ETHERCAT

OPERATING BULLETIN

For CODA-Series Coriolis Mass Flow Instruments

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Introduction

This bulletin covers the hardware, ESI file installation, PDO mappings, and CoE object dictionary for EtherCAT communication on CODA-series Coriolis mass flow meters (K) and controllers (KC, KF, KG). For general instrument operation, refer to *DOC-MANUAL-CODA*.

CODA instruments with EtherCAT are identified by their dual Ethernet connectors (RJ45 or M12, depending on your CODA configuration). Multiple CODA devices can be daisy-chained in a linear topology from the EtherCAT master.

Hardware

Ethernet Connectors

CODA EtherCAT instruments are equipped with two Ethernet ports. Depending on the device configuration, the instrument uses either standard RJ45 connectors or IP67-rated 4-pin M12 connectors (D-coded). Either port can be used to communicate with the EtherCAT master or to daisy-chain to the next device on the segment. The device provides a 10/100 Mbps embedded switch between the two ports.

M12 Connector Pinout (IP67 Configuration)

IP67-rated CODA EtherCAT instruments use 4-pin D-coded M12 connectors. The diagram and table below identify pin number and location for each port.

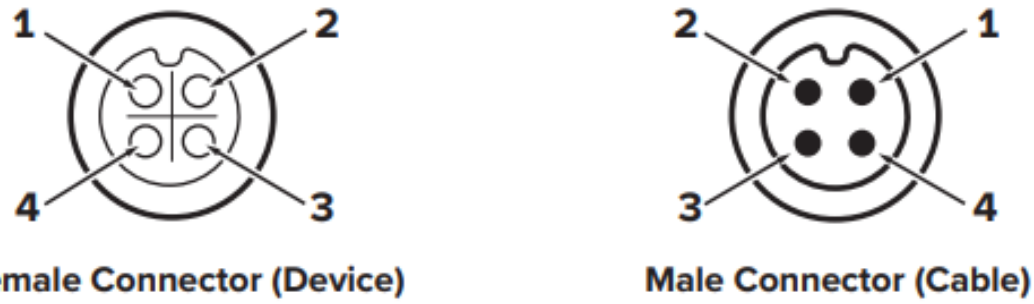

Figure 1. IP66/67 M12 4-pin and M8 4-pin connector pinout diagrams (from DOC-PINOUT-IP66-67EIP-ECAT-PROFINET-ModbusTCPIP).

Pin	Signal	Description
1	Tx+	Transmit Data +
2	Rx+	Receive Data +
3	Tx–	Transmit Data –
4	Rx–	Receive Data –

Table 1. M12 4-pin D-coded Ethernet connector pinout (female, device side, ×2). Applies to IP67 (M12) CODA configurations only.

LED Status Indicators

RJ45 CODA EtherCAT instruments have two status LEDs (RUN and ERR) located on the RJ45 Ethernet connectors. These LEDs indicate EtherCAT state machine status as described below. M12 configurations do not have status LEDs.

LED Pattern	RUN LED (Green)	ERR LED (Red)
Off	Init	No error
Blinking	Pre-Operational	Invalid configuration
Single Flash	Safe-Operational	Unsolicited state change
Double Flash	—	Application watchdog timeout
On	Operational	PDI watchdog timeout

Table 2. RUN and ERR LED status indicators (RJ45 configurations only).

ESI File

Alicat provides an EtherCAT Slave Information (ESI) file that describes the CODA device's PDO mappings, CoE object dictionary, and sync manager configuration to the EtherCAT master software. Install the ESI file before adding the CODA to your master project.

Item	Details
File name	CODAEthercat.xml (contained in CODAEthercat.zip)
Download	https://downloads.alicat.com/software/CODAEthercat.zip
Also available at	alicat.com/manuals

Table 3. ESI file details.

Adding the CODA to Your EtherCAT Master

The procedure below describes ESI installation and device configuration using Beckhoff TwinCAT 3. For other EtherCAT master software, consult your master documentation for the equivalent steps.

ESI Installation (TwinCAT 3)

1. Download and extract **CODAEthercat.zip**. Copy **CODAEthercat.xml** to the TwinCAT ESI directory:

`C:\TwinCAT\3.1\Config\Io\EtherCAT\`

2. In TwinCAT XAE, reload device descriptions: **TwinCAT** menu → **EtherCAT Devices** → **Reload Device Descriptions**.
3. The CODA will appear as **Alicat_NI** in the device catalog after reloading.

