Inspiring Motion
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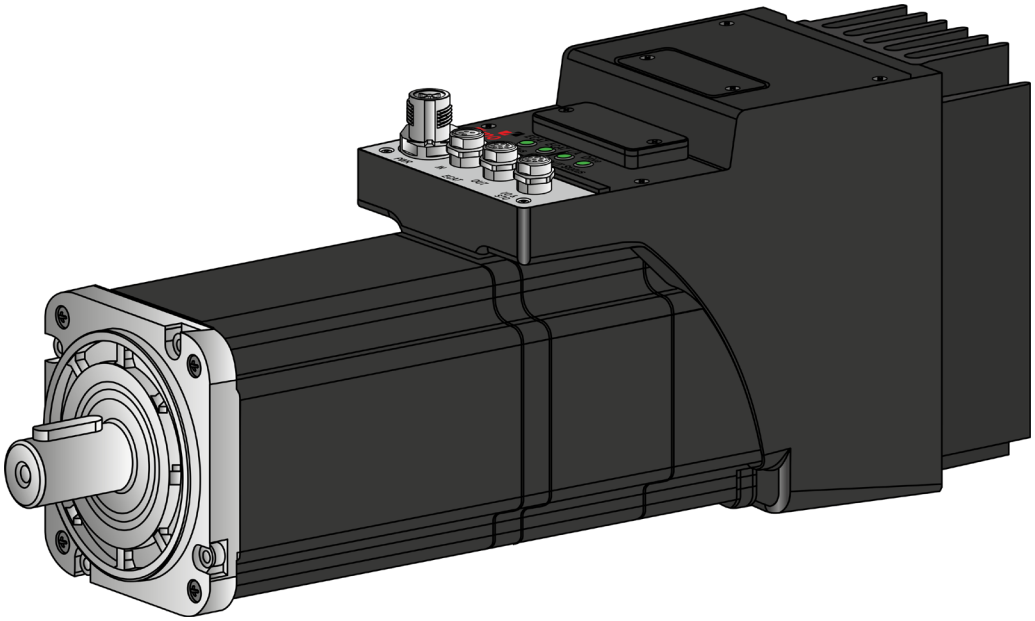
Gold Duet 80
Integrated Drive-Motor
Installation Guide
EtherCAT
For Model Flange Size: 80



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Notice

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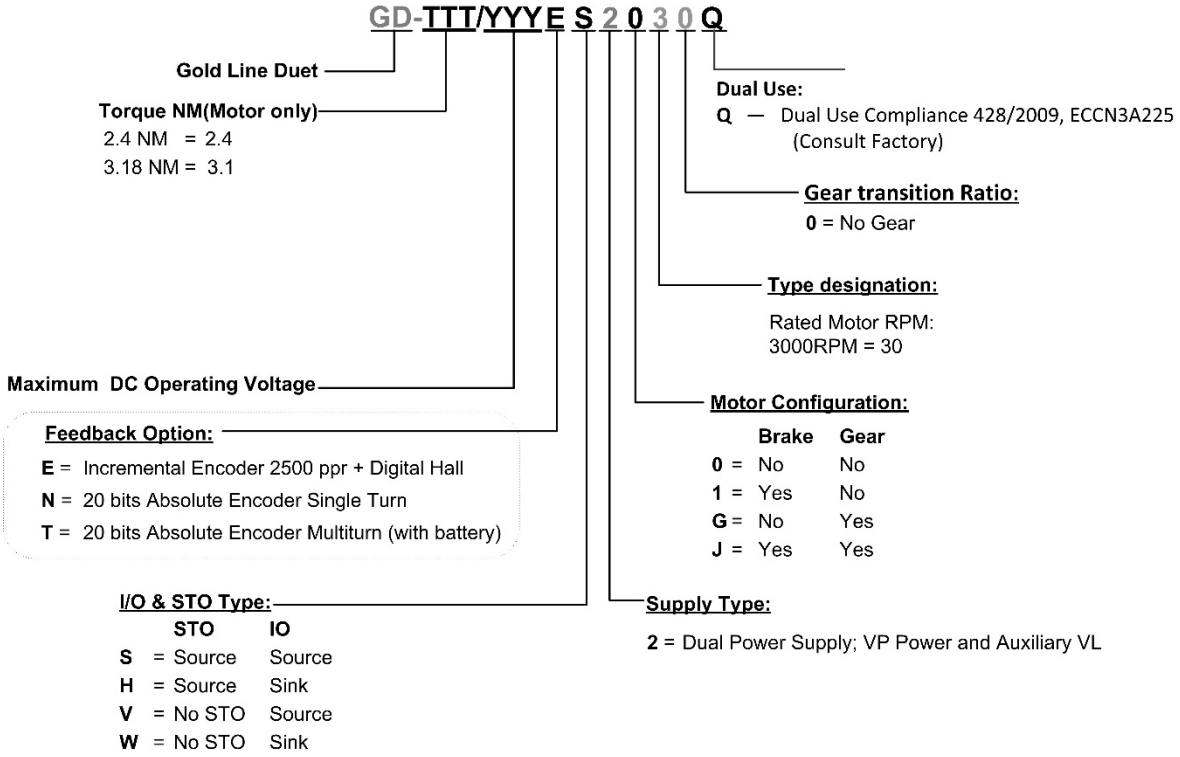
Document no. MAN-G-DUET80_IG (Ver. 1.008)

Catalog Number



Notes: The standard Gold Duets are EtherCAT with ID switches

Cable Kit

Use cable kit PN **CBL-GDUETKIT02** to connect the G-Duet 80 to power, I/O, and communications.

Revision History

Version	Date
Ver. 1.000	Dec 2016
Ver. 1.001	Dec 2016
Ver. 1.002	Dec 2016
Ver. 1.003	Jan 2016
Ver. 1.004	May 2017
Ver. 1.005	July 2017
Ver. 1.006	Oct 2017
Ver. 1.007	Jan 2021
Ver. 1.008	April 2021

Chapter 1: This Installation Guide

This installation Guide details the technical data, pinouts, wiring, and power connectivity of the Gold Duet 80.

Chapter 2: Safety Information

In order to achieve the optimum, safe operation of the Gold Duet 80, it is imperative that you implement the safety procedures included in this installation guide. This information is provided to protect you and to keep your work area safe when operating the Gold Duet 80 and accompanying equipment.

Please read this chapter carefully before you begin the installation process.

Before you start, ensure that all system components are connected to earth ground. Electrical safety is provided through a low-resistance earth connection.

Only qualified personnel may install, adjust, maintain and repair the servo drive. A qualified person has the knowledge and authorization to perform tasks such as transporting, assembling, installing, commissioning and operating motors.

The Gold Duet 80 contains electrostatic-sensitive components that can be damaged if handled incorrectly. To prevent any electrostatic damage, avoid contact with highly insulating materials, such as plastic film and synthetic fabrics. Place the product on a conductive surface and ground yourself in order to discharge any possible static electricity build-up.

To avoid any potential hazards that may cause severe personal injury or damage to the product during operation, keep all covers and cabinet doors shut.

The following safety symbols are used in this and all Elmo Motion Control manuals:

Warning:
This information is needed to avoid a safety hazard, which might cause bodily injury or death as a result of incorrect operation.

Caution:
This information is necessary to prevent bodily injury, damage to the product or to other equipment.

Important:
Identifies information that is critical for successful application and understanding of the product.

2.1 Warnings

- To avoid electric arcing and hazards to personnel and electrical contacts, never connect/disconnect the servo drive while the power source is on.
- Power cables can carry a high voltage, even when the motor is not in motion. Disconnect the Gold Duet 80 from all voltage sources before servicing.
- The high voltage products within the Gold Line range contain grounding conduits for electric current protection. Any disruption to these conduits may cause the instrument to become hot (live) and dangerous.
- After shutting off the power and removing the power source from your equipment, wait at least 1 minute before touching or disconnecting parts of the equipment that are normally loaded with electrical charges (such as capacitors or contacts). Measuring the electrical contact points with a meter, before touching the equipment, is recommended.

2.2 Cautions

- The maximum DC power supply connected to the instrument must comply with the parameters outlined in this guide.
- When connecting the Gold Duet 80 to an approved isolated auxiliary power supply, connect it through a line that is separated from hazardous live voltages using reinforced or double insulation in accordance with approved safety standards.
- Before switching on the Gold Duet 80, verify that all safety precautions have been observed and that the installation procedures in this manual have been followed.
- Make sure that the Safe Torque Off is operational

2.3 CE Marking Conformance

The Gold Duet 80 is intended for incorporation in a machine or end product. The actual end product must comply with all safety aspects of the relevant requirements of the European Safety of Machinery Directive 2006/42/EC as amended, and with those of the most recent versions of standards EN 60204-1 and EN ISO 12100 at the least, and in accordance with 2006/95/EC.

Concerning electrical equipment designed for use within certain voltage limits, the Gold Duet 80 meets the provisions outlined in 2006/95/EC. The party responsible for ensuring that the equipment meets the limits required by EMC regulations is the manufacturer of the end product.

2.4 Warranty Information

The products covered in this manual are warranted to be free of defects in material and workmanship and conform to the specifications stated either within this document or in the product catalog description. All Elmo drives are warranted for a period of 12 months from the date of shipment. No other warranties, expressed or implied — and including a warranty of merchantability and fitness for a particular purpose — extend beyond this warranty.

Chapter 3: Product Description

This installation guide describes the installation of the Gold Duet 80 models with flange sizes; 80 mm. The Gold Duet 80 series of digital servo drives are highly resilient and designed to deliver the highest density of power and intelligence. The Gold Duet 80 delivers up to **1000 W of continuous power** and **3000 W peak power** in a compact high quality package.

The Gold Duet includes the digital drive which is part of Elmo's advanced Gold Line. The digital servo drives are designed for use with any type of sinusoidal and trapezoidal commutation, with vector control. The Gold Duet 80 can operate as a stand-alone device or as part of a multi-axis system in a distributed configuration on a real-time network.

The Elmo Application Studio (EASII) software tools enable users to quickly and simply configure the servo drive for optimal use with their motor. The Gold drive inside the Gold Duet 80, as part of the Gold Line, is fully programmable.

Power to the drives is provided by an isolated or Direct to Mains DC power source.

The Gold Duet 80 operates with dual power supply, also for backup functionality.

Chapter 4: Technical Information

4.1 80 mm Frame Electrical and Physical Data

Parameter		750W 400V	1000W 400V	750W 800V	1000W 800V
Motor		**GD-2.4/400**	**GD-3.1/400**	**GD-2.4/800**	**GD-3.1/800**
Rated Rotation Speed	rev/min	3000	3000	3000	3000
Rated Torque	Nm	**2.39**	**3.18**	**2.39**	**3.18**
Maximum Peak Torque	Nm	7.17	9.54	7.17	9.54
Rotor Inertia	$x10^{-4}$ kgm^2	1.414	1.85	1.414	1.85
Rotor Inertia with brake	$x10^{-4}$ kgm^2	1.385	1.862	1.385	1.862
Electrical					
Min DC bus for Rated Speed @ 3XRated Torque	VDC	220	200	220	200
Minimum Supply Voltage	VDC	50	50	95	95
Maximum Supply Voltage	VDC	396	396	780	780
DC Bus Input Current @Vbus At Rated Speed & Rated Torque	A/V	2.25A@320V	3.0A@320V	1.28A@560V	1.7A@560V
VL , Control & Logic Supply	VDC	See Table in section 4.2 Auxiliary Supply Input Voltage (VL)			
Mechanical					
Weight W/O Brake	Kg	3.70	4.30	3.70	4.30
Weight With brake	Kg	4.40	5.00	4.40	5.00
Dimensions W/O Brake	mm (in)	261.7x119.2x86.2 (10.30x4.69x3.39)	281.7x119.2x86.2 (11.09x4.69x3.39)	261.7x119.2x86.2 (10.30x4.69x3.39)	281.7x119.2x86.2 (11.09x4.69x3.39)
Dimensions With Brake	mm (in)	311.8x119.2x86.2 (12.28x4.69x3.39)	331.8x119.2x86.2 (13.06x4.69x3.39)	311.8x119.2x86.2 (12.28x4.69x3.39)	331.8x119.2x86.2 (13.06x4.69x3.39)
Encoders		Options: 1. Single turn 20 bits Absolute Encoder, **N option**. 2. Multi-turn, 20 bits single turn + 16 bits multi-turn, including battery, **T option** 3. Quadrature 2500 ppr + commutation signals (Hall signals), **E option** Other resolution on request			
Structure		Totally enclosed, non-ventilated			
Protection level		IP65			

4.2 Auxiliary Supply Input Voltage (VL)

The Gold Duet 80 400V and 800V rated power options require a VL auxiliary power supply

Feature		400V and 800V
		VL required
Without Brake		
VL input range	VDC	18 to 30
Power consumption	W	8
With Brake		
VL input range	VDC	23 to 25.5
Power consumption	W	20

4.3 Environmental Conditions

Feature	Details
Operating ambient temperature according to IEC60068-2-2	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature	-20 °C to +85 °C (-4 °F to +185 °F)
Maximum non-condensing humidity according to IEC60068-2-78	95%
Maximum Operating Altitude	2,000 m (6562 feet) It should be noted that servo drives capable of higher operating altitudes are available on request.
Mechanical Shock according to IEC60068-2-27	15g / 11ms Half Sine
Vibration according to IEC60068-2-6	5 Hz ≤ f ≤ 10 Hz: ±10mm 10 Hz ≤ f ≤ 57 Hz: 4G 57 Hz ≤ f ≤ 500 Hz:5G

4.4 Product Resource

Main Feature	Details	
STO	PLC Source	**√**
Digital Input Option	PLC Source or PLC Sink	**With STO = 2** **Without STO = 4**
Digital Output Option	PLC Source or PLC Sink	**1**
Communication Option	USB	**√**
	EtherCAT	**√**

Chapter 5: Product Features

5.1 Supply Input

The Gold Duet can operate from a 50V to 396V for the 400VDC series, and 95V to 780V for the 800VDC series, Isolated or Direct to Mains DC power source.

5.2 Communications

- Fast and efficient EtherCAT networking
- EtherCAT Slave:
  - CoE (CANopen over EtherCAT)
  - EoE (Ethernet over EtherCAT)
  - FoE (File over EtherCAT) for firmware download
  - Supports Distributed Clock
  - EtherCAT cyclic modes supported down to a cycle time of 250 µs
- Ethernet TCP/IP:
  - UDP
  - Telnet
- USB; Accessible via drive body compartment

5.3 Feedback Sensor Specifications

The feedback of the Gold Duet 80 motor includes 20 bit Absolute serial encoders.

5.4 STO

- For STO standard compliance, refer to chapter Chapter 11: Compliance with Standards

5.5 Safety

- For Safety standard compliance, refer to chapter Chapter 11: Compliance with Standards

5.6 Outputs

- One digital output (OUT1; 250 mA current) can be configured to the following options:
  - Source mode – High Current PLC voltage level, Conforming to IEC 61131-2
  - Sink mode – High Current PLC voltage level
- Opto-isolated
- Short circuit protection
- Thermal protection
- Optional functions:
  - Fast output compare
  - Brake control (OUT2; 250 mA current)
  - Amplifier fault indication
  - General purpose
  - Servo enable indication

5.7 Inputs

- There are two digital inputs for the Gold Duet 80 with the STO option.
  However, there are four digital inputs for Gold Duet 80 without STO option.
  The digital input can be configured to the following options:
  - Source mode – PLC voltage level
  - Sink mode – PLC voltage level
- All the digital inputs are fast digital capture data (<5 µs)
- Optional functions:
  - Fast event capture (for two inputs only)
  - Inhibit/Enable motion
  - Stop motion under control (hard stop)
  - Motion reverse and forward limit switches
  - Begin on input
  - Abort motion
  - Homing
  - General purpose

5.8 Motor Product Features

The motor has the following features:

- Sinusoidal Commutation servo motor

- For Torque – Speed operating curves, refer to Chapter Chapter 8: Gold Duet 80 Motor Characteristic Curves

5.9 Drive Product Features

The Gold Duet 80's features determine how it controls motion, as well as how it processes host commands, feedback and other input.

5.9.1 Servo Control

- Advanced and extremely fast vector control algorithm (current closed loop bandwidth exceeds 4 kHz)
- Current/Torque sampling rate: up to 20kHz (50 µs)
- Velocity sampling rate: up to 10 kHz (default 100 µs, can be increased to 16.67 kHz 60 µs (1:1:1))
- Position sampling rate: up to 10 kHz (default 100 µs, can be increased to 16.67 kHz 60 µs (1:1:1))
- Electrical commutation frequency: up to 3 kHz
- Position over velocity, with full dual loop support
- Current gain scheduling to compensate for the motor's non-linear characteristics
- Advanced filtering: Low pass, Notch, Lead/Lag, General Biquad
- Current loop gain scheduling to compensate for bus voltage variations
- Gains and filter scheduling vs. position for mechanical coupling optimization, speed and position tracking errors
- Velocity gain scheduling for ultimate velocity loop performance using high order filters gain scheduling vs. speed and position
- S-curve Profile Smoothing
- Cogging compensation
- Dual Loop Operation supported by Auto Tuning
- Fast, easy and efficient advanced Auto Tuning
- Incremental encoder frequency of up to 75 Megacounts/sec
- Motion profiler numeric range:
- Position range: full 32 bit
- Velocity range up to 2 x 10^9 counts/sec
- Acceleration range: up to 2 x 10^9 counts/sec^2

5.9.2 Advanced Filters and Gain Scheduling

- "On-the-Fly" gain scheduling of current and velocity
- Velocity and position with 1:2:2, and 1:1:1 PIP controllers

- Automatic commutation alignment
- Automatic motor phase sequencing
- Current gain scheduling to compensate for the motor's non-linear characteristics
- Advanced filtering: Low pass, Notch, Lead/Lag, General Biquad
- Current loop gain scheduling to compensate for bus voltage variations
- Gains and filter scheduling vs. position for mechanical coupling optimization, speed and position tracking errors
- Velocity gain scheduling for ultimate velocity loop performance using high order filters gain scheduling vs. speed and position

5.9.3 Motion Control

- Motion control programming environment
- Motion modes: PTP, ECAM, Follower, Dual Loop, Current Follower
- Full DS-402 motion mode support, in both the CANopen and CANopen over EtherCAT (CoE) protocols, including Velocity modes.
- Fast (hardware) Output Compare, with < 1 µs latency
- Output compare repetition rate: 13 KHz
- Motion Commands: Analog current and velocity, pulse-width modulation (PWM) current and velocity, and Pulse and Direction
- Distributed Motion Control
- EAS (Elmo Application Studio) software: an efficient and user friendly auto tuner

5.9.4 Fully Programmable

- Third generation programming structure
- Event capturing interrupts
- Event triggered programming

5.9.5 Built-In Protection

- Software error handling
- Abort (hard stops and soft stops)
- Status reporting
- Protection against:
  - Shorts between motor power outputs
  - Shorts between motor power outputs and power input/return
  - Failure of internal power supplies
  - Over-heating

- Continuous temperature measurement. Temperature can be read on the fly; a warning can be initiated x degrees before temperature disable is activated.
- Over/Under voltage
- Loss of feedback
- Following error
- Current limits

5.9.6 Status Indication

- Red/Green dual LED, used for immediate indication of the initiation and working states.

