ORCA™ IO SmartHub

User Guide 230424

Version 1.3, November 2025

This document applies to the following ORCA motor firmware:

- > 6.2.8

For more recent firmware versions, please download the latest version of this user guide at https://irisdynamics.com/downloads

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Revision History

Version	Date	Author	Reason
1.0	May, 2023	sj	Initial Release
1.1	Dec, 2023	rm, sj	Rebranding, support with v6.1.8 orca firmware
1.2	Feb, 2024	sj, rm, kc	Update diagrams and renders
1.3	Nov, 2025	Sj, mro	Clarify analog outputs, Correct Digital Input functions.

Overview

This document is intended for users who intend to control an ORCA motor using the ORCA IO SmartHub. The ORCA IO SmartHub allows for control of ORCA motors in Force, Position, and Kinematic Modes through simple digital and analog inputs. Real-time force and position data are fed back from the motor to the ORCA IO SmartHub and provided as analog outputs. The ORCA IO SmartHub handles the high-speed digital communication with the motor, allowing easier integration with existing industrial control methods such as PLCs with 4-20 mA current loop outputs.

For information on operation of ORCA motors, please consult the ORCA Motor Reference Manual.

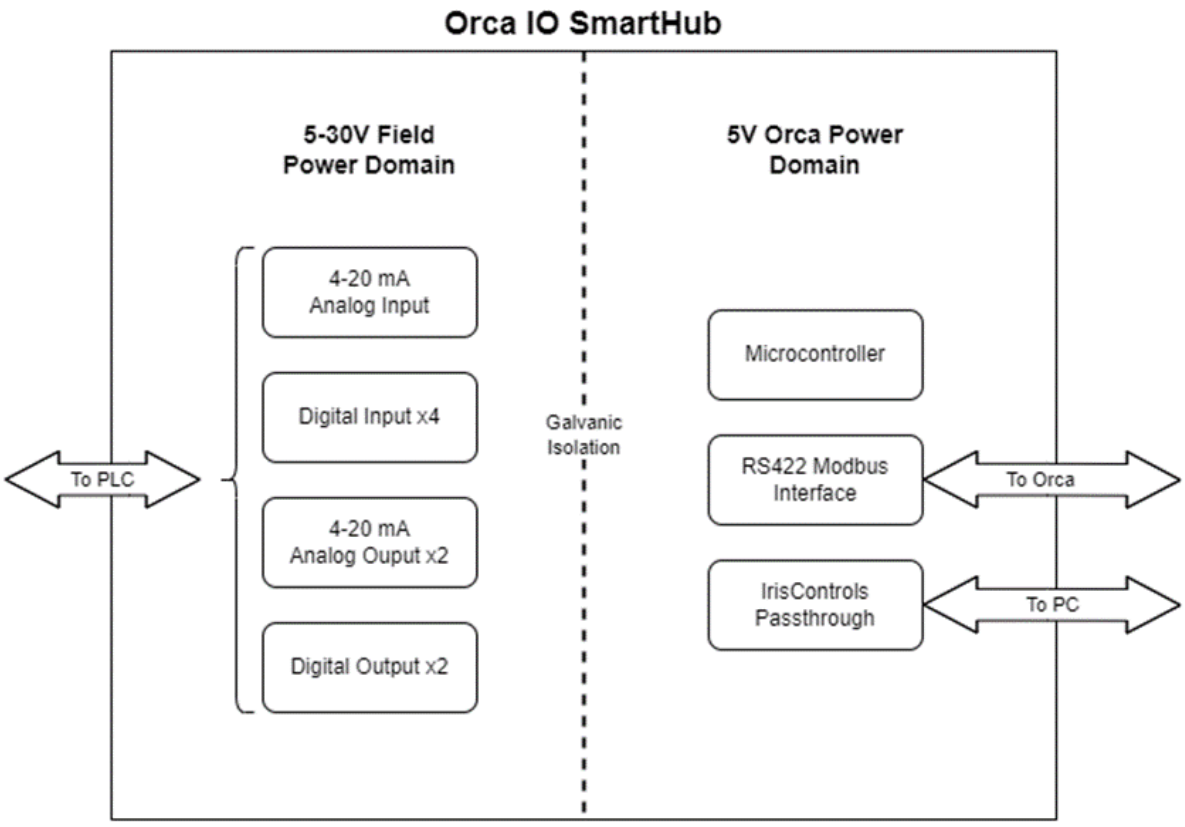


Figure 1: ORCA IO SmartHub Block Diagram

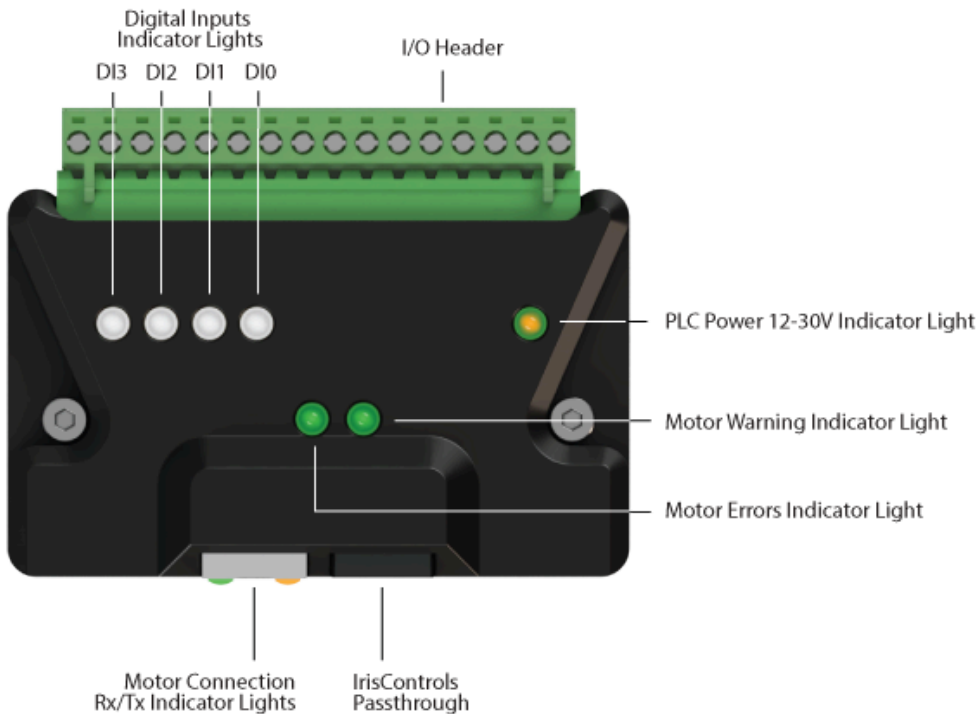


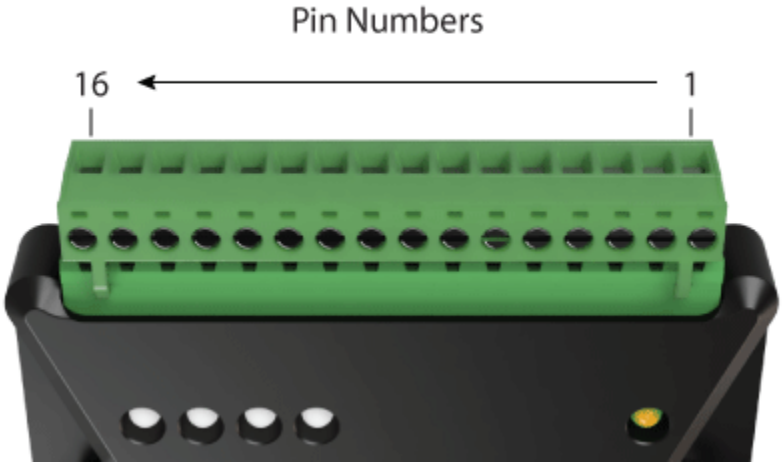
Figure 2: Device Overview

Feature	Description
Digital Input Indicator Lights 0-3	White = High Input Off = Low Input
I/O Header	Pluggable terminal block socket for connection to PLC.
PLC Power 12-30V Indicator Light	Amber = Powered Off = Not Powered
Motor Warning Indicator Light	Green = No Warning Yellow = Warning Off = No Motor Connection / Power
Motor Errors Indicator Light	Green = No Motor Errors Red = Motor Errors Off = No Motor Connection / Power
Motor Connection Rx/Tx Indicator Lights	Green = Rx Yellow = Tx
IrisControls Passthrough	For connecting to ORCA motor GUI through IrisControls.

