TOSVERT VF-S15 / VF-AS3 series

CANopen®

Communication Function Manual

TOSHIBA INDUSTRIAL PRODUCTS AND SYSTEMS CORPORATION

NOTICE

1. Read this manual before installing or operating. Keep this instruction manual on hand of the end user, and make use of this manual in maintenance and inspection.
2. All information contained in this manual will be changed without notice. Please contact your Toshiba distributor to confirm the latest information.

Introduction

Thank you for purchasing TOSVERT VF-S15 / VF-AS3 series.

Before using CANopen® communication function, carefully read this function manual in order to completely and correctly utilize its excellent performance.

After reading this function manual, please keep it handy for future reference.

For details of its general handling, see an instruction manual attached with the option unit.

- ·TOSVERT VF-S15 Instruction Manual ····· E6581611
- ·TOSVERT VF-S15 Communications Function Instruction Manual ····· E6581913
- ·VF-S15 Option Adapter Instruction Manual ····· E6581838

- ·TOSVERT VF-AS3 Instruction Manual ····· E6582062
- ·TOSVERT VF-AS3 Communications Function Instruction Manual ····· E6582143

* CANopen® and CiA® are a registered trademark of CAN in Automation.

■ **Handling in general**

⚠ Danger	
Mandatory	▼ Do not connect or disconnect a network cable while the drive power is on. It may lead to electric shocks or fire. ▼ See the instruction manual attached with the option unit for cautions the handling. Otherwise, it may lead to electric shocks, fire, injuries or damage to product.

■ **Network control**

⚠ Warning	
Prohibited	▼ Do not send the value out of the valid range to network variables. Otherwise, the motor may suddenly start/stop and that may result in injuries. ▼ Do not use application of writing into same parameter more than 100,000 times. The Life of EEPROM is approximately 100,000 times. Do not write to the user parameter area of inverter by SDO to avoid EEPROM broken. See "5.2.Manufacturer specific profile" in detail.
Mandatory	▼ Use an additional safety device with your system to prevent a serious accident due to the network malfunctions. Usage without an additional safety device may cause an accident.
⚠ Warning	
Mandatory	▼ Set up “Communication error trip function (see below)” to stop the drive when the network is deactivated by an unusual event such as tripping, an operating error, power outage, failure, etc. - Communication error trip time, Operation at communication error (Refer to “7.4 Communication disconnection detection function” for details) Deactivated the drive may cause an accident, if the “Communication error trip function” is not properly set up. ▼ Make sure that the operation signals are STOP before resetting drive’s fault. The motor may suddenly start and that may result in injuries.

■ **Notes on operation**

Notes	
	▼ When the control power is shut off by the instantaneous power failure, communication will be unavailable for a while.

Table of Contents

1. Scope

1.1. Overview

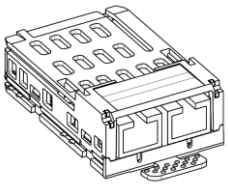
Thank you for purchasing TOSVERT VF-S15 / VF-AS3. These drives can connect with open field network CANopen and the communication supports up to 64 nodes in one segment.
By using CANopen function, the monitor of run/stop and the setting change of the parameter become possible from the network, and it can cope with various applications.

This manual is also aimed at the operator using "VF-S15 / VF-AS3", so please use it for future maintenance and inspection.

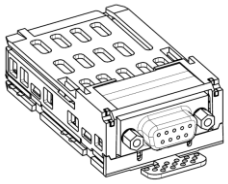
1.2. Applicable model

If VF-AS3 is used, it needs CPU1 version is 112 or more.

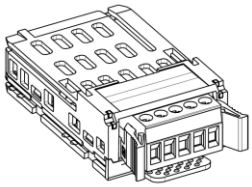
Communication option	Applicable model
CAN001Z CAN002Z CAN003Z	VF-S15
	VF-AS3 (CPU1 version is 112 or more)



Type form	CAN001Z
Connector	2×RJ45



Type form	CAN002Z
Connector	9pin D-sub



Type form	CAN003Z
Connector	5 pin open type

1.3. EDS file

When CAN001Z/CAN002Z/CAN003Z is used, please use following EDS (Electronic data sheet) file for VF-S15/VF-AS3. Please contact your Toshiba distributor.

.

EDS file	Applicable model
VF-S15_CANopen.eds	VF-S15
VF-AS3_CANopen.eds	VF-AS3 (CPU1 version is 112 or more)

2. Hardware Setup

When using this product with VF-S15, the optional adapter (SBP009Z) is required.

2.1. Mounting and removing

2.1.1. Mounting/removing insert type option of VF-S15

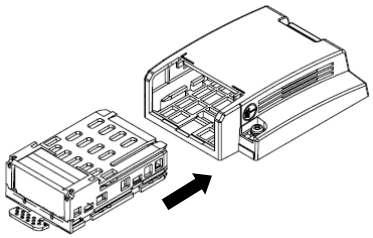
Refer to [Optional external devices] of E6581611.

⚠Warning	
Mandatory action	▼ Mounting/removing option should be performed 15 minutes or more after the power is shout off, and checking the charge lamp of the drive is OFF. The drive and option may be damaged. ▼ Do not use tools for mounting/removing option . The drive and option may be damaged.

2.1.1.1. Mounting of option

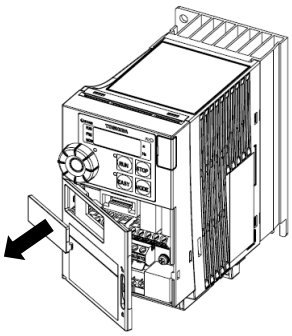
1. Insert option into option adapter.

SBP009Z

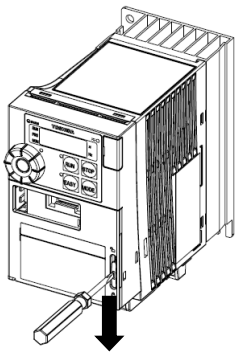


*Note: Mount option adapter to drive after option insertion.
Insert the option straightly and slowly along the guide inside option adapter. Otherwise, the connecter can become damaged.

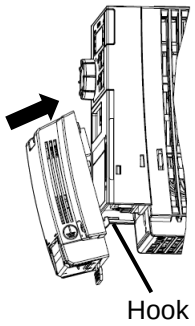
2. Remove the option connector cover on control terminal cover.



