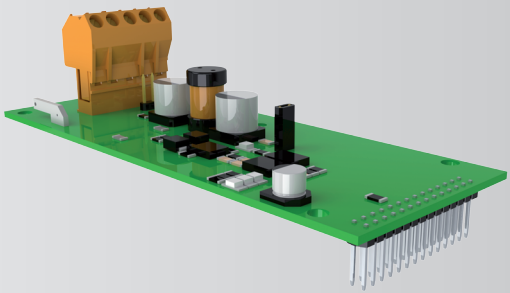
SD700
Series

ACCESSORIES



Communication Network

DeviceNet Communication

POWER ELECTRONICS®

SD700 Series

ACCESSORIES

Communication Network

DeviceNet Communication

Edition: March 2013

SD70BC04CI Rev. C

SAFETY SYMBOLS

Always follow safety instructions to prevent accidents and potential hazards from occurring.

	This symbol means improper operation may results in serious personal injury or death.
	Identifies shock hazards under certain conditions. Particular attention should be given because dangerous voltage may be present. Maintenance operation should be done by qualified personnel.
	Identifies potential hazards under certain conditions. Read the message and follow the instructions carefully.

Edition of March2013

This publication could present technical imprecision or misprints. The information here included will be periodically modified and updated, and all those modifications will be incorporated in later editions.
To consult the most updated information of this product you might access through our website www.power-electronics.com where the latest version of this manual can be downloaded.

Revisions

Date	Revision	Description
21 / 07 / 2010	A	First Edition
31 / 03 / 2011	B	Software Version Update SW 2026
07 / 03 / 2013	C	Corrección de errores

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SAFETY INSTRUCTIONS

IMPORTANT!

- Safety instructions showed in this manual are useful to teach user how to use the product in a correct and safety way with the purpose of preventing possible personal injuries or property damages.
- Safety messages included here are classified as it follows:

WARNING

Be sure to take ESD (Electrostatic Discharge) protection measures when you touch the board.
Otherwise, the optional board may get damaged due to static charges.

Implement wiring change on the optional board after checking that the power supply is off.
Otherwise, there is a danger of connecting error and damage to the board.

Be sure to connect correctly the optional board to the inverter.
Otherwise, there is a danger of connecting error and damage to the board.

Be sure to install a termination resistor (120Ω, 1/4W) at the end of the network.

Do not remove the cover while the power is applied or the unit is in operation.
Otherwise, electric shock could occur.

Do not run the inverter with the front cover removed.
Otherwise, you may get an electric shock due to the high voltage terminals or exposure of charged capacitors.

Do not remove the cover except for periodic inspections or wiring, even if the input power is not applied.
Otherwise, you may access the charged circuits and get an electric shock.

Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power and after checking the DC Link voltage is discharged with a meter (below 30VDC).
Otherwise, you may get an electric shock.

Operate the switches with dry hands.
Otherwise, you may get an electric shock.

Do not use cables with damaged insulation.
Otherwise, you may get an electric shock.

Do not subject the cables to the abrasions, excessive stress, heavy loads or pinching.
Otherwise, you may get an electric shock.

CAUTION

Install the inverter on a non-flammable surface. Do not place flammable material nearby.
Otherwise, fire could occur.

Disconnect the input power if the inverter gets damaged.
Otherwise, it could result in a secondary accident or fire.

After the input power is applied or removed, the inverter will remain hot for a couple of minutes.
Touching hot parts may result in skin burns.

Do not apply power to a damaged inverter or to an inverter with parts missing even if the installation is complete.
Otherwise, fire or accident could occur.

Do not allow lint, paper, wood chips, dust, metallic chips or other foreign matter into the drive.
Otherwise, fire or accident could occur.

WARNINGS

RECEPTION

- Material of Power Electronics is carefully tested and perfectly packed before leaving the factory.
- In the even of transport damage, please ensure that you notify the transport agency and POWER ELECTRONICS: 902 40 20 70 (International +34 96 136 65 57) or your nearest agent, within 24hrs from receipt of the goods.

UNPACKING

- Make sure received merchandise corresponds with delivery note, models and serial numbers.
- Each optional board is supplied with a technical manual.

RECYCLING (COPIADO DE ETHERNET PARA SD700)

- The packing of the drives must be recycled. For this reason it is necessary to separate different materials (plastics, paper, cardboard, wood …) and settle them in corresponding containers.
- The residual parts of electrical devices must be collected in a selective manner in order to warranty the correct environmental treatment.

CONNECTION PRECAUTIONS

- To ensure correct operation of the inverter it is recommended to use a SCREENED CABLE for the control wiring.
- For EMERGENCY STOP, make sure supply circuitry is open.
- Do not disconnect motor cables if input power supply remains connected. The internal circuits of the SD700 Series will be damaged if the incoming power is connected and applied to output terminals (U, V, W).
- It is not recommended to use a 3-wire cable for long distances. Due to increased leakage capacitance between conductors, over-current protective feature may operate malfunction.

- Do not use power factor correction capacitors, surge suppressors, or RFI filters on the output side of the inverter. Doing so may damage these components.
- Always check whether the DC Link LED is OFF before wiring terminals. The charge capacitors may hold high-voltage even after the input power is disconnected. Use caution to prevent the possibility of personal injury.

TRIAL RUN

- Verify all parameters before operating the inverter. Alteration of parameters may be required depending on application and load.
- Always apply voltage and current signals to each terminal that are within levels indicated within this manual. Otherwise, damage to the optional board may result.

EARTH CONNECTION

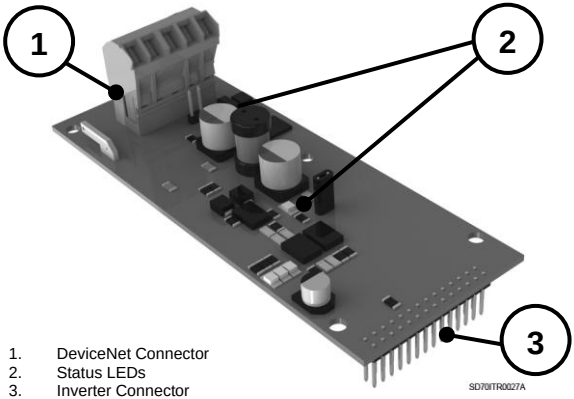
- The inverter is a high frequency switching device, and leakage current may flow. Ground the inverter to avoid electrical shock. Use caution to prevent the possibility of personal injury.
- Connect only to the dedicated ground terminal of the inverter. Do not use the case or the chassis screw for grounding.
- When installing, grounding wire should be connected first and removed last.
- The earth cable must have a minimal cross sectional area that meets local country electrical regulations.
- Motor ground must be connected to the drive ground terminal and not to the installation's ground. We recommend that the section of the ground connection cable should be equal or higher than the active conductor.
- Installation ground must be connected to the inverter ground terminal.

1. INTRODUCTION

1.1. Description of the DeviceNet Optional Board

The optional board for DeviceNet communication allows SD700 drive to connect it to a DeviceNet network. Thanks to this optional board:

- Inverter can be controlled and monitored by PLC sequence program or any master module.
- Multiple inverters can be connected to one communication cable with simple and easy installation, saving wiring, maintenance cost and time.
- Compatible with PC System, PLC and any controllers is available, making Factory Automation easier.



1. DeviceNet Connector
2. Status LEDs
3. Inverter Connector

2. TECHNICAL CHARACTERISTICS

2.1. General Information

2.1.1. Contents of DeviceNet Optional Board Kit

The DeviceNet optional board kit consists of:

- DeviceNet optional board
- 3-pin female plug (E0634) for J3 socket
- 2-pin female plug (E0635) for J2 socket
- 4 mounting poles M3x12 (M0191)
- 4 screws M3 (M0127)
- Technical Manual
- EDS file

2.1.2. Specifications of DeviceNet Optional Board

- Device Type: AC Drives.
- Group 2 Only Server
- Pre-defined MASTER/SLAVE explicit messaging
- Pre-defined MASTER/SLAVE cyclic I/O messaging
- Fragmentation Protocol
- Offline Connection set
- Baud Rate Support: 125, 250, 500 (kbps)
- Input Voltage: 24 Vdc
- The UCMM messaging connection is NOT supported in the SD 700 drive's DeviceNet stack.

2.1.3. Local Indications

The DeviceNet board includes 2 LEDs (LED1 and LED2) that provides information about the power supply of the board and communications bus. To obtain more detailed information about LEDs, please, see section 'Description of Connectors and LEDs.

3. INSTALLATION AND CONNECTION

3.1. Installation of DeviceNet Optional Board

The DeviceNet optional board is connected to the SD700 Series inverters of Power Electronics directly (through a connector) to integrate the equipment into a DeviceNet communications network. Therefore, it is necessary to use one DeviceNet optional board for each equipment to connect it to the network.