5.9.7 Automatic Procedures

- Commutation alignment
- Phase sequencing
- Current loop gain tuning
- Current gain scheduling
- Velocity gain tuning
- Velocity gain scheduling
- Position gain tuning

5.9.8 Backup Battery

The battery for absolute encoder is required to store the multi-turn data into the encoder. This battery consists of a 1200 mAh Lithium Chloride ER14250 (1/2AA Size) with the following specification:

- Nominal Voltage: 3.6 V
- Nominal Capacity:1.2 Ah

5.10 System Architecture

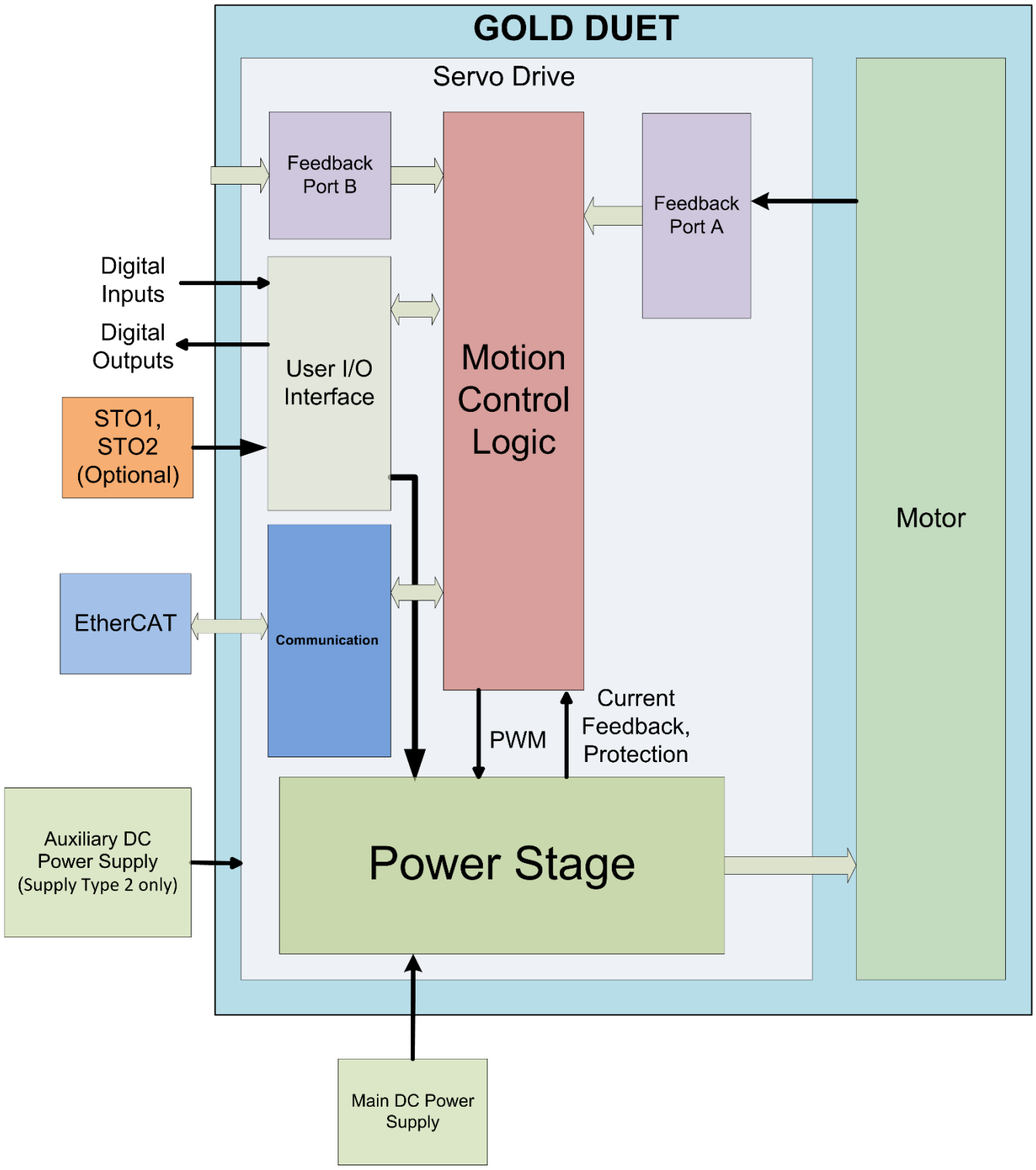


Figure 1: Gold Duet 80 System Block Diagram

Chapter 6: Installation

The Gold Duet 80 must be installed in a suitable environment and properly connected to its voltage supplies and the motor.

6.1 Unpacking the Drive Components

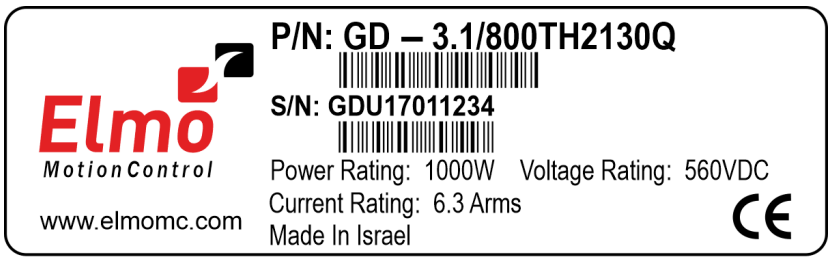
Before you begin working with the Gold Duet 80, verify that you have all of its components, as follows:

- The Gold Duet 80
- The Elmo Application Studio software and software manual

The Gold Duet 80 is shipped in a cardboard box with Styrofoam protection.

To unpack the Gold Duet 80:

1. Carefully remove the Gold Duet 80 from the box and the Styrofoam.
2. Check the drive to ensure that there is no visible damage to the instrument. If any damage has occurred, report it immediately to the carrier that delivered your Gold Duet 80.
3. To ensure that the Gold Duet 80 you have unpacked is the appropriate type for your requirements locate the part number sticker on the side of the Gold Duet 80. It looks like this:



G-DUET-110_002B

4. Verify that the Gold Duet 80 type is the one that you ordered, and ensure that the voltage meets your specific requirements.

   The part number at the top provides the type designation. Refer to the appropriate part number in the section Catalog Number at the beginning of the installation guide.

6.2 Site Requirements

You can guarantee the safe operation of the Gold Duet 80 by ensuring that it is installed in an appropriate environment. Refer to the Table in section 4.3 Environmental Conditions.

Caution: The Gold Duet 80 must be mounted on an aluminum platform of flange 255mm x 255mm x 6mm. The maximum ambient operating temperature of 40 °C (104 °F) must not be exceeded.

6.3 Mounting the Gold Duet 80

Use four M6 round head screws for the Gold Duet 80 and four M8 round head screws for the Gold Duet 110 to mount the servo drive (Figure 2).

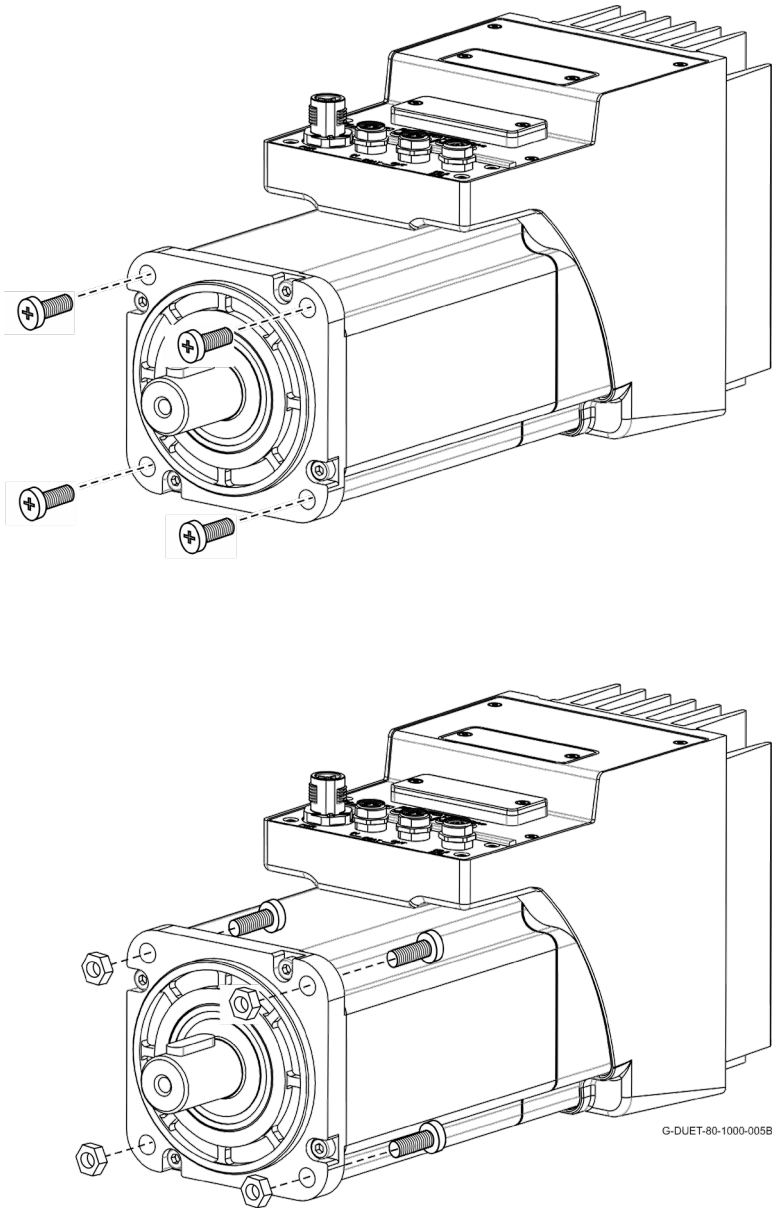
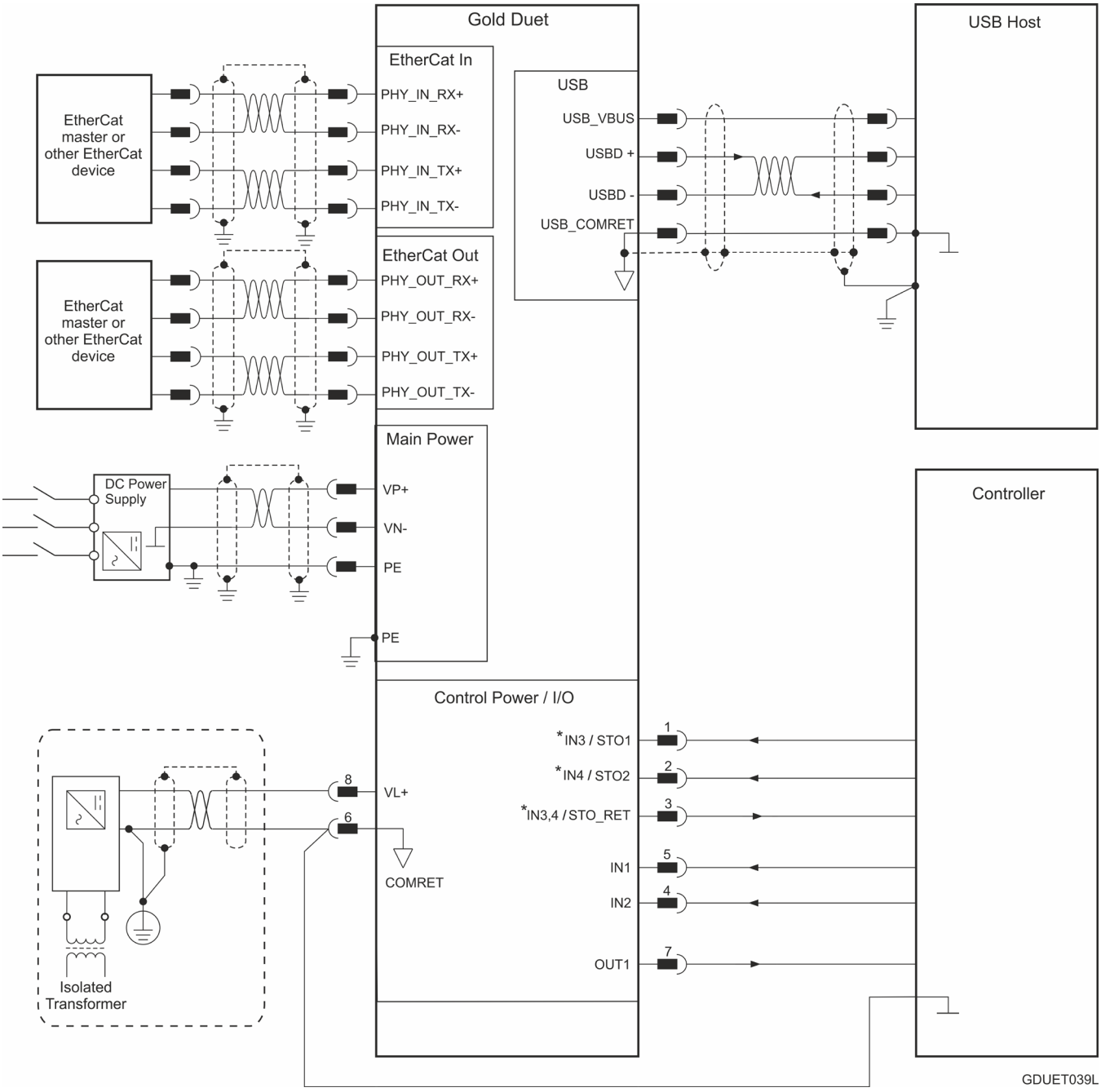


Figure 2: Mounting the Gold Duet 80

6.4 The Gold Duet 80 Connection Diagram



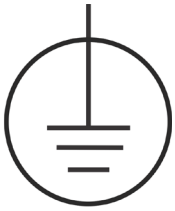
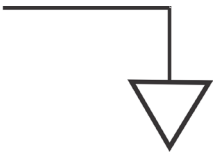
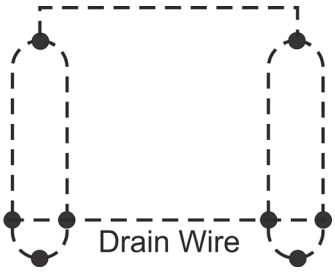
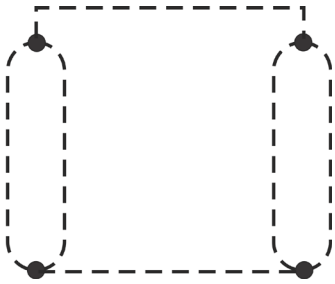
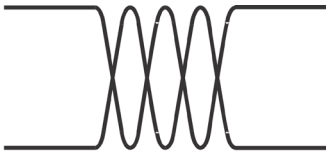
***Note:** **The Control Power I/O connector displays the symbol * to show the optional use of IN3, IN4 where STO is not applied.**

Figure 3: The Gold Duet 80 EtherCAT Connection Diagram

Chapter 7: Wiring

Once the product is mounted, you are ready to wire the device. Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance of the drive.

The following table legend describes the wiring symbols detailed in all installation guides.

Wiring Symbol	Description
 GGEN_101D-A	Earth connection (PE)
 GGEN_101D-B	Protective Earth Connection
 GGEN_101D-C	Common at the Controller
 GGEN_101D-D	Shielded cable with drain wire. The drain wire is a non-insulated wire that is in direct contact with the braid (shielding). Shielded cable with drain wire significantly simplifies the wiring and earthing.
 GGEN_101D-E	Shielded cable braid only, without drain wire.
 GGEN_101D-F	Twisted-pair wires

7.1 Wiring the Gold Duet 80

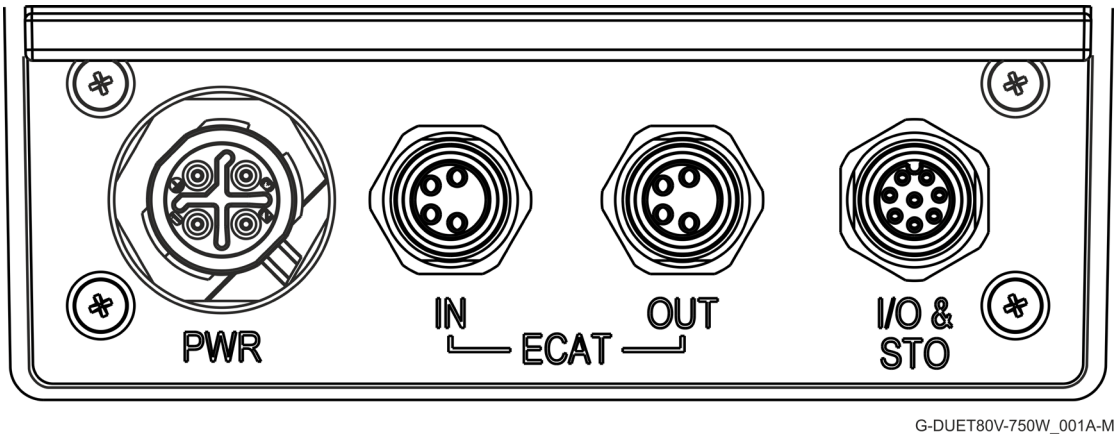
When the Gold Duet 80 is mounted, you are ready to wire the device. Proper wiring, grounding and shielding are essential for ensuring safe, immune and optimal servo performance of the Gold Duet 80.

Caution: Follow these instructions to ensure safe and proper wiring.