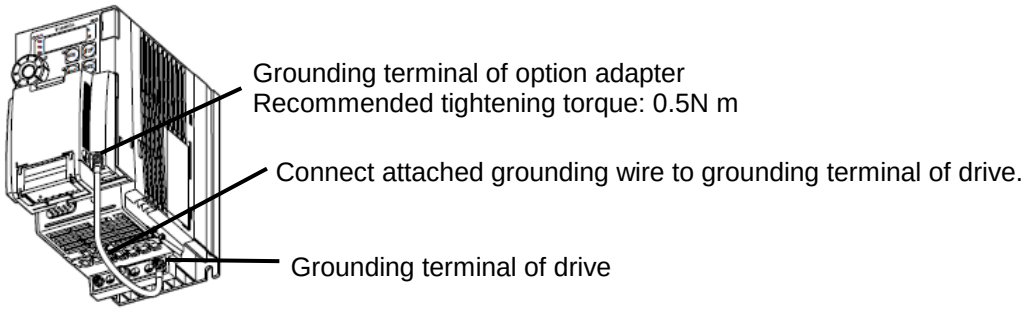
3. Lock the control terminal cover.



4. Hang the hook of option adapter on the control terminal cover.
   Insert the connector in the direction of arrow

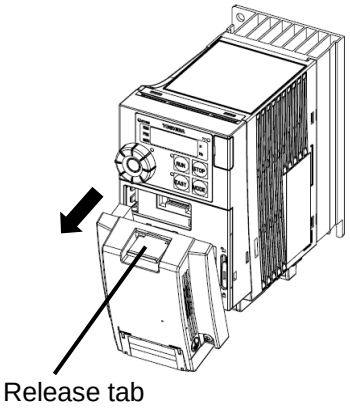


2.1.1.2. Earth wire wiring

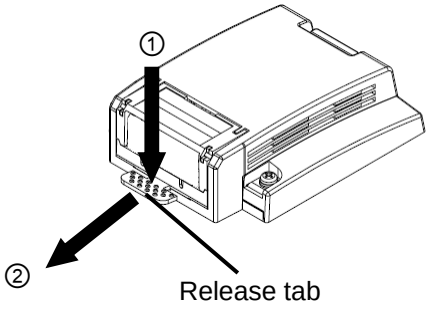


2.1.1.3. Removing of option

1. Remove the connector in the direction of arrow while pushing the release tab.



2. Remove an option in the direction of arrow ② while pushing the release tab in the direction of arrow ①.



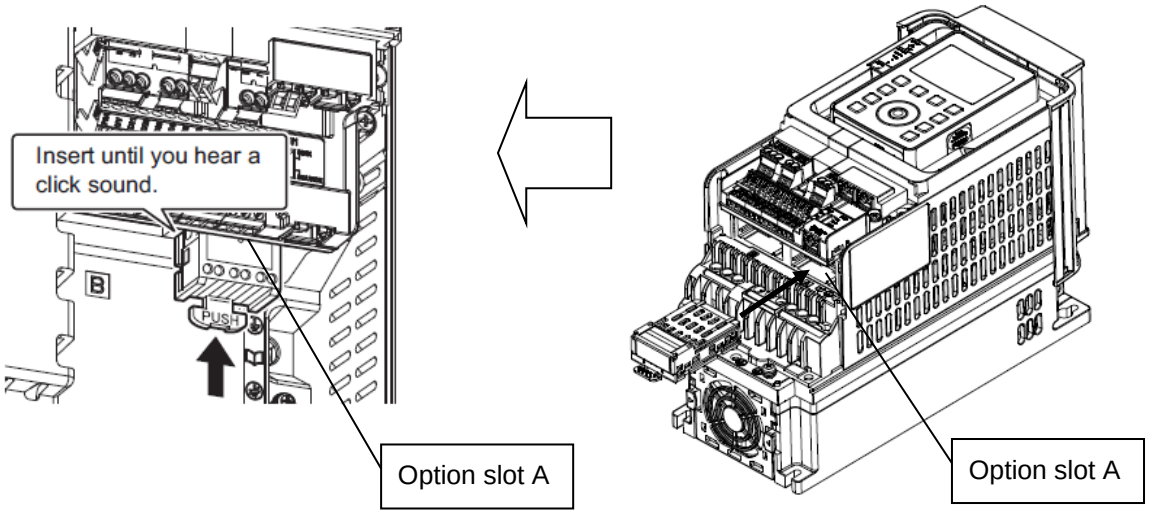
2.1.2. Mounting/removing insert type option of VF-AS3

Refer to [Mounting/removing insert type options] of E6582062.

⚠Warning	
Mandatory action	▼ Mounting/removing option should be performed 15 minutes or more after the power is shout off, and checking the charge lamp of the drive is OFF. The drive and option may be damaged.

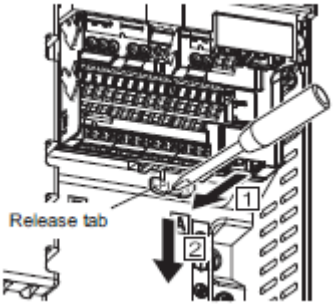
2.1.2.1. Mounting of option

Insert option to the option slot A until you hear a click sound.



2.1.2.2. Removing of option

While pressing the release tab down, pull the cassette option to remove from the option slot.

