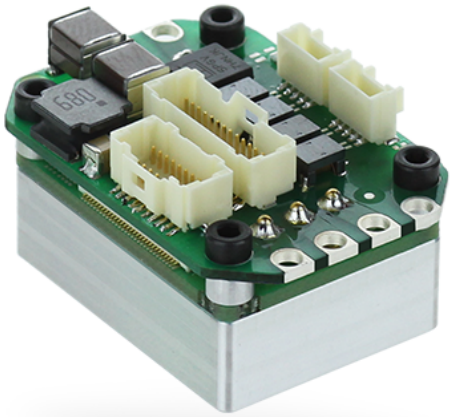
Everest XCR - Product Manual



Edition 10/15/2018

For the most up to date information visit the online manual.

INGENIA-CAT S.L.

8-14 MARIE CURIE, ADVANCED INDUSTRY PARK

08042 BARCELONA

INGENIA
passion for motion

1. Table of Contents

2. General Information

2.1. Manual revision history

Revision	Release Date	Changes	PDF
v1		Preliminary draft.	

For the most up to date information use the online Product Manual. The PDF manual is generated only after major changes.

Please refer to product hardware revisions for information on previous hardware revisions and changes.

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2.3. Contact

INGENIA-CAT S.L.
8-14 Marie Curie
Advanced Industry Park
08042 Barcelona
Spain

Telephone: +34 932 917 682
E-mail: hello@ingeniamc.com
Web site: www.ingeniamc.com

3. Safety Information

3.1. About this manual

Read carefully this chapter to raise your awareness of potential risks and hazards when working with the Everest XCR Servo Drive.

To ensure maximum safety in operating the Everest XCR Servo Drive, it is essential to follow the procedures included in this guide. This information is provided to protect users and their working area when using the Everest XCR Servo Drive, as well as other hardware that may be connected to it. Please read this chapter carefully before starting the installation process.

3.2. Warnings

The following statements should be considered to avoid serious injury to those individuals performing the procedures and/or damage to the equipment:

- To prevent the formation of electric arcs, as well as dangers to personnel and electrical contacts, never connect/disconnect the Everest XCR Servo Drive while the power supply is on.
- Disconnect the Everest Servo Drive from all power sources before proceeding with any possible wiring change.
- After turning off the power and disconnecting the equipment power source, wait at least 10 seconds before touching any parts of the controller that are electrically charged or hot.

3.3. Precautions

The following statements should be considered to avoid serious injury to those individuals performing the procedures and/or damage to the equipment:

- The Everest Servo XCR Drive components temperature may exceed 100 ºC during operation.
- Some components become electrically charged during and after operation.
- The power supply connected to this controller should comply with the parameters specified in this document.
- When connecting the Everest Servo XCR Drive to an approved power source, do so through a line that is separate from any possible dangerous voltages, using the necessary insulation in accordance with safety standards.
- High-performance motion control equipment can move rapidly with very high forces. Unexpected motion may occur especially during product commissioning. Keep clear of any operational machinery and never touch them while they are working.
- Do not make any connections to any internal circuitry. Only connections to designated connectors are allowed.
- All service and maintenance must be performed by qualified personnel.
- Before turning on the Everest Servo XCR Drive, check that all safety precautions have been followed, as well as the installation procedures.

4. Product Description

PRELIMINARY

Everest XCR is a compact, smart digital servo drive. Thanks to its small size and rugged design it can be mounted virtually anywhere: collaborative robot joints, wearable robots, unmanned ground or aerial vehicles as well as inside motors. The drive features best in class energy efficiency thanks to the latest GAN technology. At 30 A_{RMS} (42 A amplitude) 80 V_{DC} it generates just 20 W of total heat dissipation exceeding by far any comparable servo drive. The standby power losses of Everest XCR are minimal, even using EtherCAT, the consumption is less than 2.5 W. **Everest will save energy on your project and provide longer battery times**.

The control loops have sampling times that exceed the electrical and mechanical time constants of almost any motor. Up to 14 µs (75 kHz) current loop and 40 µs (25 kHz) position and velocity loops. The bandwidth of the control system will only be limited by the physical limits of the system and the feedback. Configurable digital filters offer extra flexibility. In addition, control algorithms can be programmed and executed real time on the drive. Power stage PWM frequency can be adapted to each application, with a minimum 10 kHz for low electrical noise and power losses and a maximum of 100 kHz for low inductance motors. Current gain can also be configured on 4 different ranges allowing the same drive and part number to used for various motor sizes and thus simplifying stocking and complexity in your application.

The Everest XCR can close loops with a Digital Incremental Encoder, Dual BiSS-C encoder and Digital Halls. Everything can be easily configured with the new INGENIA MotionLab 3.

Everest XCR include compliant EtherCAT & CANopen communication. The drive can be accessed from a standard EtherNET port for configuration.