- Use twisted pair shielded cables for communication connections. For best results, the cable should have an aluminum foil shield covered by copper braid, and should contain a drain wire.
- The drain wire is a non-insulated wire that is in contact with parts of the cable, usually the shield. It is used to terminate the shield and as a grounding connection.
- The impedance of the wire must be as low as possible. The size of the wire must be thicker than actually required by the carrying current.
- Keep all wires and cables as short as possible.
- Ensure that in normal operating conditions, the shielded wires and drain *carry no current.* The only time these conductors carry current is under abnormal conditions, when electrical equipment has become a potential shock or fire hazard while conducting external EMI interferences directly to ground, in order to prevent them from affecting the drive. Failing to meet this requirement can result in drive/controller/host failure.
- After completing the wiring, carefully inspect all wires to ensure tightness, good solder joints and general safety.

7.2 Gold Duet 80 Connector Types

The Gold Duet 80 has the following M12 and M8 connectors:



Gold Duet-Connector Interface

No. Pins	Type	Function
4	4-pin M12 Connector	Main Power
8	8-pin M8 Connector	I/O and STO
4	4-pin M8 Connector	EtherCAT OUT
4	4-pin M8 Connector	EtherCAT IN
4	USB Device Mini-B (at top compartment)	USB

Table 1: Connector Types

The pinouts in the following sections describe the function of each pin in the Gold Duet 80 connectors.

7.3 Drive Status Indicator

The G-DUET is equipped with light-emitting diode (LED) indicators and a Drive status indicator.

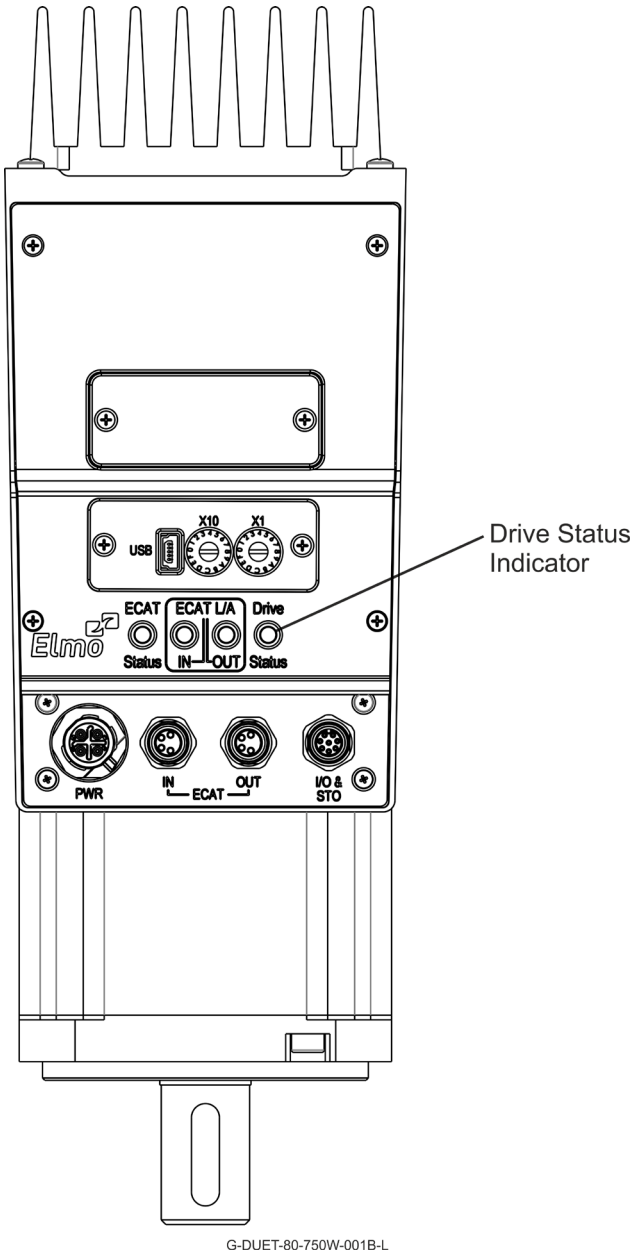


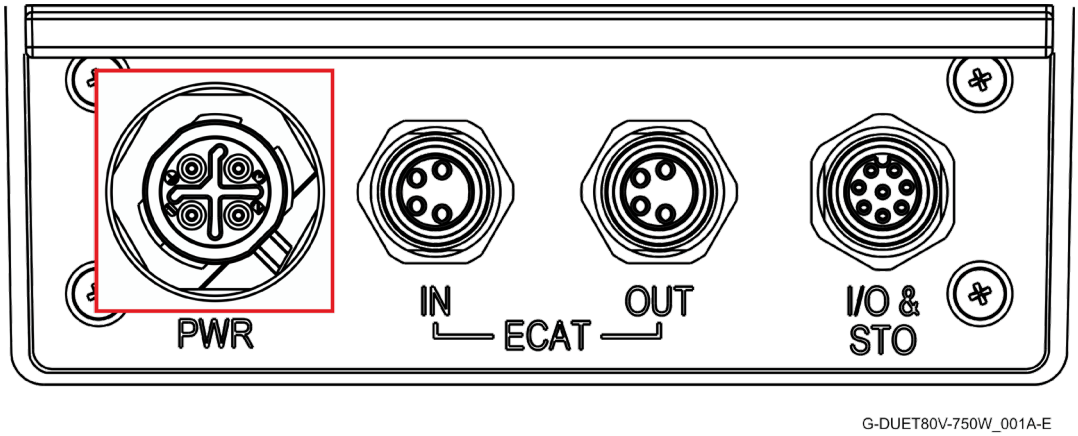
Figure 4: LED Indicators

Figure 4 shows the position of the red/green dual LED for drive status indication. The Drive Status red/green dual LED is used for immediate indication of the following states:

- **Initiation state:** In this state the LED indicates whether the drive is in the boot state (blinking red) or in the operational state (steady red).
- **Working state:** In this state the LED indicates whether the drive is in an amplifier failure state (red) or is ready to enable the motor (green).

7.4 Main Power (J1)

Pin (J6)	Signal	Function	Cable
1	-	Reserved	
2	VN-	Supply return	Power
3	VP+	Power supply input	Power
⏚	PE	Protective Earth	Power



G-DUET80V-750W_001A-E

Figure 5: M12 socket 4-pos S-encoded Power Male Connector and interface

7.4.1 Description

The DC power source for the Gold Duet 80 is delivered from a separated rectifying unit (supplied by the user). Elmo recommends using the Tambourine rectifier specifically designed for use with Elmo drives which offers a range of versatile options.

This section describes the Main and Auxiliary Power for power rating 400V and 800V. The Gold Duet 80 400V and 800V model power rating must have a VL auxiliary power supply. The VL is connected via the IO and STO connector.

Two power DC power sources are required, a main power of 50 V to 396V for the 400V model or 95V to 780V for the 800V model, and Auxiliary Power logic as follows:

- Without Brake, 18 to 30 VDC
- With Brake, 23 to 25.5 VDC

The following sections contain topology recommendations for implementing three-phase and single-phase supply chains.

The power stage of the Gold Duet 80 is fully isolated from the other sections of the Gold Duet 80, such as the control supply and the heat-sink. **This isolation allows the user to connect the common of the control section to the PE, a connection which significantly contributes to proper functionality, safety and EMI immunity, leading to better performance of the Gold Duet 80**.

In addition, this isolation simplifies the requirements of the DC power supply that is used to power the DC bus of the Gold Duet 80, by allowing it to operate with a non-isolated DC power source (a direct-to-mains connection) which eliminates the need for a bulky and expensive isolation transformer.

However, as well as operating from a non-isolated/direct-to-mains DC power supply, the Gold Duet 80 can also operate from an isolated power supply or batteries.

When rectifying an AC voltage source, the AC voltage level must be limited to:

- 270 VAC so as not to exceed the maximum 390 VDC for the 400V model
- 550 VAC so as not to exceed the maximum 780 VDC for the 800V model

To connect the Direct-to-Main DC power supply:

1. For best immunity, it is highly recommended to use twisted and shielded cables for the DC power supply. A 3-wire shielded cable should be used. The gauge is determined by the actual current consumption of the motor.
2. Connect the cable shield to the closest ground connection near the power supply.
3. Connect the PE to the closest ground connection near the power supply.
4. Before applying power, first verify the polarity of the connection.

The Auxiliary VL backup functionality can be used for storing auxiliary parameters in case of power-outs, providing maximum flexibility and backup capability when required.

To connect the auxiliary supply:

1. The source of the auxiliary supply must be isolated.
2. For safety reasons, connect the return (common) of the auxiliary supply source to the closest ground near the auxiliary supply source
3. Connect the cable shield to the closest ground (PE) near the auxiliary supply source
4. Before applying power, first verify the polarity of the connection.

7.4.2 Dual Power Supplies

Note: The Duet requires an external VL Logic power supply; the Gold Duet 80 cannot operate without it. The Auxiliary power supply must be isolated.

7.4.2.1 Direct to Main Non Isolated Power Source

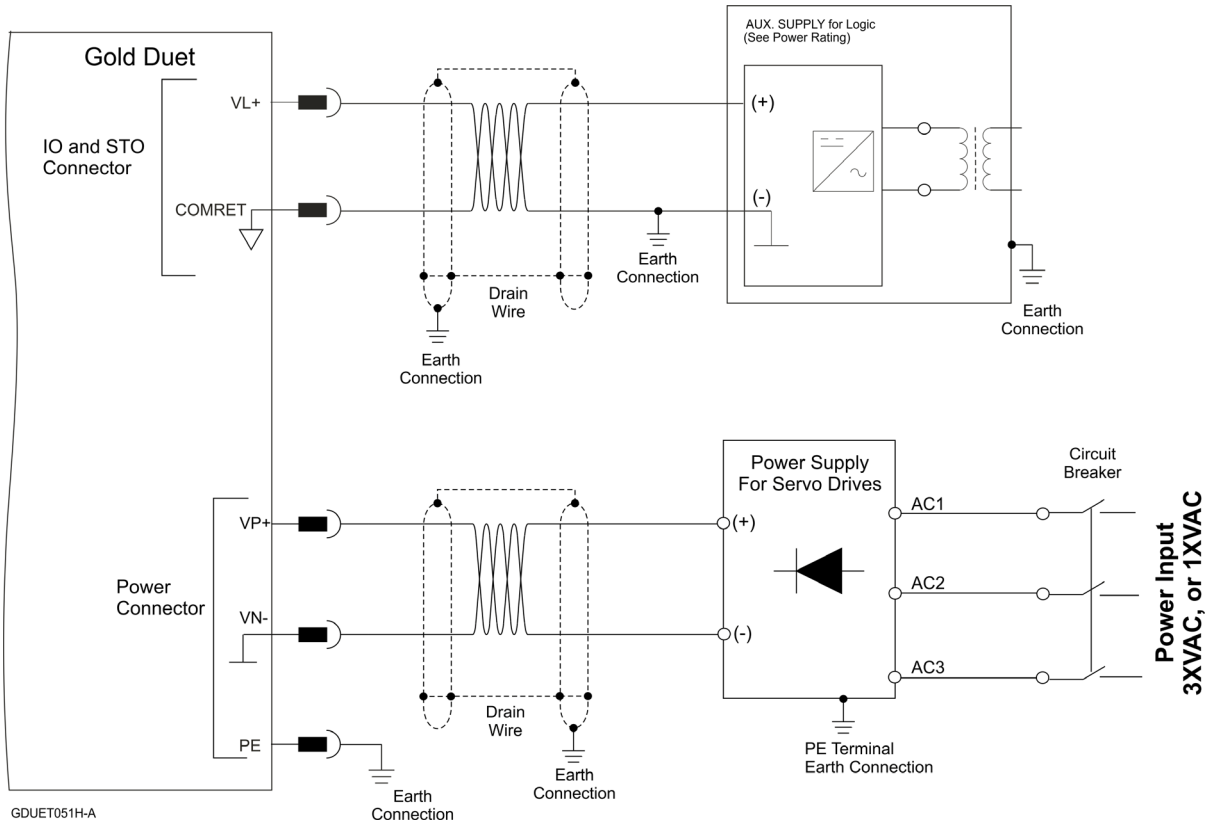


Figure 6: Direct to Main Non Isolated Power Source Connection Diagram
VL connected via IO & STO connector

7.4.2.2 Direct to Main Isolated Power Source

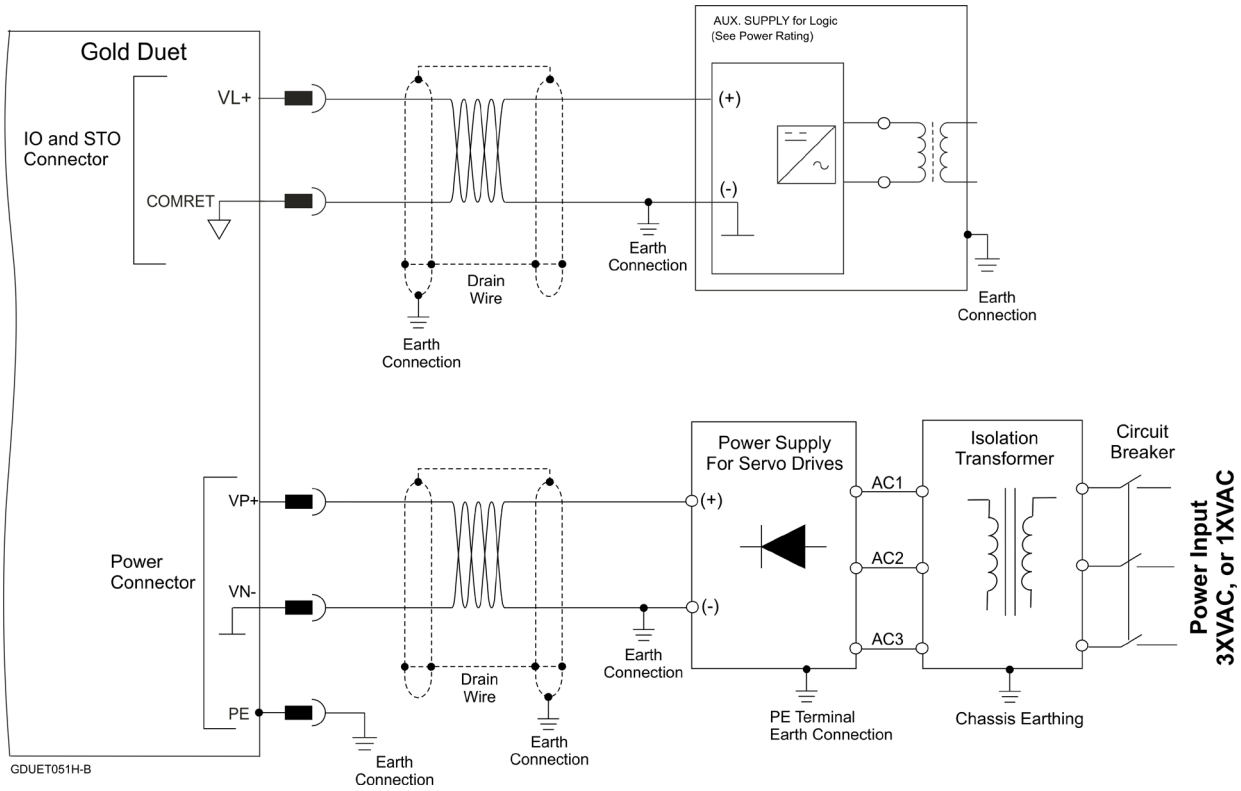


Figure 7: Isolated Power Source Connection Diagram – VL connected via IO & STO connector

7.5 I/O, STO, and Auxiliary Connector (J3)

The Gold Duet 80 has up to four digital inputs and 1 digital outputs, which can be configured to the following options:

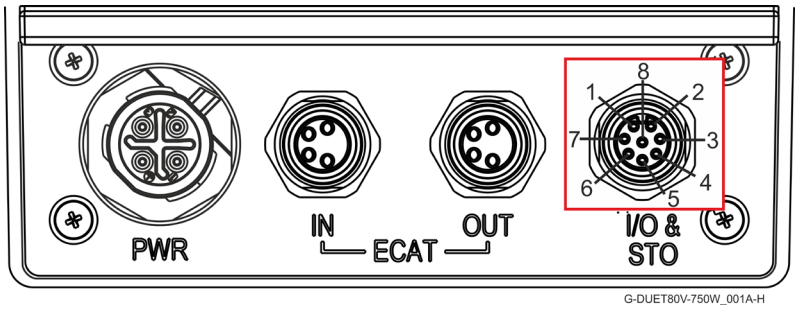
- Source mode – PLC voltage level
- Sink mode – PLC voltage level

Gold Duet 80 versions S, H - with STO, have two digital inputs

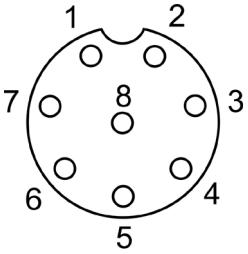
Gold Duet 80 versions V, W - without STO, have four digital inputs

Cat No.	S or H		V or W	
Pin	**Signal**	**Function**	**Signal**	**Function**
1	STO1	STO 1 input	IN3	Programmable input 3
2	STO2	STO 2 input	IN4	Programmable input 4
3	STO_RET	STO Common Return	IN_RET3, 4	The common of inputs 3&4, isolated from the auxiliary section
4	IN2	Programmable input 2		
5	IN1	Programmable input 1		
6	COMRET	Common Return. This is the common of inputs1 & 2 , output 1, and VL		
7	OUT1	Programmable output 1		
8	VL+	Auxiliary Supply Input : VL+ input (control , Logic ,I/O and Brake)		

Connectors



G-DUET-80, 100 Connectors Interface



M8 8-pin Female Connector

M8 Male Cable Connector

7.5.1 STO (Safe Torque Off) Inputs (Options S, H)

Refer to Chapter 9 in the MAN-G-Panel Mounted Drives Hardware manual for full details.

