Cat No.: IDV05-E3-1

DV Series

Advanced Function General Purpose Inverter

DeviceNet Instruction Manual

Contents

1 Introduction

1.1.1 Copyright, Limitation of Liability and Revision Rights

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the manufacturer does not warrant that a software program produced according to the guidelines provided in this manual will function properly in every physical, hardware or software environment.

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Using this software package, you can control the adjustable frequency drive remotely, thereby starting an electric motor which may act as a drive for dangerous machinery.
Therefore, the necessary caution must always be observed when using the software, and suitable measures should be taken to prevent injury and damage to machinery and equipment.

1.2.1 Safety Note

The voltage of the adjustable frequency drive is dangerous whenever connected to line power. Incorrect installation of the motor, adjustable frequency drive or serial communication bus may cause damage to the equipment, serious personal injury or death. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

1.2.2 Safety Regulations

1. The adjustable frequency drive must be disconnected from line power if repair work is to be carried out. Make sure that the line power supply has been disconnected and that the necessary time has passed before removing motor and line power plugs.
2. The [OFF] key on the control panel of the adjustable frequency drive does not disconnect the equipment from line power and is thus not to be used as a safety switch.
3. Correct protective grounding of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The ground leakage currents are higher than 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set par. 1-90 *Motor Thermal Protection* to data value *ETR trip* or data value *ETR warning*. Note: The function is initialized at 1.16 x rated motor current and rated motor frequency. For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and line power supply while the adjustable frequency drive is connected to line power. Make sure that the line power supply has been disconnected and that the necessary time has passed before removing motor and line power plugs.
7. Please note that the adjustable frequency drive has more voltage inputs than L1, L2 and L3 when load sharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Make sure that all voltage inputs have been disconnected and that the necessary time has passed before commencing repair work.

1.2.3 Warning Against Unintended Start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the adjustable frequency drive is connected to line power. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated; following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the adjustable frequency drive, or if a temporary overload or a fault in the supply line power or the motor connection ceases.

1.2.4 Warning

Touching the electrical parts may be fatal - even after the equipment has been disconnected from line power.

Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic backup.

Please refer to the relevant Instruction Manual for further safety guidelines.

1.3 About this Manual

First time users can obtain the most essential information for quick installation and set-up in these chapters:

Introduction
How to Install
How to Configure the System
Application Examples

For more detailed information including the full range of set-up options and diagnosis tools please refer to the chapters:

How to Control the Adjustable Frequency Drive
How to Access the Parameters
Parameters
Troubleshooting

1.4 Technical Overview

DeviceNet is a low-level network that standardizes communications between industrial devices (sensors, limit switches, motor controls) and high-level devices (controllers). DeviceNet follows the Open Systems Interconnection (OSI) model and is based on CAN technology for Media Access Control and Physical Signaling.

DeviceNet systems can be configured to operate in a master-slave or a distributed control architecture using peer-to-peer communication. Up to 63 nodes in a multi-drop network topology are supported, and communication options can be powered directly from the bus, using the same cable for communication. Nodes can be removed or inserted without powering down the network.

Each node on the network has its own unique Media Access Control IDentifier (MAC ID) to distinguish it on the network. The access control is based on the CSMA/CA (Carrier Sense Multiple Access / Collision Avoidance) principle, meaning that all nodes may have access to the network at the same time. If two nodes attempt to get control of the network bus simultaneously, the CAN protocol resolves the issue by arbitration. In this way collisions on the network are avoided.

DeviceNet defines device profiles for devices belonging to specific classes. For other devices, a custom class must be defined in order to make it DeviceNet compatible. This further enhances the interchangeability and interoperability of the network.

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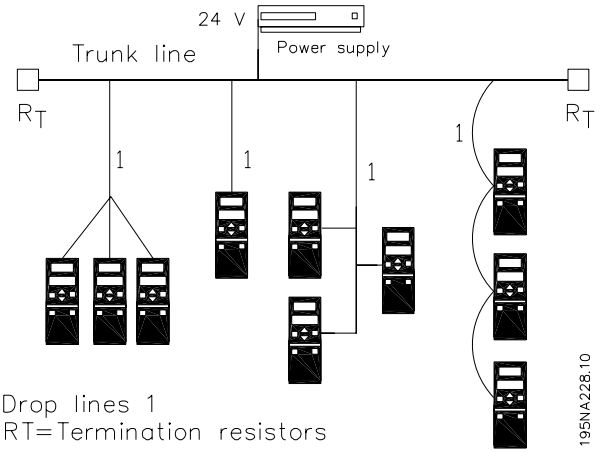


Figure 1.1: **Topology**

1.5 Assumptions

This instruction manual assumes that you are using a "aDVanced AC Drive" adjustable frequency drive with DeviceNet. It is also assumed that as master, you are using a PLC or PC equipped with a serial communication card supporting all the DeviceNet communication services required by your application. Furthermore, it is assumed that all requirements stipulated in the DeviceNet standard as well as those set up in the AC Drive Profile and those pertaining to the adjustable frequency drive are strictly observed as well as all limitations therein fully respected.

1.6 Hardware

This instruction manual relate to the DeviceNet option type no..

1.7 Background Knowledge

The the manufacturer DeviceNet is designed to communicate with any master abiding by the DeviceNet standard. It is therefore assumed that you have full knowledge of the PC or PLC you intend to use as a master in your system. Any questions pertaining to hardware or software produced by any other manufacturer is beyond the scope of this instruction manual and is of no concern to the manufacturer. If you have questions about how to set up master - master communication or communication toslaves from other vendors, please consult the appropriate documentation.

1.8 Available Literature

The following literature is available for the "aDVanced AC Drive" series.

Title	Literature no.
"aDVanced AC Drive" Instruction Manual	MG.35.DX.YY
"aDVanced AC Drive" Design Guide	MG.35.GX.YY
"aDVanced AC Drive" Programming Guide	MG.35.FX.YY
"aDVanced AC Drive" PROFIBUS Instruction Manual	MG.35.IX.YY
"aDVanced AC Drive" DeviceNet Instruction Manual	MG.35.HX.YY

1.9 Abbreviations

ACK	ACKnowledge
BOC	Bus-Off Counter
BOOL	BOOLean expression
CAN	Controller Area Network
CSMA/CA	Carrier Sense Multiple Access/Collision Avoidance
COS	Change of State
CTW	Control Word
EDS	Electronic Data Sheet
EMC	Electromagnetic Compatibility
ETR	Electronic Thermal Relay
FIFO	First In First Out
HF	High Frequency
HPFB	High Performance Field Bus
I/O	Input/Output
ISO	International Standards Organization
LCD	Liquid Crystal Display
Digital Operator	Local Control Panel
LED	Light Emitting Diode
LSB	Least Significant Bit
MAC ID	Media Access Control IDentifier
MAV	Main Actual Value
MRV	Main Reference Value
MSB	Most Significant Bit
N/A	Not Applicable
ODVA	Open DeviceNet Vendor Association
OSI	Open Systems Interconnection
PC	Personal Computer
PCD	Process Data
PIW	Peripheral Input Word
PLC	Programmable Logic Control
PNU	Parameter Number
PPO	Parameter-Process Data Object
QW	Peripheral Output Word
SINT	Signed Integer
STW	Status Word
VSD	Variable Speed Drive
UDINT	Unsigned Double Integer
UNIT	Unsigned Integer
USINT	Unsigned Short Integer

2 How to Install

2.1 Cabling

2.1.1 Cable Lengths

Baud rate	Max total cable length	Drop length	
		Maximum per drop	Cumulative maximum
125k baud	500 meters (1640 ft.)	6 meters (20 ft.) for one drop	156 meters (512 ft.)
250k baud	250 meters (820 ft.)		78 meters (256 ft.)
500k baud	100 meters (328 ft.)		39 meters (128 ft.)

2.1.2 Cable Specifications

The cable used should be according to ODVA specifications.

Be aware that the ODVA "Flat Cable" is a non-shielded cable type, and is not suited for use with adjustable frequency drives.

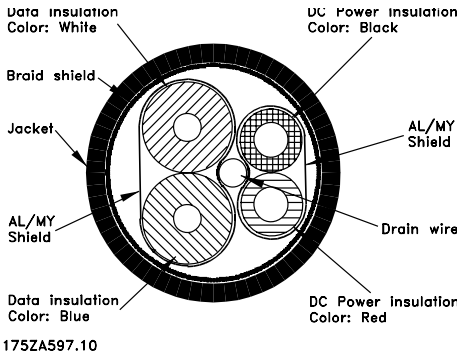


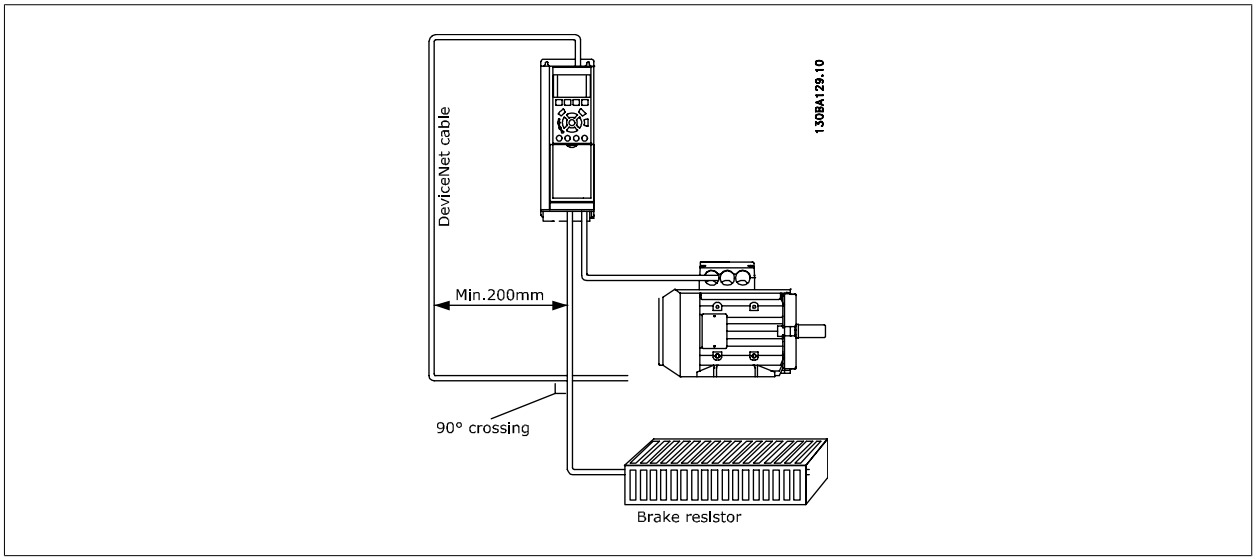
Figure 2.1: **ODVA "Thin Cable" cross-section**

2.1.3 EMC Precautions

The following EMC precautions are recommended in order to achieve interference-free operation of the DeviceNet network. Additional EMC information is available in the relevant "aDVanced AC Drive" Instruction Manual and Design Guides.

NOTE!
Relevant national and local regulations, for example, regarding protective ground connection, must be observed.

The DeviceNet communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to the other. Normally a distance of 200 mm (8 inches) is sufficient, but it is generally recommended to keep the greatest possible distance between the cables, especially where cables run in parallel over long distances. If the DeviceNet cable has to cross a motor and brake resistor cable, they must cross each other at an angle of 90 degrees.



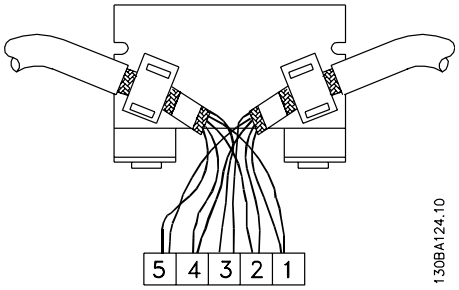
2.1.4 Connection of the Cable Shield

the manufacturer recommends connection of the screen of the DeviceNet cable to ground at both ends of the cable at every DeviceNet station (see the manufacturer's recommendation for further details). Low impedance ground connection of the shield is very important, also at high frequencies. Achieve this by connecting the surface of the shield to ground, for example by means of a cable clamp or a conductive cable connector. The adjustable frequency drive package includes various clamps and brackets to enable a proper ground connection of the DeviceNet cable shield. The shield connection required for CE and EMC compliance is shown in the following drawing.

2.1.5 ODVA Recommendation

The shield must be connected to ground at only one point on the network.

NOTE!
Please note that this recommendation conflicts with the correct EMC installation.



2.1.6 Ground Connection

It is important that all stations connected to the DeviceNet network are connected to the same ground potential. The ground connection must have a low HF (high frequency) impedance. This can be achieved by connecting a large surface area of the cabinet to ground, for example by mounting the adjustable frequency drive on a conductive rear plate.

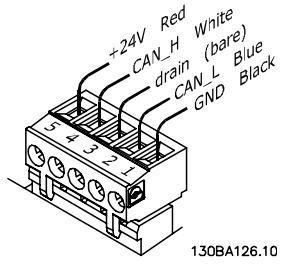
NOTE!
Particularly when there are long distances between the stations in a DeviceNet network, it may be necessary to use additional potential equalizing cables, connecting the individual stations to the same ground potential.

Pin no.	Terminal	Color	Name
1	V-	Black	GND
2	CAN_L	Blue	CAN LOW
3	Drain	(bare)	Shield
4	CAN_H	White	CAN HIGH
5	V+	Red	+24 V

2.1.7 DeviceNet Connection

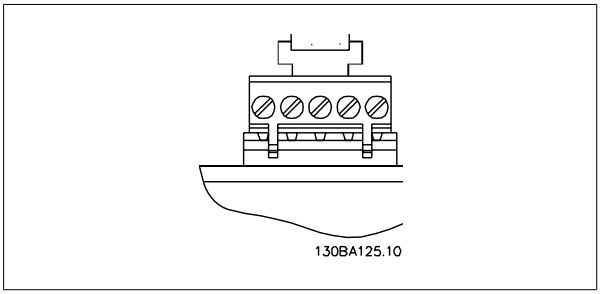
It is essential to terminate the bus line properly. A mismatch of impedance may result in reflections on the line that will corrupt data transmission. The DeviceNet control card is provided with a plug-cable connector. When a plug connector is used as a splice between two trunk lines, the removal of devices will not sever the network. If required, strain relief must be provided by the developer. In current installations of this type of connector, the strain relief is attached to the product.

NOTE!
Install wires only when the network is inactive. This will prevent problems such as shorting the network supply or disrupting communications.