CAUTION

Motor controllers of Power Electronics operate with a high electric energy.
Make sure the power supply has been disconnected and wait for at least 10 minutes to guarantee that DC Link voltage is discharged, before installing the DeviceNet optional board. Otherwise, you may get personal injuries or an accident could occur.

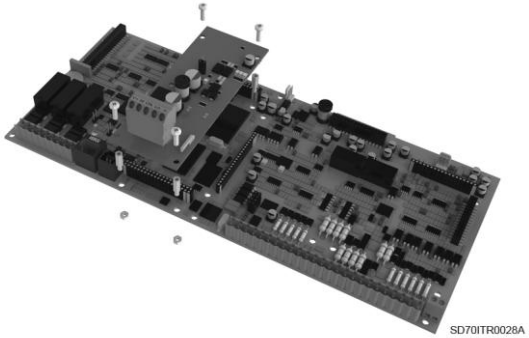


Figure 3.1 Installation of DeviceNet optional board to the inverter

3.2. Connections of DeviceNet Optional Board

3.2.1. Description of Connectors and LEDs

There are three connectors, two jumpers and two LEDs on the DeviceNet optional board. First connector is used to connect the board to the SD700 inverter; the second one is the DeviceNet proper connector with its specific signals, the last one gives the possibility of earth connection. The two jumpers can enable: termination resistance and power on the device. On the other hand, LEDs provides information about the device and bus power supply.

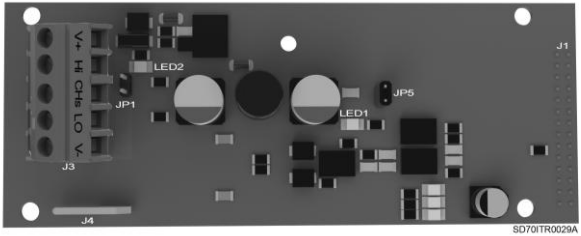


Figure 3.2 Location of connectors on the DeviceNet board

<table>
<tr><th>CONNECTOR / LED</th><th>DESCRIPTION</th></tr>
<tr><td>DeviceNet Connector (J3)</td><td>Connector for the connections of the specific signals of DeviceNet network.

<table>
<tr><th>Pin</th><th>Signal</th><th>Function</th></tr>
<tr><td>1</td><td>V-</td><td>Common</td></tr>
<tr><td>2</td><td>LO</td><td>Low Signal (-)</td></tr>
<tr><td>3</td><td>CHs</td><td>Shield (Chassis)</td></tr>
<tr><td>4</td><td>Hi</td><td>High Signal (+)</td></tr>
<tr><td>5</td><td>V+</td><td>Power Supply (24Vdc)</td></tr>
</table>

Figure 3.3 Detail of DeviceNet connector</td></tr>
<tr><td>Inverter Connector (J1)</td><td>Through this connector, DeviceNet board is connected to the inverter.</td></tr>
<tr><td>Faston Connector to Ground (J4)</td><td>Recommended to be connected when dealing with noise problems.</td></tr>
<tr><td>Termination Resistor Jumper (JP1)</td><td>To be set when DeviceNet board is situated on the wire physical end.</td></tr>
<tr><td>Power Supply Jumper (JP5)</td><td>Connects 5V_CAN with 5V_DEVICE</td></tr>
<tr><td>5V_CAN Power Supply LED (LED1)</td><td>Active when 5V_CAN = 5V_DEVICE (when jumper JP5 is set) and there is voltage present.</td></tr>
<tr><td>Connector Power Supply LED (LED2)</td><td>DeviceNet connector is powered on (there is a voltage between V+ and V- terminals)</td></tr>
</table>

4. CONFIGURATION OF DEVICENET OPTIONAL BOARD

Once the board has been connected to the inverter, this one can be configured by using the software.
Board configuration can be divided in two parts. First, installation of the EDS file by using configuration software of DeviceNet network; then, drive parameters setting related to DeviceNet.

4.1. EDS File

One EDS file is supplied with the DeviceNet Optional Board kit.
The EDS files are specially formatted ASCII files. They are text files that must be interpreted by the configuration software. These files supply all the information necessary for a configuration tool (software), to access and modify the parameters of a device.

The EDS file contains information about the numbers of parameters in a device and how those parameters are grouped together. Information about each parameter is contained in this file such as minimum, maximum and default parameter values, parameter data format and scaling, and the parameter name and units.
Install the EDS file for the SD700 inverter supplied with the kit, to control the inverter parameters. For this, use DeviceNet configuration software.

4.2. DeviceNet Parameters Setting

There are some parameter groups used to configure the operation in a communication network:

[G4 Inputs ➔ G4.1 Digital Inputs]
[G20 Communication Buses ➔ G20.0 Communications Control,
➔G20.4 DeviceNet].

The SD700 drive's DeviceNet stack configuration involves the following steps.

- Baud rate selection
- MAC ID selection
- DeviceNet control selection

4.2.1. Subgroup 4.1 – G4.1: Digital Inputs

Drive control modes need to be defined in order to cede the control to the communication network.

<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>1 CNTROL MODE1=1</td><td>G4.1.1 / Main Control Mode</td><td>0-3</td><td>It allows user to set the control mode for the drive commands (Start/Stop, Reset, ...).
<table>
<tr><th>OPT.</th><th>DESCRIPTION</th><th>FUNCTION</th></tr>
<tr><td>0</td><td>NONE</td><td>Ctrl mode 1 is not operative</td></tr>
<tr><td>1</td><td>LOCAL</td><td>Drive is controlled by keypad.</td></tr>
<tr><td>2</td><td>REMOTE</td><td>Drive controlled through control terminals.</td></tr>
<tr><td>3</td><td>SERIAL COMMS</td><td>Drive controlled through communication bus.</td></tr>
</table></td><td>NO</td></tr>
</table>

<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>2 CNTROL MODE2=2</td><td>G4.1.2 / Alternative Control Mode</td><td>0-3</td><td>It allows user to set the control mode for the drive commands (Start/Stop, Reset, ...).

<table>
<tr><th>OPT.</th><th>DESCRIPTION</th><th>FUNCTION</th></tr>
<tr><td>0</td><td>NONE</td><td>Ctrl mode 2 is not operative</td></tr>
<tr><td>1</td><td>LOCAL</td><td>Drive controlled by keypad.</td></tr>
<tr><td>2</td><td>REMOTE</td><td>Drive controlled through control terminals.</td></tr>
<tr><td>3</td><td>SERIAL COMMS</td><td>Drive controlled through communication bus.</td></tr>
</table>
Note: Control mode 2 will be activated through digital inputs exclusively. To use this set one of the digital inputs to '17 ➔ CONTROL 2'. When this input is activated, auxiliary control mode will be activated</td><td>NO</td></tr>
</table>

4.2.2. Subgroup 20.0 – G20.0: Communications Control

This subgroup specifies the communication module to be used. Once previous parameters are set, the subgroup [20.0] will specify the particular communication bus to use.

<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>1 COM. CONTROL=0</td><td>G 20.0.1 / Communication Module</td><td>0-5</td><td>Set the value according to communications network controlling the drive
<table>
<tr><th>OPC.</th><th>FUNCIÓN</th></tr>
<tr><td>0</td><td>Modbus</td></tr>
<tr><td>1</td><td>Profibus</td></tr>
<tr><td>2</td><td>Modbus TCP</td></tr>
<tr><td>3</td><td>Ethernet IP</td></tr>
<tr><td>4</td><td>Can Open</td></tr>
<tr><td>5</td><td>Devicenet</td></tr>
</table>
Note: This parameter is only functional after the boot up.</td><td>NO</td></tr>
</table>

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4.2.3. Subgroup 20.4 – G20.4: Devicenet

Once the DeviceNet board become connected to the drive, a new parameter subgroup [20.4 DEVICENET] is available. The drive is configured to operate in a DeviceNet network by means of this parameters setting

<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>1DN MAC ID= 0</td><td>G20.4.1 / Devicenet MAC ID</td><td>0-63</td><td>DeviceNet MAC ID setting. Each device must be assigned a unique MAC ID within the network.
MAC ID can be changed at any time, but it will come into effect after power-cycling the drive. The default value is 0x00.</td><td>SI</td></tr>
<tr><td>2DNBaud=500</td><td>G20.4.2 / DeviceNet Baud Rate</td><td>125 Kbps
250 Kbps
500 Kbps</td><td>Choose the DeviceNet Baud Rate (set by Master device)
<table><tr><th>OPTIONS</th><th>DESCRIPTION</th></tr><tr><td>0</td><td>125 Kbps</td></tr><tr><td>1</td><td>250 Kbps</td></tr><tr><td>2</td><td>500 Kbps</td></tr></table>DeviceNet Baud Rate can be changed at any time, but it will come into effect after power-cycling the drive.</td><td>SI</td></tr>
<tr><td>3 CONTROL MODE=0</td><td>G20.4.3 / Control Mode</td><td>0-2</td><td>Adjust this parameter according to your application´s needs.
<table><tr><th>OPT.</th><th>FUNCT.</th><th>DESCRIPTION.</th></tr><tr><td>0</td><td>Local</td><td>The drive control is given in [G4.1.1] or [G4.1.2] parameter</td></tr><tr><td>1</td><td>Network</td><td>If the Control Mode 1 parameter [G4.1.1] is active and set to 3 (Comm.), then the drive is operated through DeviceNet. Identically, when Control Mode 2 is active, the value contained in [G4.1.2] parameter determines the way it is finally controlled.</td></tr><tr><td>2</td><td>Net Decides</td><td>The PLC will decide how the drive is controlled. If it is controlled over network, option 1 will be enabled. However, if the net resigns control, it will be controlled locally.</td></tr></table></td><td>NO</td></tr>
</table>