Pinout

Pin Number	Pin Name	Function
1	V+	+5-30VDC power supply terminal.
2	V-	0V power supply terminal.
3	AI+	Analog input positive current terminal.
4	AI-	Analog input return current terminal.
5	AO1	Analog force sensed output: positive current terminal.
6	G1	Common current return terminal for AO1 and AO2 pins.
7	AO2	Analog position sensed output: positive current terminal.
8	WRN	Warning signal digital output.
9	G2	Common terminal for WRN and ERR pins.
10	ERR	Error signal digital output.
11	DI0	Digital input signal 0.
12	G3	Common terminal for DI0 and DI1 pins.
13	DI1	Digital input signal 1.
14	DI2	Digital input signal 2.
15	G4	Common terminal for DI2 and DI3 pins.
16	DI3	Digital input signal 3 (Enable)

Shaded groups of pins share an isolated common. This pin must be connected to the appropriate ground for the circuit they are interfacing with.



External Connections

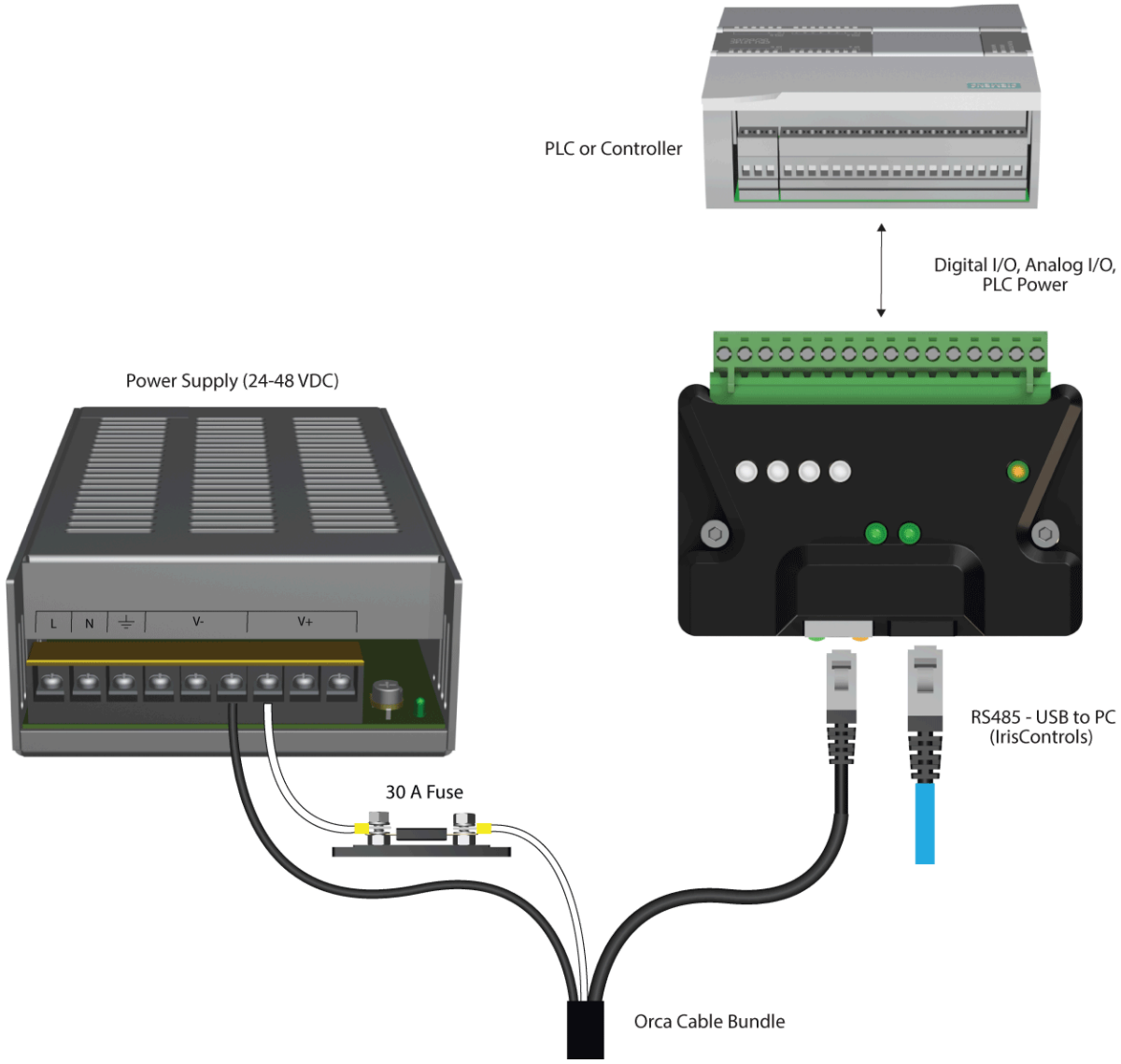


Figure 3: ORCA IO SmartHub Connection Diagram

Connecting to an ORCA Motor

To connect the ORCA IO SmartHub to an ORCA motor and establish communications, plug the male RJ45 connector from the motor into the shielded female RJ45 jack on the ORCA IO SmartHub. Please note the IO SmartHub requires the default Modbus baud rate of 19200 to be set on the ORCA motor. The baud rate can be configured via Iris Controls on the Modbus page. Once the motor is powered with the appropriate power supply, the ORCA IO SmartHub logic will receive power and attempt to establish a connection with the motor.

Upon successful connection to the motor, the transmit and receive lights on the female RJ45 jack on the ORCA IO SmartHub should appear solid. Please note that for proper operation, the ORCA motor must be configured with the desired control settings. See the Configuration section of this guide for more information.

Connecting to a PLC / Microcontroller

The ORCA IO SmartHub features a 16-pin header designed to fit 5.0 mm pitch swappable terminal blocks. Possible terminal block options include push-in spring and screw type terminals. This header provides access to all analog and digital inputs and outputs, as well as power terminals.