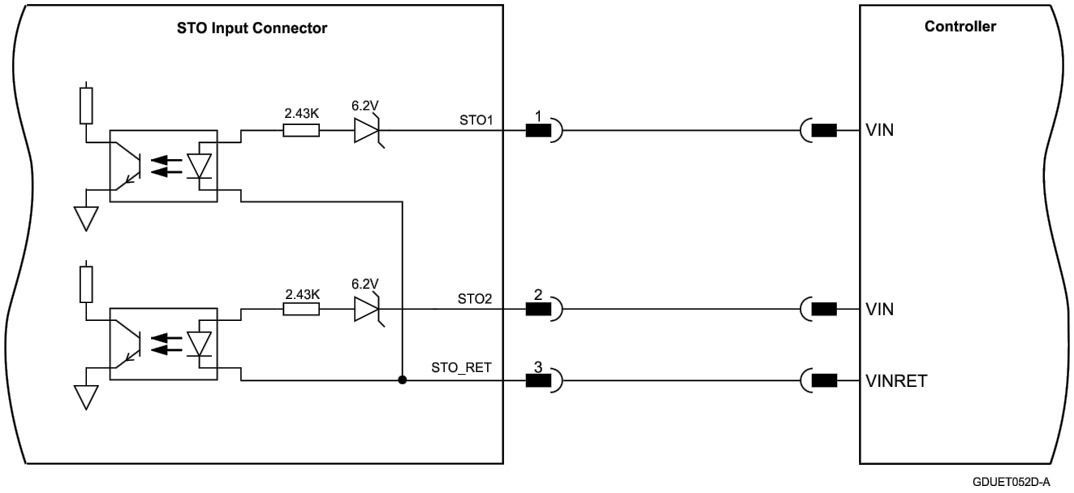
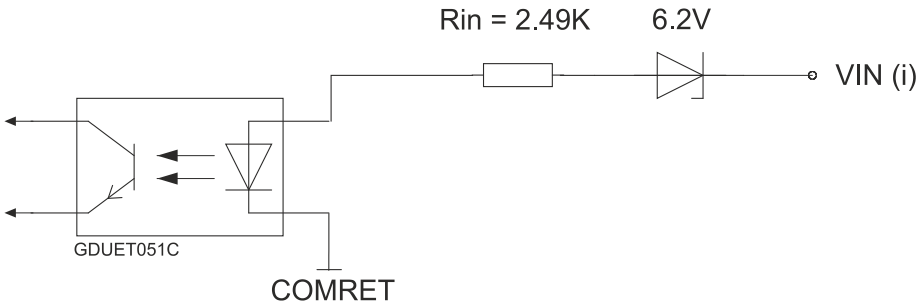


Figure 8: STO Input Connection – PLC Option

7.5.2 Digital IO PLC Source Type

7.5.2.1 Digital Input

Feature	Details
Type of input	Isolated PLC Source
Input current for all inputs	I_{in} = 2 mA @ V_{in} = 12 V
High-level input voltage	12 V < V_{in} < 30 V
Low-level input voltage	0 V < V_{in} < 7 V
Minimum pulse width	>250 µsec
Execution time (all inputs): the time from application of voltage on input until execution is complete	0 < T < 250 µsec
High-speed inputs – 1–5 pulse width, in high-speed mode	T > 5 µsec if the input functionality is set to latch/capture (index/strobe). **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • Highest speed is achieved when turning on optocouplers.
 **Figure 9: Digital Input PLC Schematic**	
Capture with differential input Port A Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

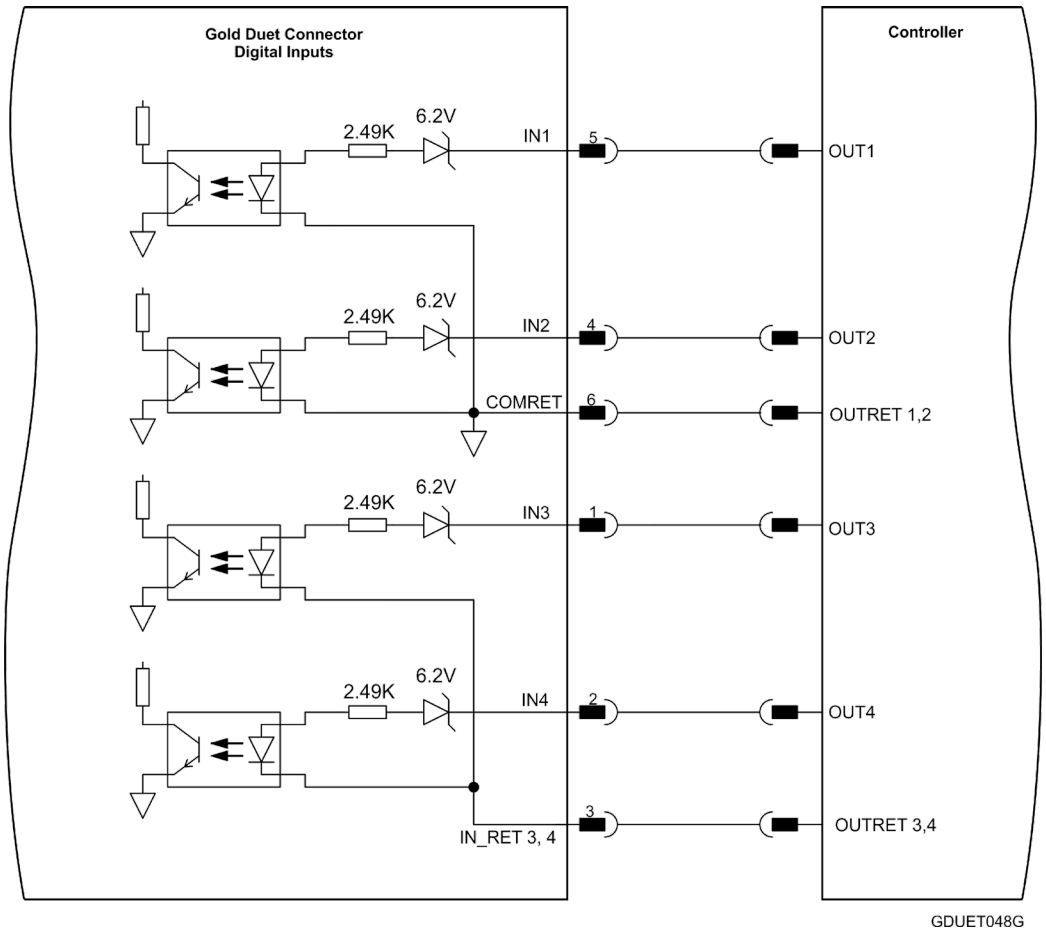


Figure 10: Digital Input PLC Source Mode Connection Diagram for Cat. No. V

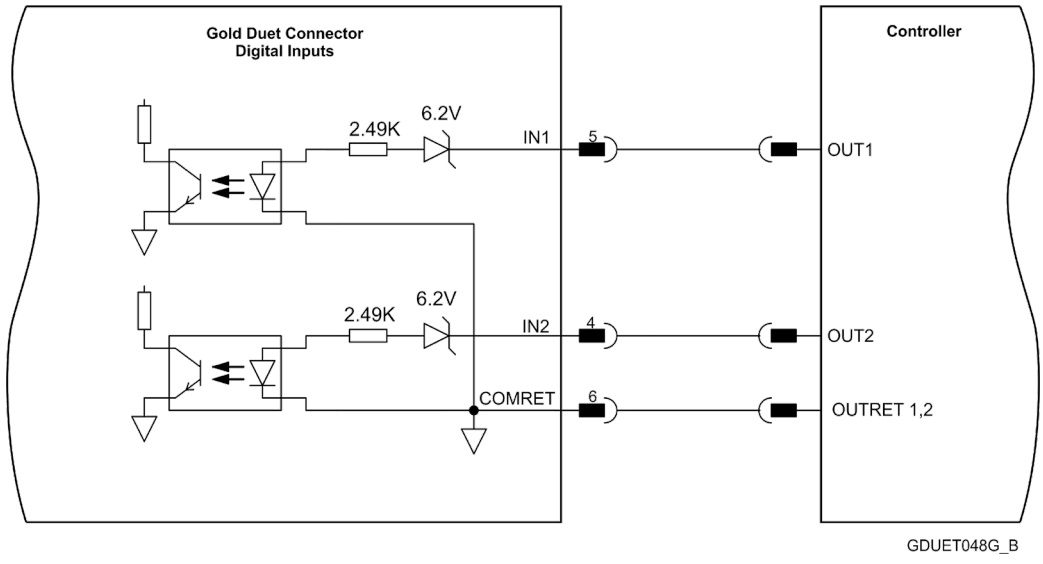


Figure 11: Digital Input PLC Source Mode Connection Diagram for Cat. No. S

7.5.2.2 Digital Output

The following table describes the specification of digital output

Feature	Details
Type of output	Isolated PLC source
Low-level output voltage	V_{out} (on) ≤ 0.3 V
High-level output voltage	VL
Total Maximum output current I_{out} (V_{out} = Low)	≤ 250 mA
R_L	The external resistor R_L must be selected to limit the output current to no more than 250 mA (output 1). $$R_L = \frac{V_L - VOL}{I_{out}\,(max)}$$
Executable time	0 < T < 250 µsec

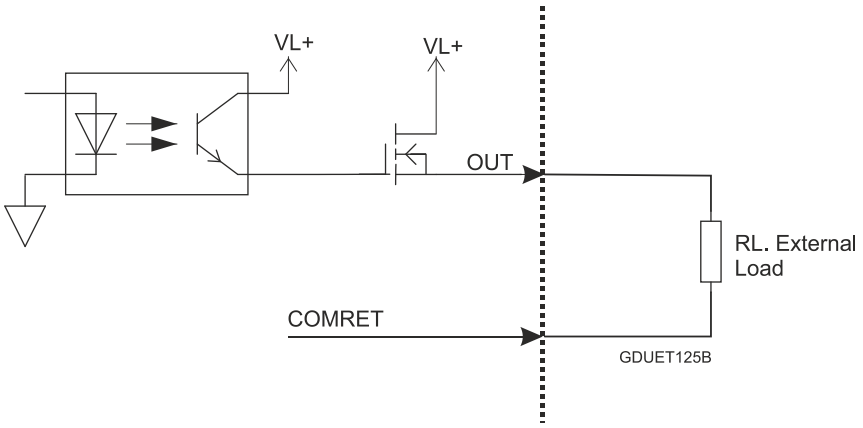


Figure 12: Digital Output Schematic – Source Mode PLC Level

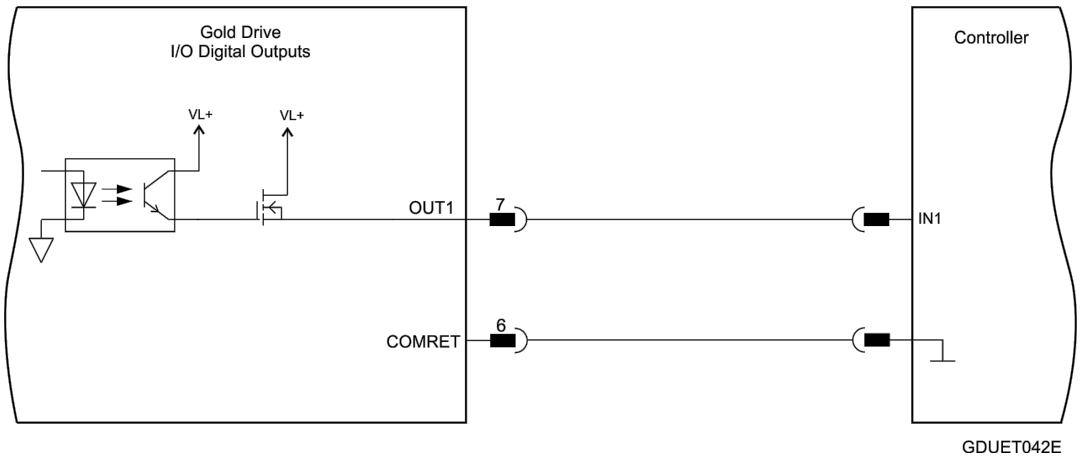
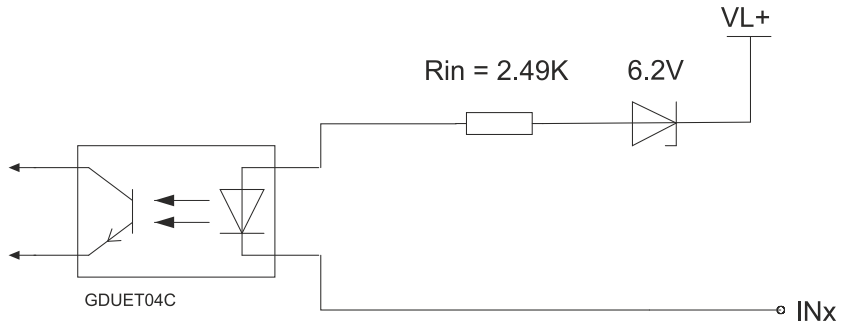


Figure 13: Digital Output as PLC Source Configuration Connection Diagram

7.5.3 Digital IO PLC Sink Type

7.5.3.1 Digital Input

Feature	Details
Type of input	Isolated PLC Sink
Supply Voltage (VL)	18V < VL < 30V
Input current for all inputs	I_{in} = 3.25 mA @ V_{in} = 12V
High-level input voltage	0 V < V_{in} < 7 V
Low-level input voltage	(VL-7V) < V_{in} < 30 V
Minimum pulse width	>250 µsec
Execution time (all inputs): the time from application of voltage on input until execution is complete	0 < T < 250 µsec
High-speed inputs – 1–5 pulse width, in high-speed mode	T > 5 µsec if the input functionality is set to latch/capture (index/strobe). **Notes:** • Home mode is high-speed mode and can be used for fast capture and precise homing. • Highest speed is achieved when turning on optocouplers.
 **Figure 14: Digital Input Sink Schematic**	
Capture with differential input Port A Index	T > 0.1 µsec if the differential input functionality is set to touch probe/capture (index/strobe).

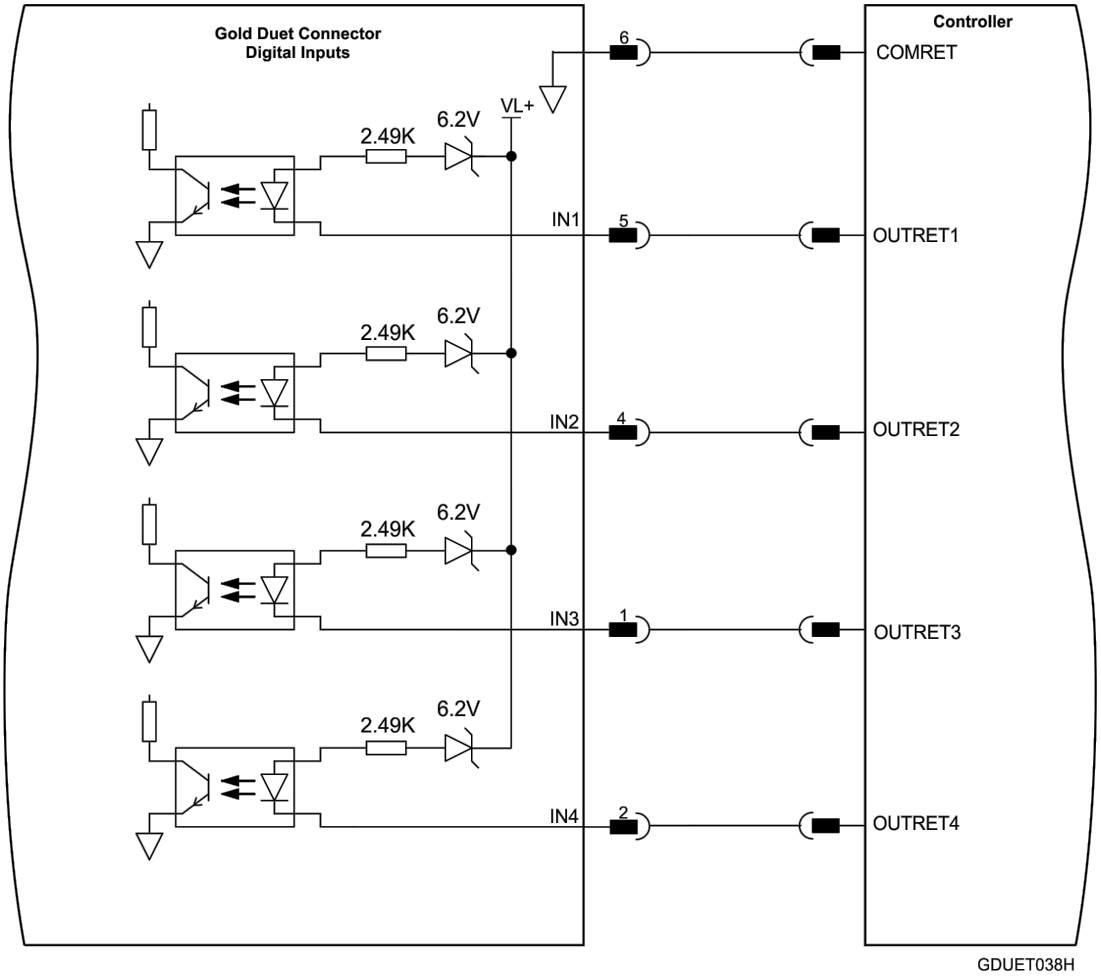


Figure 15: Digital Input as Sink Configuration Connection Diagram for Cat. No. W

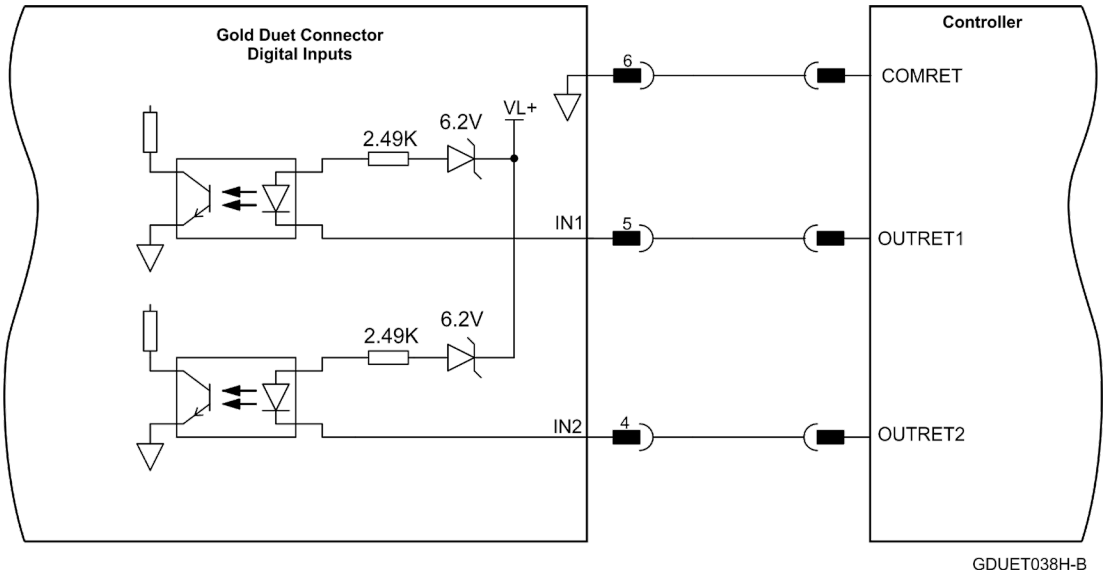


Figure 16: Digital Input as Sink Configuration Connection Diagram for Cat. No. H

7.5.3.2 Digital Output

The following table describes the specification of digital output

Feature	Details
Type of output	Isolated PLC Sink
Low-level output voltage	V_{out} (on) ≤ 0.3 V
High-level output voltage	VL
Total Maximum output current I_{out} (V_{out} = Low)	≤ 250 mA
R_L	The external resistor R_L must be selected to limit the output current to no more than 250 mA (output 1). $$R_L = \frac{V_{DD} - VOL}{I_{out}\ (max)}$$
Executable time	0 < T < 250 µsec

