicked, the information Frame will return to the current SmartFlow status display.

4. Confirm any changes made to the parameter values.

- Review the current Flow Warning, Flow Fault and Leak Response settings displayed at the bottom of the Information Frame the SETUP button.
- To review the current setting for all parameter values, select the SETUP button to return to the Parameter Setup page.

7 TROUBLE SHOOTING

The NET and MOD status indicators are off

- 24 VDC power is not present

    1. Confirm the presence of 24 VDC at pins 2 and 4 of the 4-pin power connector on the bottom of the SmartFlow body.

    2. If 24 VDC is present but the NET and MOD status indicators are off, replace the electronics board.

The LINK and ACTIVITY status indicators are off

- The SmartFlow does not have a valid Ethernet connection

    1. Confirm the Ethernet cable connection on top of the SmartFlow unit.

    2. Confirm that the Ethernet network is functioning properly.

- A firewall or other security software is blocking access to the SmartFlow

    1. Disable or reconfigure any firewall or security software running on the system.

    2. If the problem persists, consult with your network administrator.

The SmartFlow user interface does not display correctly on the web browser

- JavaScript™ is not enabled

    1. Enable JavaScript following the steps necessary for your specific browser.[Refer to your browser's Help menu for assistance.]

    2. Select the browser Reload/Refresh button to reload the SmartFlow interface.

- A firewall or other security software is blocking access to the SmartFlow

    1. Disable or reconfigure any firewall or security software running on the system.

    2. If the problem persists, consult with your network administrator.

The SmartFlow status information is no longer updating on the user interface

- The browser has stopped retrieving status information from the SmartFlow

    1. Select the browser Reload/Refresh button to reload the SmartFlow interface.

    2. If the problem persists, check the network connections and status.

The SmartFlow does not detect a cap-off condition

- The unit is in Bypass Mode

  Select the BYPASS button to exit Bypass Mode and enable leak detection.

- The Leak Response setting is too slow

  1. Select the SETUP button to enter Parameter Setup.
  2. Select a faster Leak Response parameter value from the pull-down menu.
  3. Select the Submit button to save the new value and return to normal operation.

The SmartFlow does not detect a cap loss immediately after reset

- The Startup Leak Detection Threshold setting is too high

  1. Select the SETUP button to enter Parameter Setup.
  2. Select a lower Startup Leak Detection Threshold parameter value from the pull-down menu.
  3. Select the Submit button to save the new value and return to normal operation.

A FLOW FAULT or CAP OFF FAULT is detected immediately after replacing a weld cap

- The Startup Stabilization Delay setting is too short

  1. Select the SETUP button to enter Parameter Setup.
  2. Select a higher Startup Stabilization Delay parameter value from the pull-down menu.
  3. Select the Submit button to save the new value and return to normal operation.

- The solenoid valve pilot flow is blocked

  Clean or replace the solenoid valve.

- The check valve is blocked or fouled

  Clean or replace the check valve.

The flow rate reduces over time

- For SmartFlow units fitted with the optional Y-strainer: The filter is clogged

  Clean or replace the filter.

False cap-loss events occur repeatedly at the same step in the weld cycle when rapid robot movement occurs

- The Leak Response setting is too fast

    1. Select the SETUP button to enter Parameter Setup.
    2. Select a slower Leak Response parameter value from the pull-down menu.
    3. Select the Submit button to save the new value and return to normal operation.

8 MAINTENANCE

Recommended Maintenance

Maintenance of the SmartFlow is ordinarily limited to cleaning the flow sensor chambers and sensors. The frequency at which the SmartFlow requires cleaning or other maintenance is wholly dependent on the quality and cleanliness of the liquid that is passed through the unit.

NOTE	
	Annual cleaning of the SmartFlow is required to maintain reliable operation. Annual replacement of perishable of perishable components the original flow rate calibration accuracy.

The first indication of the need for cleaning may be an increasing frequency of false cap-loss events, which can occur when the flow sensors have become so unbalanced due to wear or fouling that they no longer spin in uniform manner.

NOTE	
	The accuracy of flow rate measurement affects only the repeatability of the Flow Warning and Flow Fault flow rate settings. The SmartFlow's patented cap-loss detection algorithm is not affected by changes in the response of either of the flow sensors.

SmartFlow Maintenance Kit

A SmartFlow maintenance kit containing replacements of all perishable components is available from Quantsen Intelligence System (Shanghai) company limited. and our service partners around the world.

Flow Sensor Maintenance Instructions

NOTE	
	The SmartFlow flow sensor components can be cleaned and replaced without removing the unit from the coolant circuit.

CAUTION !	
	Coolant flow to the SmartFlow must be shut OFF before accessing the flow sensors. Failure to shut off the coolant flow could result in damage to the SmartFlow and other equipment.