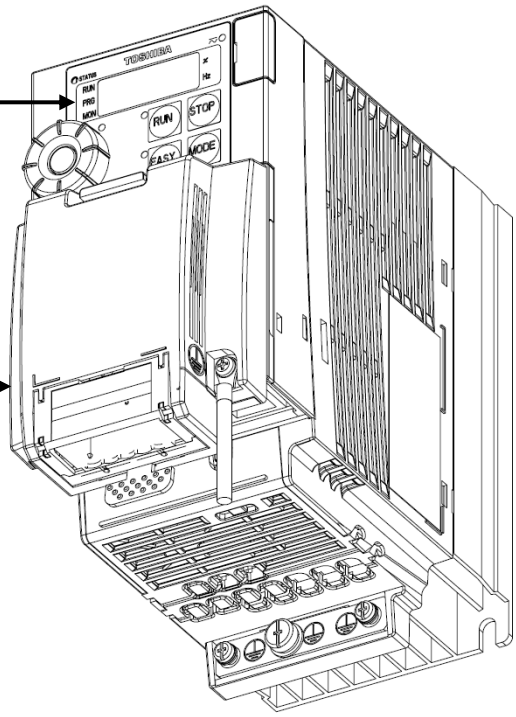


3. LED information

3.1. VF-S15 LED location

CANopen LED indicator
GREEN : CAN RUN
RED : CAN ERR

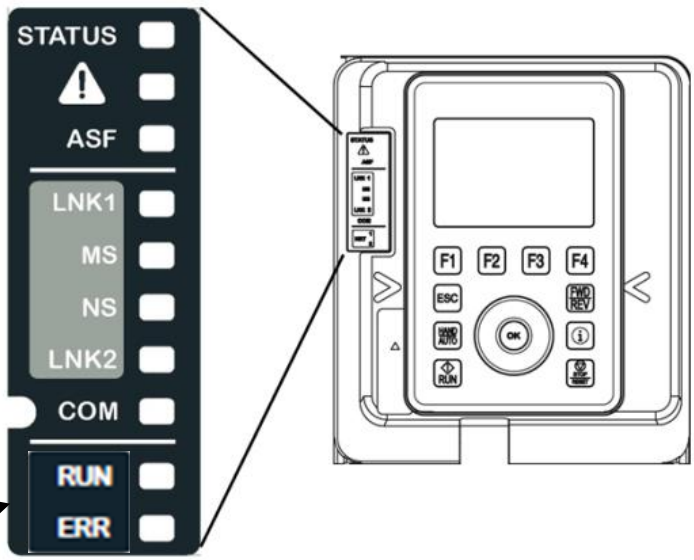
Refer to E6581838 about VF-S15
Option adapter (SBP009Z)



3.2. VF-AS3 LED location

When the option is mounted to VF-AS3, please attach the LED label (RUN/ERR *1) for the option to lower side of communication indicator of VF-AS3.
The LED label is included in danger label kit of VF-AS3.
RUN and ERR are displayed on communication indicator.

*1

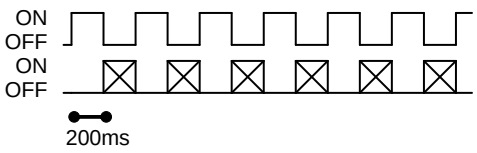
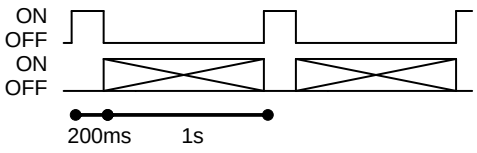


3.3. LED indicator (CiA303-3)

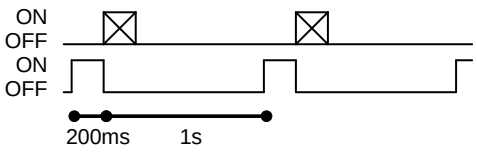
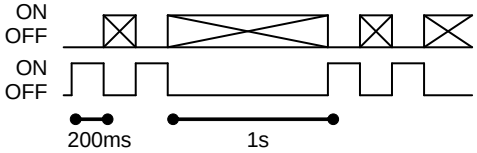
CAN LED indicate CANopen communication Status and Error condition.

3.4. CAN LED indicator

The flashing pattern of RUN LED depends on each state at the normal status. See the following table.

CAN RUN Status Green LED CAN ERR Status Red LED	State	Description
Blinking 	PRE-OPERATIONAL	The device is in state PRE-OPERATIONAL
Single flash 	STOPPED	The device is in state STOPPED
RUN : On ERR : Off	OPERATIONAL	The device is in state OPERATIONAL

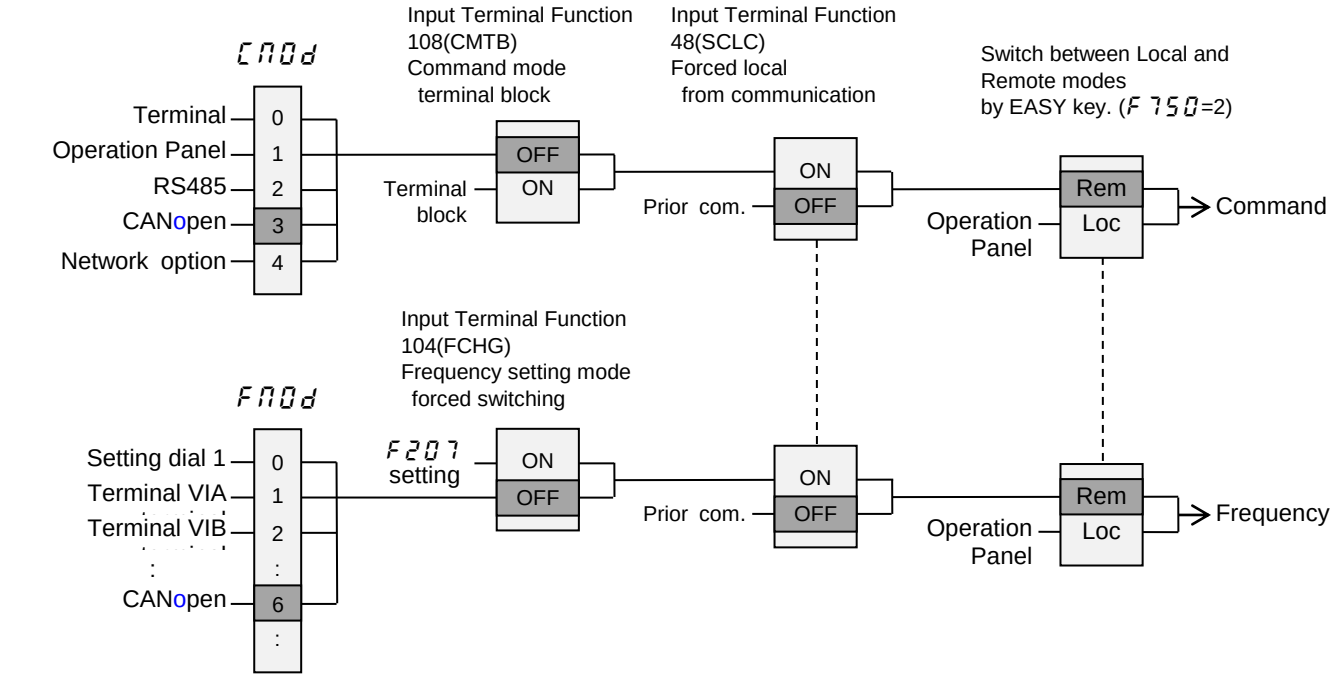
The flashing pattern of ERR LED depends on each state at the abnormal status. See the following table.