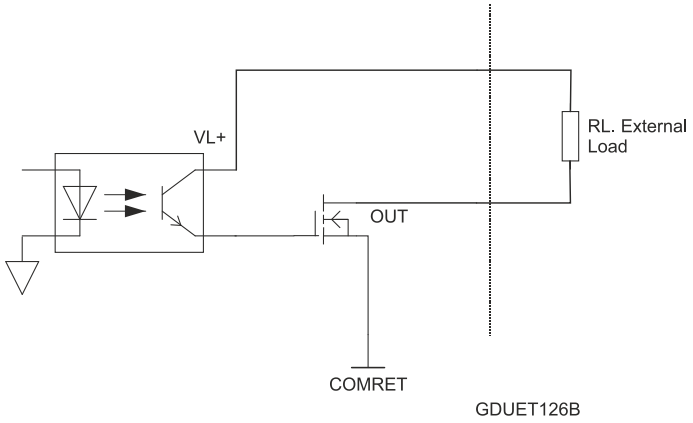


Figure 17: Digital Output PLC Sink Schematic

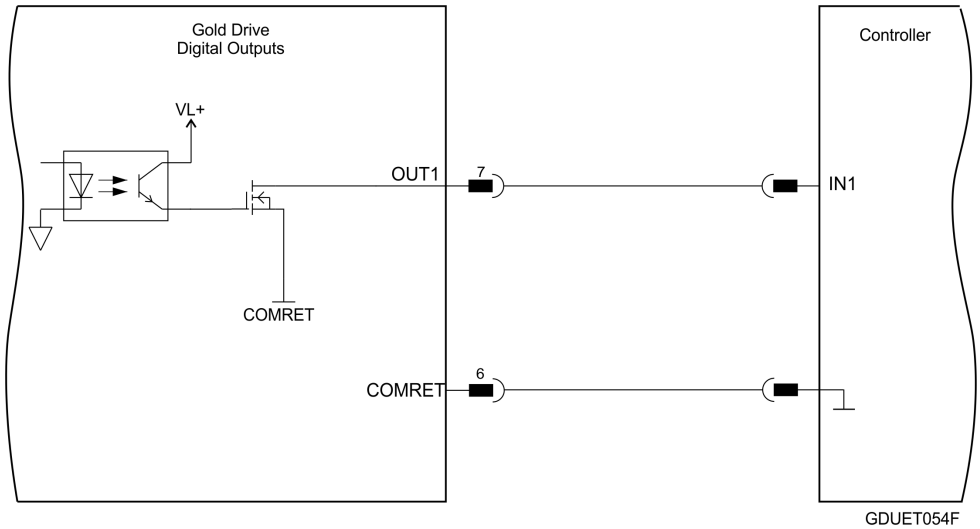


Figure 18: Digital Output as PLC Sink Configuration Connection Diagram

7.6 EtherCAT /Ethernet Communications

7.6.1 Introduction

The Gold Duet 80 serves as an EtherCAT slave device, therefor it includes EtherCAT_IN and EtherCAT_OUT ports. The EtherCAT_IN port can be configured to an Ethernet port using the **FW** command. Refer to the Gold Command Reference manual.

7.6.2 Specification

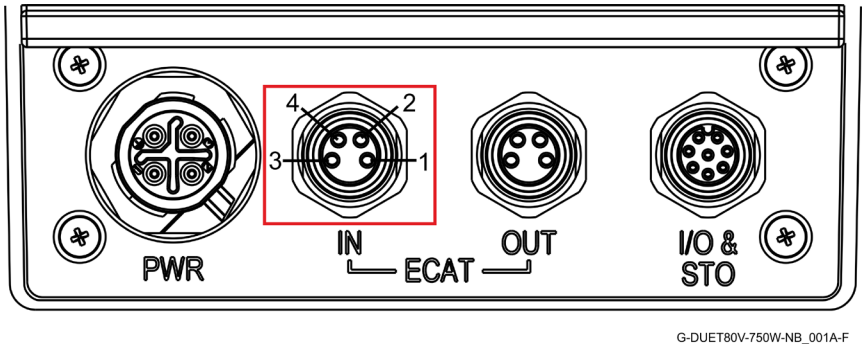
Specification	Details
Physical layer	• 100base-T
Speed	• 100 Mbit/sec
Cable Type	CAT5e (Category 5 cable is a high signal integrity cable with four twisted pairs. It is recommended to use with shielded cable).
EtherCAT	
EtherCAT Type	EtherCAT Slave (Includes EtherCAT IN and EtherCAT out ports)
Protocols	CoE, FoE, EoE Distributed clock **Note: During the FoE operation, the USB cable connection must be disconnected.**
Ethernet (EtherCAT IN Port)	
Protocols	UDP

7.6.3 EtherCAT IN Signals (J2)

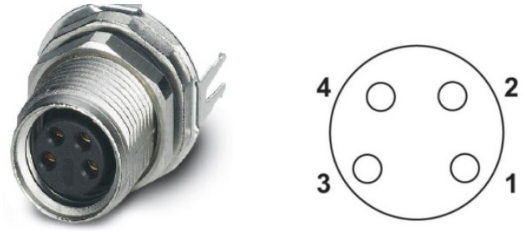
The EtherCAT IN port can be configured as an Ethernet port for TCP/IP – see the EtherCAT Manual.

The following table describes the signals of EtherCAT_IN

Pin (J2)	Signal	Function
1	EtherCAT_IN_TX+/Ethernet_TX+	EtherCAT in/Ethernet transmit +
4	EtherCAT_IN_TX-/Ethernet_TX-	EtherCAT in/Ethernet transmit -
2	EtherCAT_IN_RX+/Ethernet_RX+	EtherCAT in/Ethernet receive +
3	EtherCAT_IN_RX-/Ethernet_RX-	EtherCAT in/Ethernet receive -
Connector Location		



G-DUET-80, 110 Connectors Interface



M8 4 Socket Female

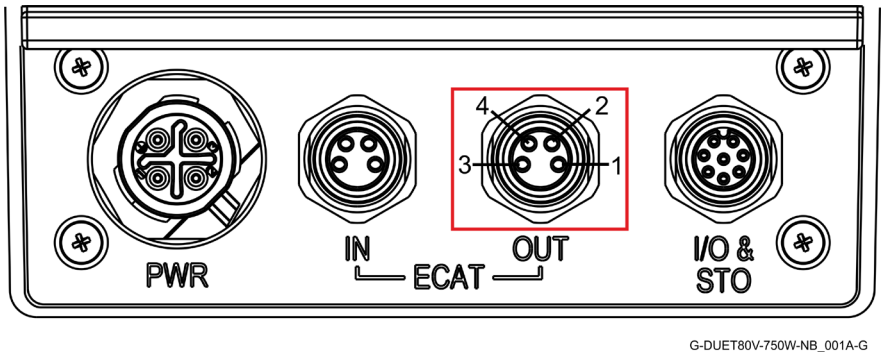
M8 4 pins Male

Table 2: EtherCAT/Ethernet IN - Pin Assignments

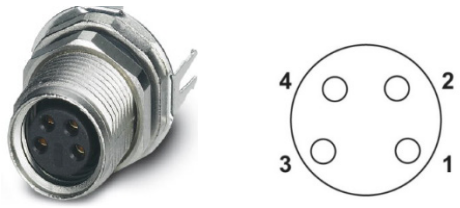
7.6.4 EtherCAT OUT Signals (J4)

The following table describes the signals of EtherCAT_OUT.

Pin (J4)	Signal	Function
1	EtherCAT_OUT_TX+	EtherCAT OUT transmit +
4	EtherCAT_OUT_TX-	EtherCAT OUT transmit -
2	EtherCAT_OUT_RX+	EtherCAT OUT receive +
3	EtherCAT_OUT_RX-	EtherCAT OUT receive -
Connector Location		



G-DUET-80 Connectors Interface



M8 4 socket Female

M8 4 pins Male

Table 3: EtherCAT/Ethernet OUT Pin Assignments

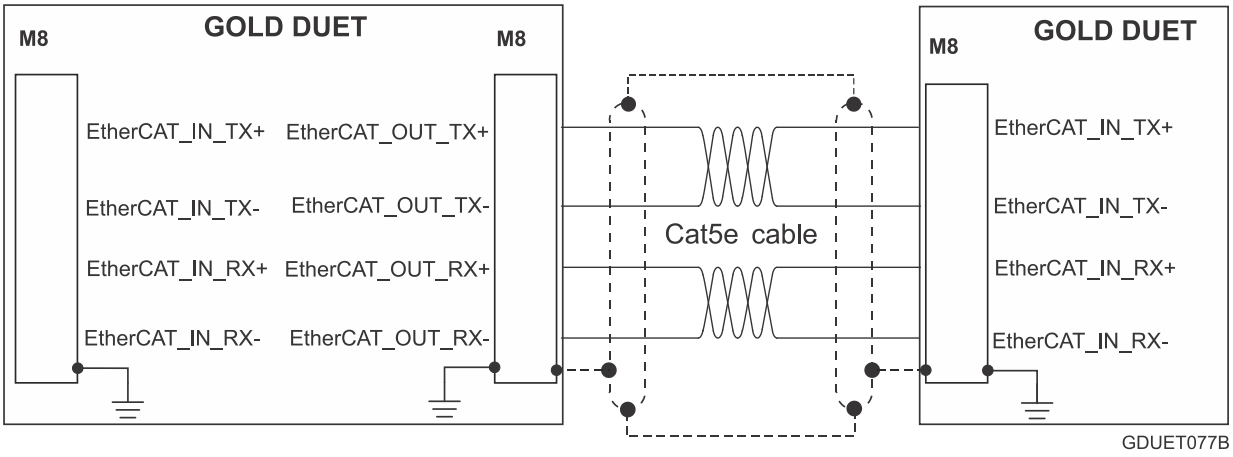


Figure 19: EtherCAT Connections

7.6.5 EtherCAT Indicators

The G-DUET is equipped with EtherCAT status LEDs.

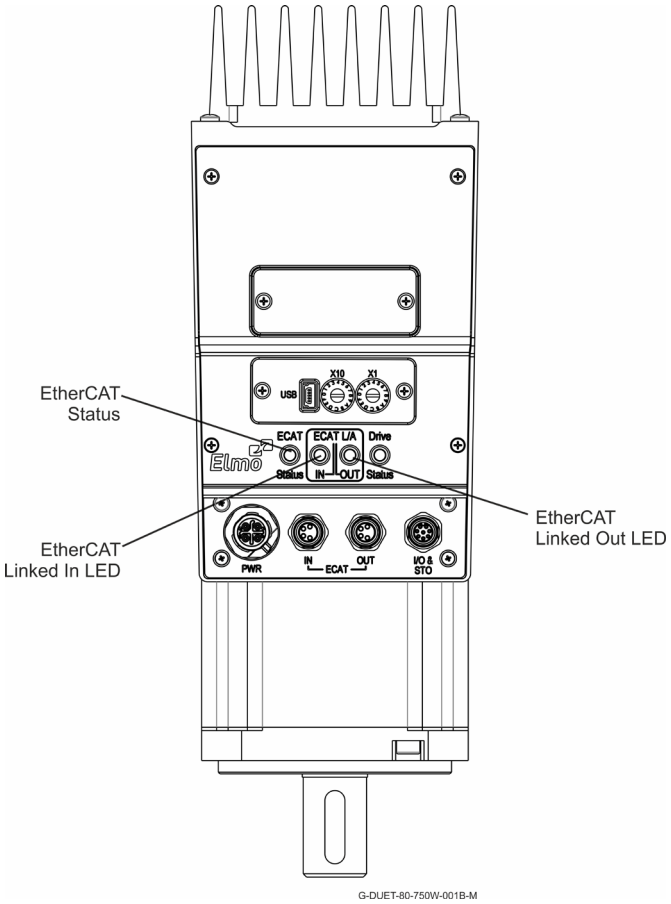


Figure 20: EtherCAT LED Indicators

7.6.5.1 EtherCAT Status Indicator

The EtherCAT status indicator is a red/green LED (Figure 20). It combines run state indication (when it is green) and error state indication (when it is red) of the EtherCAT device. For further details, see the EtherCAT Application Manual.

7.6.5.2 EtherCAT Link Indicators

The Gold Duet 80 has EtherCAT IN and EtherCAT OUT link/activity LED indicators. The green LED is the link/activity indicator Figure 20), and shows the state of the applicable physical link and the activity on that link.

LED	State	Meaning
Link /Activity	Off	No link is established
	On	A link is established
	Blinking	There is data transmission activity

Table 4: LED States

7.6.6 EtherCAT Address Switches

The Gold Duet 80 includes EtherCAT switches which determine the EtherCAT address.

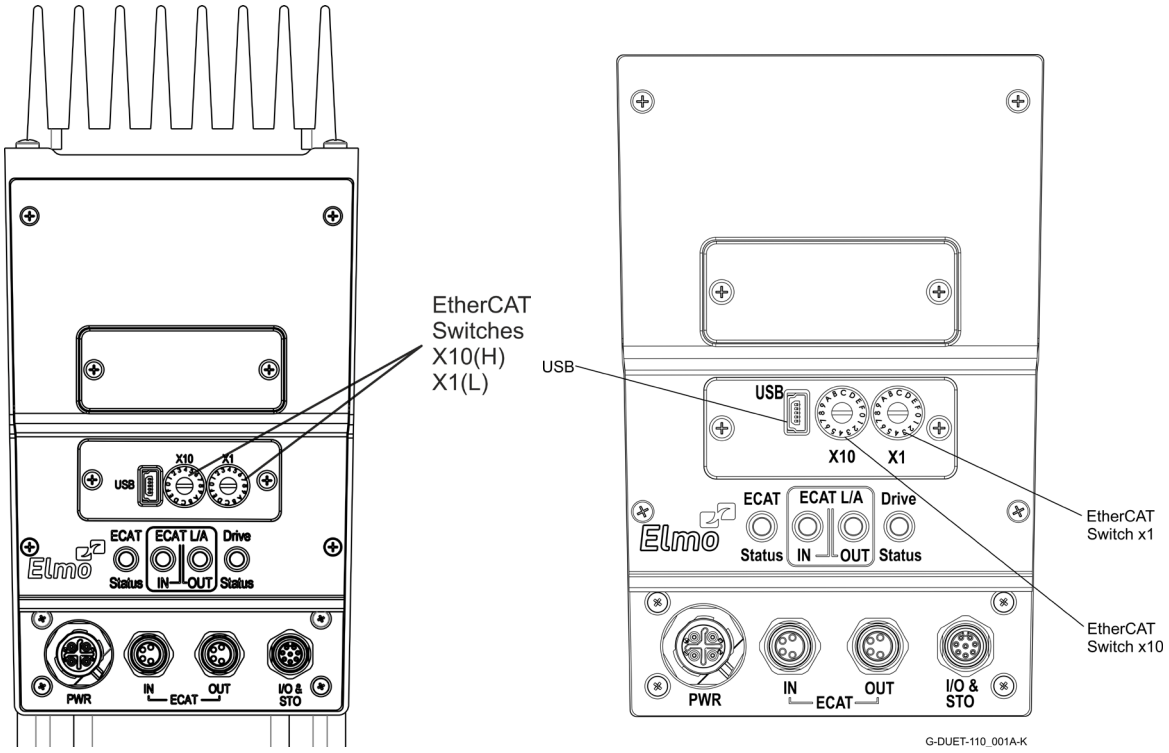


Figure 21: EtherCAT Address Switches

Using a screwdriver, you can set the low (X1 switch) and the high (X10 switch) bytes of the EtherCAT address.

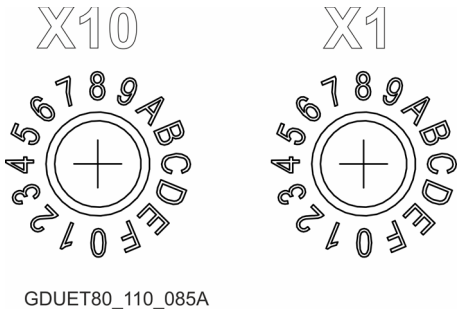


Figure 22: EtherCAT Address Switches

Note: When the EtherCAT switches are set to 0, it is similar to operating without EtherCAT switches.

To tune the EtherCAT switches:

1. To access the EtherCAT switches, remove the two small screws securing the EtherCAT switches (beside the battery compartment), and release the compartment.
2. Tune the X1 and X10 EtherCAT switches inside the compartment.
3. Reinstall the EtherCAT switches compartment using the original screws.