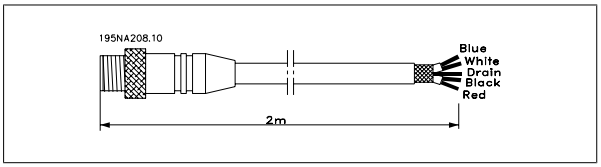
2.1.8 DeviceNet Termination

Termination resistors should be installed at each end of the bus line. The resistors must be mounted between terminal 2 (CAN_L) and terminal 4 (CAN_H) and should have the following specification:
121 Ohm, 1% Metal film, 1/4 Watt



2.1.9 Drop Cable

An alternative to splicing two trunk lines in the connector on the control card is to use a DeviceNet connection box or a T-connector. For this kind of installation a drop cable is available as an option.



The connector is a micro-style, male, with rotating coupling nut, and fits into a Micro Device port.

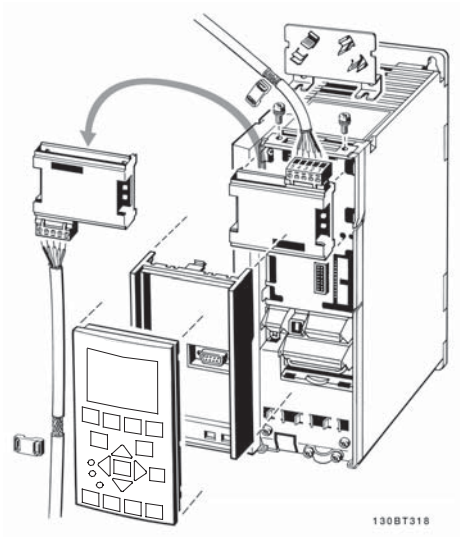
2.1.10 Network Power Consumption

The DeviceNet option is powered via the internal power supply in the drive. The network voltage (+24 V) is detected only to determine if the bus is energized or not, thus the current draw from the network is negligible.

2.2 Installation of Option in the Adjustable Frequency Driver

To install a serial communication option in the adjustable frequency drive, you will need:

- The serial communication option
- Serial communication bus option adaptor frame for the adjustable frequency drive. This frame is deeper than the standard frame, to allow space for the serial communication option beneath.
- Cable holders



Instructions:

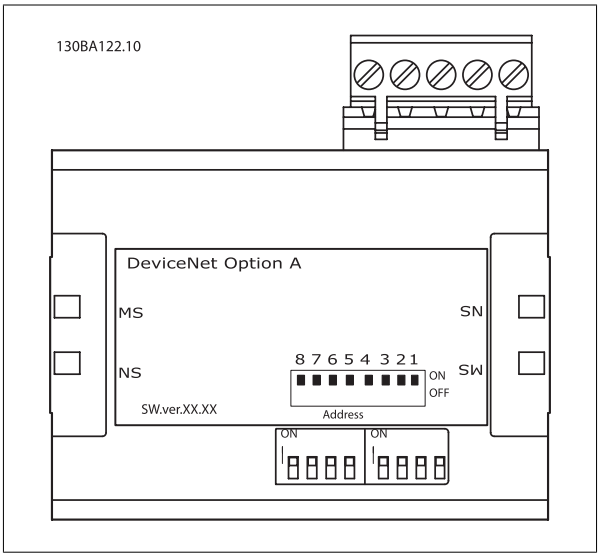
- Remove the LCD panel from the adjustable frequency drive.
- Remove the frame located beneath and discard.
- Push the option into place. Two positions are possible, with cable terminal facing either up or down. The cable up position is often most suitable when several adjustable frequency drives are installed side by side in a rack, as this position permits shorter cable lengths.
- Push the serial communication option adaptor frame for the adjustable frequency drive into place.
- Replace the LCD panel.
- Attach cable.
- Fasten the cable in place using cable holders. The top surface of the adjustable frequency drive has pre-drilled threaded holes for attaching the cable holders to the unit.
- If an option is installed after initial power-up, the adjustable frequency drive will be tripped and display: Alarm 67 *Option Change*.

3 How to Configure the System

3.1 Configure the DeviceNet Network

All DeviceNet stations that are connected to the same bus network must have a unique station address. The DeviceNet address of the adjustable frequency drive can be selected via:

- Hardware switches (default 63)
- par. 10-02 *MAC ID* (default 63)
- Class code 0X03, Instance 1, Attribute 1



3.1.1 Setting the DeviceNet Address using the Hardware Switches

Setting the DeviceNet Address using the Hardware Switches: Using the hardware switches it is possible to select an address range from 0-63 (factory setting 63) according to the table below:

Switch	8	7	6	5	4	3	2	1
Address value	-	-	+32	+16	+8	+4	+2	+1
Ex. address 5	-	-	OFF	OFF	OFF	ON	OFF	ON
Ex. address 20	-	-	OFF	ON	OFF	ON	OFF	OFF
Ex. address 35	-	-	ON	OFF	OFF	OFF	ON	ON

NOTE!
Switch off the power supply before changing the hardware switches.

The address change will come into effect at the next power-up, and can be read in par. 10-02 *MAC ID*.

3.1.2 Setting the DeviceNet Address via par. 10-02 *MAC ID*

The address can be set via par. 10-02 *MAC ID* if the hardware switches are set to 63 (factory setting). The address change will come into effect at the next power-up.

3.1.3 Setting the DeviceNet Address with the Object Class Code 0x03, Attribute 1, Instance 1

The address can be set via the DeviceNet object class code 0x03 attribute 1 command if the hardware switch is set to 63 (factory setting). A new address becomes effective immediately after the class code 0x03, Instance 1, Attribute 1 command.

3.1.4 Baud Rate Setting

All DeviceNet stations connected to the same bus network must have the same baud rate. The baud rate of the adjustable frequency drive can be selected via:

- Hardware switches
- par. 10-01 *Baud Rate Select* (default 125k Baud)
- Object Class code 0x03, Instance 1, Attribute 2.

3.1.5 Setting the DeviceNet Baud Rate using the Hardware Switches

Using the hardware switches, it is possible to select a baud rate of 125k baud (factory setting), 250k baud or 500 k baud according to the following table:

Baud rate switch	8	7
par. 10-01 *Baud Rate Select*	1	1
125 k Baud	0	0
250 k Baud	0	1
500 k Baud	1	0

NOTE!
Switch off the power supply before changing the hardware switches.

The baud rate change will come into effect at the next power-up, and can be read in par. 10-01 *Baud Rate Select*.

3.1.6 Setting the DeviceNet Baud Rate via par. 10-01 *Baud Rate Select*

The baud rate can be set via par. 10-01 *Baud Rate Select* if the hardware switches 1 and 2 are set to ON (factory setting). The baud rate change will come into effect at the next power-up.

3.1.7 Setting the DeviceNet Baud Rate with the Object Class Code 0x03 Attribute 2

The baud rate can be set via the DeviceNet object class code 0x03 attribute 2 command, if the hardware switches 1 and 2 are set to ON (factory setting). A new baud rate becomes effective immediately after the class code 0x03 attribute 2 command.

3.2 Configure the Master

3.2.1 EDS File

A large part area of the system configuration is the setting of application related parameters. EDS (Electronic Data Sheet) files simplify the setting up of most of the DeviceNet configurable parameters. the manufacturer provides a generic English EDS file covering all voltage and power sizes, for off-line configuration.

NOTE!
The EDS file does not contain all parameters but a selected, limited number of parameters with generic minimum, maximum and default values.

3.3 Configure the Adjustable Frequency Drive

3.3.1 Adjustable Frequency Drive Parameters

Pay particular attention to the following parameters when configuring the adjustable frequency drive with a DeviceNet interface. Please refer to the Parameters chapter for more details of each parameter.

- par. 0-40 *[Hand on] Key on LCP*.
  If the Hand button on the adjustable frequency drive is activated, control of the drive via the DeviceNet interface is disabled. After initial power-up the adjustable frequency drive will automatically detect whether a serial communication option is installed in slot A, and set par. 8-02 *Control Word Source* to [Option A]. If an option is added to, changed in or removed from an already commissioned drive, it will not change par. 8-02 *Control Word Source* but will enter trip mode, and the adjustable frequency drive will display an error.
- par. 8-10 *Control Word Profile* (see section *How to Control the Adjustable Frequency Drive*). Choose between the FC Profile and the ODVA profile. Select the desired DeviceNet instance in par. 10-10 *Process Data Type Selection*.
- par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select* (see section *Parameters*). Selection of how to gate the DeviceNet control commands with digital input command of the control card.

NOTE!
When par. 8-01 *Control Site* is set to [2] Control word only, then the settings in par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select* will be overruled, and will all act on bus control.

- par. 8-03 *Control Word Timeout Time* to par. 8-05 *End-of-Timeout Function*. The reaction in the event of a bus timeout is set via these parameters
- par. 10-10 *Process Data Type Selection*. Default is 125 kbps.
- par. 10-02 *MAC ID*. Default is 63.

3.3.2 LEDs

The DeviceNet control card contains two bi-color (green/red) LEDs for each connector hook-up port, to indicate the state of the device and the network respectively. For details of the range of communications status indicated by the LEDs, please refer to the Troubleshooting chapter.

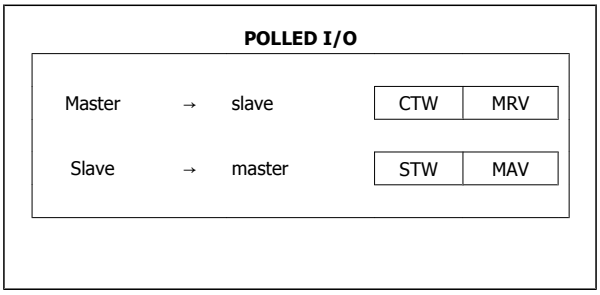
4 How to Control the Adjustable Frequency Drive

4.1 DeviceNet Process Control Modes

This section describes two of three possible process control modes: Polling and Change of State (COS).
The third adjustable frequency control mode uses the acyclical mode Explicit Messaging via the Standard DeviceNet Control Supervisory object CLASS 29H. The Control Supervisory object is described within the *DeviceNet Object Classes* section, *How to Access the Parameters* chapter.

4.1.1 Polling

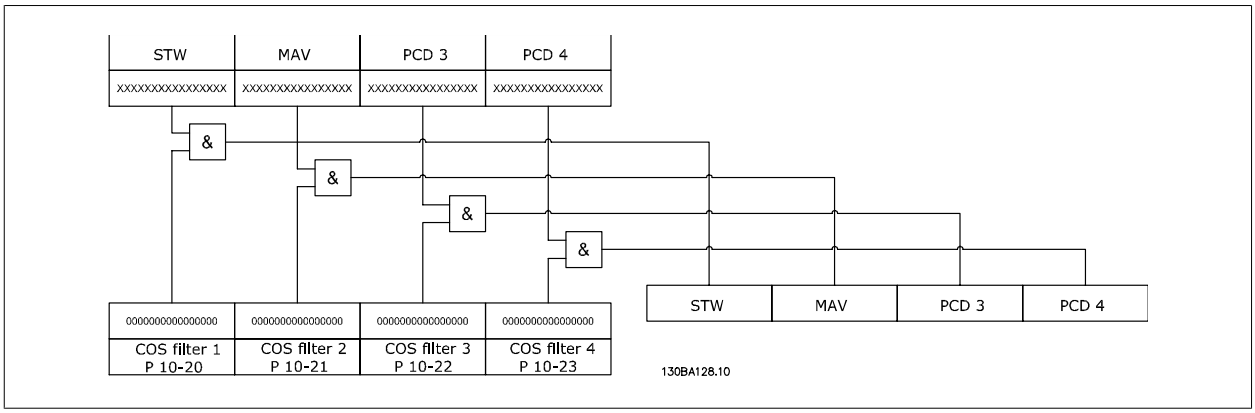
This is a classical master-slave connection and the standard DeviceNet operation mode. The master controls the data exchange by sending cyclical poll requests to the connected slaves, and the slaves answer by sending a poll response to the master. The master can control and monitor the adjustable frequency drive by polling the DeviceNet or objects (I/O Instances).



4.1.2 Change of State, COS

This is an event-controlled operation mode used to minimize network traffic. Messages are transmitted only if a defined state or value has changed. The condition for triggering a COS message is determined by the insertion of COS filters (par. 10-20 *COS Filter 1* to par. 10-23 *COS Filter 4*), for each bit in the different PCD words. The filter acts like a logical AND function: If a bit in the filter is set to "1", the COS function triggers a change to the corresponding bit for the PCD word.

The figure below shows the different PCDs and their corresponding filter parameters.



par. 10-20 *COS Filter 1* to par. 10-23 *COS Filter 4* can be used to filter out undesired events for COS. If a filter bit is set to 0, the corresponding I/0 Instance bit will be unable to produce a COS message. By default, all bits in the COS filters are set to 0.

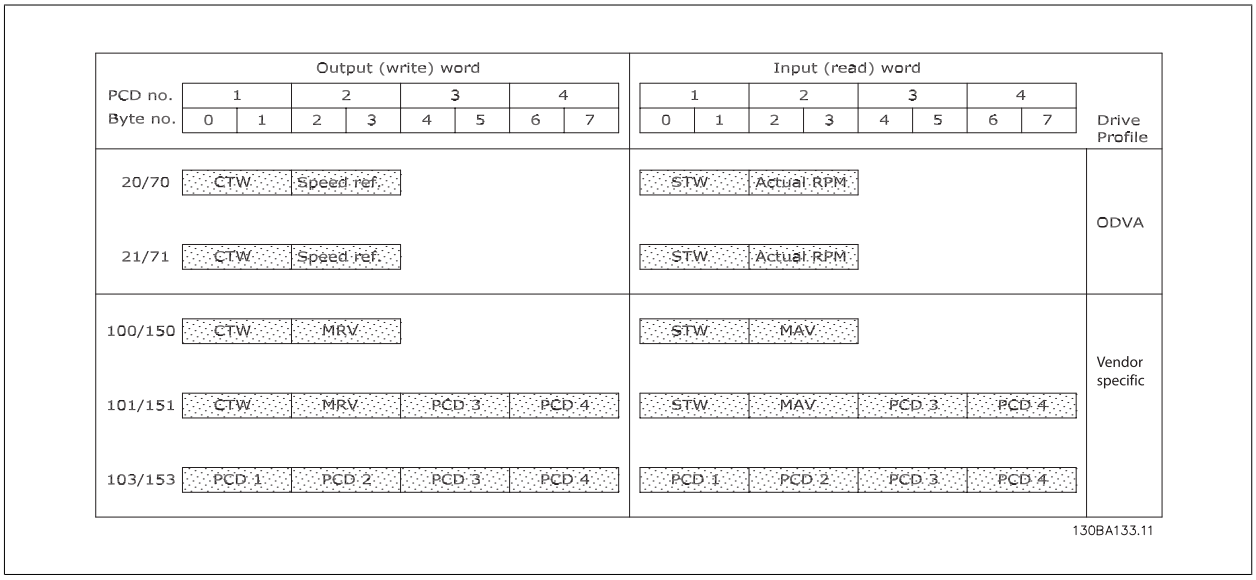
In order to signal that the connection has not been interrupted, or the device is not powered off, a heartbeat message is transmitted within a specified time interval (heartbeat interval). This interval is defined in heartbeat time attribute of the connection object, Class Code 0x05.