CAN RUN Status Green LED CAN ERR Status Red LED	State	Description
RUN : --- ERR : Off	No Error	The device is in working condition
Single flash 	Warning limit reached	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
Double flash 	Error control event	A guard event (NMT-slave or NMT-master) or a heartbeat event (heartbeat consumer) has occurred
RUN : --- ERR : On	Bus off	The CAN controller is bus off

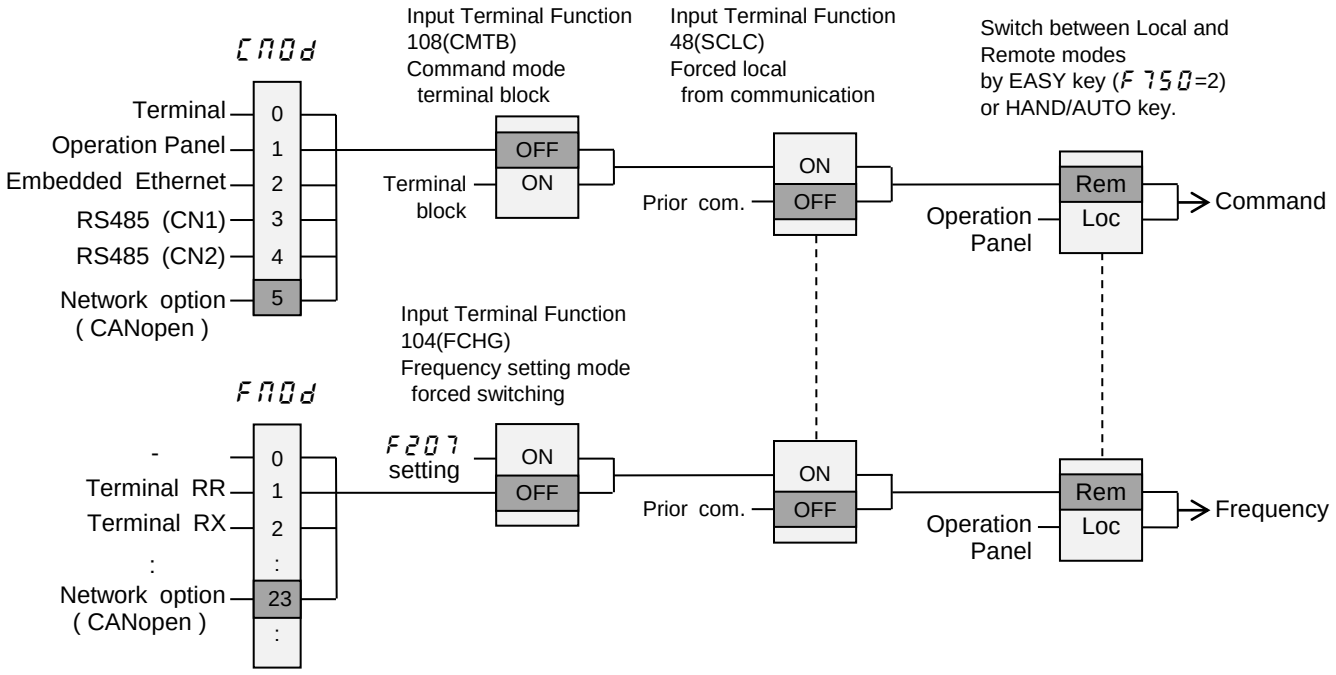
3.5. Command & Setpoint selection (Local/Remote)

CANopen communication command and setpoint (= Frequency) are activated on remote mode.
Drives have some switches to select the command and setpoint location. Following figure shows the diagram. Refer to the drive instruction manual for the parameter in detail.

Example: VF-S15



Example: VF-AS3



3.6. Cable Specification

Recommended cable specification is below
AC parameters: 120 ohm impedance and 5ns/m specific line delay

Selected recommended cable is below.

Manufacture : JMACS Japan Co., Ltd.
www.jmacs-j.co.jp

Distributor : KOSHOW Co., Ltd
www.koshow.jp

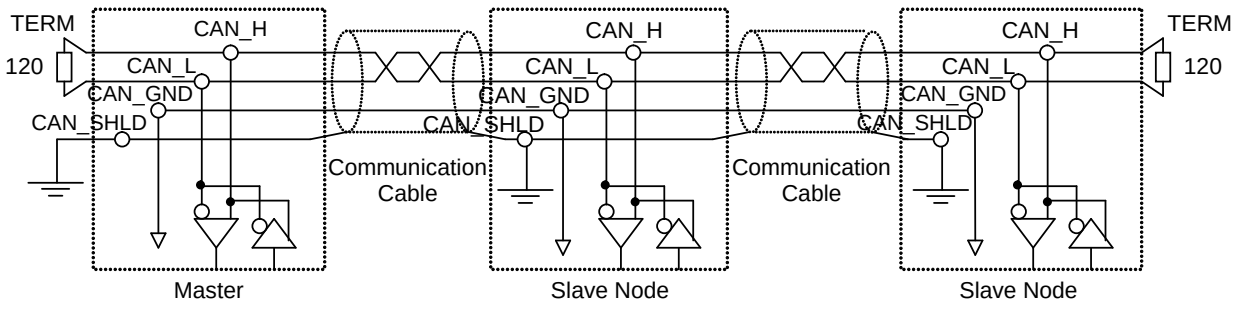
Model No.	CANC-22
Conductor size	24 AWG, 0.22mm^2
Number of pairs	2 (Blue/White, Yellow/ Green)
Conductor resistance at 20 Centigrade	less than 88.0 ohm/km
Capacitance	less than 60nF/km (1kHz)
Characteristic impedance	120 ohm +/-10% (1MHz)
Delay	5 ns typ. (1MHz)
Overall dia. Approx.	8.5mm
UL style No.	UL 2704
Weight	75kg/km

* Fix a cable so that a communication connector may be not taken the weight of wire.