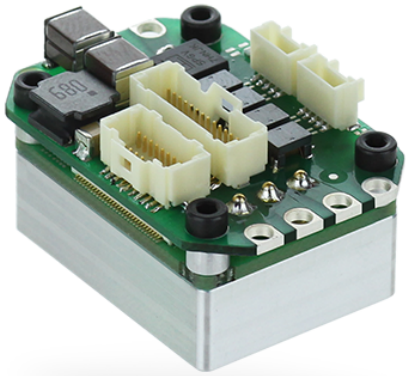
The Everest XCR can be operated with a single power supply on its full operating range and includes an additional logic supply up to 50 V. It includes 4 digital inputs and 4 digital outputs, a dedicated brake output, motor temperature sensing input and a 16 bit ±10 V analog input to interface with load cells and torque meters.

The driver has built-in safety torque off (STO) and includes several safety protections to protect against most issues like short-circuits, temperature and voltage based current foldback, overtemperature, overvoltage, and has industry grade EMC and ESD inmunity.

PRELIMINARY

4.1. Everest XCR part numbering

Everest XCR is available on a single part number. Rated at 30 A_{RMS} continuous current and an operation voltage between 8 V_{DC} to 85 V_{DC}. Variable gain current sense amplifier and 16 bit ADC allow controlling low current motors.

Product	Ordering part number	Status	Image
Everest XCR	EVE-30/100-XCR	PRE-PROD	

4.2. Specifications

A list of features of the Everest XCR Servo Drive is shown next. For further details, please check the Operational characteristics section below.

Electrical and power specifications	
Minimum power supply voltage	8 V_{DC}
Maximum absolute power supply voltage	80 V_{DC} (continuous) 85 V_{DC} (peak 100 ms)
Recommended power supply voltage	12 V_{DC} ~ 72 V_{DC} This voltage range ensures a safety margin including power supply tolerances and regulation.
Logic power supply voltage (optional)	8 to 50 V_{DC} Providing the logic supply is optional, as the drive is supplied from the DC bus (single supply) on its full operating voltage range.
Nominal phase continuous current (BLDC mode)	30 A_{RMS}
Nominal phase continuous current (DC mode)	30 A_{DC}
Maximum phase peak current	60 A_{RMS} @ 5 sec Active current limiting based on power stage and motor temperature.

Efficiency (at nominal conditions)	> 99%
Bus voltage utilization	> 96%
Motion control specifications	
Standby power	≤ 2.5 W
Supported motor types	• Rotary brushless (sinusoidal commutation only)
Power stage PWM frequency	10 kHz, 20 kHz, 50 kHz & 100 kHz user configurable
Current sensing	16 bit ADC resolution. Accuracy is ± 1% full scale. Current gain is configurable in 4 ranges.
Current sense range (configurable 4 gain levels)	±87.7A, ±47.7A, ±20.6A, ±13.8A
Current sense resolution (configurable)	2.676 mA/count, 1.46 mA/count, 0.63 mA/count, 0.42 mA/count
Max. Current loop bandwidth	TBD
Feedbacks	• Digital Hall • Quad. Incremental encoder / BiSS-C • BiSS-C
Supported target sources	• Network communication
Control modes	Cyclic Synchronous Position, Cyclic Synchronous Velocity, Cyclic Synchronous Torque Profile Position, Profile Velocity, Profile Torque, Interpolated Position, Homing
Inputs/outputs and protections	
Inputs and outputs	General purpose: • 4 x non-isolated single-ended digital inputs - 5 V logic level. 3.3V ready. • 1 x non-isolated single-ended digital outputs - 5 V logic level (continuous short circuit capable with 470 Ω series resistance. • 1 x ±10V fully differential analog input 16 bit. Typ. for load cells and closing torque loop. Dedicated: • 1 x Motor temperature analog input (with 1.65 kΩ pullup to 3.3V) • 2 x isolated STO dedicated inputs.