<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>4 REFEREN. MODE=0</td><td>G20.4.4 / Reference Mode</td><td>0</td><td>Adjust this parameter according to your application´s needs.
<table><tr><th>OPT.</th><th>FUNCT.</th><th>DESCRIPTION.</th></tr><tr><td>0</td><td>Local</td><td>Speed Reference the drive refers to accords to parameters G3.1 and G3.2</td></tr><tr><td>1</td><td>Network</td><td>If the Reference Source 1 of Speed (G3.1) is active, then the speed reference is given to the drive from the network. Analogically, when Reference Source 2 of Speed (G3.2) is active, it determines the source</td></tr><tr><td>2</td><td>Net Decides</td><td>The PLC will decide how the drive is controlled. If it is controlled over network, option 1 will be enabled. However, if the net resigns control, it will be controlled locally</td></tr></table></td><td>NO</td></tr>
<tr><td>5 ASM IN =70</td><td>G20.4.5 / Input Assembly</td><td>70
71
100
150</td><td>It is used to select, which input instance of the assembly object is to be used for the default data production of IO connection.
<table><tr><th>OPT</th><th>FUNCTION</th></tr><tr><td>70</td><td>Basic Speed Status</td></tr><tr><td>71</td><td>Extended Speed Status</td></tr><tr><td>100</td><td>Power Electronics Basic Status</td></tr><tr><td>150</td><td>Power electronics Extended Status</td></tr></table></td><td>NO</td></tr>
<tr><td>6 ASM OUT =20</td><td>G20.4.6 / Output Assembly</td><td>20
21
100</td><td>It is used to select, which output instance of the assembly object is to be used for the default data consumption of the IO connection.
<table><tr><th>OPT.</th><th>FUNCTION</th></tr><tr><td>20</td><td>Basic Speed Control</td></tr><tr><td>21</td><td>Extended Speed Control</td></tr><tr><td>101</td><td>Power Electronics Basic Control</td></tr></table></td><td>NO</td></tr>
</table>

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<table>
<tr><th>Display</th><th>Name / Description</th><th>Range</th><th>Function</th><th>Set on RUN</th></tr>
<tr><td>7DNSt=Notused</td><td>G20.4.7 /
DeviceNet State</td><td>0-4
(Read Only)</td><td>It is a read-only parameter, which value indicates the current state of DeviceNet communications.
<table><tr><th>OPT.</th><th>DESCRIPTION</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>1</td><td>Does not exist</td></tr><tr><td>2</td><td>MAC ID Duplicated</td></tr><tr><td>3</td><td>Online</td></tr><tr><td>4</td><td>Communications Fault</td></tr></table>On a switch on, the drive automatically enters into the MAC_ID_Duplicated check state. After the successful response to the duplicated MAC ID request messages (2 messages), the drive will enter into the Online state. There, the drive is ready to communicate within DeviceNet network by mean of explicit and I/O messages.

If the drive receives any duplicate MAC ID response message, while in Online state, it will switch over to Communications_Fault state. The drive will recover from this communication-faulted state by means of the offline connection set mechanism.

The SD700 DeviceNet stack can communicate with the other DeviceNet node which is present in the DeviceNet network through explicit or cyclic I/O messages.</td><td>-</td></tr>
</table>

5. OPERATION MODES

5.1. Group 2 Only Server

As the SD700 drive's DeviceNet stack does not supports the UCMM connection set, the communication can be carried out only by pre-defined Master/Slave connection set. To establish communications with a SD700 drive's DeviceNet stack, a client (PLC) must allocate the predefined explicit messaging connection and/or the I/O connection by means of a pre-defined Master/Slave connection set. The request to allocate a Group 2 Only device is transmitted as a Group 2 only unconnected explicit request message id.

5.2. Explicit Messaging

The explicit messaging is the basic request-response mechanism. The SD700 DeviceNet stack receives and process the explicit request messages from the PLC, and send the explicit response message to the PLC. The explicit messages are used to perform the CIP common services like set attribute single, get attribute single etc… The SD700 DeviceNet stack's explicit messages supports 8/16 (class id/instance id) messaging format.
All the supported attributes can be read, and the attributes which supports set service can be written through an explicit message service.

5.3. I/O Messaging

The I/O messaging service is used to transmit or receives a group of data from the drive. Since there is no request or response in the I/O messaging service, the data access using I/O connection is faster than the explicit messaging connection. Once the I/O message is configured and established the transmission/reception of the I/O message will be start with the configured time period. The SD700

DeviceNet stack supports the 20, 21, 70, 71, 100, 101, 150 I/O instances from the assembly object.
The I/O messaging can be either confirmed or un-confirmed service. For the confirmed I/O messaging service, an acknowledgement will be transmitted by the receiver of the I/O messages. For the un-confirmed I/O messaging service, no acknowledgement will be sent back.

5.4. Static Input Messages

These static input messages are used to transfer the data from the SD700 drive to the PLC. The supported static input messages are listed in the following table.

Instance ID	Input Instance Name
70	Standard input assembly
71	Standard input assembly
100	PE 100 input assembly
150	PE 150 input assembly

5.5. Static Output Messages

These static output messages are used to transfer the data from the PLC to the SD700 drive. The supported static output messages are listed in the following table.

Instance ID	Output Instance Name
20	Standard output assembly
21	Standard output assembly
101	PE 101 output assembly

5.6. Fragmentation Protocol

When the number of bytes to be transmitted across a single CAN frame exceeds 8 – bytes, the fragmentation protocol is used. This fragmentation protocol contains the information like fragmentation type and the sequence count. The SD700 DeviceNet stack supports up to 50 bytes of fragmented data transfer (excluding fragmentation protocol byte).

5.7. Offline Connection Set

This offline connection set is used to retrieve the SD700 DeviceNet stack from the Communications_Fault state to the MAC_ID_Duplicated detection state.

6. CIP OBJECTS

Next, the different objects implemented by the drive are listed. In order to obtain detailed information about these objects and attribute, refer to the CIP specifications.

S. No	Name	Class ID
1.	Identity Object	0x01
2.	Message Router Object	0x02
3.	DeviceNet Object	0x03
4.	Assembly Object	0x04
5.	Connection Object	0x05
6.	Parameter Object	0x0F
7.	Parameter Group Object	0x10
8.	Motor Data Object	0x28
9.	Control Supervisor Object	0x29
10.	AC Drive Object	0x2A
11.	Acknowledge Handler Object	0x2B

The objects and the implemented attributes are listed below.

6.1. Identity Object

Instance number 1 is implemented for this standard object and the following attributes are supported.

Attribute	Description	Type	GET / SET	Value
1	Vendor ID	UINT	Get	1104: Power Electronics
2	Device Type	UINT	Get	2: AC Drive
3	Product Code	UINT	Get	700
4	Revision	STRUCT of:	Get	
	Revision (High Byte)	USINT		1
	Revision (Low Byte)	USINT		1
5	Status	WORD	Get	Drive Status
6	Serial Number	UDINT	Get	0x12345678
7	Product Name	SHORT_STRING	Get	PESD700Drive

6.2. Message Router Object

This object is implemented

6.3. DeviceNet Object

This object is specific to DeviceNet communication stack.
The following instances are supported by the drive.

Attribute	Description	Type	GET / SET	Value
1	MAC ID	USINT	Get	1 – Power Electronics
2	Baud Rate	USINT	Get	2 – 500 Kbps

Attribute	Description	Type	GET / SET	Value
5	Allocation Information:	STRUCT of:	Get	
	Allocation Choice	USINT		
	Allocator's MAC ID	USINT		
6	MAC ID Switch Changed (since last Reset or Power-up)	BOOL	Get	0 – MAC ID switch not changed 1 – MAC ID switch changed
7	Baud Rate Switch Changed (since last Reset or Power-up)	BOOL	Get	0 – Baud Rate switch not changed 1 – Baud Rate switch changed
8	MAC ID Switch Value	USINT	Get	Current MAC ID switch value
9	Baud Rate Switch Value	USINT	Get	Current Baud Rate switch value

6.4. Assembly Object

This is the only object that can support the I/O connection.
The following instances are supported by the drive.