All inputs and outputs accessible from the header are galvanically isolated from the motor-supplied portion of the circuit that includes the digital logic. The device is tolerant to large ESD events on these pins.

The connections made to an external controller or PLC are application dependent. Any combination of the array of analog and digital input/outputs may be used at once. The functions of each of the inputs and outputs are dependent on the configured mode of operation and will be covered later in this guide.

As shown in the Pinout section of this guide, pairs of inputs and outputs share common pins, labeled G1, G2, G3, and G4. These pins must be connected to the appropriate ground for the circuit they are interfacing with. All inputs and outputs on the ORCA IO SmartHub are in a sinking configuration and can tolerate 5-30 V DC.

The IOSH requires a 5-30 VDC connection to the V+ and V- pins, which will illuminate the amber power light upon correct connection.

Troubleshooting Connections

Motor Not Moving / Staying in Sleep Mode

- Ensure the digital enable pin is asserted (digital pin 3). This pin must be held high to enable any forces and when this pin is brought low or disconnected, the motor will go to sleep (stop outputting force).

No Connection to ORCA Motor

- Ensure the motor is powered with the appropriate power supply for the model.
- Verify that the RJ45 connector is fully seated in the jack.
- Verify that the connected ORCA motor firmware version is 6.2.8 or higher.
- Verify that the ORCA Modbus baud rate is set to 19200.

Incorrect Analog Input / Output Values

- Ensure the field powered side of the ORCA IO SmartHub is powered with 12-30 VDC across the V+ and V- terminals.
- The ORCA IO SmartHub only supports current loop signals, not voltage. A voltage input or output can be used, but must first be converted to a current of the appropriate range with a resistor or other dedicated circuitry.