Scanning and Configuring the Device

1. In the Solution Explorer, add an EtherCAT master if one is not already present and select the Ethernet adapter connected to the CODA.
2. Right-click the EtherCAT master → **Scan** to detect connected slaves.
3. The CODA appears as **Alicat_NI** in the I/O tree under the master.
4. Map RxPDO and TxPDO variables to your PLC program variables using the **Variable Mapping** tab.
5. Activate the configuration and set the master to Run mode. The RUN LED on the CODA should be steady green when the device reaches Operational state.

EtherCAT Communication

CODA EtherCAT devices support both cyclic process data (PDO) and mailbox-based CoE (CANopen over EtherCAT) communication. Cyclic data is exchanged via the RxPDO and TxPDO on every bus cycle. Device configuration and diagnostic parameters are accessible via CoE SDO (Service Data Object) messages to object 0x4000.

Identity Object (0x1018)

SubIndex	Name	Type	Value
1	Vendor ID	UDINT	0x093A (Alicat Scientific, Inc.)
2	Product Code	UDINT	0x0022
3	Revision Number	UDINT	0x0001
4	Serial Number	UDINT	Device-specific

Table 4. Identity object (0x1018) attributes.

Sync Manager Configuration

The four sync managers are configured as shown below. SM0 and SM1 carry CoE mailbox traffic; SM2 and SM3 carry cyclic process data.

Sync Manager	Start Address	Size	Description
SM0 — Mailbox Out	0x1000	128 bytes	Master → slave CoE SDO requests
SM1 — Mailbox In	0x1080	128 bytes	Slave → master CoE SDO responses
SM2 — Outputs	0x1100	Variable	Process Data Out — RxPDO (0x1600)
SM3 — Inputs	0x1D00	Variable	Process Data In — TxPDO (0x1A00)

Table 5. Sync manager configuration.

PDO Mappings

Process Data Objects (PDOs) carry real-time cyclic data between the master and the CODA device. RxPDOs transfer data from the master to the device; TxPDOs transfer data from the device to the master.

RxPDO — 0x1600 (Master → Device)

PDO Index	Object	SubIdx	Name	Type
0x1600:01	0x2000	01	Device Control	USINT (8-bit)
0x1600:02	0x2000	02	Mass Flow Setpoint	REAL (32-bit IEEE 754)

Table 6. RxPDO 0x1600 mapping. Total process data: 5 bytes.

Mass Flow Setpoint units are determined by the device's Mass Flow Units setting (CoE object 0x4000, SubIndex 15). Read SubIndex 15 via SDO to identify the current unit selection. See the CoE Object Dictionary section. Contact Alicat support if you are unsure of your unit configuration.

TxPDO — 0x1A00 (Device → Master)

PDO Index	Object	SubIdx	Name	Type
0x1A00:01	0x3000	01	Device Status	USINT (8-bit)
0x1A00:02	0x3000	02	Density	REAL (32-bit IEEE 754)
0x1A00:03	0x3000	03	Temperature	REAL
0x1A00:04	0x3000	04	Volumetric Flow	REAL
0x1A00:05	0x3000	05	Mass Flow	REAL
0x1A00:06	0x3000	06	Totalizer	REAL
0x1A00:07	0x3000	07	Mass Flow Setpoint	REAL
0x1A00:08	0x3000	08	Totalizer Time	REAL

Table 7. TxPDO 0x1A00 mapping. Total process data: 29 bytes. Density in kg/m³; Temperature in °C; Volumetric Flow in m³/hr; Mass Flow and Mass Flow Setpoint units depend on device configuration; Totalizer in g; Totalizer Time in seconds.

Device Control Byte

The Device Control byte is an 8-bit field in RxPDO 0x1600 (object 0x2000, SubIndex 01). It is used to send commands to the instrument.

Bit(s)	Name	Description
0	Tare	Initiate a flow tare at the current no-flow condition.
1	Reset Totalizer	Reset the totalizer to zero.
2	Start Batch Run	Reset and start a new batch dispensing run.
3–4	Valve Override	0 = No override (normal control) 1 = Normal 2 = Fully closed 3 = Fully open
5–7	Reserved	Set to 0.

Table 8. Device Control byte bit definitions.

Edge-Triggered Commands

Commands are **processed on change**. Sending the same Device Control value repeatedly will not re-issue the command. To send sequential identical commands (for example, two tare operations in a row), write 0x00 between commands.

Example: To tare the instrument, write 0x01, then write 0x00 to clear before sending any further commands.

Device Status Byte

The Device Status byte is an 8-bit field in TxPDO 0x1A00 (object 0x3000, SubIndex 01). It reports the current instrument state.