Instance Number		Type	Size	Name
Decimal	Hex	Input / Output	(bytes)	
20	14	Output	4	Basic Speed Control
21	15	Output	4	Extended Speed Control
70	46	Input	4	Basic Speed Control Status
71	47	Input	4	Extended Speed Control Status
100	64	Input	8	PE SD700 Basic Status
101	65	Output	8	PE SD700 Basic Control
150	96	Input	40	PE SD700 Extended Status

The format of the attributes is given below:

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
20	0						Fault Reset		Run Fwd
	1								
	2	Speed Reference (Low Byte) [in RPM]							
	3	Speed Reference (High Byte) [in RPM]							
21	0		NetRef	NetCtrl			Fault Reset	Run Rev	Run Fwd
	1								
	2	Speed Reference (Low Byte) [in RPM]							
	3	Speed Reference (High Byte) [in RPM]							
70	0						Running 1 (Fwd)		Faulted
	1								
	2	Actual Speed (Low Byte) [in RPM]							
	3	Actual Speed (High Byte) [in RPM]							
71	0	At Ref.	Ref from Net	Ctrl from Net	Ready	Running 2 (Rev)	Running 1 (Fwd)	Warning	Faulted
	1	Drive State							
	2	Speed Reference (Low Byte) [in RPM]							
	3	Speed Reference (High Byte) [in RPM]							
100	0	Fault	Alarm	Ready	At Ref	Reset Active	Running 2 (Rev)		Running 1 (Fwd)
	1	Hi Bus Active	Drive Over Cur	Relay 3	Relay 2	Relay 1	Local/ Remote	Motor Overload	Drive Overload
	2	Actual Speed (Low Byte) [in RPM]							
	3	Actual Speed (High Byte) [in RPM]							
	4	Actual Torque (Low Byte) [in Nm]							
	5	Actual Torque (High Byte) [in Nm]							
	6	Output Current (Low Byte) [in 100mA]							
	7	Output Current (High Byte) [in 100mA]							

ENGLISH

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
101	0							Run Rev	Run Fwd
	1							Reset	Force Fault
	2	Speed Reference (Low Byte) – RPM							
	3	Speed Reference (High Byte) – RPM							
	4								
	5								
	6								
	7								
150	0	Fault	Alarm	Ready	At Ref	Reset Active	Running 2 (Rev)		Running 1 (Fwd)
	1	Hi Bus Active	Drive Over Cur	Relay 3	Relay 2	Relay 1	Local/ Remote	Motor Overload	Drive Overload
	2	Fault Code (Low Byte) – Vendor Specific							
	3	Fault Code (High Byte) – Vendor Specific							
	4	Actual Speed (Low Byte)[in RPM]							
	5	Actual Speed (High Byte) [in RPM]							
	6	Output Voltage (Low Byte)[in V]							
	7	Output Voltage (High Byte) [in V]							
	8	Output Power (Low Byte) [in 0.1 kW]							
	9	Output Power (High Byte) [in 0.1 kW]							
	10	Run time in days (Low Byte)							
	11	Run time in days (High Byte)							
	12	Run time in hours (Low Byte)							
	13	Reserved							
	14	Output Current (Low Byte)[in 100mA]							
	15	Output Current (High Byte) [in 100mA]							
	16	Output Torque (Low Byte) [in Nm]							
	17	Output Torque (High Byte) [in Nm]							
	18	DC Bus Voltage (Low Byte) [in V]							

Instance	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
150	19	DC Bus Voltage (High Byte) [in V]							
	20	Cos Phi (Low Byte)							
	21	Cos Phi (High Byte)							
	22	Motor Temperature (Low Byte) [in %]							
	23	Motor Temperature (High Byte) [in %]							
	24	L1 Input Voltage (Low Byte)[in V]							
	25	L1 Input Voltage (High Byte) [in V]							
	26	L2 Input Voltage (Low Byte) [in V]							
	27	L2 Input Voltage (High Byte) [in V]							
	28	L3 Input Voltage (Low Byte) [in V]							
	29	L3 Input Voltage (High Byte) [in V]							
	30	L1 Input Frequency (Low Byte) [in Hz]							
	31	L1 Input Frequency (High Byte) [in Hz]							
	32	L2 Input Frequency (Low Byte) [in Hz]							
	33	L2 Input Frequency (High Byte) [in Hz]							
	34	L3 Input Frequency (Low Byte) [in Hz]							
	35	L3 Input Frequency (High Byte) [in Hz]							
	36	IGBT Temperature (Low Byte) [in °C]							
	37	IGBT Temperature (High Byte) [in °C]							
	38	Internal Temperature (Low Byte) [in 0.01 °C]							
	39	Internal Temperature (High Byte) [in 0.01 °C]							

6.5. Connection Object

This object is implemented and is responsible for establishing Explicit and I/O connections with the drive.

6.6. Parameter Object

The object model has all the non-debug MODBUS register mapped as parameter instances. All the instances are either of type UINT or INT and of type GET/SET depending up on the MODBUS registers parameters.

The following attributes are supported for every instance.

Attribute Number	Access	Data Type	Description
1	Set (only if it is a Read / Write parameter)	Depends on Attributes 4, 5, 6	Actual value of the parameter
2	Get	USINT	Link Path Size
3	Get	Packed EPATH	Link Path
4	Get	WORD	Descriptor
5	Get	EPATH	Data Type
6	Get	USINT	Data Size

Note: See section 'Parameter Object Instances' for further information about the supported instances.

6.7. Parameter Group Object

All the parameter instances are grouped as parameter groups. Only Attribute 1 (Group Name String) and Attribute 2 (Number of Members in group) are supported apart from the Parameter Instance numbers starting from Attribute ID 16.

Instance No.	Parameter Group	Number of Parameter Objects
1	Motor Control Registers	20
2	DC Brake Registers	6
3	Digital Input Registers	10
4	Multi Reference Set point Registers	34
5	Inch Speed Registers	3
6	Limit Registers	9
7	Speed Reference Registers	3
8	Skip Speed Registers	3
9	PID Control Registers	8
10	Motor/Drive Status Registers	84
11	Analogue Input Registers	34
12	Nameplate Registers	10
13	Comparator Registers	27
14	Active Algorithm Registers	10
15	Analogue Output Registers	10
16	Digital Output Registers	12
17	Ethernet TCP IP Registers	18
18	Acc/Dec Rates Registers	12
19	Communication Registers	6
20	Fault Registers	7
21	Protection Registers	12
22	Encoder Registers	2
23	Motor Parameters Registers	11
24	Load Parameters Registers	9
25	Control Type Registers	4
26	Options Registers	14
27	Miscellaneous Registers	9
28	Auto Reset Registers	8
29	MFI Pulse Registers	8
30	Tuning Registers	7
31	Profibus CAN Interface Registers	3
32	Ethernet Control and Status Registers	18
33	MODBUS TCP/IP Registers	1
34	CIP Registers	3

For example, the MODBUS register of parameter [G.9.1.1 ➔ Source selection for Comparator 1] in address 40302 is mapped to Parameter Instance 225, and it is the first placed in the Parameter Group 'Comparator Registers' numbered 13.

In the same way, the MODBUS register of parameter [G4.1.5 ➔ Multi-function Digital Input 1 configuration] is placed fifth in the Parameter Group numbered 3 and called 'Input Digital Registers'.

6.8. Motor Data Object

Instance number 1 is implemented for this standard object and the following attributes are supported.

Attribute	Description	Type	GET / SET	Value
3	Motor Type	USINT	Get	0: Non Standard
6	Rated Current	UINT	Set	Rated Stator Current Units: 100mA
7	Rated Voltage	UINT	Set	Rated Base Voltage Units: V

6.9. Control Supervisor Object

Instance number 1 is implemented for this standard object and the following attributes are supported.

Attribute	Description	Type	GET / SET	Value
3	Run1	BOOL	Set	RUN_FWD Command
4	Run2	BOOL	Set	RUN_REV Command
5	Net Control	BOOL	Set	RUN/STOP Control 0: Local Control 1: Network Control

Attribute	Description	Type	GET / SET	Value
6	Status	USINT	Get	Drive Status. 0: Vendor Specific 1: Start-up 2: Not Ready 3: Ready 4: Enabled 5: Stopping 6: Fault Stop 7: Faulted
7	Running1	BOOL	Get	Drive Running RUN_FWD
8	Running2	BOOL	Get	Drive Running RUN_REV
9	Ready	BOOL	Get	1: Ready or Enabled or Stopping 0: Other Status
10	Faulted	BOOL	Get	1: Fault (latched) 0: No Faults Present
11	Warning	BOOL	Get	1: Warning (not latched) 0: No Warnings Present
12	Fault Reset	BOOL	Set	0 → 1: Fault Reset 0: No action
13	Fault Code	UINT	Get	Currently Active Fault Code. See section '5.2 PE – CIP Fault Code Mapping.
14	Warn Code	UINT	Get	Currently Active Warning Code. See section '5.3 PE – CIP Warning Code Mapping.
15	Ctrl From Net	BOOL	Get	Status of RUN/STOP Control Source. 0: Control is Local 1: Control is from Network
17	Force Fault	BOOL	Set	0 → 1: Fault F41 forced
18	Force Status	BOOL	Get	Status of the forced fault. 0: Not Forced 1: Forced

6.10. AC Drive Object

Instance number 1 is implemented for this standard object and the following attributes are supported.