Digital Input / Output Not Working

- Ensure the appropriate common terminal is connected for the signal of interest. Individual pins are described in the Pinout section of this guide.

Configuration

Configuration for operation with an ORCA IO SmartHub is stored and saved in the nonvolatile memory of ORCA motors, not the ORCA IO SmartHub itself. The actual data transmitted between the ORCA IO SmartHub and a motor does not change with configuration, only the way it is interpreted by the motor. This means that any ORCA IO SmartHub can be plugged into a given motor and the same behaviour should be expected.

Information on connecting to the IrisControls GUI can be found in the ORCA Motors Quickstart Guide. Once connected, navigate to the Interfaces page to begin configuring the ORCA IO SmartHub settings.

Figure 4: IrisControls ORCA IO SmartHub Configuration Panel

GUI Element Descriptions

(1) Current Loop Status

Displays the status of each of the three current loops.

The Force and Position current loop status displays the amount of current requested by the motor to be output by the ORCA IO SmartHub. These values will update along with changing force and positions, even without connecting to an ORCA IO SmartHub.

The Input display shows the current measured by the ORCA IO SmartHub, reported back to the motor.

(2) Digital Input Status

Displays the status of the three digital inputs. Digital inputs that are currently high will be displayed in orange, and digital inputs that are currently low will be displayed in grey.

(3) Force Range Setting

Determines the range of forces that are mapped to the current loop. This applies for both the force output current loop, and the input current loop if in force input mode.
The minimum force value is mapped to the low current value (either 0 or 4 mA) and the maximum value is mapped to 20 mA. Force values below the minimum or above the maximum will be clipped to their respective current.

(3) Position Range Setting

Determines the range of positions that are mapped to the current loop. This applies for both the position output current loop, and the input current loop if in position input mode.
The minimum position value is mapped to the low current value (either 0 or 4 mA) and the maximum value is mapped to 20 mA. Position values below the minimum or above the maximum will be clipped to their respective current.

(4) Save Configuration Button

Saves all settings to the motor's nonvolatile memory to be retained through power cycles.

(5) Current Range Selection

Selects the current range that all force, position, and input values will be normalized to. This setting can either be 4-20 mA or 0-20 mA.

(6) ORCA IO SmartHub Mode Selection

Determines how the motor will respond to the analog and digital inputs. See the Input Modes section for more information.

(7) Kinematic Trigger Settings

Selects the kinematic motion IDs that will be triggering on rising and/or falling edges of digital input trigger signals.

Input Modes

ORCA motors can be configured to communicate with ORCA IO SmartHubs in three different modes. In this section each mode will be covered in detail. ORCA motors will only exhibit the following behaviour while connected to an IO SmartHub.
Below is a table explaining how each input is used in each of the three modes.

	Force	Position	Kinematic
Digital Input 0	*Reserved*	**Control Max Force**	**Trigger 1**
Digital Input 1	*Reserved*	*Reserved*	**Trigger 2**
Digital Input 2	*Reserved*	*Reserved*	**Trigger 3**
Digital Input 3	**Enable**	***Enable***	**Enable**
Analog Input	**Force Command**	**Position Command (Max Force when DI0 high)**	*Reserved*

Force Mode

If Force Input Mode is selected, an ORCA motor will enter IOSH Force Mode (8) while the Enable Digital Input (DI3) is high.

Once in IOSH Force Mode, the Analog Input channel of the ORCA IO SmartHub will be used to set the force outputted by the motor. The force value F is calculated based on the force and current range configurations.

$$F = (I_{Input} - I_{Low}) / (20 - I_{Low}) * (F_{Max} - F_{Min}) + F_{Min}$$

Where I_{Low} may be 0 mA or 4 mA, and F_{Max} and F_{Min} are determined by the 'force range setting'. Once a force value F is calculated, it is sent to the motor's force controller as a command.
Digital Inputs 0,1, and 2 are reserved and have no function in this mode.

Position Mode

If **Position** Input Mode is selected, an ORCA motor will enter IOSH Position Mode (9) while the Enable digital input (DI3) is high.