To prevent the device from producing heavy network traffic if a value changes frequently, the production inhibit time (an attribute of the connection object) is defined. This parameter defines the minimum time between two COS messages.

The expected package rate attribute defines the maximum time between two COS messages even when the value is unchanged. In the event of COS connection, the explicit package rate is identical with the heartbeat interval mentioned above. This timer is used both as transmission trigger and inactivity watchdog, depending upon whether the connection is producer or consumer.

4.2 I/O Assembly Instances

I/O assembly instances are a number of defined process control objects with defined content comprising control and status information. The figure below shows the I/O assembly instance options for controlling and monitoring the adjustable frequency drive.



4.3 Process Data

Process data comprises the control and status data in the I/O assembly instances.

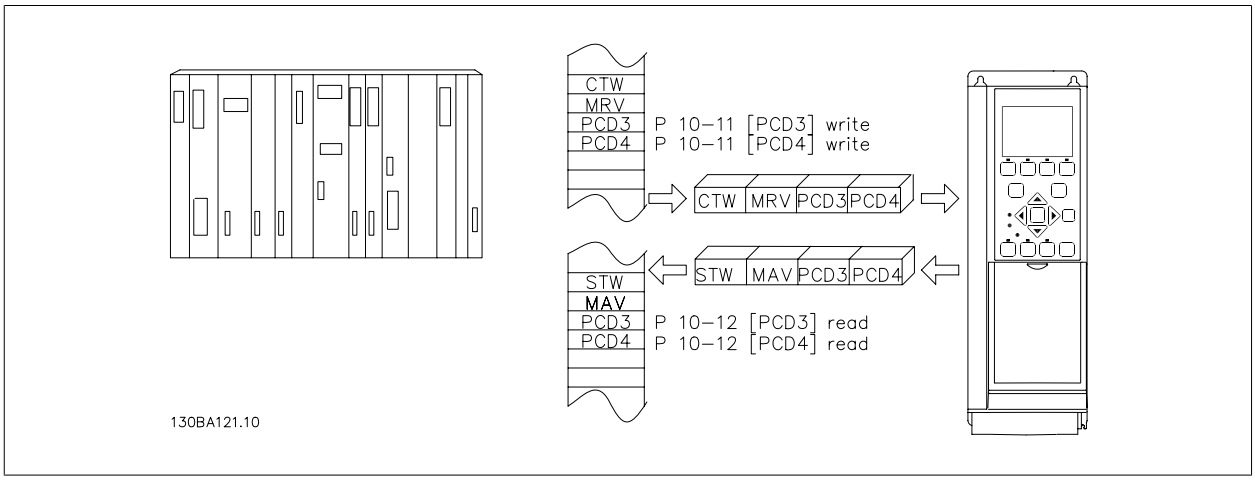
The CTW, MRV and STW and MAV have defined formats and functions, depending upon the I/O instance chosen. PCD3 and PCD4 are freely configurable for instance 101/151 via par. 10-11 *Process Data Config Write* and par. 10-12 *Process Data Config Read*.
All PCDs are freely configurable for instance 102/152

DeviceNet provides a flexible way for the user to customize the number of process data (I/O words) and the functionality of each word. To activate the user definable process data, select the I/O instance 101/151 in par. 10-10 *Process Data Type Selection*. This will change the I/O size to four words in the input and output area. This selection uses the vendor-specific profile for the control word and status word as well for the main reference value/main actual value.

The first two words are fixed on the DeviceNet, whereas the user can select the input and output, PCD 3 and PCD 4. The number of PCDs active in a system is fixed to 2 words.

NOTE!
Selection of Instance 101/151 under par. 10-10 *Process Data Type Selection* is only possible if our FC Profile has been selected in par. 8-10 *Control Word Profile*.

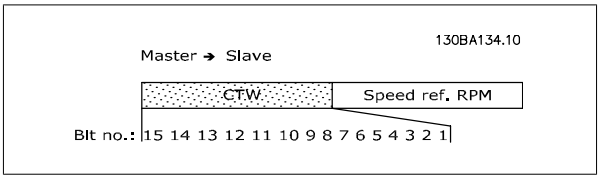
To enable use of PCD data from the DeviceNet, configure the contents of each single PCD word in par. 10-11 *Process Data Config Write* and par. 10-12 *Process Data Config Read*. Changes to par. 10-11 *Process Data Config Write* and par. 10-12 *Process Data Config Read* are effected immediately in the PCD data.



4.4 ODVA Control Profile

4.4.1 Control Word under Instances 20/70 and 21/71

Control word under instances 20/70 and 21/71 set par. 8-10 *Control Word Profile* to ODVA, and select the instance in par. 10-10 *Process Data Type Selection*.



The control word in instances 20 and 21 is defined in the overview to the right:

NOTE!
Note that the bits 00 and 02 in instance 20 are identical with bits 00 and 02 in the more extensive instance 21.

Bit	Instance 20		Instance 21	
	Bit = 0	**Bit = 1**	**Bit = 0**	**Bit = 1**
00	Stop	Run Fwd	Stop	Run Fwd
01	-	-	Stop	Run Rev
02	No function	Fault reset	No function	Fault reset
03	-	-	-	-
04	-	-	-	-
05	-	-	-	Net Ctrl
06	-	-	-	Net Ref
07-15	-	-	-	-

Explanation of the Bits:

Bit 0, Run Fwd:
Bit 0 = "0" means that the adjustable frequency drive has a stop command.
Bit 0 = "1" leads to a start command and the adjustable frequency drive will start to run the motor clockwise.

Bit 1, Run Rev:
Bit 1 = "0" leads to a stop of the motor.
Bit 1 = "1" leads to a start of the motor.

Bit 2, Fault Reset:
Bit 2 = "0" means that there is no reset of a trip.
Bit 2 = "1" means that a trip is reset.

Bit 3, No function:
Bit 3 has no function.

Bit 4, No function:
Bit 4 has no function.

4

Bit 5, Net Control:
Bit 5 = "0" means that the drive is controlled from the standard inputs.
Bit 5 = "1" means that DeviceNet controls the drive.

NOTE!
Please note that changes will affect par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select*.

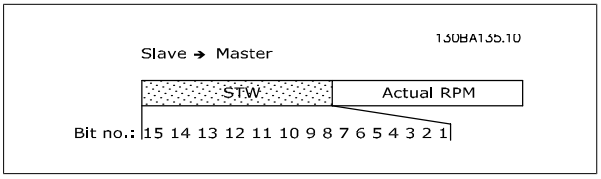
Bit 6, Net Reference:
Bit 6 = "0" Reference is from the standard inputs.
Bit 6 = "1" Reference is from DeviceNet.

NOTE!
Please note that changes will affect par. 3-15 *Reference Resource 1* to par. 3-17 *Reference Resource 3*.

For the speed reference, see section *Bus Speed Reference Value under Instances 20/70 and 21/71*.

4.4.2 Status Word under Instances 20/70 and 21/71

The status word in instances 70 and 71 is defined in the overview to the right:



NOTE!
Note that the bits 00 and 02 in instance 70 are identical with bits 00 and 02 in the more extensive instance 71.

Bit	Instance 70		Instance 71	
	Bit = 0	Bit = 1	Bit = 0	Bit = 1
00	-	Fault	-	Fault
01	-	-	-	Warning
02	-	Running 1 Fwd	-	Running 1 Fwd
03	-	-	-	Running 2 Rev.
04	-	-	-	Ready
05	-	-	-	Ctrl from Net
06	-	-	-	Ref. from Net
07	-	-	-	At ref.
08-15	-	-	State Attribute	

Explanation of the Bits:

Bit 0, Fault:
Bit 0 = "0" means that there is no fault in the adjustable frequency drive.
Bit 0 = "1" means that there is a fault in the adjustable frequency drive.

Bit 1, Warning:
Bit 0 = "0" means that there is no unusual situation.
Bit 0 = "1" means that an abnormal condition has arisen.

Bit 2, Running 1:
Bit 2 = "0" means that the drive is not in one of these states or that Run 1 is not set.
Bit 2 = "1" means that the drive state attribute is enabled or stopping, or that fault stop and bit 0 (Run 1) of the control word are set at the same time.

Bit 3, Running 2:
Bit 3 = "0" means that the drive is in neither of these states or that Run 2 is not set.
Bit 3 = "1" means that the drive state attribute is enabled or stopping, or that fault stop and bit 0 (Run 2) of the control word are set at the same time.

Bit 4, Ready:
Bit 4 = "0" means that the state attribute is in another state.
Bit 4 = "1" means that the state attribute is ready, enabled or stopping.

Bit 5, Control from net:
Bit 5 = "0" means that the drive is controlled from the standard inputs.
Bit 5 = "1" means that DeviceNet has control (start, stop, reverse) of the drive.

Bit 6, Ref from net:
Bit 6 = "0" means that the reference comes from inputs to the drive.
Bit 6 = "1" means that the reference comes from DeviceNet.

Bit 7, At reference:
Bit 7 = "0" means that the motor is running, but that the present speed is different from the preset speed reference, i.e., the speed is being ramped up/down during start/stop.
Bit 7 = "1" means that the drive and reference speeds are equal.

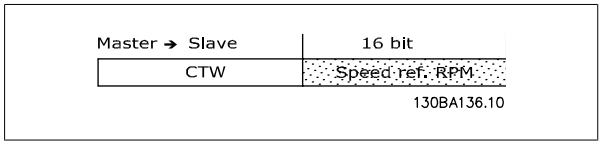
Bit 8 - 15, State attribute:
(Instance 71 only)
Represents the state attribute of the drive, as indicated in the table to the right:

Bit Number	Meaning
8	(Vendor specific)
9	Start up
10	Not ready
11	Ready
12	Enabled
13	Stopping
14	Fault stop
15	Faulted

For more detail of the actual output speed, see the section *Actual Output Speed under Instances 20/70 and 21/71*.

4.4.3 Bus Speed Reference Value under Instances 20/70 and 21/71

The speed reference value is transmitted to the adjustable frequency drive in the form of a 16-bit word. The value is transmitted as a whole number. Negative figures are formatted by means of 2's complement.



The bus speed reference has the following format:

par. 3-00 *Reference Range* = "0" [ref_{MIN} -> ref_{MAX}] 0 (0000 Hex) [RPM] =>+ 32767 (7FFF Hex) [RPM]

par. 3-00 *Reference Range* = "1" [-ref_{MAX} -> +ref_{MAX}] -32767 (8001 Hex) =>+32767 [RPM] (7FFF Hex)

The actual reference [Ref. %] in the adjustable frequency drive depends on the settings in the following parameters:
par. 1-23 *Motor Frequency*
par. 1-25 *Motor Nominal Speed*
par. 3-03 *Maximum Reference*

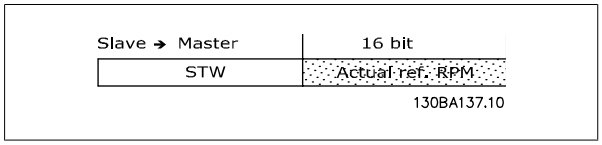
Note that if the bus speed reference is negative, and the control word contains a run reverse signal, the drive will run clockwise (- - is +).

Example:
par. 1-25 *Motor Nominal Speed* = 1420 RPM
par. 1-23 *Motor Frequency* = 50 Hz
par. 3-03 *Maximum Reference* = 1420 RPM

In order to run the motor at 25%, the reference transmitted must be: (1420*0.25) = 355 = 163hex

163hex => 25% => Fout = 12.5Hz

4.4.4 Actual Output Speed under Instances 20/70 and 21/71



The value of the actual speed of the motor is transmitted in the form of a 16-bit word. The value is transmitted as a whole number. Negative figures are formed by means of 2's complement.

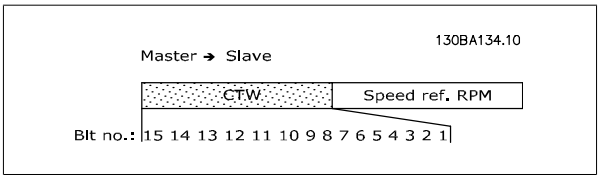
The actual speed value has the following format:

-32767 (8000 Hex) [RPM] -> +32767 [RPM] (7FFF Hex) [RPM]

4.5 Drive Control Profile

4.5.1 Control Word under Instances 100/150, 101/151 and 102/152

To select FC protocol in the control word, par. 8-10 *Control Word Profile* must be set to Adjustable Frequency protocol [0]. The control word is used to send commands from a master (PLC or PC) to a slave (adjustable frequency drive).



The control words in Instances 100/101/102 are defined as follows to the right:

Bit	Bit value = 0	Bit value = 1
00	Reference value	External selection lsb
01	Reference value	External selection msb
02	DC brake	Ramp
03	Coasting	No coasting
04	Quick stop	Ramp
05	Hold output frequency	Use ramp
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data invalid	Data valid
11	No function	Relay 01 active
12	No function	Relay 04 active
13	Parameter set-up	Selection lsb
14	Parameter set-up	Selection msb
15	No function	Reverse

Explanation of the Control Bits:

Bits 00/01

Bits 00 and 01 are used to choose between the four reference values, which are pre-programmed in par. 3-10 *Preset Reference* according to the table to the right:

Programmed ref. value	Parameter	Bit 01	Bit 00
1	3-10 [0]	0	0
2	3-10 [1]	0	1
3	3-10 [2]	1	0
4	3-10 [3]	1	1

NOTE!
In par. 8-56 *Preset Reference Select*, a selection is made to define how Bit 00/01 gates with the corresponding function on the digital inputs.