Bit(s)	Name	Description
0	Zero Operation in Progress	A tare operation is currently running.
1	Density Under-range	Measured density is below the measurable range.
2	Density Over-range	Measured density is above the measurable range.
3	Batch Control Running	A batch dispensing operation is currently active.
4–7	Reserved	Always 0.

Table 9. Device Status byte bit definitions.

CoE Object Dictionary (0x4000)

Object 0x4000, Instance 1 provides access to device configuration and diagnostic parameters via CoE SDO messaging (SDO Read / SDO Write). In TwinCAT, browse these attributes in the **CoE Online** tab of the EtherCAT device, or access them programmatically using the *FB_EcCoESdoRead* and *FB_EcCoESdoWrite* function blocks. All values use little-endian byte order.

SubIdx	Name	Type	Access	Notes
01	Fullscale Mass Flow	REAL	Get/Set	Units depend on SubIdx 15
02	Fullscale Density	REAL	Get/Set	kg/m³
03	Exp Alpha	REAL	Get/Set	Exponential filter alpha gain
04	STP Density	REAL	Get/Set	kg/m³
05	Fullscale Volumetric Flow	REAL	Get/Set	Units depend on SubIdx 16
06	P-Gain	REAL	Get/Set	PID proportional gain
07	I-Gain	REAL	Get/Set	PID integral gain
08	D-Gain	REAL	Get/Set	PID derivative gain
09	Crack	REAL	Get/Set	Valve crack-open offset
10	Power-Up Setpoint	REAL	Get/Set	Setpoint applied at startup
11	Setpoint Source	USINT	Get/Set	Setpoint input source selection
12	Valve Override	USINT	Get	Valve override mode (read-only)
13	Controller Feedback Select	USINT	Get/Set	Control loop feedback variable
14	Device Type	USINT	Get/Set	Instrument type code
15	Mass Flow Units	USINT	Get/Set	Engineering units for mass flow
16	Volumetric Flow Units	USINT	Get/Set	Engineering units for volumetric flow
17	Totalizer Select	USINT	Get/Set	Totalizer variable selection
18	Totalizer Units	USINT	Get/Set	Units depend on SubIdx 17
19	Serial Number	STRING	Get	Instrument serial number
20	Application Firmware Revision	STRING	Get	Current firmware version string

SubIdx	Name	Type	Access	Notes
21	Batch Size Target	REAL	Get/Set	Target batch size
22	Default P-Gain	REAL	Get/Set	Factory default PID P-gain
23	Default I-Gain	REAL	Get/Set	Factory default PID I-gain
24	Default D-Gain	REAL	Get/Set	Factory default PID D-gain
25	Default Crack	REAL	Get/Set	Factory default valve crack offset

Table 10. CoE object 0x4000 sub-items. All REAL values are 32-bit IEEE 754 floating point. Little-endian byte order.

Troubleshooting

Symptom	Likely Cause	Resolution
Device not found during bus scan	ESI not installed, wrong adapter, or no power	Verify CODAEthercat.xml is in the master's ESI directory and device descriptions have been reloaded. Confirm the correct Ethernet adapter is selected. Verify power and cable connections (RJ45 or M12, depending on your CODA configuration).
ERR LED blinking	Invalid configuration	Check PDO assignment and sync manager configuration in the master project. Reload the ESI file if device descriptions appear incorrect.
ERR LED single flash	Unsolicited state change	The device received an unexpected state transition. Check for master configuration errors and verify no watchdog timeout is active.
ERR LED double flash	Application watchdog timeout	The master is not refreshing process data within the watchdog period. Verify the master cycle time is within the device watchdog setting.
ERR LED steady red	PDI watchdog timeout	Power-cycle the device. If the fault persists, reduce the master cycle time or contact Alicat support.
RUN LED stays blinking (Pre-Operational)	Master not transitioning device to Operational	Check for active ERR LED faults. Verify the PDO mapping matches the ESI configuration and confirm the master is in Run mode.
No live process data	Device not in Operational state	Confirm the RUN LED is steady green (Operational). If not, resolve any ERR LED faults first.
Commands not executing (tare, reset, etc.)	Device Control value not changing	Device Control is edge-triggered. Write 0x00 between commands so the next command is detected as a new value.
SDO write rejected	Read-only attribute or out-of-range value	Valve Override (SubIndex 12) is read-only and cannot be written via SDO. For other attributes, verify the value is valid for the data type.

Table 11. Common issues and resolutions.

For issues not listed above, contact Alicat support:

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