Attribute	Description	Type	GET / SET	Value
3	At Reference	BOOL	Get	1: Drive at actual reference
4	Net Ref	BOOL	Set	Configuration of torque or speed reference mode setting (local or from Network). 0: Reference setting not from Network 1: Reference setting from Network
6	Drive Mode	USINT	Get	0: Vendor specific mode
7	Speed Actual	UINT	Get	Actual drive speed
8	Speed Ref	UINT	Set	Speed Reference (RPM)
9	Current Actual	INT	Get	Actual phase current in 100mA
10	Current Limit	INT	Set	Current limit in 100mA
11	Torque Actual	INT	Get	Actual torque in Nm
15	Power Actual	INT	Get	Actual output power in W (scaling used – see Attribute 26)
16	Input Voltage	INT	Get	Input voltage in V
17	Output Voltage	INT	Get	Output voltage in V
18	Acceleration Time	UINT	Set	Time for 0 to max. speed in ms
19	Deceleration Time	UINT	Set	Time from max. speed to 0 in ms
20	Low Speed Limit	UINT	Get	Minimum speed in RPM
21	High Speed Limit	UINT	Get	Maximum speed in RPM

Attribute	Description	Type	GET / SET	Value
26	Power Scale	SINT	Get	Fixed to -6. Power = PowerActual/$2^{(-6)}$ = PowerActual · 64
29	Ref From Net	BOOL	Get	Status of torque / speed reference. 0: Local torque / speed reference 1: Network torque / speed reference

6.11. Acknowledge Handler Object

This object is implemented and is responsible for the acknowledgement time out of the IO connections with the drive.

7. ACCESSING TO CIP OBJECTS

7.1. Object Access using Explicit Message Service

Using explicit message service, the read only objects can be read and the Read/Write Objects can be either read or write.

7.1.1. Object Read Using Explicit Messaging

A standard frame with the ID = (0x404 | (DNET_MAC_ID << 3)), can be used to read any of the supported object. The frame format is as follows.

Explicit Message Read Request

ID	CAN MSG DATA							
	Byte-0	**Byte-1**	**Byte-2**	**Byte-3**	**Byte-4**	**Byte-5**	**Byte-6**	**Byte-7**
Explicit Request Message id	Source MAC ID	Response Service Code [0E]	Class id	Instance id (LSB)	Instance id (MSB)	Attribute id		

Explicit request Message id = **(0x403 | (DNET_MAC_ID << 3))**

The response to the explicit request is as follows:

Explicit Message Read Response

ID	CAN MSG DATA							
	Byte-0	**Byte-1**	**Byte-2**	**Byte-3**	**Byte-4**	**Byte-5**	**Byte-6**	**Byte-7**
Slave's Explicit Response Message id	Master MAC ID	Response Service Code [8E]	Data (LSB)	Data (MSB)				

Slave's explicit response message id = (**0x403 | (DNET_MAC_ID << 3))**

Example:

To read drive's speed register with class id = 0x2A Instance id = 0x01 and attribute id = 0x07, following frame can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x414	0x01	0x0E	0x2A	0x01	0x00	0x07		

The response might be (Assume the drive's current speed is 0x1234),

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x413	0x01	0x8E	0x34	0x12				

7.1.2. Write Using Explicit Message

A standard frame with the ID = (0x404 | (DNET_MAC_ID << 3)), can be used to write any of the supported object. The frame format is as follows.

Explicit Message Write Request

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Explicit Request Message id	Source MAC ID	Response Service Code [10]	Class id	Instance id (LSB)	Instance id (MSB)	Attribute id	Service Data (LSB)	Service Data (MSB)

Explicit request Message id = **(0x403 | (DNET_MAC_ID << 3))**

Explicit Message Write Response

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Slave's Explicit Response Message id	Master MAC ID	Response Service Code [90]	Data (LSB - Optional)	Data (MSB - Optional)				

Slave's explicit response message id = (**0x403 | (DNET_MAC_ID << 3)**)

Example 1:

To write drive's reference speed register at class id = 0x2A Instance id = 0x01 and attribute id = 0x08 with the value 0x1234, following frame can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x414	0x01	0x10	0x2A	0x01	0x00	0x08	0x34	0x12

The response might be,

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x413	0x01	0x90						

Example 2:

To write the pre-defined explicit message connection's ERP rate with class id = 0x05 Instance id = 0x01 and attribute id = 0x09 with the value 0x02E4, following frame can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x414	0x01	0x10	0x05	0x01	0x00	0x09	0xE4	0x02

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x413	0x01	0x90	0xE8	0x02				

7.1.3. Explicit Message Fragmentation Protocol

For the explicit messaging the fragmentation protocol is placed in the second byte, and for the fragmented I/O message the fragmentation protocol is placed in the first byte of the CAN frame.

Fragmented Explicit Message Request

First Fragment:

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Explicit Request Message id	Source MAC ID + 0x80	Fragmentation Protocol	Service Code	Class id	Instance id (LSB)	Instance id (MSB)	Attribute id	Service Data (LSB)

Final Fragment:

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Explicit Request Message id	Source MAC ID + 0x80	Fragmentation Protocol	….	…	…	…	….	Service Data (MSB)

Explicit request Message id = **(0x403 | (DNET_MAC_ID << 3))**

The response to the explicit request is as follows:

Explicit Message Write Response

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Slave's Explicit Response Message id	Master MAC ID	Response Service Code + 0x80	Data (LSB - Optional)	..	..	Data (MSB - Optional)		

Slave's explicit response message id = (**0x403 | (DNET_MAC_ID << 3))**

Example:

To write the pre-defined IO message connection's Produced connection path with class id = 0x05 Instance id = 0x04 and attribute id = 0x0E with the values (20 04 24 46 30 03), following frames can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x414	81 00 10 05 04 00 0E 20	81 C0 00	First Fragment
0x414	81 81 04 24 46 30 03	81 C1 00	Second Fragment
		01 90 (with id = 0x413)	Explicit Response Received

7.2. Object Access using Pre-Defined IO Connection

Outside of a fragmentation protocol that can be used to transmit an I/O message greater than eight (8) bytes in length, DeviceNet does not define any protocol related information within the data field of an I/O Message. The following steps are involved in the configuration and establishment of the I/O connection.

- Allocate the cyclic I/O connection after or along with the explicit connection.
- Now the I/O connection will be in configuring state.
- Change the produced connection path and the consumed connection path if needed.
- Sets the EPR rate of the I/O connection and this will trigger the state transition.
- Now the I/O connection state will be established state and production/consumption commences.

The following sequences have been performed to allocate the I/O connection and change its state to established state. The Drive's MAC ID is 0x02 and the Master's MAC ID is 0x01.

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x416	01 4B 03 01 01 01	01 CB 01	Allocate Explicit
0x416	01 4B 03 01 20 01	01 CB 01	Allocate I/O Connection
0x414	01 0E 05 04 00 01	01 8E 01	The current state of the I/O connection (Configuring)
0x414	01 10 05 04 00 09 E4 02	01 90 E8 02	Configure the EPR of the I/O connection
		00 00 02 00 (with id = 0x342)	Transmitting I/O data
0x412	(Acknowledge message of "0" Byte)	00 00 02 00 (with id = 0x342)	Transmitting I/O data
0x412	(Acknowledge message of "0" Byte)	00 00 02 00 (with id = 0x342)	Transmitting I/O data

By default the instance 70, attribute 0x03 of the Assembly Object (class id 0x04) is mapped with production path of the I/O connection and the instance 20, attribute 0x03 of the Assembly Object (class id 0x04) is mapped with consumption path of the I/O connection. The default EPATHs are listed in the following table.

Default EPATHs for Cyclic I/O connection

Path Name	EPATH
Default Production Path	20 04 24 46 30 03
Default Consumption Path	20 04 24 14 30 03

This mapping can be changed by the following fragmented explicit message service, when the I/O connection is in "configuring" state.