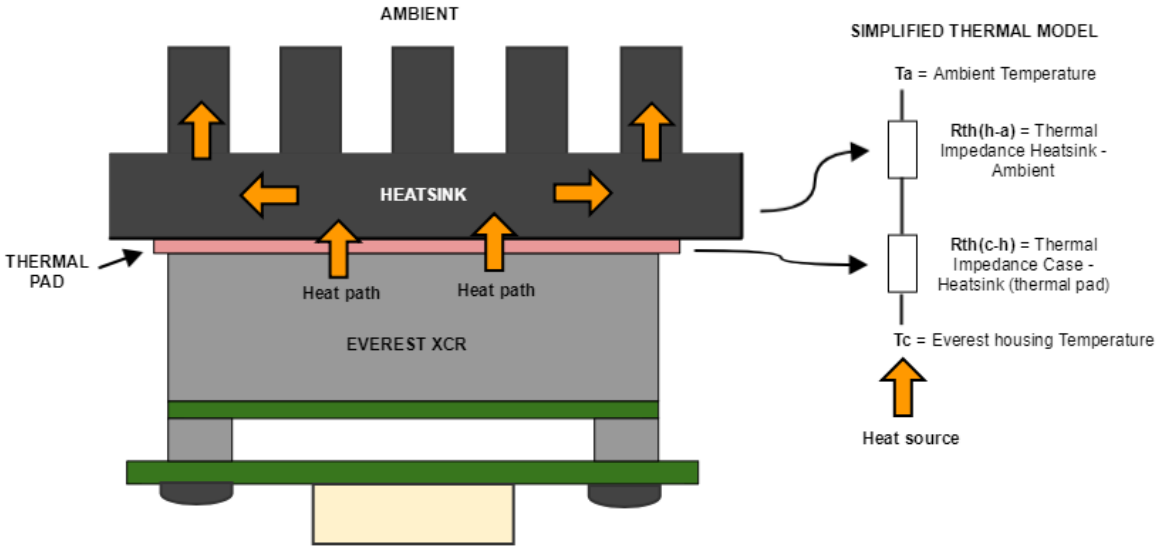
Protections	• User configurable:
	  • DC bus over-voltage
	  • DC bus under-voltage
	  • Drive over-temperature
	  • Drive under-temperature
	  • Over-current
	  • Overload (I^2t)
	• Short-circuit protections:
	  • Phase to DC bus
	  • Phase to phase
	  • Phase to GND
	• Motor over-temperature
	• Motor under-temperature
	• Mechanical limits for homing functions
	• Hall sequence / combination error
	• Following error

Motor brake	1 A 50 V Dedicated brake output. Open drain with re-circulation diode to +V_LOGIC. Brake enable and disable timing can be configured accurately. PWM modulation available to reduce brake voltage and power consumption.
Communications for Operation	
EtherCAT	CANopen over EtherCAT (CoE) File over EtherCAT (FoE) Ethernet over EtherCAT (EoE)
CANopen (Software selectable)	CiA-301, CiA-303, CiA-305, CiA-306 and CiA-402 (3.0) compliant
Environmental conditions	
Cold plate	Yes
Cold plate temperature	• -40 ºC to +85 ºC full current • +85 ºC to +95ºC derated current Storage: ▪ -55 ºC to +100 ºC
Maximum humidity	5% - 85% non-condensing
ESD and EMC inmunity	ESD immunity IEC 61000-4-2: ± 30 kV contact discharge , ± 30 kV air discharge EFT immunity IEC 61000-4-4: > 40 A Surge immunity: IEC 61000-4-5 IPPM > 8 A

Mechanical specifications	
Dimensions	42.1 mm x 29.1 mm x 23.1 mm Dimensions include mating connectors
Weight	TBD
Certifications	
Certification	CE, RoHS STO SIL3 (certification pending)