3.7. Network configuration

Make up the network as follows.

- Transmission/reception signals (CAN_H, CAN_L)
  Make up the communication path by connecting twisted cables with shield.
- Signal common (CAN_GND)
  GND is the signal common.
- Grounding the shield of cable (CAN_SHLD)
  Connect the all shield lines of network cable. The shield shall be grounded at one end only prevent currents from being created.
- Termination resistor
  A termination resistance of 120 ohms plus or minus 5% shall be connected at each of the two ends of the segment medium.

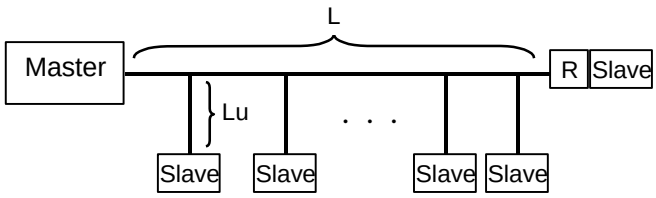


N.B.: RJ45 connector shield case is connected to the drive frame grounded in the drive.
Keep the network cables 20cm or more separate from the power cables to prevent from malfunctioning due to electromagnetic noise.

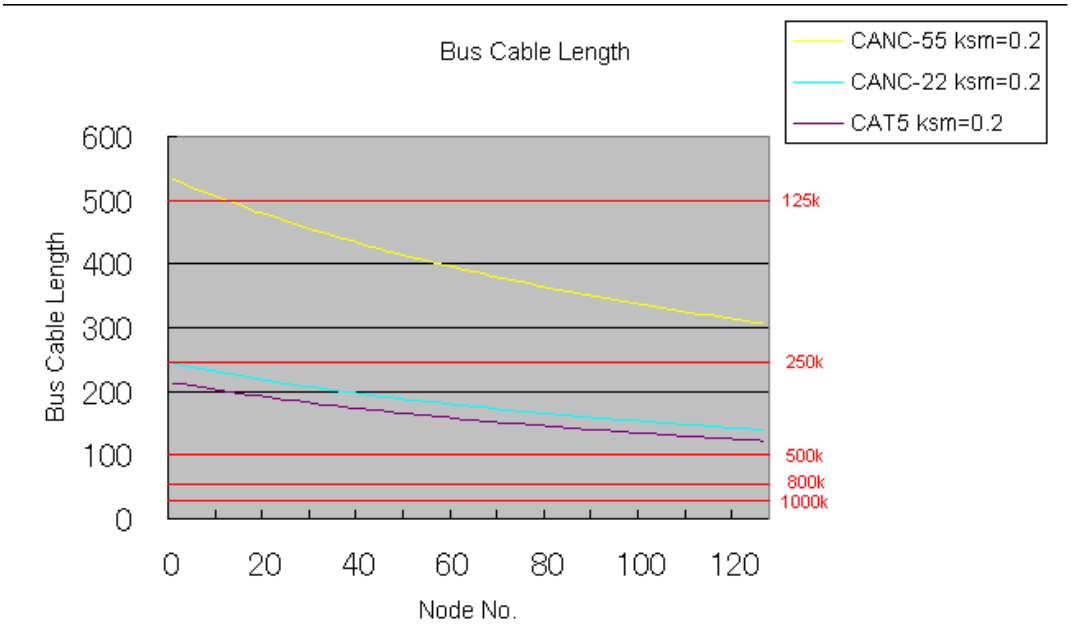
3.8. Bus cable length (CiA303-1)

Bus cable length depends on the below items.

a) Number of the slave
b) Cable type
c) Bit rate



AC parameters: 120 ohm impedance and 5ns/m specific line delay



Number of Node and Bit rate.

Bit rate	Number of node 20	40	60	80	100	120	Lu max	ΣLu
1M	25m						1.5m	5m
800k	50m						2.5m	7.5m
500k	100m						5m	25m
250k	219m (193m)	198m (174m)	181m (159m)	160m (146m)	154m (135m)	143m (126m)	10m	50m
125k							20m	100m
50k							60m	350m
20k							150m *1	750m
10k							300m *1	1500m

CANC-22 (CAT5) cable

*1: Limited by Number of node

3.9. Example of SCAN time

Below table is the recommended scan time depend on the number of the drive and the baud rate.

1 unit : Tx 8byte(4word) / Rx 8byte(4word) ・・・ total 129bit (include stub 5 bits)

Delay: 3.5ms

Margin: 80%

SCAN time (ms)

Drive Unit No. / bps	8	16	32	48	64
1M	7	9	14	19	25
800k	7	10	17	23	30
500k	9	14	25	35	45
250k	14	25	45	66	87
125k	25	45	87	128	169
50k	56	107	210	314	417
20k	133	262	520	778	1036
10k	262	520	1036	1552	2068

Time = (No of bit) x (No of Drive unit) x (No. of PDO) / (baud rate) / (margin)+delay+@

Ex. 1Mbps, 1TPDO, 1RPDO, 80%, 3.5ms delay

Time = 129bit x 64unit x 2PDO / (1e6) / (80%/100) +3.5ms+@

= 25ms

4. Parameters

4.1. Command and Freq. Reference setting

Set up the parameters as follows when command via CiA402 drive profile. From CANopen network, the parameters can be commanded directory. The latest commanded parameters are activated when same run command / frequency reference command.

Refer to the below table and the figurer and the capture “3.5 Command & Setpoint selection (Local/Remote)”.