Bit 02, DC brake:

Bit 02 = 0 leads to DC braking and stop. Braking current and duration are set in par. 2-01 *DC Brake Current* and par. 2-02 *DC Braking Time*.
Bit 02 = 1 leads to ramping.

Bit 03, Coasting:

Bit 03 = 0 causes the adjustable frequency drive to immediately "let go" of the motor (the output transistors are "shut off") so that it coasts to a standstill.
Bit 03 = 1 enables the adjustable frequency drive to start the motor if the other starting conditions have been fulfilled.

NOTE!
In par. 8-50 *Coasting Select* a selection is made to define how Bit 03 gates with the corresponding function on a digital input.

Bit 04, Quick stop:

Bit 04 = 0 causes a stop, in which the motor speed is ramped down to stop via par. 3-81 *Quick Stop Ramp Time*.

Bit 05, Hold output frequency:

Bit 05 = 0 causes the present output frequency (in Hz) to freeze. The frozen output frequency can then be changed only by means of the digital inputs (par. 5-10 *Terminal 18 Digital Input* to par. 5-15 *Terminal 33 Digital Input*) programmed to Speed up and Slow.

NOTE!
If Hold output is active, only the following can stop the adjustable frequency drive:

- Bit 03 Coasting stop
- Bit 02 DC braking
- Digital input (par. 5-10 *Terminal 18 Digital Input* to par. 5-15 *Terminal 33 Digital Input*) programmed to DC braking, coasting stop or reset and coast stop.

Bit 06, Ramp stop/start:

Bit 06 = 0 causes a stop, in which the motor speed is ramped down to stop via the selected *ramp down* parameter.
Bit 06 = 1 permits the adjustable frequency drive to start the motor, if the other starting conditions have been fulfilled.

NOTE!
In par. 8-53 *Start Select*, a selection is made to define how Bit 06 Ramp stop/start gates with the corresponding function on a digital input.

Bit 07, Reset:

Bit 07 = 0 does not cause a reset.
Bit 07 = 1 causes the reset of a trip. Reset is activated on the leading edge of the signal, i.e., when changing from logic 0 to logic 1.

Bit 08, Jog:

Bit 08 = 1 causes the output frequency to be determined by par. 3-19 *Jog Speed [RPM]*.

Bit 09, Selection of ramp 1/2:

Bit 09 = "0" means that ramp 1 is active (par. 3-40 *Ramp 1 Type* to par. 3-47 *Ramp 1 S-ramp Ratio at Decel. Start*).
Bit 09 = "1" means that ramp 2 (par. 3-50 *Ramp 2 Type* to par. 3-57 *Ramp 2 S-ramp Ratio at Decel. Start*) is active.

Bit 10, Data not valid/Data valid:
Is used to tell the adjustable frequency drive whether the control word is to be used or ignored. Bit 10 = 0 causes the control word to be ignored, Bit 10 = 1 causes the control word to be used. This function is relevant, because the control word is always contained in the message, regardless of which type of message is used, i.e., it is possible to turn off the control word if you do not wish to use it in connection with updating or reading parameters.

Bit 11, Relay 01:
Bit 11 = "0" Relay not activated.
Bit 11 = "1" Relay 01 activated, provided control word bit 11 has been chosen in par. 5-40 *Function Relay*.

Bit 12, Relay 04:
Bit 12 = "0" Relay 04 has not been activated.
Bit 12 = "1" Relay 04 has been activated, provided control word bit 12 has been chosen in par. 5-40 *Function Relay*.

Bit 13/14, Selection of set-up:
Bits 13 and 14 are used to choose from the four menu set-ups according to the table to the right:

Set-up	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

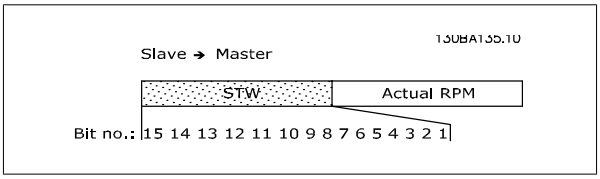
The function is only possible when Multi Set-ups is selected in par. 0-10 *Active Set-up*.

NOTE!
In par. 8-55 *Set-up Select* a selection is made to define how bits 13/14 gate with the corresponding function on the digital inputs.

Bit 15 Reverse:
Bit 15 = 0 causes no reversing.
Bit 15 = 1 causes reversing.

4.5.2 Status Word under Instances 100/150, 101/151 and 102/152

The status words in instances 150/151/152 are defined as follows to the right:



Bit	Bit = 0	Bit = 1
00	Control not ready	Control ready
01	Drive not ready	Drive ready
02	Coasting	Enable
03	No error	Trip
04	No error	Error (no trip)
05	Reserved	-
06	No error	Trip lock
07	No warning	Warning
08	Speed reference	Speed = reference
09	Local operation	Bus control
10	Out of frequency limit	Frequency limit ok
11	No operation	In operation
12	Drive ok	Stopped, auto start
13	Voltage ok	Voltage exceeded
14	Torque ok	Torque exceeded
15	Timer ok	Timer exceeded

Explanation of the Status Bits:

Bit 00, Control not ready/ready:

Bit 00 = 0 means that the adjustable frequency drive has tripped.

Bit 00 = 1 means that the adjustable frequency drive controls are ready, but that the power component is not necessarily receiving any power supply (in case of external 24 V supply to controls).

Bit 01, Drive ready:

Bit 01 = 1. The adjustable frequency drive is ready for operation.

Bit 02, Coasting stop:

Bit 02 = 0. The adjustable frequency drive has released the motor.

Bit 02 = 1. The adjustable frequency drive can start the motor when a start command is given.

Bit 03, No error/trip:

Bit 03 = 0 means that the adjustable frequency drive is not in fault mode.

Bit 03 = 1 means that the adjustable frequency drive is tripped, and that a reset signal is required to re-establish operation.

Bit 04, No error/error (no trip):

Bit 04 = 0 means that the adjustable frequency drive is not in fault mode.

Bit 04 = 1 means that there is an adjustable frequency drive error but no trip.

Bit 05, Not used:

Bit 05 is not used in the status word.

Bit 06, No error / trip lock:

Bit 06 = 0 means that the adjustable frequency drive is not in fault mode.

Bit 06 = 1 means that the adjustable frequency drive is tripped, and locked.

Bit 07, No warning/warning:

Bit 07 = 0 means that there are no warnings.

Bit 07 = 1 means that a warning has occurred.

Bit 08, Speed reference/speed = reference:

Bit 08 = 0 means that the motor is running, but that the present speed is different from the preset speed reference. It might, for example, be the case while the speed is being ramped up/down during start/stop.

Bit 08 = 1 means that the present motor present speed matches the preset speed reference.

Bit 09, Local operation/bus control:

Bit 09 = 0 means that [STOP/RESET] is activated on the control unit, or that Local control in par. 3-13 *Reference Site* is selected. It is not possible to control the adjustable frequency drive via serial communication.

Bit 09 = 1 means that it is possible to control the adjustable frequency drive via the serial communication bus.

Bit 10, Out of frequency limit:

Bit 10 = 0, if the output frequency has reached the value in par. 4-52 *Warning Speed Low* or par. 4-53 *Warning Speed High*.

Bit 10 = "1" means that the output frequency is within the defined limits.

Bit 11, No operation/in operation:

Bit 11 = 0 means that the motor is not running.

Bit 11 = 1 means that the adjustable frequency drive has a start signal or that the output frequency is greater than 0 Hz.

Bit 12, Drive OK/stopped, auto start:

Bit 12 = 0 means that there is no temporary overtemperature on the inverter.

Bit 12 = 1 means that the inverter has stopped because of overtemperature, but that the unit has not tripped and will resume operation once the overtemperature stops.

Bit 13, Voltage OK/limit exceeded:

Bit 13 = 0 means that there are no voltage warnings.

Bit 13 = 1 means that the DC voltage in the adjustable frequency drives intermediate circuit is too low or too high.

Bit 14, Torque OK/limit exceeded:

Bit 14 = 0 means that the motor current is lower than the torque limit selected in par. 4-16 *Torque Limit Motor Mode* or par. 4-17 *Torque Limit Generator Mode*.

Bit 14 = 1 means that the torque limits in par. 4-16 *Torque Limit Motor Mode* and par. 4-17 *Torque Limit Generator Mode* have been exceeded.

Bit 15, Timer OK/limit exceeded:

Bit 15 = 0 means that the timers for motor thermal protection and Drive thermal protection, respectively, have not exceeded 100%.

Bit 15 = 1 means that one of the timers has exceeded 100%.

4.5.3 Bus Reference Value under Instances 100/150 and 101/151

The frequency reference value is transmitted to the adjustable frequency drive in the form of a 16-bit word. The value is transmitted as a whole number (-32767 to 32767). Negative figures are formatted by means of 2's complement.

Master → slave	16 bit
CTW	Speed ref. RPM

The bus reference has the following format:

100% = 4000 Hex

par. 3-00 *Reference Range* = "0" ["ref_{MIN} -> ref_{MAX}"] 0 -> 16384 (4000 Hex) ~ 0 -> 100%

par. 3-00 *Reference Range* = "1" [- ref_{MAX} -> + ref_{MAX}] -16384 (C000 Hex) -> +16384 (4000 Hex) ~ -100% -> +100%

4.5.4 Actual Output Frequency under Instances 100/150 and 101/151

The value of the actual output frequency of the adjustable frequency drive is transmitted in the form of a 16-bit word. The value is transmitted as a whole number (-32767 -> 32767). Negative figures are formed by means of 2's complement.

Slave → master	16 bit
STW	Actual ref. RPM

The actual output frequency has the following format:

-32767 -> +32767.
-16384 (C000 Hex) corresponds to -100%, and 16384 (4000 Hex) corresponds to 100%.

5 How to Access the Parameters

5.1 Explicit Messages

DeviceNet is based on the CAN protocol. This means that every message contains an 11-bit CAN identifier field to define the connection ID. These CAN identifiers are also used to determine access priority.

The MAC ID is stored in the header of the message, which is split into four different message groups.

10	9	8	7	6	5	4	3	2	1	0	Identifier bits
0	Group 1 ID				Source MAC ID						Message Group 1
1	0	MAC ID						Group 2 ID			Message Group 2
1	1	Group 3 iD			Source MAC ID						Message Group 3
1	1	1	1	1	Group 4 ID						Message Group 4
1	1	1	1	1	1	1	X	X	X	X	Invalid Can Identifiers

"aDVanced AC Drive" parameters can be accessed by the Standard DeviceNet service Explicit Message. Two classes of explicit messages are supported: Message group 2: Explicit messages take place via pre-defined master/slave connections. Message group 3: Explicit messages take place via dynamically established lower prioritized connections.

5.2 Object Classes

The following Standard DeviceNet objects can be accessed:

Class ID 01h	Identity Object	Class ID 10h	Parameter Group Object
Class ID 03h	DeviceNet Object	Class ID 28h	Motor Data Object
Class ID 04h	Assembly Object	Class ID 29h	Control Supervisory Object
Class ID 05h	Connection Object	Class ID 2Ah	AC/DC Drive Object
Class ID 0Fh	Parameter Object	Class ID 2Bh	Acknowledge Handler Object

The following DeviceNet vendor-specific objects are also available:
Class ID 100d to 119d Drive Classes.
The above object classes are described in the following sections: *DeviceNet Object Classes* and *Drive Object Classes*.

5.3 DeviceNet Object Classes

5.3.1 Class ID 01h Identity Object

This is a standard DeviceNet object for identification of the device (adjustable frequency drive). The heartbeat interval can be set in this object. The attributes supported for this class are listed below.

5.3.2 Class ID 0x01

Attribute	Access	Name	Data type	Min/Max	Units	Default	Description
1	Get	Vendor	USINT			97	Vendor Code
2	Get	Device Type	UNIT			2	AD/DC Motor
3	Get	Product Code	UNIT			100	See EDS File Section
4	Get	Revision	UNIT				Software version on "aDVanced AC Drive"
5	Get	Status	UNIT				
6	Get	Serial Number	UDINT				From adjustable frequency drive
7	Get	Product Name	String				"aDVanced AC Drive"
10	Get/Set	Heartbeat Interval	USINT	0-255	sec	0	Off

5.3.3 Class ID 03h DeviceNet Object

This is a standard DeviceNet object for configuration and status of the DeviceNet connection.
The attributes supported for this class are listed below.

5.3.4 Class ID 0x03

Attribute	Access	Name	Data type	Min/Max	Units	Default	Description
1	Get/Set	MAC ID	USINT	0-63		63	Node address
2	Get/Set	Baud Rate	USINT	0-2		0	0=125 1=250 2=500
4	Get	BOC					Bus-Off Counter
5	Get	Allocate information					Only required if a predefined master/slave is implemented
6	Get	MAC ID Switch changed	BOOL	0-1		0	The node address switch has changed since the last power-up/reset
7	Get	Baud rate switched from last power-up	BOOL	0-1		0	The baud rate switch has changed since the last power-up

5.3.5 Class ID 04h Assembly Object

This is a standard DeviceNet object for transfer of the I/O instances (process data) described in the section "How to control the adjustable frequency drive." Using this it is possible to send or read any of the defined Instances, either by polling or explicit messaging.

The attributes supported for this class are listed below.

5.3.6 Class ID 0x04

Attribute	Access	Name	Data type	Min/Max	Units	Default	Description
3	Set	Data	ARRAY				

Instance	Access	Size	Description	Par. 10-10 selection:
20	Set	2 Words	DeviceNet AC/DC Profile	Instance 20/70
21	Set	2 Words	DeviceNet AC/DC Profile	Instance 21/71
70	Get	2 Words	DeviceNet AC/DC Profile	Instance 20/70
71	Get	2 Words	DeviceNet AC/DC Profile	Instance 21/71
100	Set	2 Words	Vendor specific, no PCD Words	Instance 100/150
101	Set	4 Words	Vendor specific, 2 PCD Words	Instance 101/151
150	Get	2 Words	Vendor specific, no PCD Words	Instance 100/150
151	Get	4 Words	Vendor specific, 2 PCD Words	Instance 101/151

5.3.7 Class ID 05h Connection Object

This is a standard DeviceNet object for allocation and managing I/O and explicit messaging connections. For this class three instances are supported: explicit messages, polled I/O and change of state connections.

The attributes supported for the different instances are listed below.