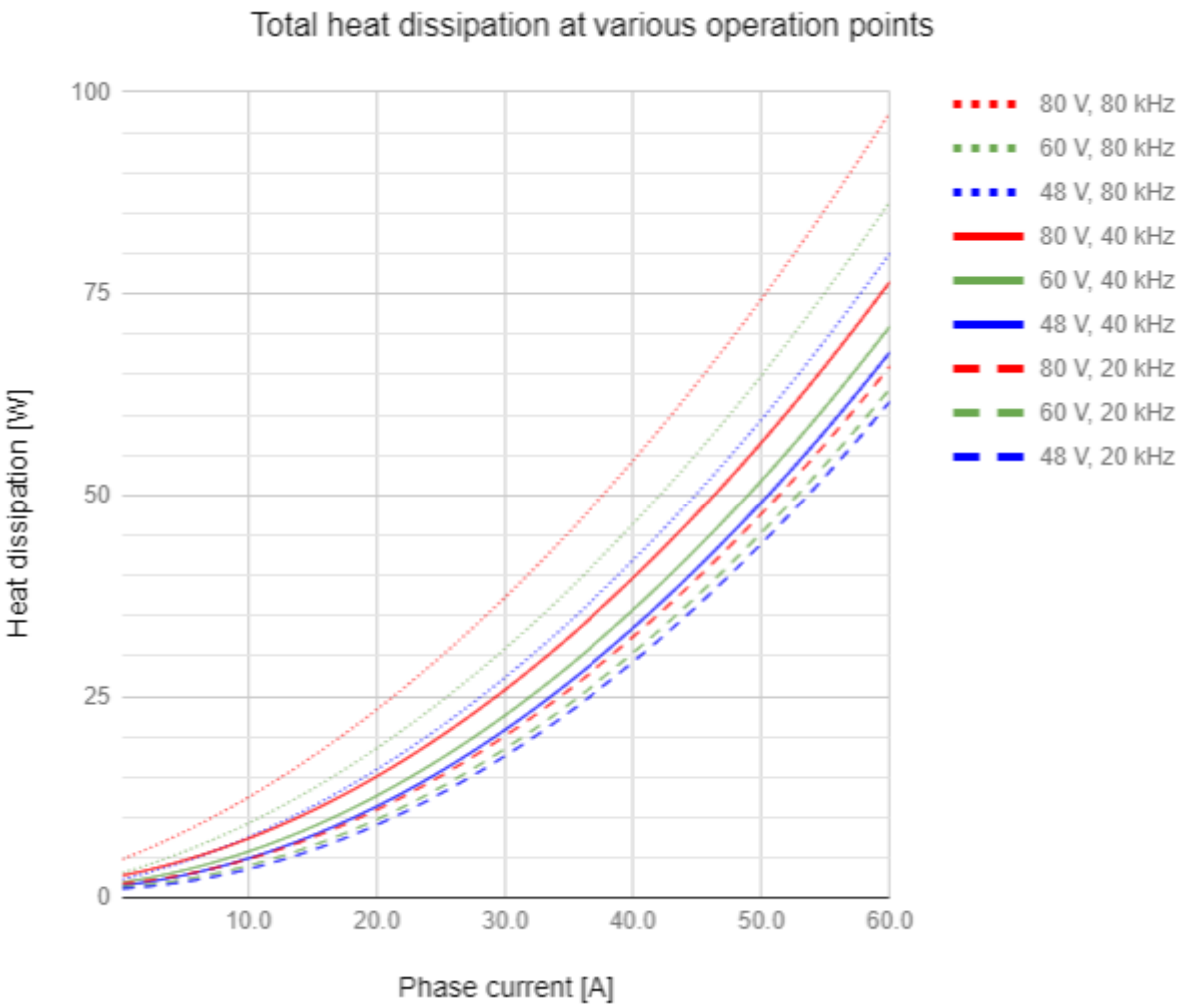
4.3. Thermal specifications

The following diagram depicts the general dissipation model and the equivalent thermal model.