7.2.1. Set produced connection path attribute

To modify the pre-defined I/O message connection's Produced connection path which is having class id = 0x05 Instance id = 0x04 and attribute id = 0x0E with the EPATH values (20 04 24 46 30 03 – Class = 0x04, Instance = 0x46, Attribute = 0x03), following frames can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x414	81 00 10 05 04 00 0E 20	81 C0 00 (Ack)	First Fragment
0x414	81 81 04 24 46 30 03	81 C1 00 (Ack)	Second Fragment
		01 90 (with the id = 0x413)	Success response for the set attribute single service

7.2.2. Set consumed connection path attribute

To modify the pre-defined I/O message connection's consumed connection path at Connection object - class id = 0x05 Instance id = 0x02 and attribute id = 0x10 with the EPATH values (20 04 24 15 30 03 – Class = 0x04, Instance = 0x15, Attribute = 0x03), following frames can be used. MAC ID of the drive is assumed to be 2 and the MAC ID of the MASTER is assumed to be 1.

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x414	81 00 10 05 02 00 10 20	81 C0 00 (Ack)	First Fragment
0x414	81 81 04 24 15 30 03	81 C1 00 (Ack)	Second Fragment
		01 90 (with the id = 0x413)	Success response for the set attribute single service

8. COMMISSIONING OF THE SD700 IN A DEVICENET NETWORK

To establish communications with the SD700 DeviceNet stack, a client (PLC) must allocate the predefined Master/Slave the explicit messaging connection and/or the I/O connection. The request to allocate the pre-defined Master/Slave connection set is transmitted as a Group 2 only unconnected explicit request message id.

The allocate master/slave connection set service is used to establish the Pre-defined master/slave explicit connection or cyclic I/O connection or both. The release master/slave connection set service is used to release the Pre-defined master/slave explicit connection and/or cyclic I/O connection.

This section explains the allocate Master/Slave connection set, release Master/Slave connection set, object access using the established explicit messaging connection and cyclic I/O connection, and some examples are also given.

8.1. Allocate Master/Slave Connection Set

This service is used to establish the Pre-defined master/slave explicit connection or cyclic I/O connection or both.

Allocate Connection Request

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Group 2 only Unconnected Request Message Port	Source MAC ID	Service Code [4B]	Class id [03]	Instance id [01]	Allocation Choice	Allocator's MAC ID		

Group 2 only Unconnected Request Message Port = **(0x406 | (DNET_MAC_ID << 3))**

Allocation Choice

Bit - 7	Bit - 6	Bit - 5	Bit - 4	Bit - 3	Bit - 2	Bit - 1	Bit - 0
0	Ack sup	Cyclic	0	0	0	0	Explicit

The relevant bit must be set to “1” to establish the required connection and all other bits must be set to “0”. If the acknowledge suppression bit is set then the cyclic I/O connection will be an un-confirmed service.

For example,

- To allocate Explicit Connection the allocation choice is 0x01.
- To allocate cyclic I/O Connection with acknowledgement the allocation choice is 0x20.
- To allocate explicit messaging connection and cyclic I/O connection without acknowledgement, the allocation choice is 0x61.

Note:

If the I/O connection needs to be established, a Master must allocate the Explicit messaging connection prior to, or along with, allocating I/O Connections.

The response to the Allocate master/slave connection set request is as follows:

Allocate Connection Response

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Unconnected Response Message id	Master MAC ID	Response Service Code [CB]	Message Body Format [01]					

Unconnected response message id = **(0x403 | (DNET_MAC_ID << 3))**

Message Body Format: 0x01 (class id = 8 bits / instance id = 16 bits)

Example:

The following example describes the allocation of the pre-defined explicit connection. Assume the MAC ID of the drive is 0x02 and the MAC ID of the MASTER is 0x01. Before accessing the objects using explicit messing service, the pre-defined explicit connection must be allocated by using the following CAN frame.

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte–6	Byte-7
0x416	0x01	0x4B	0x03	0x01	0x01	0x01		

The response might be (Assume the drive's current speed is 0x1234),

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x413	0x01	0xCB	0x01					

8.2. Release Master/Slave Connection Set

This service is used to release the already established Pre-defined master/slave explicit connection or cyclic I/O connection or both.

Release Connection Request

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Group 2 only Unconnected Request Message Port	Source MAC ID	Service Code [4C]	Class id [03]	Instance id [01]	Release Choice			

Group 2 only Unconnected Request Message Port **= (0x406 | (DNET_MAC_ID << 3))**

Release Choice

The supported release choices are listed in the following table.

Bit - 7	Bit - 6	Bit - 5	Bit - 4	Bit - 3	Bit - 2	Bit - 1	Bit - 0
0	Ack sup	Cyclic	0	0	0	0	Explicit

The relevant bit must be set to "1" to release the already established connection.

For example,

- To release Explicit Connection the release choice is 0x01.
- To release cyclic I/O Connection with acknowledgement the release choice is 0x20.

- To release explicit messaging connection and cyclic I/O connection with out acknowledgement, the release choice is 0x61.

Note:

An attempt to release the connection which is not established will result in an error response.

The response to the Release master/slave connection set request is as follows:

Release Connection Response

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Unconnected Response Message id	Master MAC ID	Response Service Code [CC]						

Unconnected response message id **= (0x403 | (DNET_MAC_ID << 3))**

Example:

The following example describes how to release the pre-defined explicit connection. Assume the MAC ID of the drive is 0x02 and the MAC ID of the MASTER is 0x01.

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x416	0x01	0x4C	0x03	0x01	0x01			

The response might be (Assume the drive's current speed is 0x1234),

ID	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
0x413	0x01	0xCC						

8.3. Error Response

If any errors are detected during the processing of any explicit request message or allocate pre-defined master/slave connection set request message an error response will be send as a response.

ID	CAN MSG DATA							
	Byte-0	Byte-1	Byte-2	Byte-3	Byte-4	Byte-5	Byte-6	Byte-7
Explicit Response Message id	Master MAC ID	Error Response Code [94]	Error Code	Additional Error Code				

Slave's explicit response message id = (**0x403 | (DNET_MAC_ID << 3)**)

8.4. Controlling Drive using I/O Connection

The following two examples illustrate the drive control using the I/O messaging service.

8.4.1. Start/Stop Using I/O Connection Example 1

The following example describes the allocation of the cyclic I/O connection with the pre-defined Master/Slave connection set and the I/O connections EPR is configured as one second and the sequences to be performed to start/stop the drive.

By default the instance 70, attribute 0x03 of the Assembly Object (class id 0x04) is mapped with production path of the I/O connection and the instance 20, attribute 0x03 of the Assembly Object (class id 0x04) is mapped with consumption path of the I/O connection. Assume the MAC ID of the drive is 0x02 and the MAC ID of the PLC is 0x01

ENGLISH

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x416	01 4B 03 01 01 01	01 CB 01	Allocate Explicit
0x416	01 4B 03 01 20 01	01 CB 01	Allocate I/O Connection with Ack
0x414	01 0E 05 04 00 01	01 8E 01	The current state of the I/O connection (Configuring)
0x414	01 10 05 04 00 09 E8 03	01 90 E8 03	Configure the EPR of the I/O connection to 1000 millisec (0x03E8)
0x414	01 0E 05 04 00 01	01 8E 03	The current state of the I/O connection (Established)
0x415	01 00 E8 02	Ack with id = 0x3C2	The drive will start with the 50 % reference speed
0x415	00 00 00 00	Ack with id = 0x3C2	The drive will stop

NOTE:

Any failure of sending the I/O data within 4 seconds the drive will trip on fault with the fault code F60 (Communication Trip).

8.4.2. Start/Stop Using I/O Connection Example 2

The following example describes the allocation of the cyclic I/O connection with the pre-defined Master/Slave connection set. The default input instance mapping 70 is changed to input instance 71 and the default output instance 20 is changed to 21 then the I/O connections EPR is configured as one second and the sequences to be performed to start/stop the drive. Assume the MAC ID of the drive is 0x02 and the MAC ID of the PLC is 0x01.

COB-ID	Request CAN MSG(Data) PLC to Drive	Response CAN MSG(Data) Drive to PLC	Remarks
0x416	01 4B 03 01 01 01	01 CB 01	Allocate Explicit
0x416	01 4B 03 01 60 01	01 CB 01	Allocate I/O Connection with out Ack
0x414	01 0E 05 04 00 01	01 8E 01	The current state of the I/O connection (Configuring)
0x414	81 00 10 05 04 00 0E 20	81 C0 00 (Ack)	First Fragment
0x414	81 81 04 24 47 30 03	81 C1 00 (Ack)	Second Fragment
		01 90 (with the id = 0x413)	Success response for the set attribute single service
0x414	81 00 10 05 02 00 10 20	81 C0 00 (Ack)	First Fragment
0x414	81 81 04 24 15 30 03	81 C1 00 (Ack)	Second Fragment
		01 90 (with the id = 0x413)	Success response for the set attribute single service
0x414	01 10 05 04 00 09 E8 03	01 90 E8 03	Configure the EPR of the I/O connection to 1000 millisec (0x03E8)
0x414	01 0E 05 04 00 01	01 8E 03	The current state of the I/O connection (Established)
0x415	01 00 E8 02		The drive will start with the 50 % reference speed
0x415	00 00 00 00		The drive will stop

NOTE:

Any failure of sending the I/O data within 4 seconds the drive will trip on fault with the fault code F60 (Communication Trip).