5.3.8 Instance 1 Attributes: Explicit Message Instance

Attribute	Access	Name	Data type	Description
1	Get	State	USINT	State of the object
2	Get	Instance Type	USINT	Indicates either I/O or Explicit Message
3	Get	Transport Class Trigger	USINT	Defines behavior of the connection
4	Get	Produced Connection ID	UINT	CAN Identifier Field when the connection transmits
5	Get	Consumed Connection ID	UINT	CAN Identifier Field value that denotes message to be received
6	Get	Initial Communication Characteristics	USINT	Defines the message group(s) across which productions and consumptions associated with this connection occur
7	Get	Produced Connection size	UINT	Maximum number of bytes transmitted across this connection
8	Get	Consumed Connection size	UINT	Maximum number of bytes received across this connection
9	Get/Set	Expected Package Rate	UINT	Defines value used in Transmission Trigger Timer and Inactivity/Watchdog timer
12	Get	Watchdog timeout action	USINT	Defines how to handle Inactivity/Watchdog timeout
13	Get	Produced Connection Path Length	UINT	Number of Bytes in the produced connection path attribute
14	Get	Produced Connection Path	Array of USINT	Specifies the Application object(s) whose data is to be produced by these connection objects
15	Get	Consumd Connection Path Length	UINT	Number of bytes in the consumed connection path attribute
16	Get	Consumed Connection Path	Array of USINT	Specifies the Application object(s) that are to receive the data consumed by this connection object
17	Get	Production Inhibit Time	UINT	Defines minimum time between new data production. This attribute is required for I/O client connection.

5.3.9 Instance 2 Attributes: Polled I/O

Attribute	Access	Name	Data type	Description
1	Get	State	USINT	State of the object
2	Get	Instance Type	USINT	Indicates either I/O or Explicit Message
3	Get	Transport Class Trigger	USINT	Defines behavior of the connection
4	Get	Produced Connection ID	UINT	CAN Identifier Field when the connection transmits
5	Get	Consumed Connection ID	UINT	CAN Identifier Field value that denotes message to be received
6	Get	Initial Communication Characteristics	USINT	Defines the message group(s) across which productions and consumptions associated with this connection occur
7	Get	Produced Connection size	UINT	Maximum number of bytes transmitted across this connection
8	Get	Consumed Connection size	UINT	Maximum number of bytes received across this connection
9	Get/Set	Expected Package Rate	UINT	Defines value used in Transmission Trigger Timer and Inactivity/Watchdog timer
12	Get	Watchdog timeout action	USINT	Defines how to handle Inactivity/Watchdog timeout
13	Get	Produced Connection Path Length	UINT	Number of Bytes in the produced connection path attribute
14	Get	Produced Connection Path	Array of USINT	Specifies the Application object(s) whose data is to be produced by these connection objects
15	Get	Consumd Connection Path Length	UINT	Number of bytes in the consumed connection path attribute
16	Get	Consumed Connection Path	Array of USINT	Specifies the Application object(s) that are to receive the data consumed by this connection object
17	Get	Production Inhibit Time	UINT	Defines minimum time between new data production. This attribute is required for I/O client connection.

5.3.10 Instance 4: Change of State/Cycle

Attribute	Access	Name	Data type	Description
1	Get	State	USINT	State of the object
2	Get	Instance Type	USINT	Indicates either I/O or Explicit Message
3	Get	Transport Class Trigger	USINT	Defines behavior of the connection
4	Get	Produced Connection ID	UINT	CAN Identifier Field when the connection transmits
5	Get	Consumed Connection ID	UINT	CAN Identifier Field value that denotes message to be received
6	Get	Initial Communication Characteristics	USINT	Defines the message group(s) across which productions and consumptions associated with this connection occur
7	Get	Produced Connection size	UINT	Maximum number of bytes transmitted across this connection
8	Get	Consumed Connection size	UINT	Maximum number of bytes received across this connection
9	Get/Set	Expected Package Rate	UINT	Defines value used in Transmission Trigger Timer and Inactivity/Watchdog timer
12	Get	Watchdog timeout action	USINT	Defines how to handle Inactivity/Watchdog timeout
13	Get	Produced Connection Path Length	UINT	Number of Bytes in the produced connection path attribute
14	Get	Produced Connection Path	Array of USINT	Specifies the Application object(s) whose data is to be produced by these connection objects
15	Get	Consumd Connection Path Length	UINT	Number of bytes in the consumed connection path attribute
16	Get	Consumed Connection Path	Array of USINT	Specifies the Application object(s) that are to receive the data consumed by this connection object
17	Get	Production Inhibit Time	UINT	Defines minimum time between new data production. This attribute is required for I/O client connection.

5.3.11 Class ID 0F4 Parameter Object

This object is an interface to the parameters of the drive. It identifies configurable parameters and supplies their description, including min. and max. values and a descriptive text.

The attributes supported are listed below.

Attribute	Access	Stub/Full	Name	Data type	Description
1	Set/Get	Stub	Parameter value	Data type[1]	Actual value of parameter
2	Get	Stub	Link path size	USINT	Size of link path
3	Get	Stub	Link path	ARRAY	DeviceNet's path to parameter's origin
			Segment type/port	BYTE	
			Segment Address	Path	
4	Get	Stub	Descriptor	WORD	Description of parameter
5	Get	Stub	Data type	EPATH	Data type code
6	Get	Stub	Data size	USINT	Number of bytes in parameter value
7	Get	Full	Parameter name string	SHORT STRING	Human-readable text string representing parameter name
8	Get	Full	Units string	SHORT STRING	Human-readable text string representing parameter name
9	Get/Set	Full	Help string	SHORT STRING	Human-readable text string representing parameter name
10	Get	Full	Min value	Data type[1]	Min valid value
11	Get	Full	Max value	Data type[1]	Max valid value
12	Get	Full	Default value	Data type[1]	Parameters default value
13	Get	Full	Scaling multiplier	UINT	Multiplier for scaling factor
14	Get	Full	Scaling divisor	UINT	Divisor for scaling factor
15	Get	Full	Scaling base	UINT	Base for scaling formula
16	Get	Full	Scaling offset	INT	Offset for scaling formula
17	Get	Full	Multiplier link	UINT	Parameter instance of multiplier source
18	Get	Full	Divisor link	UINT	Parameter instance of divisor source
19	Get	Full	Base link	UINT	Parameter instance of base source
20	Get	Full	Offset link	UINT	Parameter instance of offset source
21	Get	Full	Decimal precision	USINT	Specifies parameter value format

[1] = Same data type as the parameter.

5.3.12 Class ID 10h Parameter Group Object

This object defines 14 parameter groups for all "aDVanced AC Drive" parameters. One class instance exists for each parameter group. A read out of an instance will contain the name of the current parameter group.

Group	Instance	Name (max. 16 characters)															
0	1	O	P	E	R	A	T	I	O	N		D	I	S	P	L	.
1	2	L	O	A	D		M	O	T	O	R						
2	3	B	R	A	K	E	S										
3	4	R	E	F	E	R	E	N	C	E		R	A	M	P	S	
4	5	L	I	M	I	T	S		W	A	R	N	I	N	G	S	
5	6	D	I	G	I	T	A	L		I	N		O	U	T		
6	7	A	N	A	L	O	G		I	N		O	U	T			
7	8	C	O	N	T	R	O	L	L	E	R	S					
8	9	C	O	M	M	.		A	N	D		O	P	T	I	O	N
9	10	C	A	N		F	I	E	L	D	B	U	S				
10	11	S	P	E	C	I	A	L		F	U	N	C	T	I	O	N

5.3.13 Class ID 28 Motor Data Object

In this object, the current motor data can be configured and read out. The instances, attributes and services supported for this class are listed below.

5.3.14 Class ID 0/28 Motor Data Object

Attribute	Access	Name	Data type	Generic maximum values	Units	Default	Description	Parameter reference
3	Get/set	Motor type	USINT	7		7	7 = Squirrel Cage Induction Motor	par. 1-10 *Motor Construction*
6	Get/set	Rated current	UNIT	0–100.00	100 mA	Drive dependent	Stator current rating (from motor nameplate)	par. 1-24 *Motor Current*
7	Get/set	Rated voltage	UNIT	200-500	volt	Drive dependent	Base voltage rating (from motor nameplate)	par. 1-22 *Motor Voltage*
8	Get/set	Rated power	UDINT	0-18500	Watt	Drive dependent	Power rating at rated frequency (from motor nameplate)	par. 1-20 *Motor Power [kW]*
9	Get/set	Rated frequency	UNIT	1-1000	Hz	Drive dependent	Elec. frequency rating (from motor nameplate)	par. 1-23 *Motor Frequency*
12*	Get/set	Pole count	UINT			Drive dependent	Number of poles in the motor	par. 1-39 *Motor Poles*
15	Get/set	Base speed	UNIT	100-60000	RPM	Drive dependent	Nominal motor speed (from motor nameplate)	par. 1-25 *Motor Nominal Speed*

5.3.15 Class ID 29h Control Supervisory Object

The control supervisory object can be used for process control and monitoring of the adjustable frequency drive, as an alternative to the I/O instances defined in the section "How to control the adjustable frequency drive".

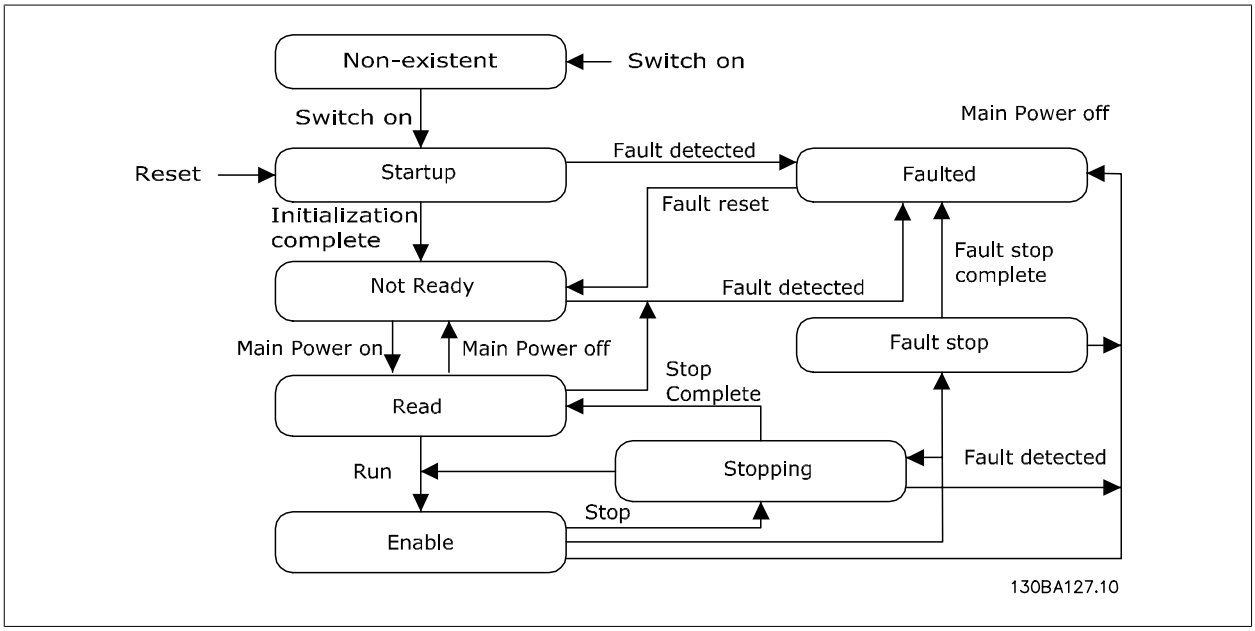
The attributes supported for this class are listed below.

5.3.16 Class ID 0x29

Attribute	Access	Name	Data type	Min/ Max	Default	Description
3	Get/Set	Run 1	Bool	0-1		Run Fwd, see note below
4	Get/Set	Run 2	Bool	0-1		Run rev, see note below
5	Get/Set	NetCtrl	Bool	0-1	1	0 = Local Control 1 = Control from Network
6	Get	State	USINT	0-7		0 = Vendor specific 1 = Start up 2 = Not ready 3 = Ready 4 = Enabled 5 = Stopping 6 = Fault stop 7 = Fault
7	Get	Running 1	Bool	0-1	0	0 = Other state 1 = (Enable and Run 1) or (Stopping and Running 1) or (Fault Stop and Running 1)
8	Get	Running 2	Bool	0-1	0	0 = Other state 1 = (Enable and Run 2) or (Stopping and Running 2) or (Fault Stop and Running 2)
9	Get	Ready	Bool	0-1		0 = Other state 1 = Ready or Enabled or Stopping
10	Get	Fault	Bool	0-1	0	0 = No Faults Present 1 = Fault Occurred (latched)
12	Get/Set	Fault Rst	Bool	0-1		0 = No Action 1 ->1 = Reset Fault
13	Get	Fault Code	UINT			
15	Get	Ctrl From Net	Bool	0-1	1	0 = Control is local 1 = Control is from Network
16	Get/Set	DN Fault Mode	UINT	0-2	1	Action on loss of DeviceNet 0 = Fault + Stop 1 = Ignore (Warning Optional) 2 = Vendor-specific

NOTE!
The ODVA drive profile selected in par. 1-10 *Motor Construction* is available only when instances 20/70 or 21/71 are selected.

The State – Transition diagram below shows how the adjustable frequency drive will respond to the various command attributes associated with Class ID 0x29.



5.3.17 Class ID 2Ah AC/DC Drive Object

Use this object to set and read out a range of "aDVanced AC Drive" drive control and status information. The attributes supported for this class are listed below.

5.3.18 Class ID 0x2A

Attribute	Access	Name	Data type	Min/ Max	Default	Description
3	Get	At Reference	Bool	0-1		0 = Drive not at reference 1 = Drive at reference
4	Get/Set	Net REf	Bool	0-1	1	0 = Set reference at non-DeviceNet reference 1 = Set reference at DeviceNet reference
6	Get/Set	Drive Mode	USINT	0-1	1	0 = Vendor specific mode 1 = Open-loop speed (Frequency) 2 = Closed-loop speed control
7	Get	Speed Actual	INT		RPM/$2^{\text{Speed Scale}}$	Actual drive speed (best approximation)
8	Get/Set	Speed Ref	INT		RPM/$2^{\text{Speed Scale}}$	Speed reference
22	Get/Set	Speed Scale	SINT	-128-127		Speed scaling factor
29	Get	Ref from Net	Bool	0-1		0 = Local speed reference 1 = DeviceNet speed reference

5.3.19 Class ID 2Bh (Acknowledge Handler Object)

Use this object to manage message reception acknowledgements, necessary for Change-Of-State support.