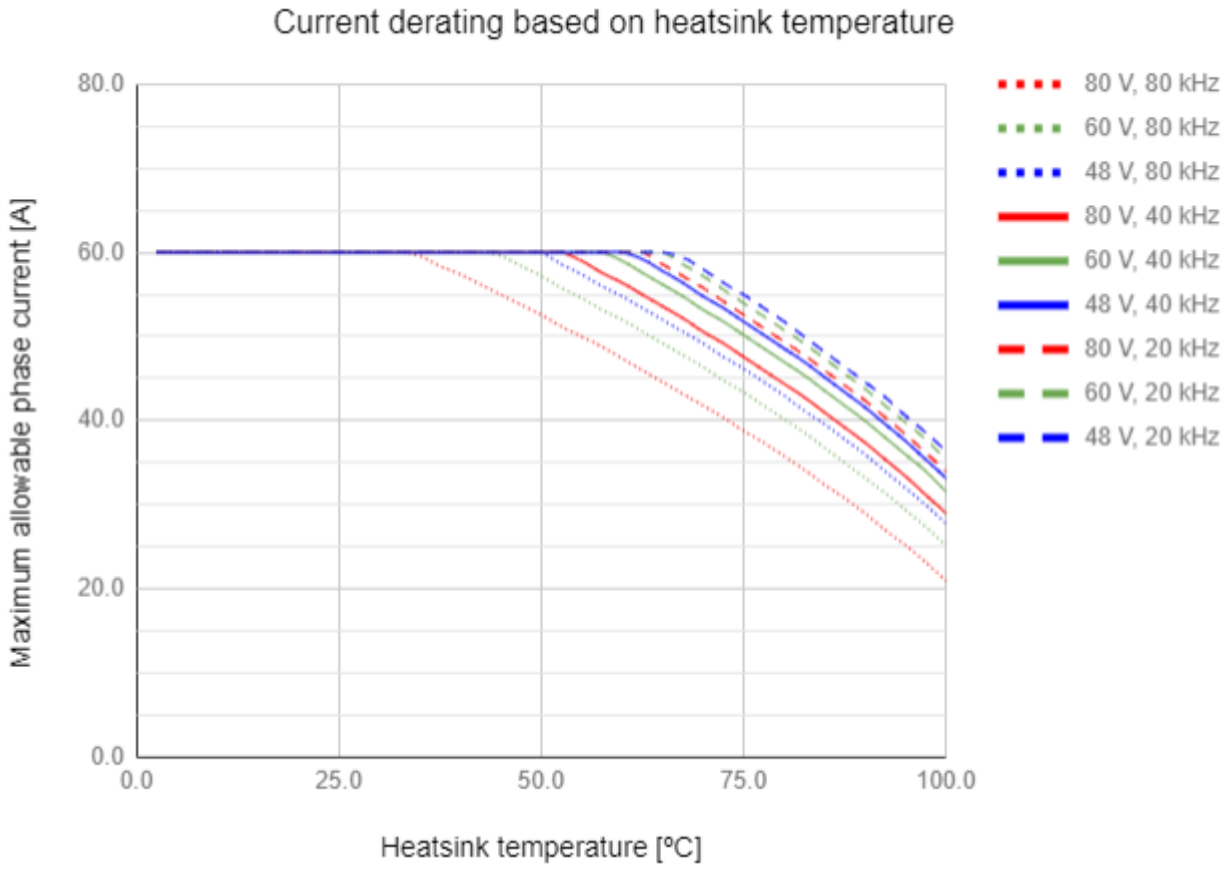


To ensure a proper performance of Everest XCR, the **housing temperature must be held below 85 ºC.** The following figures show how to calculate the required heatsink

The following figure depict the power losses of Everest Core for different phase current values in RMS value. To obtain the equivalent current in amplitude, multiply by 1.41.



Note this is theoretical. The maximum heatsink temperature must be kept at 85ºC.



For ensuring a good thermal coupling between Everest and the heatsink, a good quality thermal pad is required. For example, a thermal sheet **TGX-150-150-0.5-0,** which (for Everest XCR contact surface) has an estimated thermal impedance of **Rth(c-h) = 0.2 K/W**

Considering the previous parameters, the **maximum thermal impedance heatsink-to-air** required can be calculated as:

$$R_{th(h-a\ max)} = \frac{T_c - P \cdot R_{th(c-h} - T_a}{P}$$

5. Connectors Guide

5.1. Supply

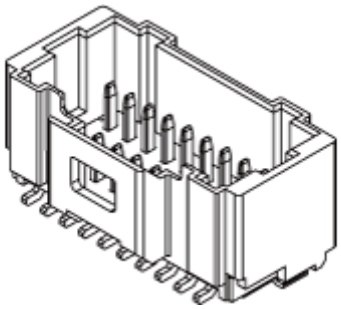
P1 connector		
2.6 mm diameter gold plated solder pads or flying leads option. Pad pitch is 5.08 mm.		
Pin	**Signal**	**Function**
1	POW_SUP	Power supply positive
2	GND_P	Power supply return
Notes		
Recommended section wire is 2.5 mm^2 ~ 5.3 mm^2 , AWG 10 ~ AWG 13 for applications working at maximum current. Adapt the cable diameter to your current needs. It is recommended to use flexible silicone cables to ensure low mechanical stress to the board as well as high temperature ratings (≥ 110 ºC). Diameter of the cable Jacket (insulator) should be less than 5.08 mm to prevent collision between wires.		

5.2. Motor

P2 connector		
2.6 mm diameter gold plated solder pads or flying leads option. Pad pitch is 5.08 mm.		
Pin	**Signal**	**Function**
1	PH_A	Motor phase A
2	PH_B	Motor phase B
3	PH_C	Motor phase C
4	PE	Protective earth connection, internally connected to standoffs and drive cold plate.
Notes		
Recommended section wire is 2.5 mm^2 ~ 5.3 mm^2 , AWG 10 ~ AWG 13. For long cables it is essential to use a shielding connected to protective earth at both ends of the cable.		

5.3. Feedback connector

J1 connector



20 pins 2 row Pico-Clasp 1 mm pitch header. Molex 501190-2027

Pin	Signal	Function
1	+5V_OUT	5 V 200 mA total max. Short circuit protected. Pins 1, 9, 14 are internally connected.
2	GND_D	Digital signal ground
3	ENC_A+/DATA2+	Differential digital encoder: A+ input Single ended digital encoder: A input Absolute encoder 2: Data +
4	ENC_B+	Differential digital encoder: B+ input Single ended digital encoder: B input
4	ENC_A-/DATA2-	Differential digital encoder: A- input Single ended digital encoder: Leave unconnected Absolute encoder 2: Data -
6	ENC_B-	Differential digital encoder: B- input Single ended digital encoder: Leave unconnected
7	ENC_Z+/CLK+	Differential digital encoder: Index+ input Single ended digital encoder: Index input Absolute encoder 2: Clock +
8	ENC_Z-/CLK-	Differential digital encoder: Index- input Single ended digital encoder: Leave unconnected Absolute encoder 2: Clock -

9	+5V_OUT	5 V 200 mA total max. Short circuit protected. Pins 1, 9, 14 are internally connected.
10	GND_D	Digital signal ground
11	HALL_1	Digital hall sensor input 1
12	HALL_2	Digital hall sensor input 2
13	HALL_3	Digital hall sensor input 3
14	+5V_OUT	5 V 200 mA total max. Short circuit protected. Pins 1, 9, 14 are internally connected.
15	GND_D	Digital signal ground
16	DATA+	Absolute encoder DATA postive signal input
17	CLK+	Absolute encoder CLK positive signal output
18	DATA-	Absolute encoder DATA negative signal input. For single ended absolute encoders with TTL or CMOS levels leave this pin floating and connect the signal to DATA+.
19	CLK-	Absolute encoder CLK negative signal output. For single ended absolute encoders with TTL or CMOS levels leave this pin floating and connect the clock to CLK+.
20	PE	Protective earth connection, internally connected to standoffs and drive cold plate.