9. ADDITIONAL INFORMATION

9.1. Parameter Object Instances

The following table shows the Parameter object instances supported and their Modbus addresses to access to them.

All the parameters objects are either of type INT or UINT. Each object is either of access type GET or SET. For further details about the individual object instances, like the limits, properties, etc., refer to the drive documentation.

Parameter Instance Number	Description	MODBUS address
1	Start Mode	40002
2	Stop Mode	40003
3	Alternate Stop Mode	40004
4	Stop Mode change Speed	40005
5	Start Delay Time	40006
6	Stop Delay	40007
7	Stop below Minimum speed	40008
8	Run on Supply Loss	40009
9	Run After Reset	40010
13	Delay after OFF	40014
14	Start Mode 2	40015
16	Spin Start Tuning Parameter	40017
17	Damping Gain	40018
18	Reserved	40019
19	Reserved	40020
20	Bus Control Voltage	40021
21	DC Brake current Level	40022
22	DC Holding Voltage	40023
23	DC Heating Current	40024
24	DC Brake time	40025
25	Dynamic Break Enable	40026
26	Start Delay Min	40031
27	Multi Function Input Selection 1	40032
28	Multi Function Input Selection 2	40033

Parameter Instance Number	Description	MODBUS address
29	Multi Function Input Selection 3	40034
30	Multi Function Input Selection 4	40035
31	Multi Function Input Selection 5	40036
32	Multi Function Input Selection 6	40037
33	Multi Function Input Mode Selection	40038
34	Enable Keypad Reset in Remote control mode	40039
35	Control Mode	40040
36	Alternate Control Mode	40041
37	Communication Module	40042
38	Multi Reference Set Points 1	40052
39	Multi Reference Set Point 2	40053
40	Multi Reference Set Points 3	40054
41	Multi Reference Set Points 4	40055
42	Multi Reference Set Points 5	40056
43	Multi Reference Set Points 6	40057
44	Multi Reference Set Points 7	40058
72	Inch Speed 1	40092
73	Inch Speed 2	40093
74	Inch Speed 3	40094
75	Limit 1 Minimum Speed	40102
76	Limit 2 Minimum Speed	40103
77	Limit 1 Maximum Speed	40104
78	Limit 2 Maximum Speed	40105
79	Current Limit	40106
80	Torque Limit	40107
81	Enable Drive Negative Speed	40108
82	Current Limit 2	40109
83	Current Limit break speed	40110
84	Speed Reference Source	40122
85	Alternate Speed Reference Source	40123
86	Local Speed Reference	40124
87	Skip Speed 1	40132
88	Skip Speed 2	40133
89	Skip Speed Bandwidth	40134
90	Process Control Set point Source	40142
91	Process Control Feedback Source	40143
92	Process Control Gain	40144
93	Process Control Integration Time	40145
94	Process Control differentiation Time	40146
95	Process Control Invert PID	40147

Parameter Instance Number	Description	MODBUS address
96	Process Control Error	40148
97	Process Control Local Speed	40149
99	RS Input frequency	40159
100	ST Input frequency	40160
101	TR Input frequency	40161
102	Actual Reference Speed	40162
103	Motor Output Current	40163
104	Motor Output Torque	40164
105	Motor Output Power	40165
106	Motor Output Voltage	40166
107	Motor Output Frequency	40167
108	Motor Cos Phi	40168
109	Motor Speed RPM	40169
110	Motor Speed Percent	40170
111	DC Bus Voltage	40171
112	IGBT Temperature	40172
113	Motor Temperature	40173
117	Output U Phase Current	40177
118	Output V Phase Current	40178
119	Output W Phase Current	40179
120	Output U Phase Voltage	40180
121	Output V Phase Voltage	40181
122	Output W Phase Voltage	40182
123	Input R Phase Voltage	40183
124	Input S Phase Voltage	40184
125	Input T Phase Voltage	40185
126	Analogue Input 1 Value (V/mA)	40186
127	Analogue Input 2 Value (V/mA)	40187
128	Analogue Input 1 Value in Sensor Unit	40188
129	Analogue Input 2 Value in Sensor Unit	40189
130	Analogue Input 1 Value in percent	40190
131	Analogue Input 2 Value in percent	40191
132	Analogue Output 1 Value (V/mA)	40192
133	Analogue Output 2 Value (V/mA)	40193
134	Analogue Output 1 Value in percent	40194
135	Analogue Output 2 Value in percent	40195
136	Digital Input state	40196
137	Digital Output state	40197
143	Process Error	40203
144	Process Control Reference Set point	40204

Parameter Instance Number	Description	MODBUS address
145	Process Control Feedback	40205
146	Software Revision ID	40206
147	Hardware Revision ID	40207
148	DSP Software Revision ID	40208
149	Inverter Current	40209
150	Inverter Voltage	40210
158	Motor PTC Status	40218
159	Drive Status	40219
169	Digital Output 1 State	40229
170	Digital Output 2 State	40230
171	Digital Output 3 State	40231
172	Comparator 1 Output State	40232
173	Comparator 2 Output State	40233
174	Comparator 3 Output State	40234
175	Drive Current Fault	40235
180	Rntc Temperature	40240
182	Analogue Input 1 Reference Speed High	40242
183	Analogue Input 2 Reference Speed High	40243
184	Analogue Input 1 Working Range High	40244
185	Analogue Input 2 Working Range High	40245
186	Analogue Input 1 Reference Speed Low	40246
187	Analogue Input 2 Reference Speed Low	40247
188	Analogue Input 1 Working Range Low	40248
189	Analogue Input 2 Working Range Low	40249
190	Analogue Input 1 Sensor Range High	40250
191	Analogue Input 2 Sensor Range High	40251
194	Analogue Input 1 Sensor Range Low	40254
195	Analogue Input 2 Sensor Range Low	40255
202	Analogue Input 1 Sensor Value	40262
203	Analogue Input 2 Sensor Value	40263
204	Analogue Input 1 Format	40264
205	Analogue Input 2 Format	40265
206	Analogue Input 1 Missing Enable	40266
207	Analogue Input 2 Missing Enable	40267
208	Analogue Input 1 Sensor Enable	40268
209	Analogue Input 2 Sensor Enable	40269
210	Analogue Input 1 Hysteresis	40270
211	Analogue Input 2 Hysteresis	40271
212	Analogue Input Sensor Unit 1	40272
213	Analogue Input Sensor Unit 2	40273
214	Analogue Input 1 Filter time co-eff	40274
215	Analogue Input 2 Filter time co-eff	40275
216	Rated Nameplate Current	40282
217	Rated Nameplate Voltage	40283

Parameter Instance Number	Description	MODBUS address
218	Rated Nameplate Frequency	40284
219	Rated Nameplate Power	40285
220	Rated Nameplate RPM	40286
221	Rated Nameplate Cooling Factor	40287
222	Rated Nameplate Cos Phi	40288
223	Pump Overload Level	40289
224	Pump Overload Filter delay	40290
225	Pump Overload Fault delay	40291
226	Comparator 1 source	40302
227	Comparator 1 mode	40303
228	Comparator 1 Limit1	40304
229	Comparator 1 Limit2	40305
230	Comparator 1 Delay Limit1	40306
231	Comparator 1 Delay Limit 2	40307
232	Comparator 1 Output Selection	40308
235	Comparator 2 source	40311
236	Comparator 1 mode	40312
237	Comparator 2 Limit1	40313
238	Comparator 2 Limit2	40314
239	Comparator 2 Delay Limit1	40315
240	Comparator 2 Delay Limit 2	40316
241	Comparator 2 Output Selection	40317
244	Comparator 3 source	40320
245	Comparator 3 mode	40321
246	Comparator 3 Limit1	40322
247	Comparator 3 Limit2	40323
248	Comparator 3 Delay Limit1	40324
249	Comparator 3 Delay Limit 2	40325
250	Comparator 3 Output Selection	40326
253	Active Algorithm	40329
255	IL KP	40331
256	IL IT	40332
257	Flux Tune	40333
258	PID c Kp	40334
259	PID c It	40335
260	CISpeed	40336
261	Encoder Pulse count	40337