The attributes supported for this class are listed below.

5.3.20 Class ID 0x2B

Attribute	Access	Name	Data type	Min/ Max	Default	Description
1	Set	ACK Timer	UINT	0-65535	16	Time top wait for ACK before resending
2	Get/Set	Retry Timer	USINT	0-255	1	Number of ACK timeouts to wait before producing. RetryLimit_Reached event.
3	Get/Set	COS	UINT			Connection instance ID

5.4 Object Classes

Use the Drive classes for read and write of all "aDVanced AC Drive" parameter values. For each parameter group, a corresponding object class is defined. The following table shows the classes supported, and their relationship to the "aDVanced AC Drive" parameters.

The class instance and attribute act in the following way:

- 100 added to the parameter group = the value for the class
- 100 added to the remaining parameter number = the value for the instance
- 100 added to the array index of the parameter = the value for the attribute.

Classes

Parameter range	Class
Parameter 0-00 - 0-99	Class 100
Parameter 1-00 - 1-99	Class 101
Parameter 2-00 - 2-99	Class 102
Parameter 3-00 - 3-99	Class 103
Parameter 4-00 - 4-99	Class 104
Parameter 5-00 - 5-99	Class 105
Parameter 6-00 - 6-99	Class 106
Parameter 7-00 - 7-99	Class 107
Parameter 8-00 - 8-99	Class 108
Parameter 10-00 - 10-99	Class 110
Parameter 11-00 - 11-99	Class 111
Parameter 13-00 - 13-99	Class 113
Parameter 14-00 - 14-99	Class 114
Parameter 15-00 - 15-99	Class 115
Parameter 16-00 - 16-99	Class 116

5.4.1 Example

Examples: (fictitious parameters) (All values in decimal)

- par. 0-01 *Language* [index 0] = Class 100; Instance 101; Attribute 100
- par. 1-00 *Configuration Mode* [index 0] = Class 101; Instance 100; Attribute 100
- Parameter 2-59Par. C-59 [index 0] = Class 102; Instance 159; Attribute 100
- Parameter 5-34 [index 3] = Class 105; Instance 134; Attribute 103
- par. 6-54 *Terminal 42 Output Timeout Preset* [index 9] = Class 106; Instance 154; Attribute 109
- par. 10-01 *Baud Rate Select* [index 0] = Class 110; Instance 101; Attribute 100

6 Parameters

8-01 Control Site

Option:		Function:
		The setting in this parameter overrides the settings in par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select*.
[0] *	Digital and ctrl. word	Control by using both digital input and control word.
[1]	Digital only	Control by using digital inputs only.
[2]	Control word only	Control by using control word only.

8-02 Control Word Source

Select the source of the control word: one of two serial interfaces or four installed options. During initial power-up, the adjustable frequency drive automatically sets this parameter to *Option A* [3] if it detects a valid serial communication option installed in slot A. If the option is removed, the adjustable frequency drive detects a change in the configuration, sets par. 8-02 *Control Word Source* back to default setting *Adjustable Frequency Drive* RS485, and the adjustable frequency drive then trips. If an option is installed after initial power-up, the setting of par. 8-02 *Control Word Source* will not change but the adjustable frequency drive will trip and display: Alarm 67 *Option Changed*.
This parameter cannot be adjusted while the motor is running.

Option:		Function:
[0]	None	
[1]	FC RS-485	
[2]	FC USB	
[3] *	Option A	
[4]	Option B	
[5]	Option C0	
[6]	Option C1	
[30]	External Can	

8-03 Control Word Timeout Time

Range:		Function:
1.0 s*	[0.1 - 18000.0 s]	Enter the maximum time expected to pass between the reception of two consecutive messages. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in par. 8-04 *Control Word Timeout Function* will then be carried out. The timeout counter is triggered by a valid control word.

8-04 Control Word Timeout Function

Select the timeout function. The timeout function activates when the control word fails to be updated within the time period specified in par. 8-03 *Control Word Timeout Time*.

Option:		Function:
[0] *	Off	Resumes control via serial bus (serial communication bus or standard) using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto-restart when communication resumes.
[3]	Jogging	Runs the motor at JOG frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.

[5]	Stop and trip	Stops the motor, then resets the adjustable frequency drive in order to restart: via the serial communication bus, via the reset button on the Digital Operator or via a digital input.
[7]	Select setup 1	Changes the set-up upon reestablishment of communication following a control word timeout. If communication resumes causing the timeout situation to disappear, par. 8-05 *End-of-Timeout Function* defines whether to resume the set-up used before the timeout or to retain the set-up endorsed by the timeout function.
[8]	Select setup 2	See [7] *Select set-up 1*
[9]	Select setup 3	See [7] *Select set-up 1*
[10]	Select setup 4	See [7] *Select set-up 1*

NOTE!
The following configuration is required in order to change the set-up after a timeout:
Set par. 0-10 *Active Set-up* to [9] *Multi set-up* and select the relevant link in par. 0-12 *This Set-up Linked to*.

6

8-05 End-of-Timeout Function

Option:		Function:
		Select the action after receiving a valid control word following a timeout. This parameter is active only when par. 8-04 *Control Timeout Function* is set to [Set-up 1-4].
[0]	Hold set-up	Retains the set-up selected in par. 8-04 *Control Timeout Function* and displays a warning, until par. 8-06 *Reset Control Timeout* toggles. Then the adjustable frequency drive resumes its original set-up.
[1] *	Resume set-up	Resumes the set-up active prior to the timeout.

8-06 Reset Control Word Timeout

This parameter is active only when *Hold set-up* [0] has been selected in par. 8-05 *End-of-Timeout Function*.

Option:		Function:
[0] *	Do not reset	Retains the set-up specified in par. 8-04 *Control Word Timeout Function*, following a control word timeout.
[1]	Do reset	Returns the adjustable frequency drive to the original set-up following a control word timeout. The adjustable frequency drive performs the reset and then immediately reverts to the *Do not reset* [0] setting

8-07 Diagnosis Trigger

This parameter has no function for DeviceNet.

Option:		Function:
[0] *	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm/warn.	This parameter has no function for DeviceNet.

8-10 Control Word Profile

Instances 20/70 and 21/71 are selectable in par. 10-10 *Process Data Type Selection*.

Option:		Function:
[0] *	FC profile	Instances 100/150 and 101/151 are selectable in par. 10-10 *Process Data Type Selection*.
[1]	PROFIdrive profile	
[5]	ODVA	

[7]	CANopen DSP 402	
[8]		

8-50 Coasting Select

Option:		Function:
		Select control of the coasting function via the terminals (digital input) and/or via the bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or serial communication option.
[2]	Logic AND	Activates Start command via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

6

8-51 Quick Stop Select

Select control of the quick stop function via the terminals (digital input) and/or via the bus.

Option:		Function:
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3] *	Logic OR	

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-52 DC Brake Select

Option:		Function:
		Select control of the DC brake via the terminals (digital input) and/or via the serial communication bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or serial communication option.
[2]	Logic AND	Activates Start command via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-53 Start Select

Option:		Function:
		Select control of the adjustable frequency drive start function via the terminals (digital input) and/or via the serial communication bus.
[0]	Digital input	Activates Start command via a digital input.
[1]	Bus	Activates Start command via the serial communication port or serial communication option.
[2]	Logic AND	Activates Start command via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates Start command via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-54 Reverse Select

Option:		Function:
[0]	Digital input	Select control of the adjustable frequency drive reverse function via the terminals (digital input) and/or via the serial communication bus.
[1]	Bus	Activates the reverse command via the serial communication port or serial communication option.
[2]	Logic AND	Activates the reverse command via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the reverse command via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is only active when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-55 Set-up Select

Option:		Function:
		Select control of the adjustable frequency drive set-up selection via the terminals (digital input) and/or via the serial communication bus.
[0]	Digital input	Activates the set-up selection via a digital input.
[1]	Bus	Activates the set-up selection via the serial communication port or serial communication option.
[2]	Logic AND	Activates the set-up selection via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activate the set-up selection via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-56 Preset Reference Select

Option:		Function:
		Select control of the adjustable frequency drive Preset Reference selection via the terminals (digital input) and/or via the serial communication bus.
[0]	Digital input	Activates Preset Reference selection via a digital input.
[1]	Bus	Activates Preset Reference selection via the serial communication port or serial communication option.
[2]	Logic AND	Activates Preset Reference selection via the serial communication bus/serial communication port, AND additionally via one of the digital inputs.
[3] *	Logic OR	Activates the Preset Reference selection via the serial communication bus/serial communication port OR via one of the digital inputs.

NOTE!
This parameter is active only when par. 8-01 *Control Site* is set to [0] *Digital and control word*.

8-90 Bus Jog 1 Speed

Range:		Function:
100 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. This is a fixed jog speed activated via the serial port or serial communication bus option.

8-91 Bus Jog 2 Speed

Range:		Function:
200 RPM*	[0 - par. 4-13 RPM]	Enter the jog speed. This is a fixed jog speed activated via the serial port or serial communication bus option.

10-00 CAN Protocol

Option:		Function:
[0]	CANopen	
[1] *	DeviceNet	View the active CAN protocol.

NOTE!
The options depend on installed option.

10-01 Baud Rate Select

Select the serial communication bus transmission speed. The selection must correspond to the transmission speed of the master and the other serial communication bus nodes.

Option:		Function:
[16]	10 Kbps	
[17]	20 Kbps	
[18]	50 Kbps	
[19]	100 Kbps	
[20] *	125 Kbps	
[21]	250 Kbps	
[22]	500 Kbps	

10-02 MAC ID

Range:		Function:
63. N/A*	[0 - 63. N/A]	Selection of station address. Every station connected to the same DeviceNet network must have an unambiguous address.

10-05 Readout Transmit Error Counter

Range:		Function:
0 N/A*	[0 - 255 N/A]	View the number of CAN control transmission errors since the last power-up.

10-06 Readout Receive Error Counter

Range:		Function:
0 N/A*	[0 - 255 N/A]	View the number of CAN control receipt errors since the last power-up.

10-07 Readout Bus Off Counter

Range:		Function:
0 N/A*	[0 - 255 N/A]	View the number of Bus Off events since the last power-up.

10-10 Process Data Type Selection

Option:		Function:
		Select the Instance (message) for data transmission. The instances available are dependent upon the setting of par. 8-10 *Control Profile*. When par. 8-10 *Control Profile* is set to [0] *FC profile*, par. 10-10 *Process Data Type Selection* options [0] and [1] are available. When par. 8-10 *Control Profile* is set to [5] *ODVA*, par. 10-10 *Process Data Type Selection* options [2] and [3] are available. Instances 100/150 and 101/151 are specific. Instances 20/70 and 21/71 are ODVA-specific AC Drive profiles. For guidelines in message selection, please refer to the DeviceNet Instruction Manual. Note that a change to this parameter will be executed immediately.
[0] *	INSTANCE 100/150	
[1]	INSTANCE 101/151	
[2]	INSTANCE 20/70	
[3]	INSTANCE 21/71	

10-11 Process Data Config Write

Select the process write data for I/O assembly instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option:	Function:
[0] *	None
[302]	Minimum Reference
[312]	Catch up/slow-down Value
[341]	Ramp 1 Ramp-up Time
[342]	Ramp 1 Ramp-down Time
[351]	Ramp 2 Ramp-up Time
[352]	Ramp 2 Ramp-down Time
[380]	Jog Ramp Time
[381]	Quick Stop Ramp Time
[411]	Motor Speed Low Limit [RPM]
[413]	Motor Speed High Limit [RPM]
[416]	Torque Limit Motor Mode
[417]	Torque Limit Generator Mode
[590]	Digital & Relay Bus Control
[593]	Pulse Out #27 Bus Control
[595]	Pulse Out #29 Bus Control
[653]	Terminal 42 Output Bus Control
[673]	
[683]	
[890]	Bus Jog 1 Speed
[891]	Bus Jog 2 Speed
[1680]	Fieldbus CTW 1
[1682]	Fieldbus REF 1
[3401]	PCD 1 Write to MCO
[3402]	PCD 2 Write to MCO
[3403]	PCD 3 Write to MCO
[3404]	PCD 4 Write to MCO
[3405]	PCD 5 Write to MCO
[3406]	PCD 6 Write to MCO
[3407]	PCD 7 Write to MCO
[3408]	PCD 8 Write to MCO
[3409]	PCD 9 Write to MCO
[3410]	PCD 10 Write to MCO

10-12 Process Data Config Read

Select the process read data for I/O assembly instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option:	Function:
[0] *	None
[1472]	
[1473]	
[1474]	
[1500]	Operating Hours
[1501]	Running Hours
[1502]	kWh Counter
[1600]	Control Word
[1601]	Reference [Unit]
[1602]	Reference %
[1603]	Status Word
[1605]	Main Actual Value [%]
[1609]	Custom Readout
[1610]	Power [kW]
[1611]	Power [hp]
[1612]	Motor voltage
[1613]	Frequency
[1614]	Motor Current
[1615]	Frequency [%]
[1616]	Torque [Nm]
[1617]	Speed [RPM]
[1618]	Motor Thermal
[1619]	KTY sensor temperature
[1620]	Motor Angle
[1622]	Torque [%]
[1625]	
[1630]	DC Link Voltage
[1632]	Brake Energy /s
[1633]	Brake Energy /2 min
[1634]	Heatsink Temp.
[1635]	Inverter Thermal
[1638]	SL Controller State
[1639]	Control Card Temp.
[1650]	External Reference
[1651]	Pulse Reference
[1652]	Feedback [Unit]
[1653]	Digi Pot Reference
[1660]	Digital Input
[1661]	Terminal 53 Switch Setting
[1662]	Analog Input 53

[1663]	Terminal 54 Switch Setting
[1664]	Analog Input 54
[1665]	Analog Output 42 [mA]
[1666]	Digital Output [bin]
[1667]	Freq. Input #29 [Hz]
[1668]	Freq. Input #33 [Hz]
[1669]	Pulse Output #27 [Hz]
[1670]	Pulse Output #29 [Hz]
[1671]	Relay Output [bin]
[1672]	Counter A
[1673]	Counter B
[1674]	Prec. Stop Counter
[1675]	Analog In X30/11
[1676]	Analog In X30/12
[1677]	Analog Out X30/8 [mA]
[1678]	
[1679]	
[1684]	Comm. Option Status
[1685]	FC Port CTW 1
[1690]	Alarm Word
[1691]	Alarm word 2
[1692]	Warning Word
[1693]	Warning word 2
[1694]	Ext. Status Word
[3421]	PCD 1 Read from MCO
[3422]	PCD 2 Read from MCO
[3423]	PCD 3 Read from MCO
[3424]	PCD 4 Read from MCO
[3425]	PCD 5 Read from MCO
[3426]	PCD 6 Read from MCO
[3427]	PCD 7 Read from MCO
[3428]	PCD 8 Read from MCO
[3429]	PCD 9 Read from MCO
[3430]	PCD 10 Read from MCO
[3440]	Digital Inputs
[3441]	Digital Outputs
[3450]	Actual Position
[3451]	Commanded Position
[3452]	Actual Master Position
[3453]	Slave Index Position
[3454]	Master Index Position
[3455]	Curve Position
[3456]	Track Error

[3457]	Synchronizing Error
[3458]	Actual Velocity
[3459]	Actual Master Velocity
[3460]	Synchronizing Status
[3461]	Axis Status
[3462]	Program Status
[3464]	
[3465]	
[3470]	MCO Alarm Word 1
[3471]	MCO Alarm Word 2

10-13 Warning Parameter

Range:		Function:
0 N/A*	[0 - 65535 N/A]	View a DeviceNet-specific warning word. One bit is assigned to every warning.