Once in the ORCA IO SmartHub's Position Mode, the Analog Input channel of the ORCA IO SmartHub will be used to set the position of the motor. The position value P, which is proportional to the Analog Input current, is calculated based on the Position Range, and Current Range settings values.

$$P = (I_{Input} - I_{Low}) / (20 - I_{Low}) * (P_{Max} - P_{Min}) + P_{Min}$$

Where I_{Low} may be 0 mA or 4 mA, and P_{Max} and P_{Min} are determined by the position range user setting. Once a position value P is calculated, it is sent to the motor's position controller as a command.

While Control Max Force (DI0) is held high, the Analog Input channel of the ORCA IO SmartHub will be used to set the force saturation value F_{Sat}. The force saturation value is the maximum value of force in millinewtons that the position controller will exert. Forces above the saturation value will be clipped. The saturation value calculated is based on the maximum force range setting, and the current range setting.

$$F_{Sat} = (I_{Input} - I_{Low}) / (20 - I_{Low}) * (F_{Max})$$

Where I_{Low} may be 0 mA or 4 mA, and F_{Max} is determined by the force range setting. Once a force saturation value is calculated, it is sent to the motor's position controller and is effective immediately. Force saturation is set regardless of the Enable (DI3) status, but if Enable is high, motor position will be adjusted along with the force saturation value.

Digital inputs 1 and 2 are reserved and have no function in this mode.

Kinematic Mode

If **Kinematic** Input Mode is selected, an ORCA motor will enter IOSH Kinematic Mode (10), while the Enable digital input (DI3) is high.

While in IOSH Kinematic Mode, the analog input is not used. Instead, digital inputs 0, 1, and 2 can trigger a set of pre-configured kinematic motions by associating those inputs with motion IDs. In addition the Enable input (DI3) will trigger the Home Motion ID.

Please see the *ORCA Motor Reference Manual* for more information on kinematic motions and their configuration. Two trigger options are available: Rising Trigger (rising edge only), or Edge Trigger (both rising and falling edge). Edge Trigger allows the rising and falling edges to trigger different motions.

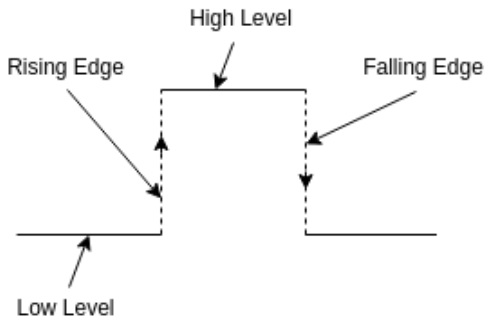


Figure 5: Signal Transitions

Note: Digital Inputs may trigger a single motion or a chain of motions, depending on the kinematic motion's configuration.

Warning and Error Signals

The ORCA IO SmartHub has two digital output pins assigned as warning and error. They act as signals that can be fed into an external controller to detect error states on the connected motor. Each signal also controls an LED for visual indication. The error signal light is red/green, and the warning light is yellow/green. During normal operation, both lights should appear green.

Warning Signal

If the warning output is asserted, the warning LED will transition to yellow. This signal is asserted when the motor indicates that a warning condition has occurred and will return to a cleared state if the warning is no longer present on the motor. For more information on configuring motor warnings, please see the ORCA Motor Reference Manual.

Error Signal

If the error output is asserted, the error LED will transition to red. This signal will be asserted whenever the connected ORCA motor experiences an error and will return to a cleared state if the error is no longer present on the motor. For more information on possible motor errors, please see the ORCA motor Reference Manual.

Clearing Error States

If an error output is detected, the error may be cleared by pulling the Enable input low. This will cause the motor to transition into Sleep Mode, which attempts to clear various errors. If the error condition still exists on the motor, the error signal will persist. In this case, further investigation on the state of the motor is required.

Limitations & Use Considerations

While an ORCA motor is plugged into a IO SmartHub, Modbus communication between the motor and other methods of control is not possible. In addition, setting the motor mode (including Auto Zeroing Mode) from within IrisControls is not possible.

It is important to remember that swapping motors requires re-configuring the new motor's settings as the IO SmartHub settings are stored on the motor and not on the SmartHub.