J1 mating connector	
Description	Molex Pico-Clasp™ 1.0 mm pitch 20 position dual row receptacle with locking ramp
Image	
Part number	Molex 501189-2010
Distributor code	Digi-Key WM7929-ND

5.3.1. Mating terminals and cables common for all signal connectors

Everest XCR signal connectors are of Molex Pico-Clasp™ family. All share the same crimp terminals and jumper wires. Given the small size of the connectors, crimping must be done with appropriate tools and application guides

provided by Molex. Otherwise it is strongly recommended to buy pre-crimped jumper wires and connect to your system using split (or butt) terminals. Spiral wraps are recommended to order and protect the thin wires.

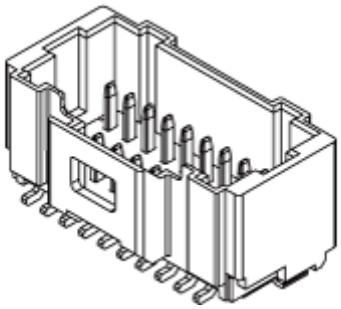
J1, J2, J3, J4 Crimp terminals	
Description	Molex Pico-Clasp™ crimp socket 28 AWG ~ 32 AWG selective gold plated
Image	
Part number	Molex 5011933000
Distributor code	Digi-Key WM10136CT-ND
Crimper tool	
Description	Hand crimper tool 28-32 AWG
	
Part number	Molex 63819-1500
Distributor code	Digi-Key WM9018-ND
J1, J2, J3, J4 Crimped wires 150 mm	
Description	Molex Pico-Clasp™ 28 AWG black jumper lead socket to socket 150 mm lenght

Image	
Part number	Molex 079758-1016
Distributor code	Digi-Key WM15694-ND
J1, J2, J3, J4 Crimped wires 300 mm	
Description	Molex Pico-Clasp™ 28 AWG black jumper lead socket to socket 300mm lenght
Image	
Part number	Molex 079758-1017
Distributor code	Digi-Key WM15695-ND
Wiring accessory: Spiral wire wrap	
Description	Nylon spiral wrap abrasion resistant. Internal diameter: 2.41 mm, 3.18 mm expanded | 5.08 mm, 6.35 mm expanded
Image	
Part number	Alpha Wire SW20 NA005 | SW21 NA008
Distributor code	Digi-Key ASW20-100-ND | ASW21-25-ND

Wiring accessory: wire to wire solder sleeve	
Description	Wire to Wire Solder Sleeve Heat shrinkable. Can be used to reliably connect pre-crimped wires to specific sensor, feedback or other thin wires.
Image	
TE	B-155-9001
Distributor code	Digi-Key A104848-ND

5.4. Input / Outputs connector

J2 connector



30 pins 2 row Pico-Clasp 1 mm pitch header. Molex 501190-3017

Pin	Signal	Function
1	STO_1	Safe Torque Off input 1 (positive, active from 5 V to 32 V, ISOLATED)
2	PE	Protective earth connection, internally connected to standoffs and drive cold plate. Can be used to connect cable shield.
3	STO_RET	Safe Torque Off common (optocoupler LEDs cathode, ISOLATED).
4	NC	Intentionally not connected.
5	STO_2	Safe Torque Off input 1 (positive, active from 5 V to 36 V, ISOLATED)
6	GND_D	Digital signal ground
7	NC	Intentionally not connected.
8	+5V_OUT	+5 V output, can be used for STO circuit.

9	CAN_H	CAN bus line dominant high
10	UART_3V3_RX	Reserved
11	CAN_L	CAN bus line dominant low
12	UART_3V3_TX	Reserved
13	GND_D	Digital signal ground
14	IN1	Digital input 1 (5V levels)
15	IN2	Digital input 2 (5V levels)
16	IN3	Digital input 3 (5V levels)
17	IN4	Digital input 4 (5V levels)
18	OUT1	Digital output 1 (5V levels)
19	OUT2	Digital output 2 (5V levels)
20	OUT3	Digital output 3 (5V levels)
21	OUT4	Digital output 4 (5V levels)
22	AN1+	Analog input 1 positive (±10V range)
23	BRAKE_N	Brake output (open drain with PWM capability)
24	AN1-	Analog input 1 negative (±10V range). Connect to GND if a single ended analog input is used.
25	+LOG_SUP	Logic supply, connected to pin 25. Can be used as brake positive
26	GND_D	Digital signal ground
27	+LOG_SUP	Logic supply positive. Providing the logic supply is optional as the drive is powered from the DC bus on its full operating voltage range. Logic supply can be used for brake or just to keep communications alive while the power bus is off.
28	MOTOR_TEMP	Motor temperature sensor input. A 1.65 kΩ pull-up resistor to 3.3 V is included on the drive.
29	GND_D	Digital signal ground, logic supply negative
30	MOTOR_TEMP_RET	Motor temperature sensor return (refered to GND_D)