Bit:	Meaning:
0	Bus not active
1	Explicit connection timeout
2	I/O connection
3	Retry limit reached
4	Actual is not updated
5	CAN bus off
6	I/O send error
7	Initialization error
8	No bus supply
9	Bus off
10	Error passive
11	Error warning
12	Duplicate MAC ID Error
13	RX queue overrun
14	TX queue overrun
15	CAN overrun

10-14 Net Reference

Read only from Digital Operator

Option:		Function:
		Select the reference source in instance 21/71 and 20/70.
[0] *	Off	Enables reference via analog/digital inputs.
[1]	On	Enables reference via the serial communication bus.

10-15 Net Control

Read only from Digital Operator

Option:		Function:
		Select the control source in Instance 21/71 and 20/70.
[0] *	Off	Enables control via analog/digital inputs.
[1]	On	Enable control via the serial communication bus.

10-20 COS Filter 1

Range:		Function:
0 N/A*	[0 - 65535 N/A]	Sets up the filter mask for the status word. When operating in COS (Change-Of-State), it is possible to filter out bits in the status word that should not be sent if they change.

10-21 COS Filter 2

Range:		Function:
0 N/A*	[0 - 65535 N/A]	Sets up the filter mask for the main actual value. When operating in COS (Change-Of-State), it is possible to filter out bits in the main actual value that should not be sent if they change.

10-22 COS Filter 3

Range:		Function:
0 N/A*	[0 - 65535 N/A]	Sets up the filter mask for PCD 3. When operating in COS (Change-Of-State), it is possible to filter out bits in PCD 3 that should not be sent if they change.

10-23 COS Filter 4

Range:		Function:
0 N/A*	[0 - 65535 N/A]	Sets up the filter mask for PCD 4. When operating in COS (Change-Of-State), it is possible to filter out bits in PCD 4 that should not be sent if they change.

10-31 Store Data Values

Option:		Function:
		This parameter is used to activate a function that stores all parameter values in the non-volatile memory thus retaining changed parameter values at power-down.
[0] *	Off	The store function is inactive.
[1]		All parameter values in the set-up selected will be stored in the non-volatile memory. The value returns to *Off* when all values have been stored.
[2]	Store all setups	All parameter values will be stored in the non-volatile memory. The value returns to *Off* when all parameter values have been stored.

10-33 Store Always

This parameter is used to select whether parameter data received via the DeviceNet option should always be stored in non-volatile memory.

Option:		Function:
[0] *	Off	
[1]	On	

16-90 Alarm Word

Range:		Function:
0 N/A*	[0 - 4294967295 N/A]	View the alarm word sent via the serial communication port in hex code.

16-92 Warning Word

Range:		Function:
0 N/A*	[0 - 4294967295 N/A]	View the warning word sent via the serial communication port in hex code.

6.2 Parameter List

Par. No. # and Description	Default value	Range	Conversion index	Data type
Par. 8-00 Enabled options	All [1]	[0 - 7]	-	5
par. 8-01 *Control Site*	Dig. & ctrl. word [0]	[0 - 2]	-	5
par. 8-02 *Control Word Source*	FC RS485 [0]	[0 - 4]	-	5
par. 8-03 *Control Word Timeout Time*	1s	0.1–18000	-1	7
par. 8-04 *Control Word Timeout Function*	Off [0]	[0 - 10]	-1	5
par. 8-05 *End-of-Timeout Function*	Hold set-up [0]	[0 - 1]	-	5
par. 8-06 *Reset Control Word Timeout*	Do not reset [0]	[0 - 1]	-	5
par. 8-07 *Diagnosis Trigger*	Disable [0]	[0 - 3]	-	5
par. 8-10 *Control Word Profile*	FC profile [0]	[0 - x]	-	5
par. 8-50 *Coasting Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-51 *Quick Stop Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-52 *DC Brake Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-53 *Start Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-54 *Reverse Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-55 *Set-up Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-56 *Preset Reference Select*	Logic OR [3]	[0 - 3]	-	5
par. 8-90 *Bus Jog 1 Speed*	100 rpm	0 - par. 4-13 *Motor Speed High Limit [RPM]*	67	6
par. 8-91 *Bus Jog 2 Speed*	200 rpm	0 - par. 4-13 *Motor Speed High Limit [RPM]*	67	6
par. 10-00 *CAN Protocol*	DeviceNet [1]	[0 - 1]	-	5
par. 10-01 *Baud Rate Select*	125 Kbps [20]	[20 - 22]	-	5
par. 10-02 *MAC ID*	63	0 - 63	0	5
par. 10-05 *Readout Transmit Error Counter*	0	0 - 255	0	5
par. 10-06 *Readout Receive Error Counter*	0	0 - 255	0	6
par. 10-07 *Readout Bus Off Counter*	0	0 - 1000	0	
par. 10-10 *Process Data Type Selection*	[0]/[2]	[0 - 3]	0	5
par. 10-11 *Process Data Config Write*	0	list	0	5
par. 10-12 *Process Data Config Read*	0	list	0	5
par. 10-13 *Warning Parameter*	0	0 - FFFF	0	5
par. 10-14 *Net Reference*	Off [0]	[0 - 1]	-	5
par. 10-15 *Net Control*	Off [0]	[0 - 1]	-	5
par. 10-20 *COS Filter 1*	0	0 - FFFF	0	6
par. 10-21 *COS Filter 2*	0	0 - FFFF	0	6
par. 10-22 *COS Filter 3*	0	0 - FFFF	0	6
par. 10-23 *COS Filter 4*	0	0 - FFFF	0	6
par. 10-31 *Store Data Values*	Off [0]	[0 - 2]	-	5
par. 10-32 *Devicenet Revision*	-	-	-	6
par. 10-33 *Store Always*	Off [0]	[0 - 1]	-	5
par. 16-90 *Alarm Word*	0	0 - FFFF	0	7
par. 16-92 *Warning Word*	0	0 - FFFF	0	7

6.3 Data Types Supported

6.3.1 Object and Data Types Supported

Data types supported

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Visible string
10	Byte string
33	Standardized value (16 bit)
35	Bit sequence
41	Byte
42	Word

6.3.2 Conversion Index

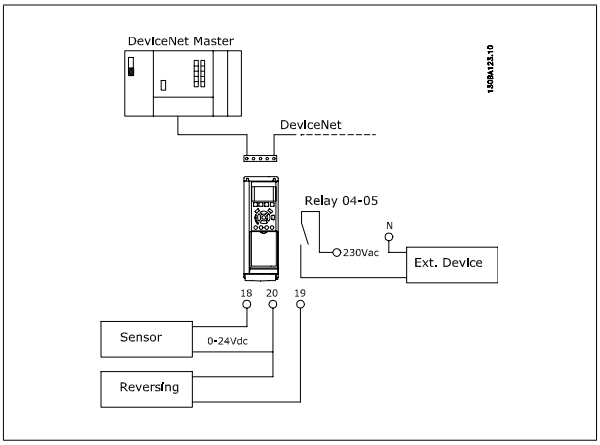
This number refers to a conversion figure used when writing or reading to parameters.

Conversion index	Conversion factor
100	1
67	1/60
6	1000000
5	100000
4	10000
3	1000
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001
-5	0.00001
-6	0.000001

7 Application Examples

7.1 Example: Working with Instance 101/151 Process

This example shows how to work with I/O Instance 101/151, which consists of control word/status word and reference/main actual value. Instance 101/151 also has two additional words, which can be programmed to monitor process signals, as shown in the figure.



The application requires monitoring of the motor torque and digital input, so PCD 3 is set up to read the actual motor torque. PCD 4 is set up to monitor the state of an external sensor via the process signal digital input. The sensor is connected to digital input 18.

An external device is also controlled via control word bit 11 and the built-in relay of the adjustable frequency drive.

Reversing is permitted only when the reversing bit 15 in the control word and the digital input 19 are set to high.

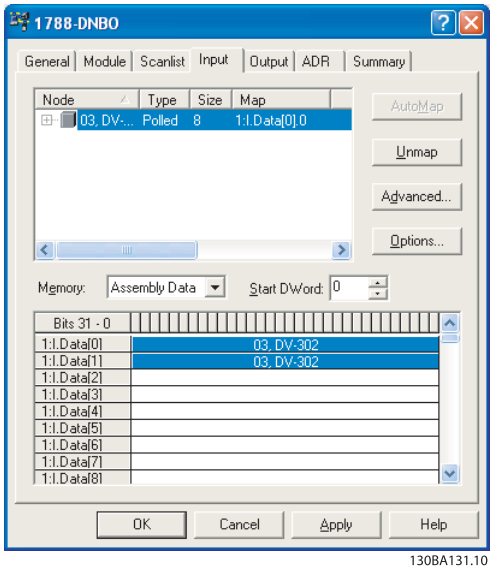
For safety reasons, the adjustable frequency drive will stop the motor if the DeviceNet cable is broken, the master has a system failure, or the PLC is in stop mode.

Parameter	Function	Setting
par. 4-10 *Motor Speed Direction*	Motor speed range/direction	Both directions [2]
par. 5-10 *Terminal 18 Digital Input*	Digital input 18	No operation [0]
par. 5-11 *Terminal 19 Digital Input*	Digital input 19	Reversing [10]
par. 5-40 *Function Relay*	Function relay	Control word bit 11 [36] Control word bit 12 [37]
par. 8-03 *Control Word Timeout Time*	Control word timeout time	1.0 sec
par. 8-04 *Control Word Timeout Function*	Control word timeout function	Stop [2]
par. 8-10 *Control Word Profile*	Control word profile	FC Profile
par. 8-50 *Coasting Select*	Coasting select	Bus [1]
par. 8-51 *Quick Stop Select*	Quick stop select	Bus [1]
par. 8-52 *DC Brake Select*	DC brake select	Bus [1]
par. 8-53 *Start Select*	Start select	Bus [1]
par. 8-54 *Reverse Select*	Reversing select	Logic AND [2]
par. 8-55 *Set-up Select*	Set-up select	Bus [1]
par. 8-56 *Preset Reference Select*	Preset reference select	Bus [1]
par. 10-01 *Baud Rate Select*	Baud rate select	- set to match other DeviceNet stations
par. 10-02 *MAC ID*	MAC ID	- set desired station address
par. 10-10 *Process Data Type Selection*	Process data type selection	Instance 101/151 [1]
par. 10-12 *Process Data Config Read*	Process Data Config Read	PCD 3: Torque PCD 4: Digital input

7.1.1 Example of PLC Programming

In this example, instance 101/151 is placed in the following input/output address:

Input address	0.0–0.15	0.16–0.31	1.0–1.15	1.16–1.31
Set-up	Status word	MAV	Motor torque	Digital input



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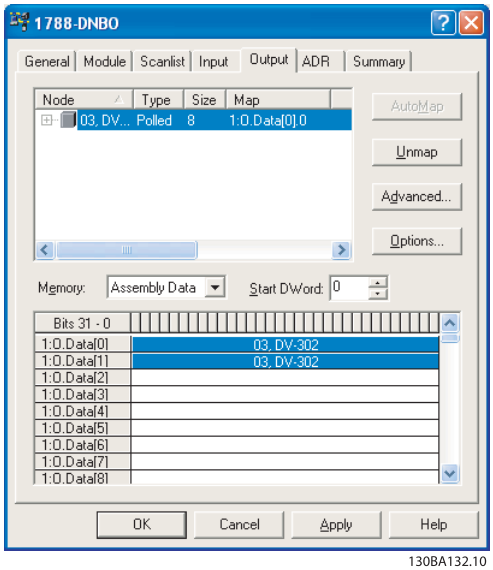
Output address	0.0–0.15	0.16–0.31	1.0–1.15	1.16–1.31
Set-up	Control word	Reference	Not used	Not used



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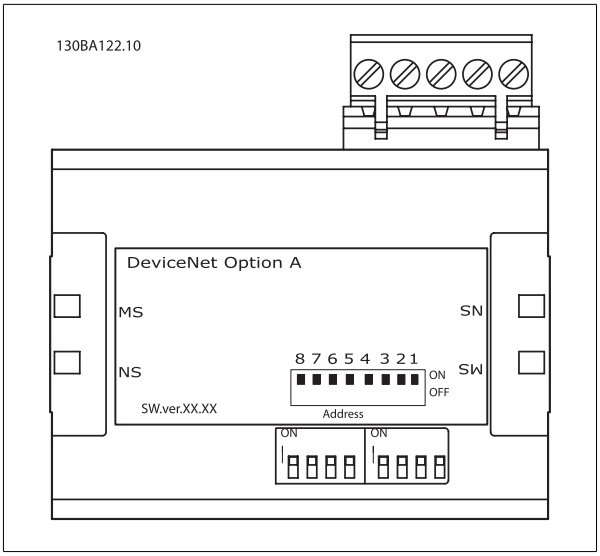
8 Troubleshooting

8.1.1 LED Status

First, check the LEDs.
The DeviceNet control card contains two bi-color (green/red) LEDs to indicate the state of the device and the network, respectively.

The upper LED indicates module status (MS). The lower LED indicates network status (NS).