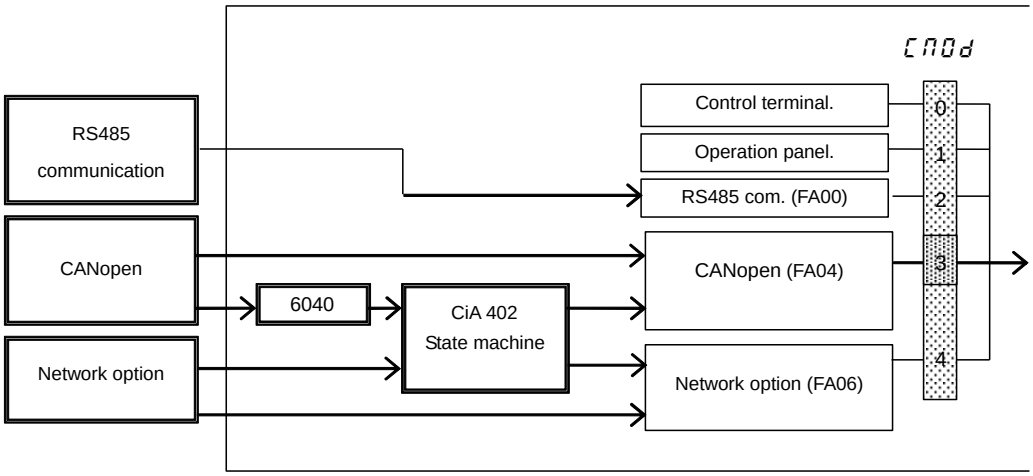
[VF-S15]

P No.	Parameter function	Default Value	Note
CMOd	Command mode selection	1	3: CANopen communication
FMOd	Frequency setting mode selection 1	0	6: CANopen communication

[VF-AS3]

P No.	Parameter function	Default Value	Note
CMOd	Run command select	0	5: Communication option (CANopen)
FMOd	Frequency command select 1	1	23: Communication option (CANopen)

Example: VF-S15



Example: VF-AS3

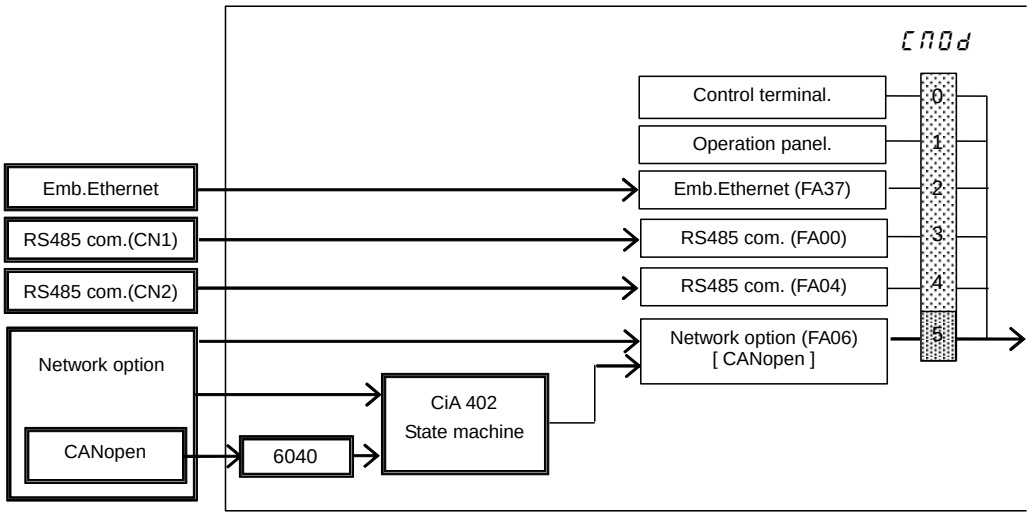
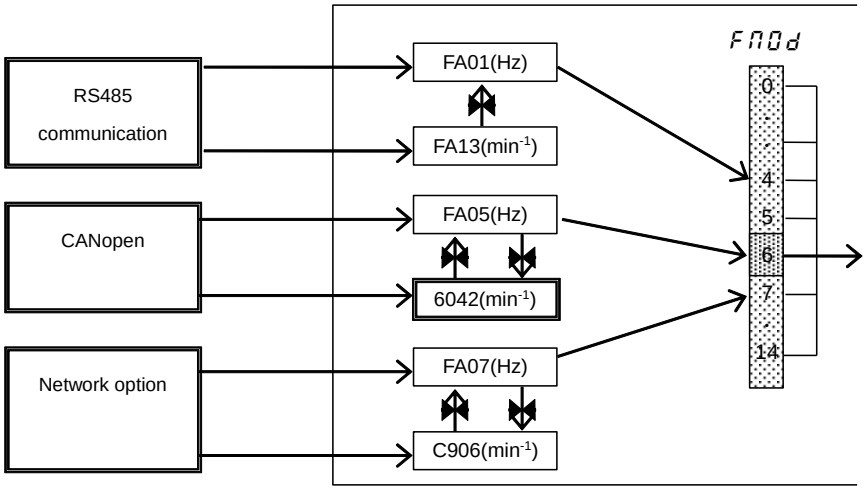


Figure 1 Command source

Example: VF-S15



Example: VF-AS3

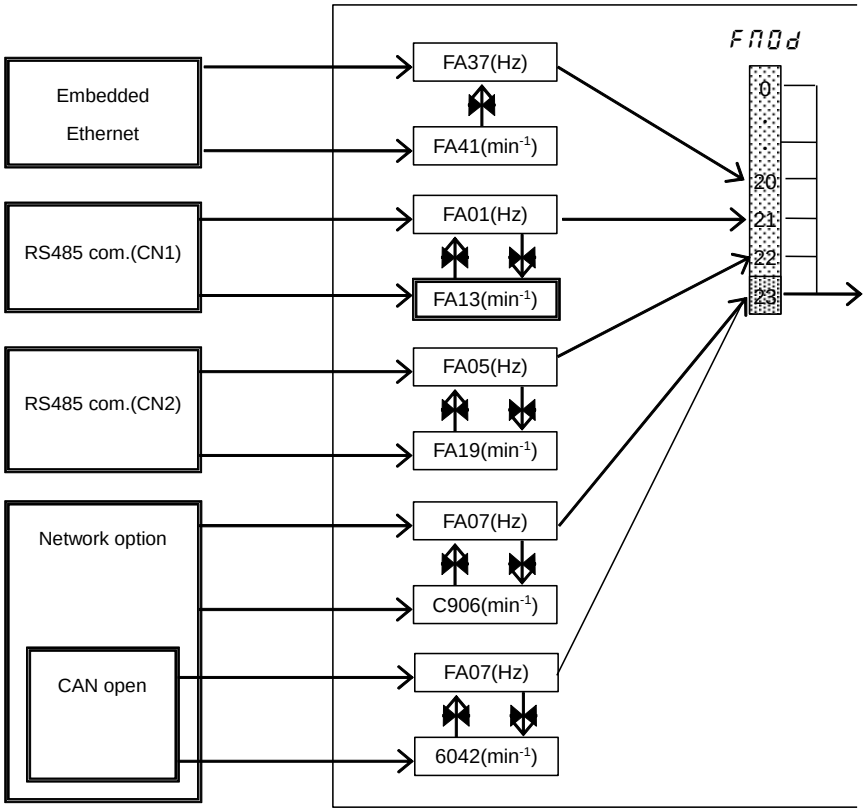


Figure 2 Frequency reference command source

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4.2. Communication parameters