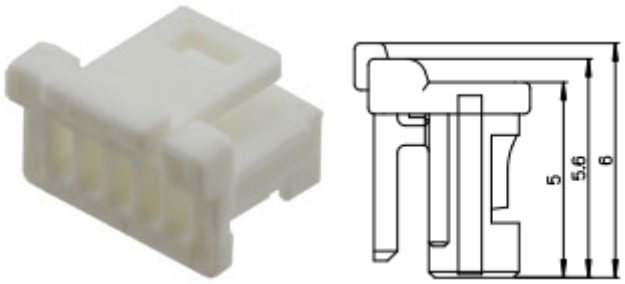
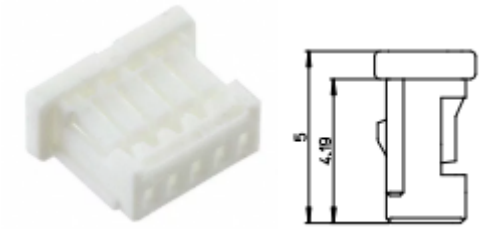
J2 mating connector	
Description	Molex Pico-Clasp™ 1.0 mm pitch 30 position dual row receptacle with locking ramp

Image	
Part number	Molex 501189-3010
Distributor code	Digi-Key WM7930-ND
Crimp terminals	
See table above.	

5.5. EtherCAT connectors

J3 & J4 connector		
5 pins 1 row Pico-Clasp 1 mm pitch header. Molex 501940-0507		
Pin	**Signal**	**Function**
1	TX_D+	Transmit Data+ line. Colour typ: White - Orange
2	TX_D-	Transmit Data- line. Colour typ: Orange
3	RX_D+	Receive Data+ line. Colour typ: White - Green
4	RX_D-	Receive Data- line. Colour typ: Green
5	GND_ETH	Connection for the EtherCAT cable shield. This pin is directly connected to the chassis of the drive - PE.

J3 & J4 mating connectors with latch holder	
Description	Molex Pico-Clasp™ 1.0 mm pitch 5 position single row receptacle with **Latch Holder.** Provides stronger locking performance and is easy to extract. Use this connector in case the wiring ensures no strong pull will be performed to the cables, this could cause damage on the PCB connector.

Image	
Part number	Molex 501939-0500
Distributor code	Digi-Key WM4384-ND
J3 & J4 mating connectors with locking ramp	
Description	Molex Pico-Clasp™ 1.0 mm pitch 5 position single row receptacle with **locking ramp**. Provides less strong locking compared to the latch holder but will avoid breaking the PCB connector in case of strong pull.
Image	
Part number	Molex 501330-0500
Distributor code	Digi-Key WM7918-ND
Crimp terminals	
See table above.	

6. Signalling LEDs

Everest XCR Drive provides information through 6 signalling LEDs:

- Supply and operation: 2 LEDs (one of them bi-color) next to the Supply, shunt and motor connector.
- EtherCAT communication: 4 LEDs next to the EtherCAT connectors (2 LEDs shared with CANopen option).

6.1. Power and Operation Signalling LEDs

Two LEDs situated next to the Supply, shunt and motor connector indicate the supply and operation status. Note that Power LED and Braking resistor LED are packed into a single green/blue bi-color LED.

LED	Colour	Meaning
POWER	**Green**	LED is on when internal power supply is working.
SHUNT	**Blue**	LED is turned on when the supply voltage is greater than the maximum voltage configured by the user. Configuration required This signal will only work if the braking resistor output is configured as active.
FAULT	**Red**	LED is on when an error event has occurred and the drive is trapped in the **Fault state**.

6.2. EtherCAT Signalling LEDs

Four LEDs below the EtherCAT connectors provide information regarding communication status according to EtherCAT specification.