State	Bi-color LED	Status
No Power	Off	There is no power applied to the option
Device operational	Green	The DeviceNet option is operating in normal condition.
Standby	Green	The DeviceNet option needs commissioning due to configuration missing, incomplete or incorrect.
Minor fault	Red	Recoverable fault.
Unrecoverable fault	Red	Unrecoverable fault, may need replacing.
Self test	Green	The DeviceNet option is in self-test mode.
	Red	

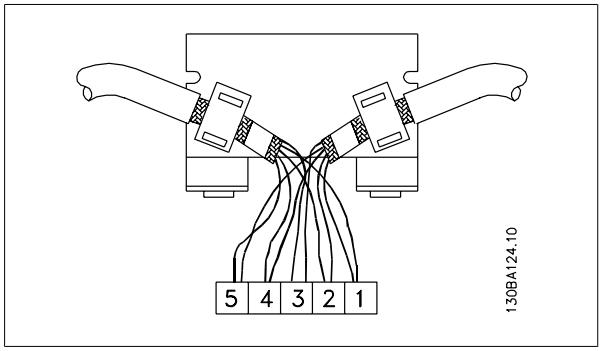
Table 8.1: LED: Module Status (MS)

State	Bi-color LED	Status
No Power/Not on-line	Off	The option has not completed "Duplicate MAC ID" test yet or may not be powered.
On-line, not connected	Green	The option is on-line, but not allocated to a master.
On-line and connected	Green	The DeviceNet option is on-line and connected to a master.
Connection timeout	Red	One or more I/O connections are in timeout state.
Critical link failure	Red	

Table 8.2: LED: Network Status (NS)

8.1.2 No Communication with the Drive

If there is no communication with the drive, proceed with the following checks:



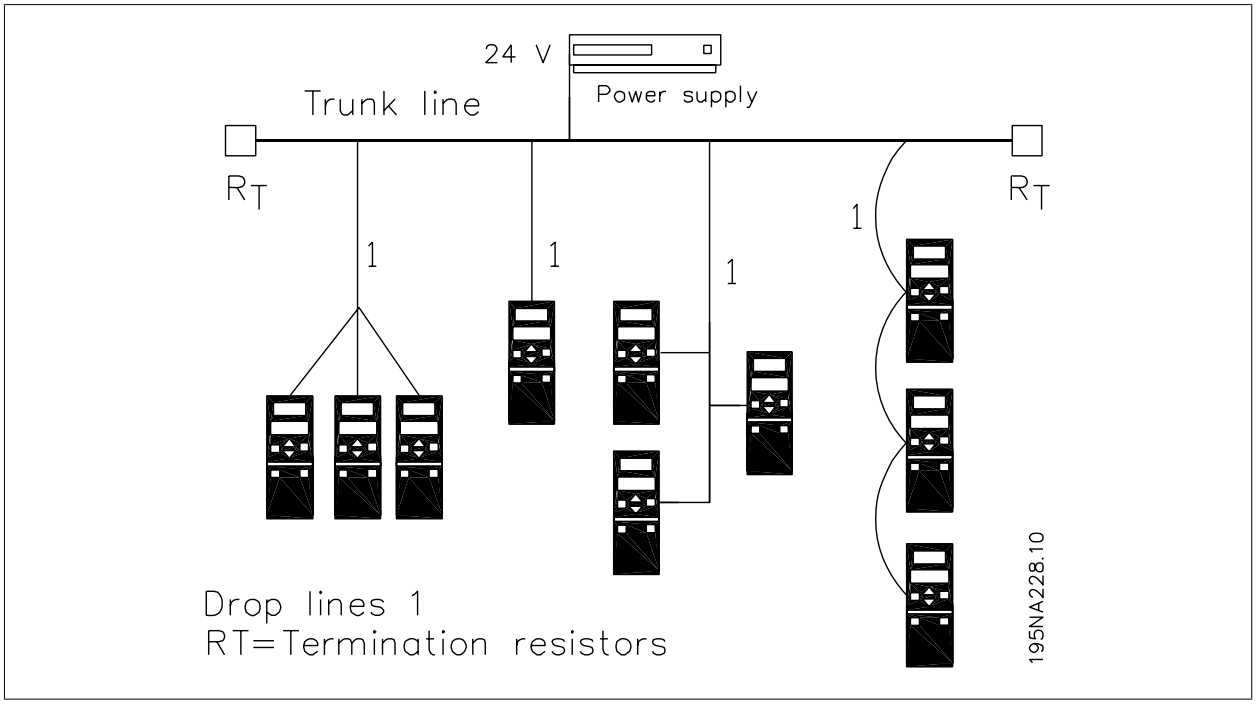
Check 1: Is the cabling correct?
Check that the cables are connected to the correct terminals as shown in the diagram.

Pin no.	Terminal	Color	Name
1	V-	Black	GND
2	CAN_L	Blue	CAN LOW
3	Drain	(bare)	Shield
4	CAN_H	White	CAN HIGH
5	V+	Red	+24 V

Check 2: Is the 24 V network voltage applied?

Check 3: Is the correct EDS file installed?

Check 4: Is the bus connection terminated at both ends?
If not, terminate the bus connection with termination resistors at the initial and final nodes, as shown in the following diagram. Termination is performed between terminal 2 (CAN_L) and 4 (CAN_H) with a resistor: 121 Ohm, 1% metal film, ¼ Watt.



8.1.3 Drive Will Not Respond to Control Signals

- Control Word profile (instances 100/150 and 101/151)

Check 1: Is the control word valid?

If bit 10=0 is in the control word, then the adjustable frequency drive will not accept the control word, because the default setting is bit 10=1. Set bit 10=1 via the PLC.

Check 2: Is the relationship between bits in the control word and the terminal I/Os correct?

Check the logical relationship in the adjustable frequency drive.

Set the logic to bit 3=1 AND digital input=1 in order to achieve a successful start.

Define the desired logical relationship in par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select* according to the following range of options. Select the FC control mode, digital input and/or bus communication, using par. 8-50 *Coasting Select* to par. 8-56 *Preset Reference Select*.

The tables below show the effect upon the adjustable frequency drive of a coast command for the full range of par. 8-50 *Coasting Select* settings.

The effect of control mode upon the function of par. 8-50 *Coasting Select*, par. 8-51 *Quick Stop Select* and par. 8-52 *DC Brake Select* is as follows:

If *Digital input* [0] is selected, the terminals will control the coast and DC brake functions.

Par. 8-50/51/52 setting: ***Digital Input [0]***

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	Coast/DC brake/Q-Stop
1	0	No Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

If Bus [1] is selected, commands will be activated only when given via the control word.

Par. 8-50/51/52 setting: ***Bus [1]***

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	No Coast/DC brake/Q-Stop
1	0	Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

If Logic AND [2] is selected, both signals must be activated to perform the function.

Par. 8-50/51/52 setting: ***Logic AND [2]***

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	No Coast/DC brake/Q-Stop
1	0	No Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

If Logic OR [3] is selected, activation of one signal will activate the function.

Par. 8-50/51/52 setting: ***Logic OR [3]***

Terminal	Bit 02/03/04	Function
0	0	Coast/DC brake/Q-Stop
0	1	Coast/DC brake/Q-Stop
1	0	Coast/DC brake/Q-Stop
1	1	No Coast/DC brake/Q-Stop

NOTE!

Please note that coasting, quick stop and DC brake functions are active for logic "0".

The effect of control mode upon the function of par. 8-53 *Start Select* and par. 8-54 *Reverse Select*:

If *Digital Input* [0] is selected, the terminals will control the start and reversing functions

Par. 8-53/54 setting: ***Digital input [0]***

Terminal	Bit 06/15	Function
0	0	Stop/counter-clockwise
0	1	Stop/counter-clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

If Bus [1] is selected, commands will be activated only when given via the control word.

Par. 8-53/54 setting: ***Bus [1]***

Terminal	Bit 02/03/04	Function
0	0	Stop/counter-clockwise
0	1	Start/Clockwise
1	0	Stop/counter-clockwise
1	1	Start/Clockwise

If Logic AND [2] is selected, both signals must be activated to perform the function.

Par. 8-53/54 setting: ***Logic AND [2]***

Terminal	Bit 02/03/04	Function
0	0	Stop/counter-clockwise
0	1	Stop/counter-clockwise
1	0	Stop/counter-clockwise
1	1	Start/Clockwise

If Logic OR [3] is selected, activation of one signal will activate the function.

Par. 8-53/54 setting: ***Logic OR [3]***

Terminal	Bit 02/03/04	Function
0	0	Stop/counter-clockwise
0	1	Start/Clockwise
1	0	Start/Clockwise
1	1	Start/Clockwise

8

The effect of control mode upon the function of par. 8-55 *Set-up Select* and par. 8-56 *Preset Reference Select*:

If *Digital input* [0] is selected, the terminals will control the set-up and preset reference functions.

Par. 8-55/56 setting: ***Digital input [0]***

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref., Set-up no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	2
0	1	0	1	2
0	1	1	0	2
0	1	1	1	2
1	0	0	0	3
1	0	0	1	3
1	0	1	0	3
1	0	1	1	3
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

If Bus [1] is selected, commands will be activated only when given via the control word.

Par. 8-55/56 setting: ***Bus [1]***

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref., Set-up no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	1
0	1	0	1	2
0	1	1	0	3
0	1	1	1	4
1	0	0	0	1
1	0	0	1	2
1	0	1	0	3
1	0	1	1	4
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

If Logic AND [2] is selected, both signals must be activated to perform the function.

Par. 8-55/56: ***Logic AND [2]***

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref., Set-up no.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	2
0	1	1	0	1
0	1	1	1	2
1	0	0	0	1
1	0	0	1	1
1	0	1	0	3
1	0	1	1	3
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

If Logic OR [3] is selected, activation of one signal will activate the function.

Par. 8-55/56 setting: ***Logic OR [3]***

Terminal		Bit 00/01, 13/14		Function
Msb	Lsb	Msb	Lsb	Preset ref., Set-up no.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	2
0	1	0	1	2
0	1	1	0	4
0	1	1	1	4
1	0	0	0	3
1	0	0	1	4
1	0	1	0	3
1	0	1	1	4
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4

8.1.4 Alarm Word and Warning Word

Alarm word and Warning word are shown on the display in Hex format. If there is more than one warning or alarm, a sum of all warnings or alarms will be shown. Alarm word and warning word can also be displayed using the serial communication bus in par. 16-05 *Main Actual Value [%]*.

"aDVanced AC Drive"				
Bit (Hex)	Alarm word (par. 16-90 *Alarm Word*)	Alarm no.	Major / minor alarm	Recoverable / unrecoverable alarm
00000001	Unused	-	-	-
00000002	Drive overtemperature	29	Major	Recoverable
00000004	Ground fault	14	Major	Unrecoverable
00000008	Unused	-	-	-
00000010	Control word timeout	18	Minor	Recoverable
00000020	Overcurrent	13	Major	Unrecoverable
00000040	Torque limit	12	Major	Recoverable
00000080	Motor thermistor overtemp.	11	Major	Recoverable
00000100	Motor ETR overtemperature	10	Major	Recoverable
00000200	Inverter overloaded	9	Major	Recoverable
00000400	DC link undervoltage	8	Major	Recoverable
00000800	DC link overvoltage	7	Major	Recoverable
00001000	Short circuit	16	Major	Unrecoverable
00002000	Soft-charge fault	33	Major	Recoverable
00004000	Line phase loss	4	Major	Unrecoverable
00008000	AMA not OK	50	Major	Recoverable
00010000	Live zero error	2	Major	Recoverable
00020000	Internal fault	38	Major	Unrecoverable
00040000	Brake resistor power limit	26	Major	Unrecoverable
00080000	Motor phase U is missing	30	Major	Unrecoverable
00100000	Motor phase V is missing	31	Major	Unrecoverable
00200000	Motor phase W is missing	32	Major	Unrecoverable
00400000	Ser. com. bus fault	34	Major	Recoverable
00800000	24 V supply fault	47	Major	Unrecoverable
01000000	Line failure	36	Major	Recoverable
02000000	1.8 V supply fault	48	Major	Unrecoverable
04000000	Brake resistor short circuit	25	Major	Recoverable
08000000	Brake chopper fault	27	Major	Recoverable
10000000	Unused	-	-	-
20000000	Unused	-	-	-
40000000	Unused	-	-	-
80000000	Unused	-	-	-

"aDVanced AC Drive"		
Bit (Hex)	Warning word (par. 16-92 *Warning Word*)	Warning no.
00000001	Unused	-
00000002	Drive overtemperature	29
00000004	Ground fault	14
00000008	Unused	-
00000010	Control word timeout	18
00000020	Overcurrent	13
00000040	Torque limit	12
00000080	Motor thermistor overtemp.	11
00000100	Motor ETR overtemperature	10
00000200	Inverter overloaded	9
00000400	DC link undervoltage	8
00000800	DC link overvoltage	7
00001000	DC link voltage low	6
00002000	DC link voltage high	5
00004000	Line phase loss	4
00008000	No motor	3
00010000	Live zero error	2
00020000	10 V low	1
00040000	Brake resistor power limit	26
00080000	Brake resistor short circuit	25
00100000	Brake chopper fault	27
00200000	Speed limit	49
00400000	Serial Communication Bus comm. fault	34
00800000	24 V supply fault	47
01000000	Line failure	36
02000000	Current limit	59
04000000	Unused	-
08000000	Unused	-
10000000	Unused	-
20000000	Unused	-
40000000	Unused	-
80000000	Warning word 2 (ext. stat. word)	-

8.2 Alarm/Warning Limits

8.2.1 Warnings and Alarm Messages

There is a clear distinction between alarms and warnings. In the event of an alarm, the adjustable frequency drive will enter a fault condition. After the cause for the alarm has been cleared, the master will have to acknowledge the alarm message for the adjustable frequency drive to start operating again. A warning on the other hand may come when a warning condition appears, and disappear when conditions return to normal without interfering with the process.

8.2.2 Warnings

All warnings within the adjustable frequency drive are represented by a single bit within a warning word. A warning word is always an action parameter. Bit status FALSE [0] means no warning, while bit status TRUE [1] means warning. To each bit and each bit status, there is a corresponding text string. In addition to the warning word message, the master will also be notified through a change of bit 7 in the status word.

8.2.3 Alarms

Following an alarm message, the adjustable frequency drive will enter fault condition. Only after the fault has been alleviated and the master has acknowledged the alarm message by setting bit 3 in the control word, can the adjustable frequency drive resume operation. All alarms within the adjustable frequency drive are represented by a single bit within an alarm word. An alarm word is always an action parameter. Bit status FALSE [0] means no alarm, while bit status TRUE [1] means alarm.

130R0471 MG35H122 Rev. 2009-05-15