Set up the parameters before the communication is started. The parameters with hatching are communication profile. Normally, these parameters are downloaded by SDO sever object. Refer to "5.1Communication Profile (DS 301)".

Title	Parameter function	Default Value	Note
F856	Number of motor poles for communication	2	2: 4 pole
F898	Drive reset mode selection	0	0: Clear trip by request from communication option. Reset by request except from communication option. 1: All reset 2: Trip clear 3-5: - [VF-AS3]
F899	Communication function reset	0	0: - 1: Reset (after execution: 0)

Title	Parameter function	Default Value	Note
C100	Communication time out	0.0	0.0 to 100.0 sec
C101	Drive operation at the communications loss action (Guard Time, Heartbeat)	4	0: Stop and Communication release (follows CnOd and FnOd setting) (Do not set at Software is Ver. 1.00.) 1: None 2: Deceleration stop 3: Coast stop 4: Emergency stop 5: Preset speed operation command (Operating at the preset speed operation frequency set with C102)
C102	Preset speed operation selection	0	0: None 1 to 15:Preset speed
C103	Communication time-out condition selection	1	0: Disconnection detection 1: When communication mode enable (Both CnOd and FnOd are set CANopen or COM option) 2:1+Driving operation
C701	Node ID	0	0: Disable CANopen 1 ~ 127 : Node ID
C702	Baud rate 0: 20k 4: 500k 1: 50k 5: 800k 2: 125k 6: 1M 3: 250k	2 (125kbps)	CAN communication baud rate
C703	SYNC message COB-ID	0x0080	0x1005 Set Lower word
C704	Guard Time:	0	0x100C 1ms unit
C705	Life Time Factor:	0	0x100D from 0 to 255
C706	Node-ID of Heartbeat Producer	0x0000	0x1016 Bits 16-23 = Node-ID of Heartbeat Producer Bits 24-31 = Reserved (00)
C707	Max. duration of Consumer Heartbeat	0x0000	0x1016 Bits 00-15 = Max. duration of Consumer Heartbeat (unit = 1 ms) Note: A single Heartbeat Producer can be configured here. By default, no producers are monitored (value = 0).
C708	Producer Heartbeat Time:	0	0x1017 1ms unit

Title	Parameter function		Default Value	Note
C711	PDO1	Receive: COB-ID entry High word	0x00000200	0x1400 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID=0x00000200+Node-
C712		Low word		
C713		RPDO transmission type	0x0FF	0x1400 subidx 02 Asynchronous
C714		Transmit: COB-ID High word	0x00000180	0x1800 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID=0x00000180+Node-ID
C715		Low word		
C716		TPDO Transition type	0x0FF	0x1800 subidx 02 Asynchronous
C717		Transmit Inhibit time:	100	0x1800 subidx 03 unit=100us, min 2ms
---		Transmit Reserved	---	0x1800 subidx 04
C719		Transmit Event timer:	0	0x1800 subidx 05 unit=1ms, min 10ms
C721	PDO2	Receive: COB-ID entry High word	0x80000300	0x1401 subidx 01 If the setting except bit31 is 0x00000300, use the default setting except bit31 0x00000300+Node-ID for 0x1401 subidx 01.
C722		Low word		
C723		RPDO transmission type	0x0FF	0x1401 subidx 02 Asynchronous
C724		Transmit: COB-ID High word	0x80000280	0x1801 subidx 01 If the setting except bit31 is 0x00000280, use the default setting except bit31 0x00000280+Node-ID for 0x1801 subidx 01.
C725		Low word		
C726		TPDO Transition type	0x0FF	0x1801 subidx 02 Asynchronous
C727		Transmit Inhibit time:	100	0x1801 subidx 03 unit=100us, min 2ms
---		Transmit Reserved	---	0x1801 subidx 04
C729		Transmit Event timer:	0	0x1801 subidx 05 unit=1ms, min 10ms
C731	PDO3	Receive: COB-ID entry High word	0x80000400	0x1402 subidx 01 If the setting except bit31 is 0x00000400, use the default setting except bit31 0x00000400+Node-ID for 0x1402 subidx 01.
C732		Low word		
C733		RPDO transmission type	0x0FF	0x1402 subidx 02 Asynchronous
C734		Transmit: COB-ID High word	0x80000380	0x1802 subidx 01 If the setting except bit31 is 0x00000380, use the default setting except bit31 0x00000380+Node-ID for 0x1802 subidx 01.
C735		Low word		
C736		TPDO Transition type	0x0FF	0x1802 subidx 02 Asynchronous
C737		Transmit Inhibit time:	100	0x1802 subidx 03 unit=100us, min 2ms
---		Transmit Reserved	---	0x1802 subidx 04
C739		Transmit Event timer:	0	0x1802 subidx 05 unit=1ms, min 10ms
C741	PDO21	Receive: COB-ID entry High word	0x80000500	0x1414 subidx 01 If the setting except bit31 is 0x00000500, use the default setting except bit31 0x00000500+Node-ID for 0x1414 subidx 01.
C742		Low word		
C743		RPDO transmission type	0x0FF	0x1414 subidx 02 Asynchronous
C744		Transmit: COB-ID High word	0x80000480	0x1814 subidx 01 If the setting except bit31 is 0x00000480, use the default setting except bit31 0x00000480+Node-ID for 0x1814 subidx 01.
C745		Low word		
C746		TPDO Transition type	0x0FF	0x1814 subidx 02 Asynchronous
C747		Transmit Inhibit time:	100	0x1814 subidx 03 unit=100us, min 2ms
---		Transmit Reserved	---	0x1814 subidx 04
C749		Transmit Event timer:	0	0x1814 subidx 05 unit=1ms, min 10ms
C750	PDO1	Number of command objects	0x02	0x1600 subidx 00 Receive PDO1 assignment: Number of objects assigned
C751		Command 1	0x6040	0x1600 subidx 01 Command Index No. 0x6040: Controlword