Parameter Instance Number	Description	MODBUS address
263	Analogue Output 1 Source Selection	40342
264	Analogue Output 1 Format	40343
265	Analogue Output 1 Low Set point	40344
266	Analogue Output 1 High Set point	40345
267	Analogue Output 1 Filter Time Constant	40346
268	Analogue Output 2 Source Selection	40347
269	Analogue Output 2 Format	40348
270	Analogue Output 2 Low Set point	40349
271	Analogue Output 2 High Set point	40350
272	Analogue Output 2 Filter Time Constant	40351
273	Digital Output 1 Source Selection	40362
274	Digital Output 1 On Delay	40363
275	Digital Output 1 Off Delay	40364
276	Digital Output 1 Inversion	40365
277	Digital Output 2 Source Selection	40366
278	Digital Output 2 On Delay	40367
279	Digital Output 2 Off Delay	40368
280	Digital Output 2 Inversion	40369
281	Digital Output 3 Source Selection	40370
282	Digital Output 3 On Delay	40371
283	Digital Output 3 Off Delay	40372
284	Digital Output 3 Inversion	40373
285	IP Address_octet_1	40374
286	IP Address_octet_2	40375
287	IP Address_octet_3	40376
288	IP Address_octet_4	40377
289	Net mask address_octet_1	40378
290	Net mask address_octet_2	40379
291	Net mask address_octet_3	40380
292	Net mask address_octet_4	40381
293	Gateway Address_octet_1	40382
294	Gateway Address_octet_2	40383
295	Gateway Address_octet_3	40384
296	Gateway Address_octet_4	40385
297	Mac Address_octet_1	40386
298	Mac address_octet_2	40387
299	Mac address_octet_3	40388
300	Mac address_octet_4	40389
301	Mac address_octet_5	40390
302	Mac address_octet_6	40391
303	Acceleration Rate	40392
304	Alt Acceleration Rate	40393
305	Deceleration Rate	40394
306	Alt Deceleration Rate	40395

Parameter Instance Number	Description	MODBUS address
307	Acc Brake Speed	40396
308	Dec Brake Speed	40397
309	MOT POT Acceleration Rate	40398
310	MOT POT Deceleration Rate	40399
311	MOT POT Acceleration Rate	40400
312	MOT POT_Deceleration Rate	40401
313	MOT POT Break speed	40402
314	Speed filter time constant	40403
316	Modbus RTU Timeout	40413
317	MODBUS RTU Slave Address	40414
318	MODBUS RTU Baud Rate	40415
319	MODBUS RTU Parity	40416
321	Fault History , First Fault	40432
322	Fault History ,Second Fault	40433
323	Fault History ,Third Fault	40434
324	Fault History ,Fourth Fault	40435
325	Fault History ,Fifth Fault	40436
326	Fault History ,Sixth Fault	40437
327	Clear Fault History ,	40438
328	Speed Limit Timeout	40452
329	Current Limit timeout	40453
330	Stop Timeout	40454
331	Torque Limit Timeout	40455
332	Ground Current Fault	40456
333	Supply Under Voltage	40457
334	Under Voltage Timeout	40458
335	Supply Over Voltage	40459
336	Over Voltage Timeout	40460
337	Input Voltage Loss response	40461
338	Enable Motor PTC_Extern	40462
339	Asym Output Voltage Fault delay	40463
340	Pulses	40472
341	Type	40473
342	Stator Resistance	40482
353	Minimum Flux Level	40502
354	Starting Torque	40503
355	Starting Torque Band adjustment	40504
356	Slip Compensation	40505
357	Damp. Gain	40506

Parameter Instance Number	Description	MODBUS address
358	Damping Reference	40507
359	Current Limit Slip	40508
360	External break voltage level	40509
362	Control Type	40522
363	Modulation Frequency	40523
364	PEWAVE Type	40524
366	Language	40542
367	Set Default Values	40543
368	Macro Selection	40544
369	short Menu Mode	40545
370	Lock	40546
373	fan control selection	40549
374	Total drive run time - Days	40550
375	Total drive run time - Hours	40551
376	Partial drive run time - Days	40552
377	Partial drive run time - Hours	40553
378	Clear Partial run time counters	40554
380	Host Start Control	40562
381	Host Stop Control	40563
382	Host Reset Control	40564
383	Host Trip Control	40565
389	fault auto reset	40571
390	fault reset attempt counter	40572
391	Reset Delay Time in seconds	40573
392	Reset counter in minutes	40574
393	auto reset fault selection 1	40575
394	auto reset fault selection 2	40576
395	auto reset fault selection 3	40577
396	auto reset fault selection 4	40578
397	Sensor Unit	40581
398	Sensor Scale	40582
399	Sensor Maximum Range	40583
405	Boost Voltage	40592
406	Boost Freq	40593
407	JUMP Freq	40594
410	Crane Relay off speed	40597
415	Enable DCHP	40922
416	Assigned IP Addr Octet 1	40923
417	Assigned IP Addr Octet 2	40924
418	Assigned IP Addr Octet 3	40925
419	Assigned IP Addr Octet 4	40926
420	Assigned Net Mask Octet 1	40927

Parameter Instance Number	Description	MODBUS address
421	Assigned Net Mask Octet 2	40928
422	Assigned Net Mask Octet 3	40929
423	Assigned Net Mask Octet 4	40930
424	Assigned Gateway Addr Octet 1	40931
425	Assigned Gateway Addr Octet 2	40932
426	Assigned Gateway Addr Octet 3	40933
427	Assigned Gateway Addr Octet 4	40934
433	CIP Drive Control	41401
434	CIP Speed Reference	41402
436	Modbus TCP/IP timeout	41451
437	CO Node ID	41501
438	CO Baud Rate	41502
439	CO Reference Speed	41503
440	DNET MAC ID	41701
441	DNET Baud Rate	41702
442	DNET STATUS	41703
443	DNET ASM IN	41704
444	DNET ASM OUT	41705

9.2. PE – CIP Fault Code Mapping

The Mapping from the PE Vendor specific fault codes to that of the CIP standard codes is presented in the following table.

PE Fault Code	Description	CIP Code (Hex)
0	F0 NO FAULT	0000
1	F1 I LIM FLT	2300
2	F2 V LIM FLT	3210
3	F3 PDINT FLT	A001
4	F4 U+DESAT	A002
5	F5 U - DESAT	A003

PE Fault Code	Description	CIP Code (Hex)
6	F6 V + DESAT	A004
7	F7 V - DESAT	A005
8	F8 W + DESAT	A006
9	F9 W - DESAT	A007
10	F10 NEG IGBT	5410
11	F11 VIN LOSS	3130
12	F12 IMB V IN	3131
13	F13 HI V IN	3110
14	F14 LW V IN	3120
15	F15 CURL Vdc	3221
16	F16 HI Vdc	3211
17	F17 LW Vdc	3220
18	F18 IMB V OUT	3300
19	F19 IMB I OUT	2330
20	F20 GROUND FLT	2230
21	F21 I LIM T/O	A008
22	F22 TQ LIM T/O	8311
23	F23 VEL LIM	A009
24	F24 V LIM	A00A
25	F25 MTR O/L	4420
26	F26 DRIVE OVERLOAD	4400
27	F27 DL SMTH	3230
28	F28 MICRO FLT	A00B
29	F29 DSP FLT	A00C
30	F30 WATCHDOG	A00D
31	F31 SCR L1	A00E
32	F32 SCR L2	A00F
33	F33 SCR L3	A010
34	F34 IGBT TEMP	4200
40	F40 EXT / PTC	A100
41	F41 COMMS TRIP	9101
42	F42 AIN1 LOSS	A101
43	F43 AIN2 LOSS	A102
44	F44 CAL FLT	A103
45	F45 STOP T/O	A104
46	F46 EEPROM FLT	A105
47	F47 COMMS T/O	8100
48	F48 SPI COM	A106
49	F49 SPD LIMIT	A107
50	F50 PSU FAULT	A108
51	F51 SCR TEMP	A109
52	F52 SUPPLY FAN	A10A
53	F53 INTRNAL TEMP	4300

PE Fault Code	Description	CIP Code (Hex)
54	F54 WATCHDOG RESET	6010
55	F55 JAM EXCESS	A10B
56	F56 EMERGEN.STOP	9100
57	F57 PUMP OVERLOA	A10C
58	F58 CAN_INTERFACE	A10D
59	F59 RESERVED	A10E
60	F60 ETH.IP T.OUT	A10F

9.3. PE – CIP Warning Code Mapping

The mapping from the Power Electronics (PE) Vendor specific warning codes to that of the CIP standard codes is presented in the following table.

PE Warning Code	Description	CIP Code (Hex)
0	No Warning	0000
1	Motor Overload	4410
2	Drive Overload	4320
3	Motor Current Overload	2312
4	Drive Current Overload	2311
5	Current Limitation	B001
6	Torque Limitation	8302
7	Voltage Limitation	3212
8	Asymmetric Current	B002
9	Output Voltage Imbalance	B003
10	Input Voltage Imbalance	3132
11	High Input Voltage	3111
12	Low Input Voltage	3121
13	Speed Limit 1 reached	8402
14	Speed Limit 2 reached	8402

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