The EtherCAT green and red LEDs (shared with CAN communication) indicate the EtherCAT state machine status. The green LED is the **RUN LED**, and the red LED is the **ERROR LED**. Next table shows their states meaning:

RUN LED state	EtherCAT slave status		**ERROR LED** state	EtherCAT slave status
Off	INIT		Off	No error
Blinking	PRE-OPERATIONAL		Blinking	Invalid configuration
Single Flash	SAFE-OPERATIONAL		Single flash	Local error
On	OPERATIONAL		Double flash	Watchdog timeout
			On	Application controller failure

For high severity errors inside the Triton Go Servo Drive, an special LED state has been developed:

Status	Signalling	**RUN LED** state	**ERROR LED** state
Internal error	Interleaved blink	Blinking (Initial status: OFF)	Blinking (Initial status: ON)

The two yellow LEDs at the sides are the **LINK 0** and **LINK 1** LEDs. The **LINK LEDs** indicates the state of the EtherCAT physical link activity:

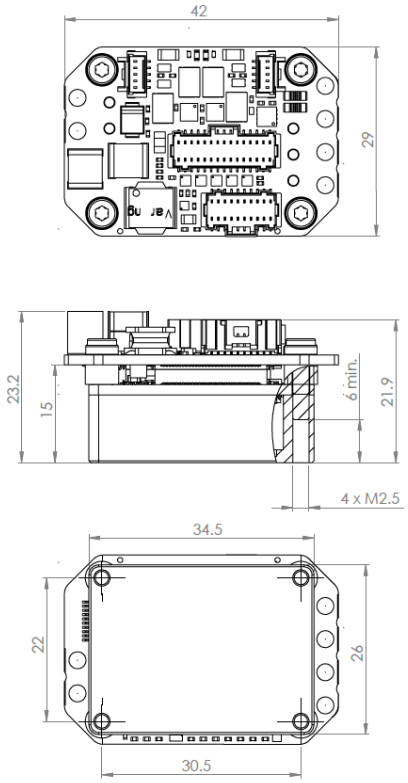
LINK LED state	Slave State
Off	Port closed
Flickering	Port opened (activity on port)
On	Port opened (no activty on port)

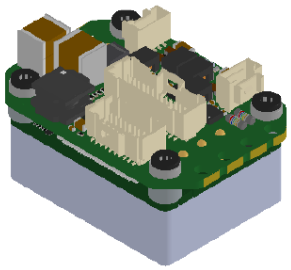
7. Dimensions

Preliminary Information

Attention, this dimension are preliminary and could change without previous notification.

All dimensions are in **mm**. All tolerances **≤ ±0.2 mm**





3D Model

For further detail, download the STEP 3D model. Note that the model is simplified: it does not show all the internal components, but does show the major volumes.

8. EtherCAT specifications

Ports available	2
LED Signals	Status LED
	Link/Act LED
Supported Mailbox	CoE, FoE, EoE
SDO info	Not supported
Segmented SDO	Supported
SDO complete access	Not supported
Modes of Operation	DS402 drive device profile
	Open loop (vector & scalar)
	Velocity Mode
	Profile Torque
	Profile Velocity
	Profile Position
	Homing modes
	Interpolated Position Mode
	Cyclic Synchronous Position Mode • *Max. Update rate up to 100 µs (10 kHz)*
	Cyclic Synchronous Velocity Mode • *Max. Update rate up to 100 µs (10 kHz)*
	Cyclic Synchronous Torque Mode • *Max. Update rate up to 100 µs (10 kHz)*
Synchronization modes	Free Run
	Distributed clock • *Cyclic modes*
Process data object	Configurable
	Up to 64 objects

9. Service

We are committed to quality customer service. In order to serve in the most effective way, please open a ticket on our service desk at www.ingeniamc.com/support or contact your local sales representative for assistance.

If you are unaware of your local sales representative, please contact the Customer Support.

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France	A2V	www.a2v.fr	a2v@a2v.fr
Germany	MACCON GMBH	www.maccon.de	info@maccon.de
India	MPAGS	www.mapgs.com	info@mpags.com
Israel	MEDITAL	www.medital.co.il	comotech@medital.co.il
Italy	SERVOTECNICA SPA	www.servotecnica.com	info@servotecnica.com
Norway	ELECTRO DRIVES AS	www.electro-drives.no	firmapost@electro-drives.no
Portugal	MECÂNICA MORDERNA	www.mecmod.com/pt	vendas@mecmod.com
Russia	AVI SOLUTIONS	www.avi-solutions.com	sales@avi-solutions.com
Singapore	I-MOTION	www.imotionasia.com	ivan@imotionasia.com
South Korea	SERVOSTAR	www.servostar.co.kr	servo@servostar.co.kr
South Korea	ALLTEK	www.alltek.co.kr	info@alltek.co.kr
Spain	MECANICA MORDERNA	www.mecmod.com/es	mecmod@mecmod.com
Spain	GIZATECH	www.gizatech.eu/	comercial@milexia.es
Switzerland	ANTRIMON MOTION AG	www.antrimon.com	motion@antrimon.com
Turkey	FEMSAN	www.femsan.com	melike@femsan.com
United Kingdom	MOTION CONTROL PRODUCTS	www.motioncontrolproducts.com	info@motioncontrolproducts.com
United States	NAMPRO	www.namproinc.com	sales@namproinc.com
United States	GROUP SIX	www.grp6.com	ingenia@grp6.com

INGENIA-CAT S.L.

8-14 MARIE CURIE, ADVANCED INDUSTRY PARK

08042 BARCELONA

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