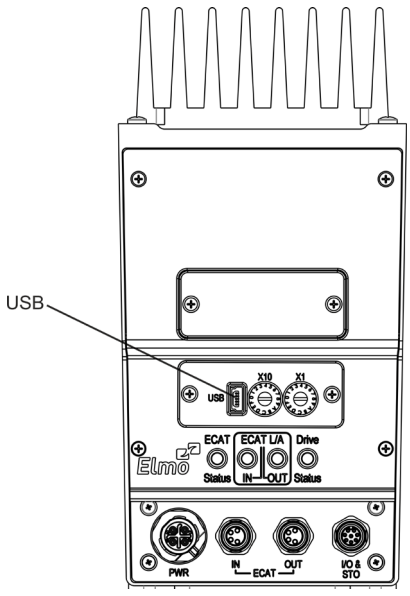
7.7 USB

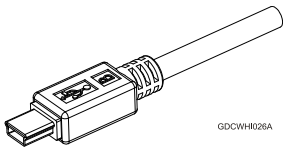
To access the Gold Duet 80 USB, release the drive body rear compartment panel two screws and remove the panel (same compartment with the EtherCAT switches).

Specification	Details
USB Type	USB 2.0 Device mode
Speed	Up to 12Mbit/s "Full Speed"
Cable length	maximum 5 m
Cable Type	Standard USB cable • constructed with 4 wires of 20AWG to 28AWG, shield with a foil • D+ and D- comprise a twisted pair in the cable • The shield of the cable is connected to the shield of the connector used for communication
Protocols	For setup and control

The following table describes the signals of the USB.

Pin	Signal	Function
1	USB VBUS	USB VBUS 5V
2	USBD-	USB _N line
3	USBD+	USB _P line
5	USB COMRET	USB communication return





USB Device Mini-B Plug

Table 5: USB 2.0 Mini-B Pin Assignments

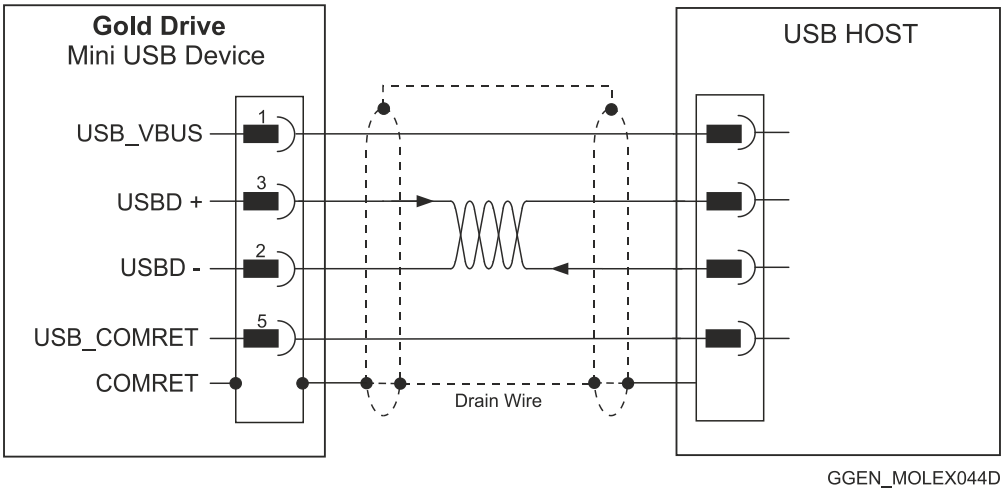


Figure 23: USB Network Diagram

7.8 Powering Up

After the Gold Duet 80 is connected to its device, it is ready to be powered up.

Caution:
Before applying power, ensure that the DC supply is within the specified range and that the proper plus-minus connections are in order.

7.9 Initializing the System

After the Gold Duet 80 has been connected and mounted, the system must be set up and initialized. This is accomplished using Elmo's Application Studio (EAS), Elmo's Windows-based software application. Install the application and then perform setup and initialization according to the directions in the *EAS II Software Manual*.

7.10 Battery Replacement

The data read by the absolute encoder include the single-revolution data that indicate the motor position per revolution, and the multi-revolution data that indicate a pulse count per revolution. Since the multi-revolution data are electrically counted, they will be backed up with a battery.

Note the following reason to replace the absolute encoder backup battery. A battery voltage drop results in an absolute encoder error. Battery voltage drop is caused by the exhausted service life of the battery, and voltage delay. The battery's service life will be reduced as the ambient conditions deteriorate.

It is recommended that the battery should be replaced whenever the encoder error is continuously recorded. This will allow sufficient time for the battery to be replaced. However, it should be noted that the data and time recorded is maintained even during replacement of the battery, to allow easy replacement of the battery without losing any data and time.

When necessary, use the following procedure to replace the battery. Refer to the battery specification in Section 5.9.8 Backup Battery.

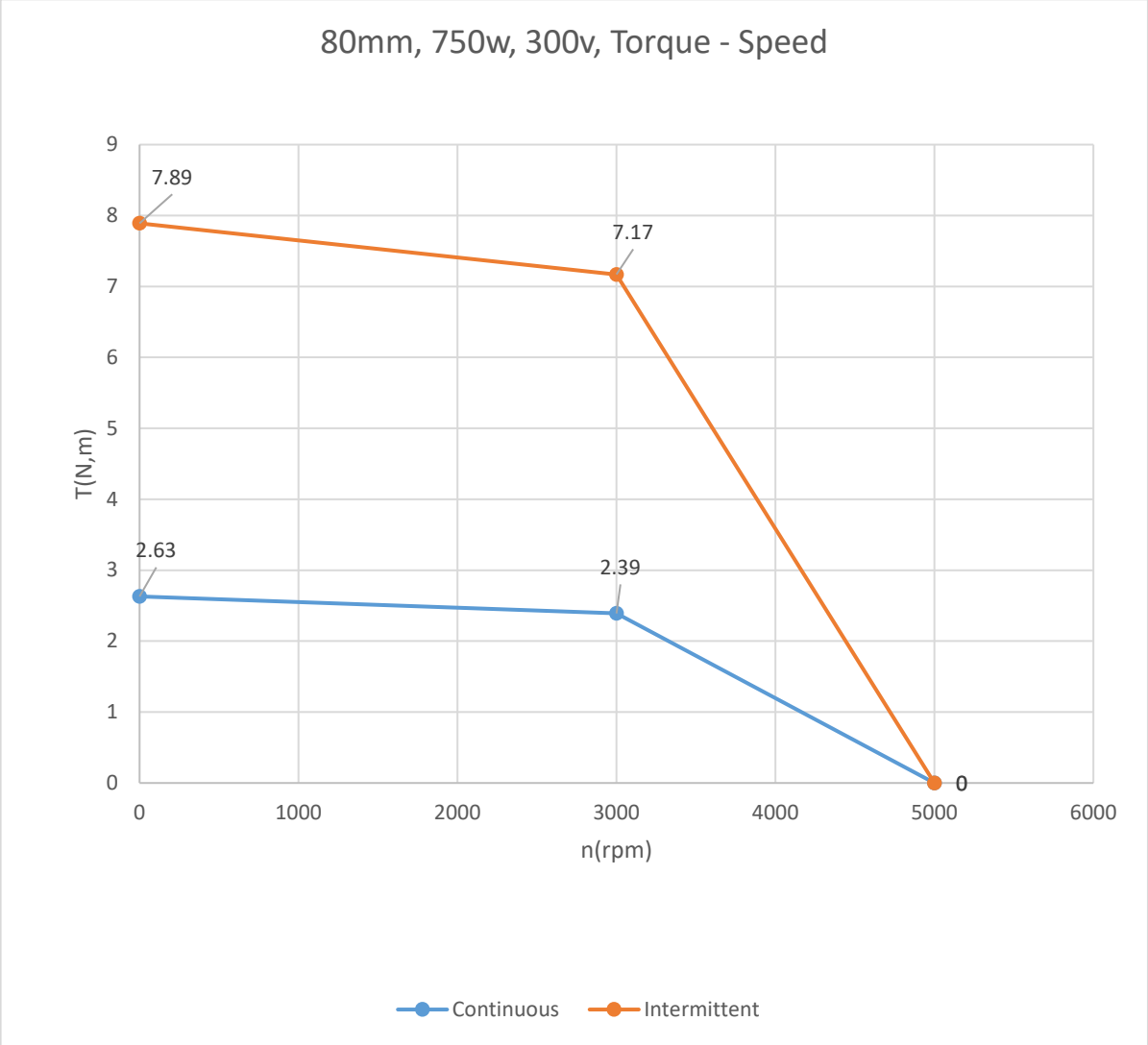
To replace the battery:

1. **Leave the auxiliary power supply on during battery replacement.**
2. Remove the two small screws securing the battery compartment, and release the compartment cover.
3. Remove the battery.
4. Disconnect the battery connectors.
5. Replace the battery.
6. Connect the battery connectors to the new battery.
7. Reinstall the battery compartment using the original screws.

Chapter 8: Gold Duet 80 Motor Characteristic Curves

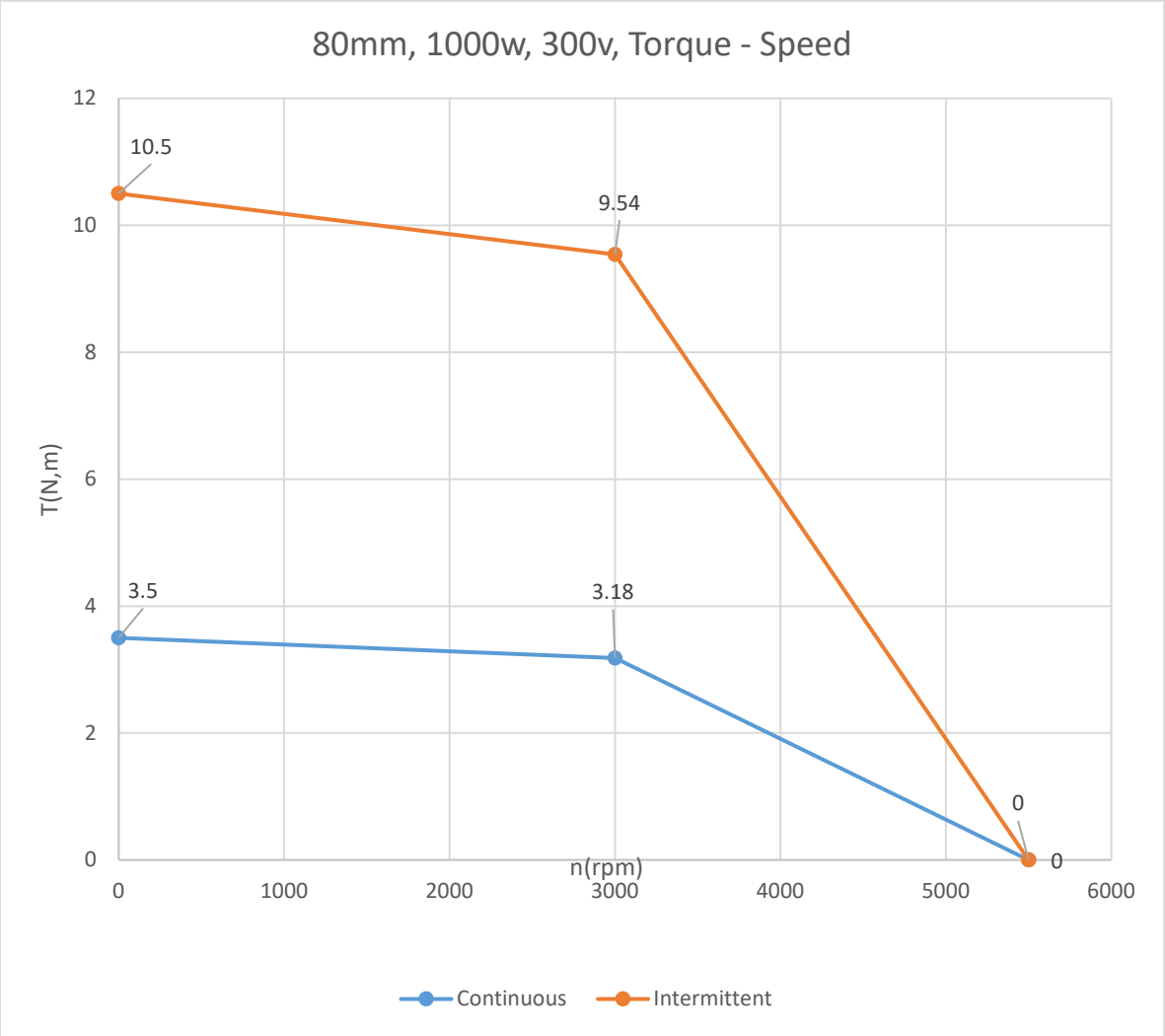
8.1 80 mm Frame 750W/ 2.39Nm

The section includes graphs of Torque-speed for the 300V DC voltage 750W model.



8.2 80 mm Frame 1000W/ 3.18Nm

The section includes graphs of Torque-speed for the 300V DC voltage 1000W model.



Chapter 9: Control Specifications

This chapter provides detailed technical information regarding the Gold Duet 80.

9.1 Current Loop

Feature	Details
Controller type	Vector, digital
Compensation for bus voltage variations	"On-the-fly" automatic gain scheduling
Motor types	AC brushless (sinusoidal)
Current control	Fully digital Sinusoidal with vector control Programmable PI control filter based on a pair of PI controls of AC current signals and constant power at high speed
Current loop bandwidth	> 4 kHz closed loop
Current sampling time	Programmable 40 to 120 µsec
Current sampling rate	Up to 25 kHz; default 20 kHz

9.2 Velocity Loop

Feature	Details
Controller type	PI + Four advanced filters + Two advanced gain scheduling filters
Velocity control	Fully digital Programmable PI and feed forward control filters On-the-fly gain scheduling according to either speed or position command or feedback. Automatic, quick, advanced or expert tuning
Velocity loop bandwidth	< 500 Hz
Velocity sampling time	80 to 240 µsec (2x current loop sample time)
Velocity sampling rate	Up to 12.5 kHz; default 10 kHz
Velocity command options	Internally calculated by either jogging or step **Note:** All software-calculated profiles support on-the-fly changes.

9.3 Position Loop

Feature	Details
Controller type	"1-2-2" PIP + three advanced filters + one advanced gain scheduling filter
Position command options	Software Pulse and Direction
Position loop bandwidth	< 200 Hz
Position sampling time	80 to 240 µsec (2x current loop sample time)
Position sampling rate	Up to 12.5 kHz; default 10 kHz

9.4 Pulse-Width Modulation (PWM)

Feature	Details
PWM resolution	Minimum 10-bit Default 12-bit Maximum 14-bit
PWM switching frequency on the load	2/Ts (factory default 40 kHz on the motor)

Chapter 10: Gold Duet 80 Dimensions

10.1 80 mm Frame 750W/2.39Nm

The Gold Duet 80 has the following dimensions:

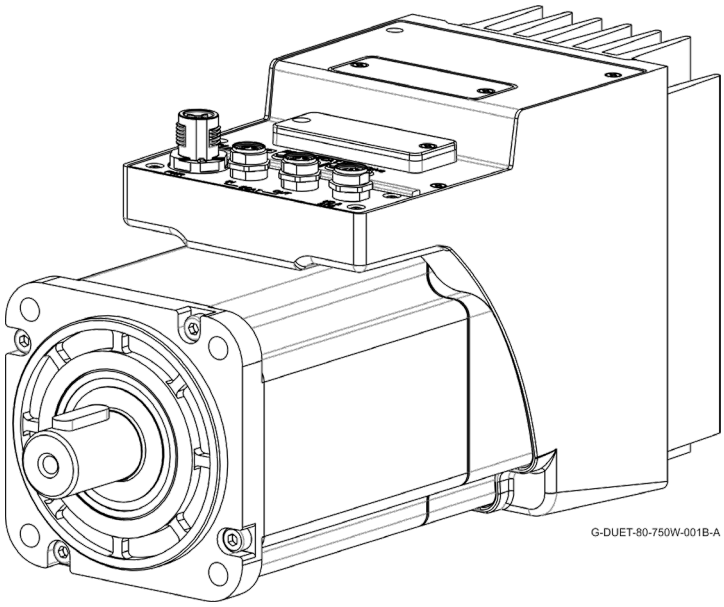


Figure 24: General View

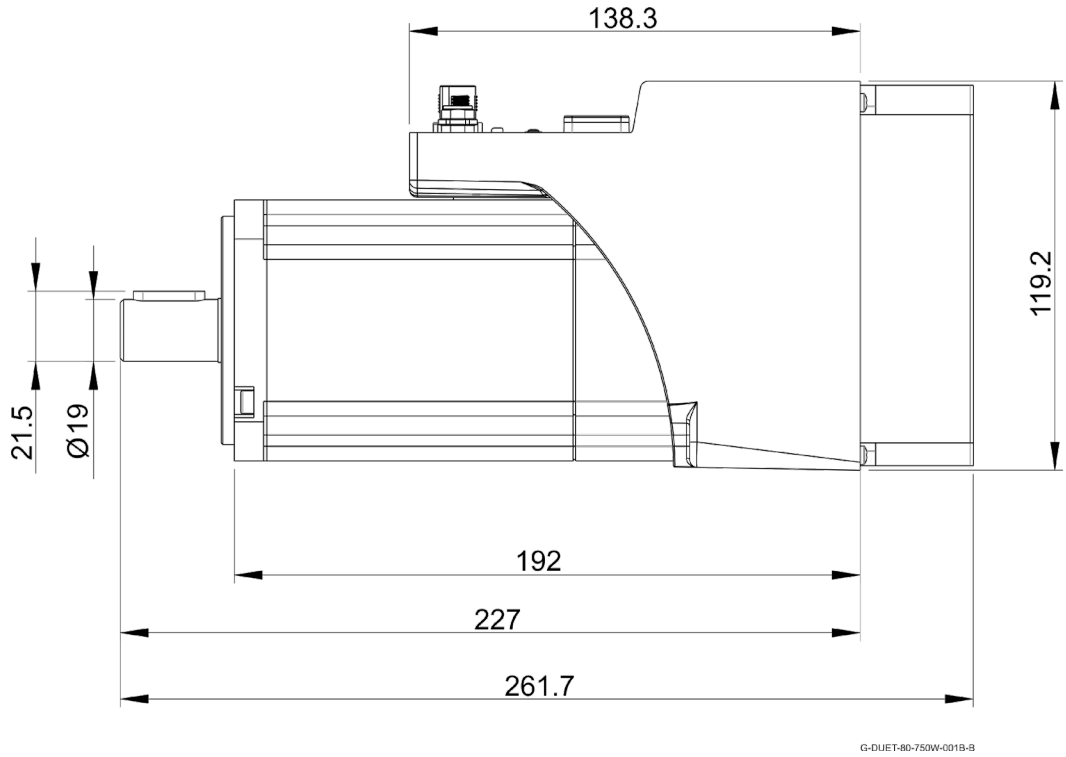


Figure 25: Side View Details

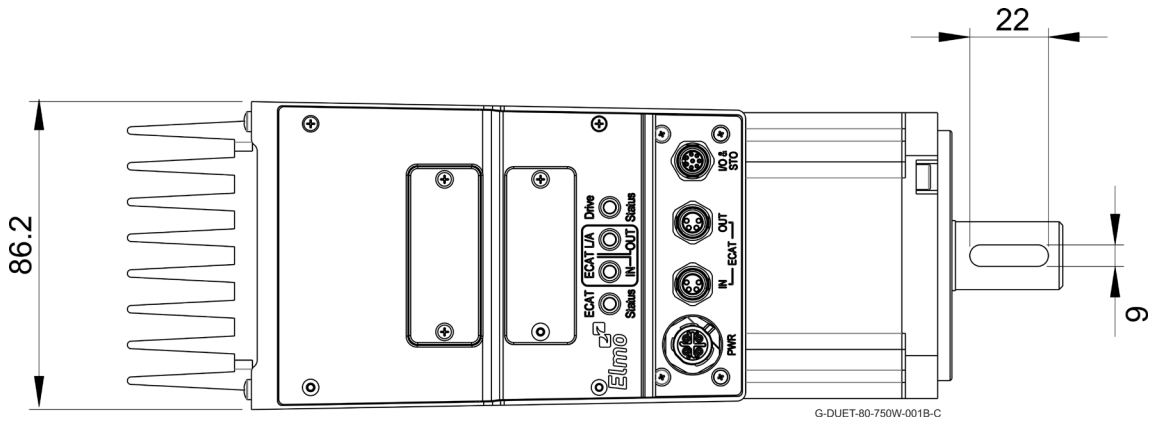


Figure 26: Top View Details

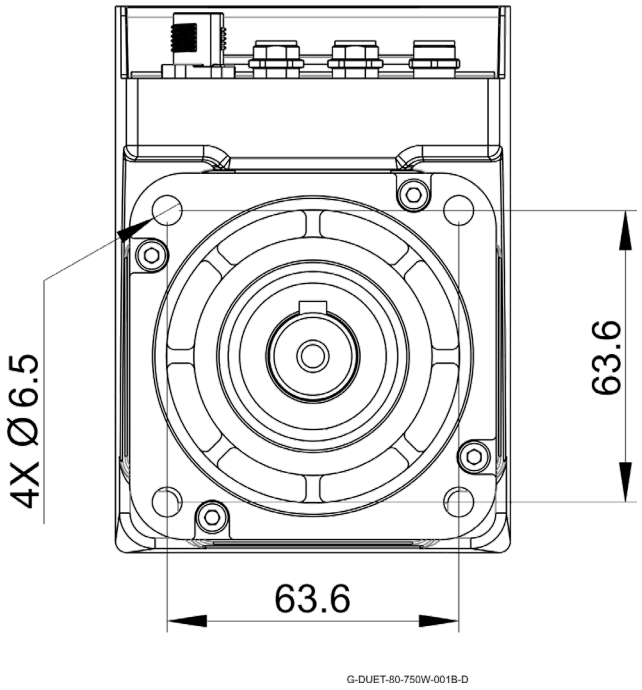


Figure 27: Front View Details and Rotor Shaft/Keyway Details

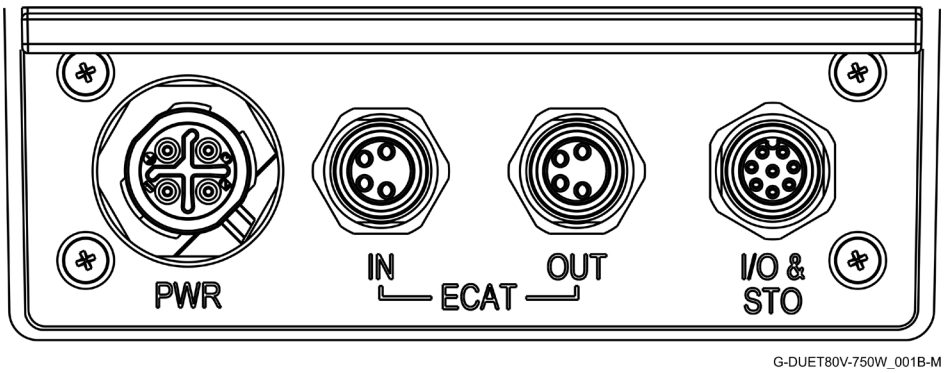


Figure 28: Interface Details

10.2 80 mm Frame 750W/2.39Nm With Brake

The Gold Duet 80 has the following dimensions:

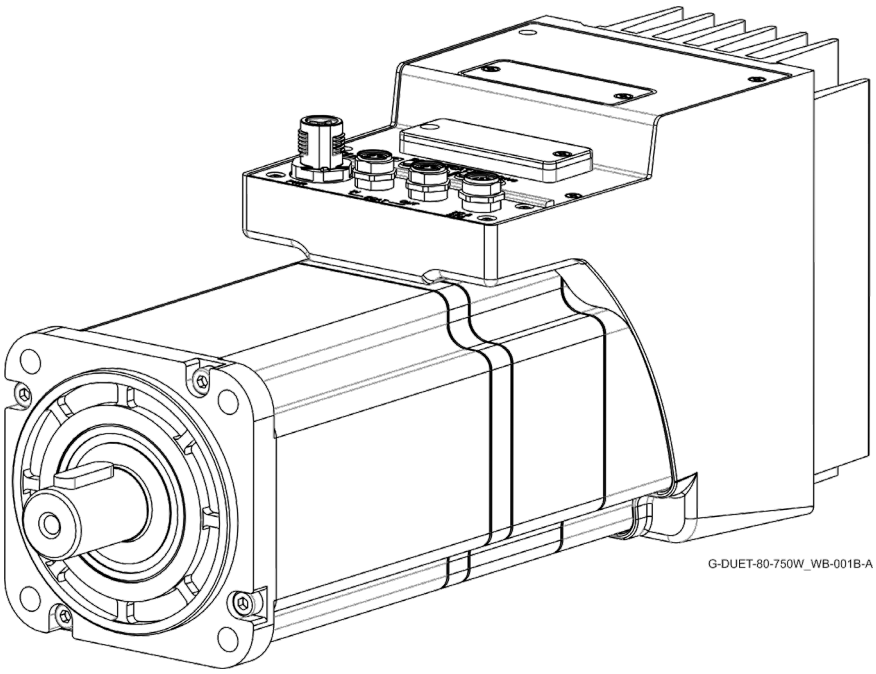


Figure 29: General View

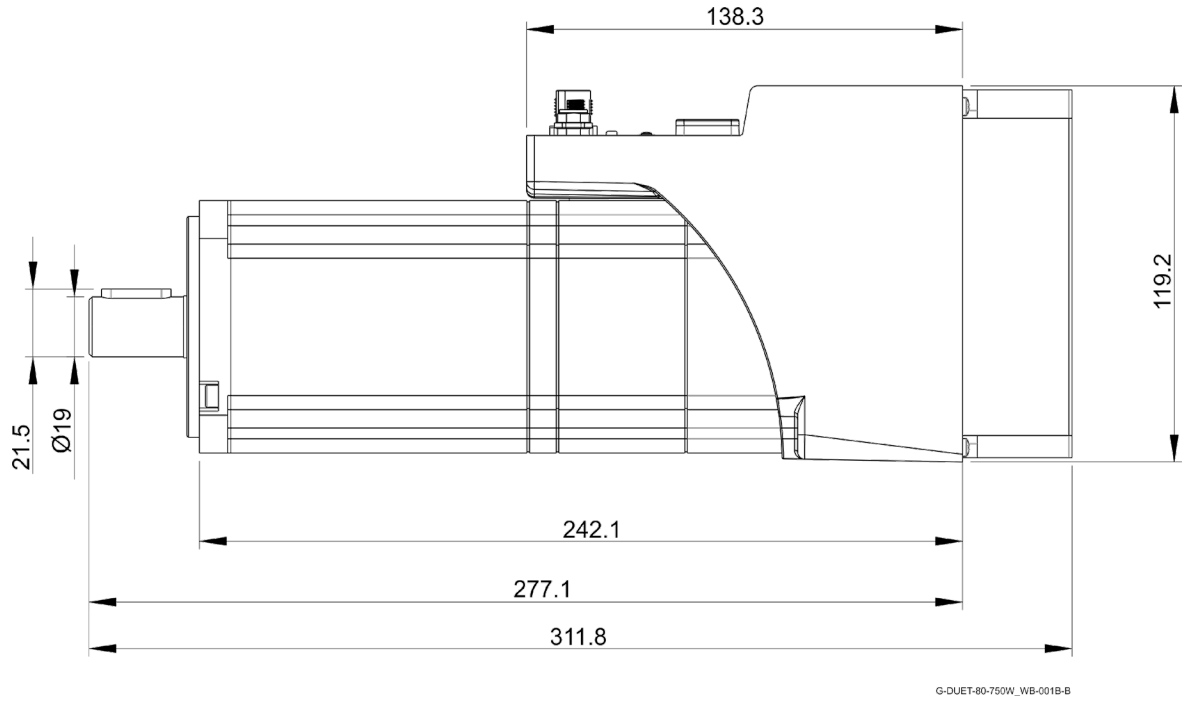


Figure 30: Side View Details

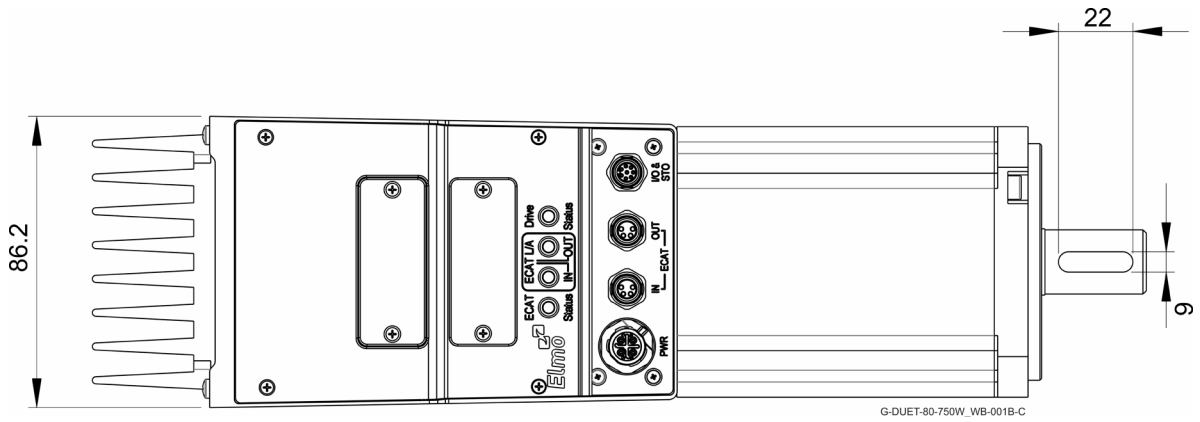


Figure 31: Top View Details

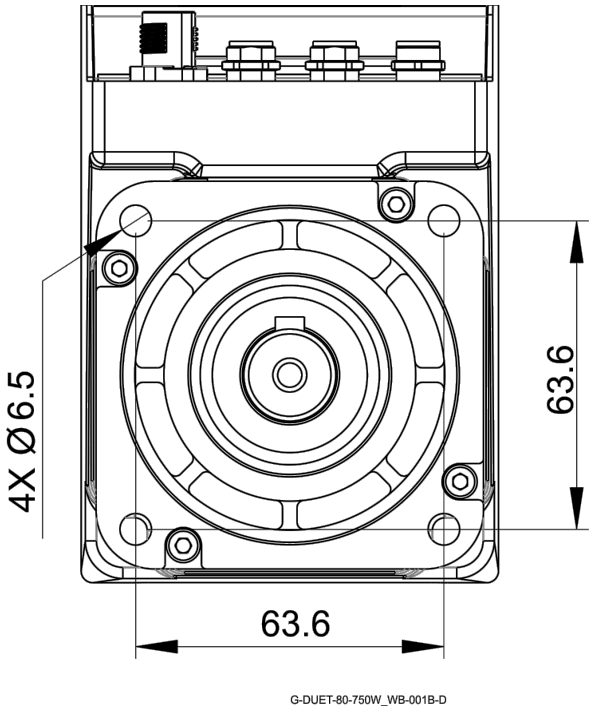


Figure 32: Front View Details and Rotor Shaft/Keyway Details

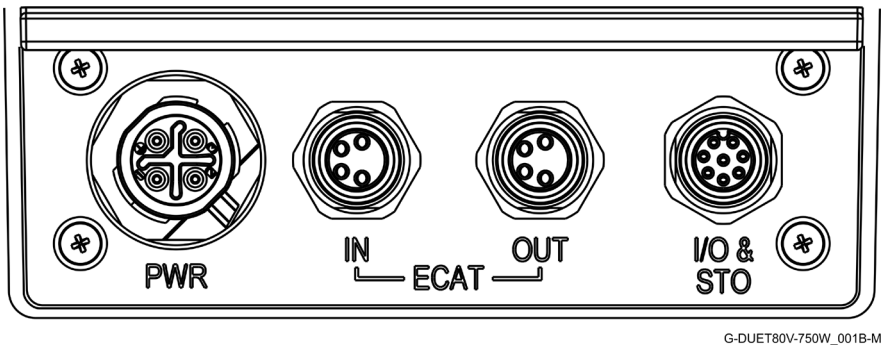


Figure 33: Interface Details

10.3 80 mm Frame 1000W/3.18Nm

The Gold Duet 80 has the following dimensions:

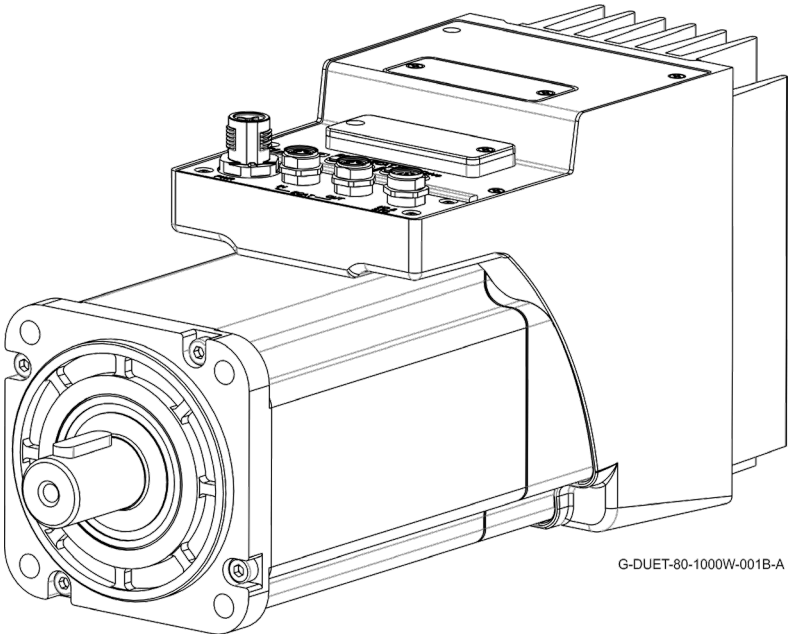


Figure 34: General View

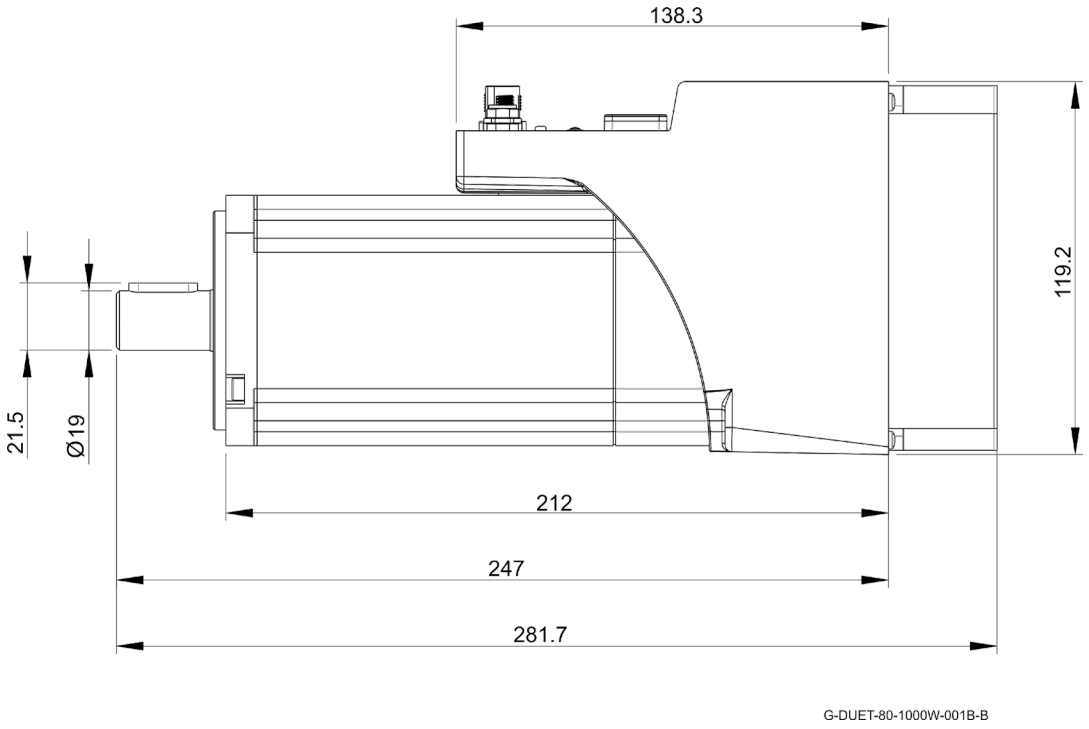


Figure 35: Side View Details

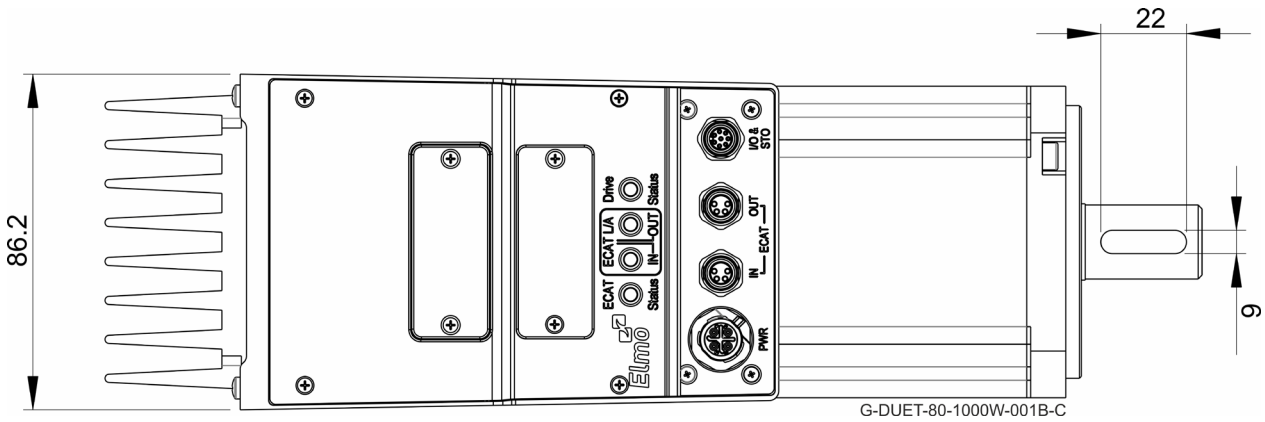


Figure 36: Top View Details

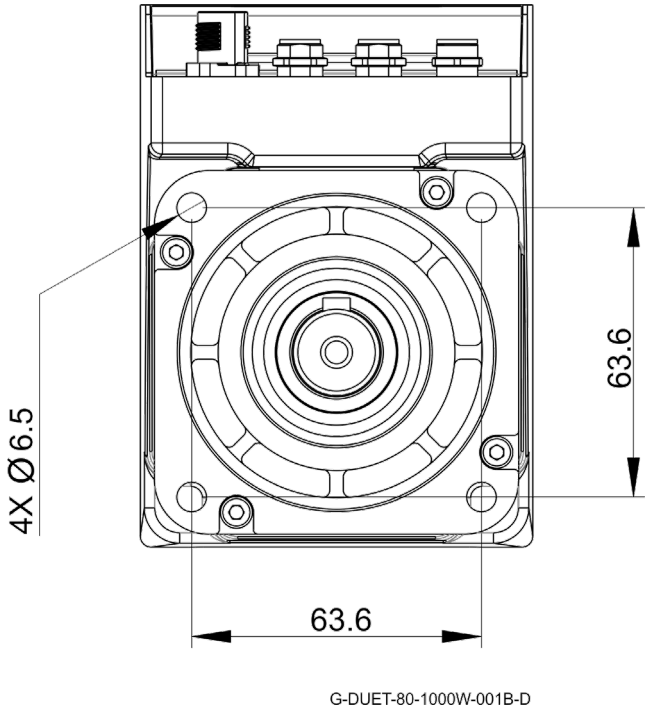


Figure 37: Front View Details and Rotor Shaft/Keyway Details

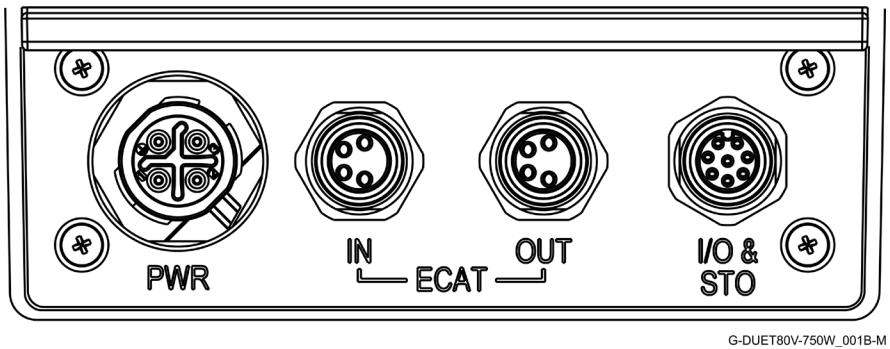


Figure 38: Interface Details

10.4 80 mm Frame 1000W/3.18Nm With Brake

The Gold Duet 80 has the following dimensions:

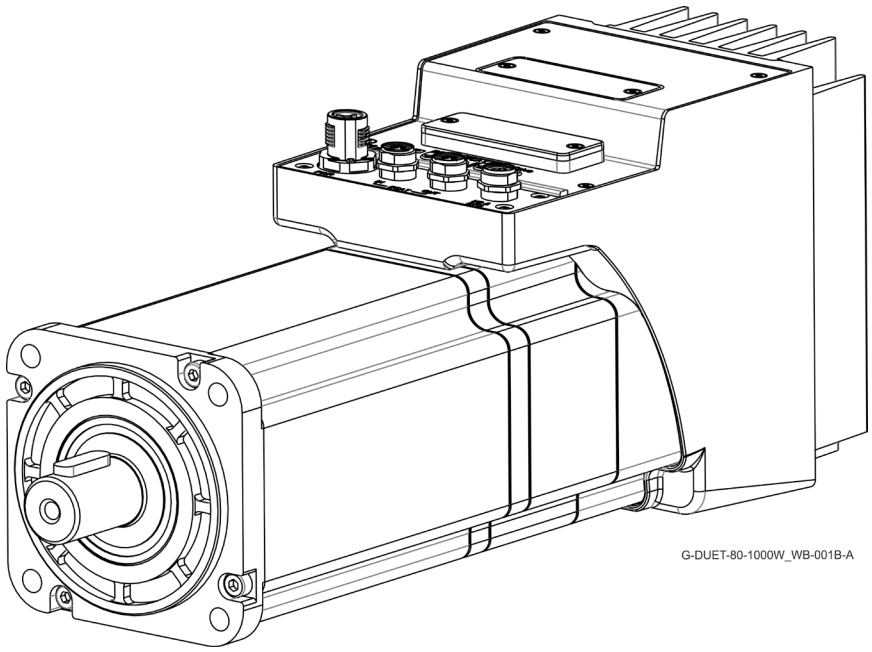


Figure 39: General View

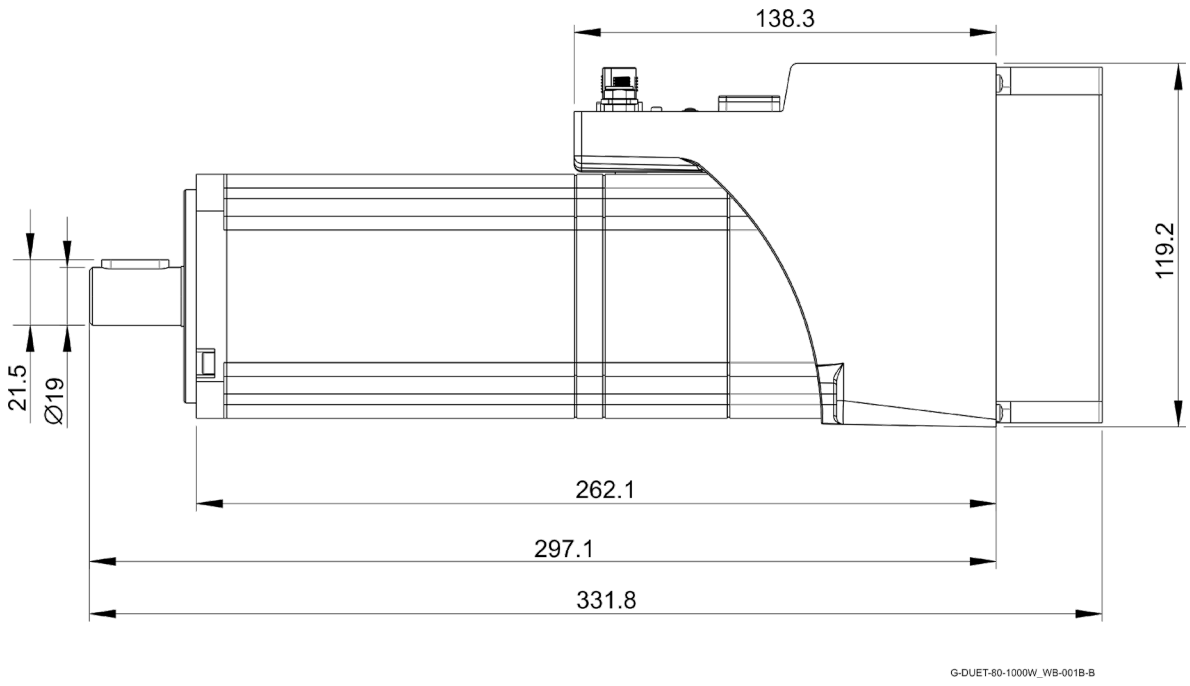


Figure 40: Side View Details

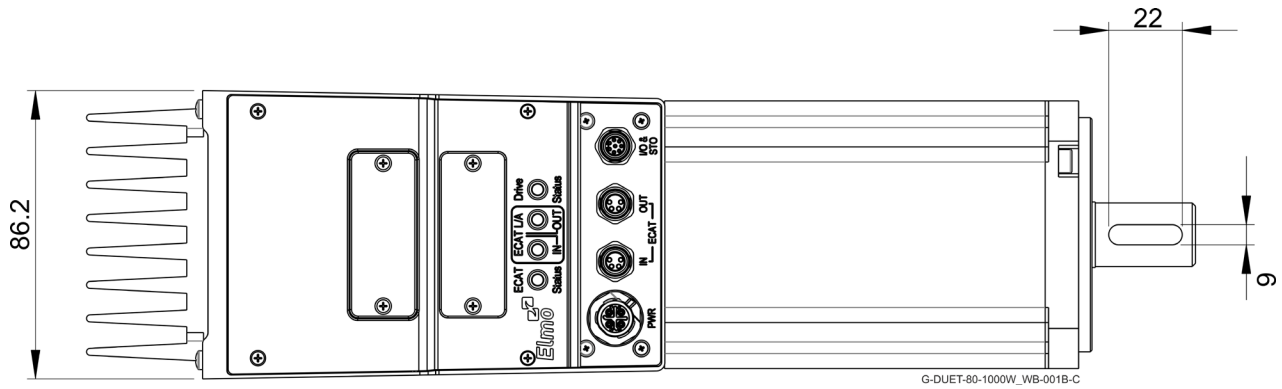


Figure 41: Top View Details

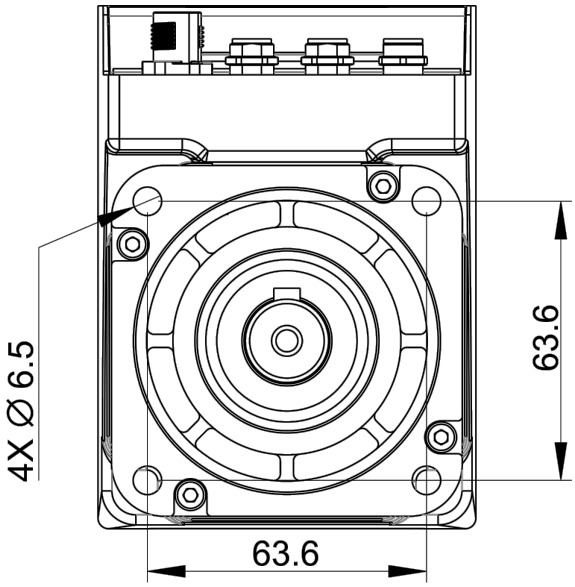


Figure 42: Front View Details and Rotor Shaft/Keyway Details

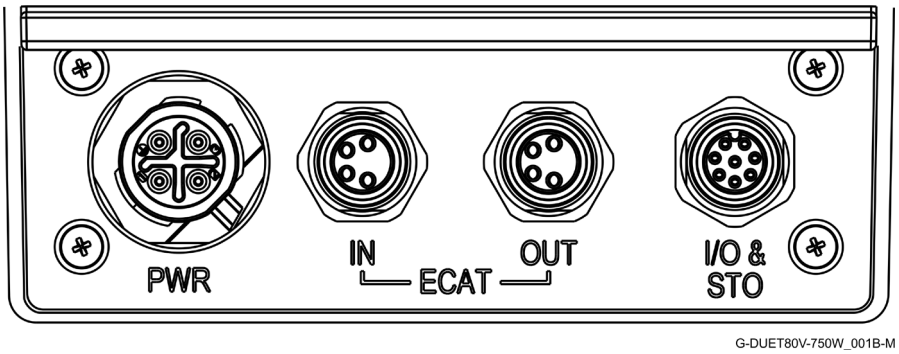


Figure 43: Interface Details

Chapter 11: Compliance with Standards

The Gold Duet 80 servo drive has been developed, produced, tested and documented in accordance with the relevant standards. Elmo Motion Control is not responsible for any deviation from the configuration and installation described in this documentation. Furthermore, Elmo is not responsible for the performance of new measurements or ensuring that regulatory requirements are met.

11.1 Functional Safety

Safe Torque Off (STO) Safety Standard	Item
The related standards below apply to the performance of the mounted servo drive within the Gold Duet 80 as stated in section 4.3 Environmental Conditions. The mounted servo drive is compliant with all the standards described.	
IEC 61800-5-2:2007 SIL 3	Adjustable speed electrical power drive systems – Safety requirements – Functional
EN ISO 13849-1:2008 PL e, Cat 3	Safety of machinery — Safety-related parts of control systems.
EN 61508-1:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-2:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems
EN 61508-3:2010 SIL 3	Functional safety of electrical/electronic/ programmable electronic safety-related systems

Certification

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z10 13 08 84596 001

Holder of Certificate: **Elmo Motion Control Ltd.**
60 Amal St. P.O. Box 3078
49516 Petach-Tikva
ISRAEL

Factory(ies): 84596

Certification Mark:

Product: **Safety Related Programmable Electronic System**

Model(s): **Drive System GOLD LINE**

Parameters:

Safety Function:	STO (EN 61800-5-2) PL e, CAT 3 (EN ISO 13849) SIL 3 (EN 61508)

Further approvals can be found in the report below.

The report below and the user documentation in the currently valid revision are mandatory part of this certificate. The product complies with the following listed safety requirements only if the specifications documented in the currently valid revision of this report are met.

Tested according to:
EN 61508-1:2010 (SIL 3)
EN 61508-2:2010 (SIL 3)
EN 61508-3:2010 (SIL 3)
EN 61800-5-2:2007
EN ISO 13849-1:2008 (Cat 3, PL e)

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: EP85169C

Date, 2013-08-12 (Peter Weiss)

584038

Page 1 of 1

A1 / 04.11

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

11.2 Safety

Specification	Details
The related standards below apply to the performance of the mounted servo drive within the Gold Duet 80 as stated in section 4.3 Environmental Conditions. The mounted servo drive is compliant with all the standards described.	
Conformity to **IEC/EN 61800-5-1**	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Conformity with **UL 61800-5-1**	Adjustable speed electrical power drive systems Safety requirements – Electrical, thermal and energy
Conformity to **CE 2006/95/EC**	Low-voltage directive 2006/95/EC
Conformity to **CSA C22.2 NO. 274-13**	Industrial Control Equipment Adjustable drive speeds

11.3 Environmental

Specification	Details
In compliance with **IEC60068-2-78**	Environmental testing – Damp heat, steady state
In compliance with **IEC60068-2-6**	Environmental testing –Vibration (sinusoidal)
In compliance with **IEC60068-2-2**	Environmental testing – Dry heat
In compliance with **IEC60068-2-27**	Basic environmental testing procedures - Shock

11.4 EMC

Specification	Details
In compliance with **IEC/EN 61800-3**	Adjustable speed electrical power drive systems
In compliance with **IEC 61326-3-1**	Electrical equipment for measurement, control and laboratory use. Standard required for STO.

11.5 EtherCAT Conformance

EtherCAT Conformance Test – certification

Certificate

EtherCAT Conformance Test

EtherCAT Technology Group

Elmo Motion Control Ltd.

64 Gisin St. Petach Tikva 49103 Israel

EtherCAT Technology Group hereby confirms the above named company that the following family devices are successfully **EtherCAT Conformance Tested**.

Device under Test 1

Product Name:	G-DCWHI
Product Code:	0x30924
Revision Number:	0x103F6

Device under Test 2

Product Name:	G-DCTRO
Product Code:	0x30924
Revision Number:	0x103F6

Device family is listed on one following page.

Assigned Vendor ID:	0x9A
Test Report Number:	0x9A_001
EtherCAT Test Center:	Beckhoff Automation GmbH, Nuremberg, Germany

The following tests were performed:

- EtherCAT Protocol Test (CTT Ver.1.20.52.0)
- Indicator Test
- Labeling Test
- Interoperability Test

Nuremberg, February 27, 2012

Martin Rostan, Executive Director
EtherCAT Technology Group

11.6 Dual Use

No export license is required for the Gold Line products signified with the suffix Q in the Part Number.

The operating frequency of the Gold Line products is “factory limited” to ≤ 599 Hz, and therefore complies with the EU Dual Use Regulation 428/2009, 3A225, and the US Dual Use regulation EAR ECCN# 3A225.

This statement applies to all identical specimens and will become invalid if a change is made in the firmware.

11.7 Other Compliant Standards

Quality Assurance	
ISO 9001:2008	Quality Management
Design	
• **IPC-D-275** • **IPC-SM-782** • **IPC-CM-770**	Printed wiring for electronic equipment (clearance, creepage, spacing, conductors sizing, etc.)
Reliability	
MIL-HDBK- 217F	Reliability prediction of electronic equipment (rating, de-rating, stress, etc.)
Workmanship	
In compliance with **IPC-A-610**, level 3	Acceptability of electronic assemblies
PCB	
In compliance with **IPC-A-600**, level 3	Acceptability of printed circuit boards
Packing	
In compliance with **EN 100015**	Protection of electrostatic sensitive devices
Environmental	
In compliance with **2002/96/EC**	Waste Electrical and Electronic Equipment regulations (WEEE) **Note:** Out-of-service Elmo drives should be sent to the nearest Elmo sales office.
In compliance with **2002/95/EC** (effective July 2006)	Restrictions on Application of Hazardous Substances in Electric and Electronic Equipment (RoHS)


Inspiring Motion
Since 1988
For a list of Elmo's branches, and your local area office, refer to the Elmo site www.elmomc.com
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