Title	Parameter function		Default Value	Note
C752		Command 2	0x6042	0x1600 subidx 02 Command Index No. 0x6042: vl target velocity
C753		Command 3	0x0000	0x1600 subidx 03 Command Index No.
C754		Command 4	0x0000	0x1600 subidx 04 Command Index No.
C755		Number of monitor objects	0x02	0x1A00 subidx 00 Transmit PDO1 assignment: Number of objects assigned
C756		Monitor 1	0x6041	0x1A00 subidx 01 Monitor Index No. 0x6041: vl Statusword
C757		Monitor 2	0x6044	0x1A00 subidx 02 Monitor Index No. 0x6044: vl velocity actual value
C758		Monitor 3	0x0000	0x1A00 subidx 03 Monitor Index No.
C759		Monitor 4	0x0000	0x1A00 subidx 04 Monitor Index No.
C760	PDO2	Number of command objects	0x01	0x1601 subidx 00 Receive PDO2 assignment: Number of objects assigned
C761		Command 1	0x6040	0x1601 subidx 01 Command Index No.
C762		Command 2	0x0000	0x1601 subidx 02 Command Index No.
C763		Command 3	0x0000	0x1601 subidx 03 Command Index No.
C764		Command 4	0x0000	0x1601 subidx 04 Command Index No.
C765		Number of monitor objects	0x01	0x1A01 subidx 00 Transmit PDO2 assignment: Number of objects assigned
C766		Monitor 1	0x6041	0x1A01 subidx 01 Monitor Index No.
C767		Monitor 2	0x0000	0x1A01 subidx 02 Monitor Index No.
C768		Monitor 3	0x0000	0x1A01 subidx 03 Monitor Index No.
C769		Monitor 4	0x0000	0x1A01 subidx 04 Monitor Index No.
C770	PDO3	Number of command objects	0x01	0x1602 subidx 00 Receive PDO3 assignment: Number of objects assigned
C771		Command 1	0x6040	0x1602 subidx 01 Command Index No.
C772		Command 2	0x0000	0x1602 subidx 02 Command Index No.
C773		Command 3	0x0000	0x1602 subidx 03 Command Index No.
C774		Command 4	0x0000	0x1602 subidx 04 Command Index No.
C775		Number of monitor objects	0x01	0x1A02 subidx 00 Transmit PDO3 assignment: Number of objects assigned
C776		Monitor 1	0x6041	0x1A02 subidx 01 Monitor Index No.
C777		Monitor 2	0x0000	0x1A02 subidx 02 Monitor Index No.
C778		Monitor 3	0x0000	0x1A02 subidx 03 Monitor Index No.
C779		Monitor 4	0x0000	0x1A02 subidx 04 Monitor Index No.
C780	PDO21	Number of command objects	0x01	0x1614 subidx 00 Receive PDO21 assignment: Number of objects assigned
C781		Command 1	0x6040	0x1614 subidx 01 Command Index No.
C782		Command 2	0x0000	0x1614 subidx 02 Command Index No.
C783		Command 3	0x0000	0x1614 subidx 03 Command Index No.
C784		Command 4	0x0000	0x1614 subidx 04 Command Index No.
C785		Number of monitor objects	0x01	0x1A14 subidx 00 Transmit PDO21 assignment: Number of objects assigned
C786		Monitor 1	0x6041	0x1A14 subidx 01 Monitor Index No.
C787		Monitor 2	0x0000	0x1A14 subidx 02 Monitor Index No.
C788		Monitor 3	0x0000	0x1A14 subidx 03 Monitor Index No.
C789		Monitor 4	0x0000	0x1A14 subidx 04 Monitor Index No.

⚠ Warning

Mandatory action

- ▼ Set up “Communication error trip function (C100 ~ C103)” to stop the drive when CANopen communication is deactivated.
- ▼ When CANopen state is “OPERATIONAL”, the CANopen communication parameters can not be changed. Set the CANopen state to “PRE-OPERATIONAL.”.
- ▼ When the parameters are changed, the power must be cycled to the drive for the changes to take effect.

5. Communication Object

Object dictionary has mainly 3 object set.

・Communication profile area (Index 0x1000 to 0x1FFF)

・Manufacturer specific profile area (Index 0x2000 to 0x5FFF)

・CiA402 drive profile area (Index 0x6000 to 0x9FFF)

5.1. Communication Profile (DS 301)

5.1.1. Communication Profile (0x1000 to 0x1018)

These object are CANopen communication configuration settings for example Node-ID etc.. These communication profile object can not be mapped into PDO.

Index (Hex)	Sub index	Access	Type	Default value	Description
1000	00	RO	u32	0x00010192	Device type Bits 24-31 not used (0), Bits 16-23 = Type of device (1) Bits 0-15 = Device profile number (402)
1001	00	RO	u8	0x00	Error register: Error (= 1) or no error (= 0) Bit0: Generic Bit4: Communication Bit1: Current Bit5: Device profile specific Bit2: Voltage Bit6: reserved (=0) Bit3: Temperature Bit7: Manufacturer specific
1003	00	RO	u8	0x01	Number of errors: Only one possible error (1), located in object 0x1003 sub 01
	01	RO	u32	0x00000000	Standard error field: Bits 16-31 = Additional information (always 0) Bits 00-15 = Error code parameter
1005	00	R/W	u32	0x00000080	COB-ID entry for SYNC message Bit 30=0: Device does not generate SYNC message. (Fixed) Bit 29=0: 11bit CAN-ID valid. (Fixed) Bit 0-10: 11bit SYNC COB-ID
1008	00	RO	string	VF-S15 (VF-AS3)	Manufacturer device name Note) This information is different by the series of drive.
100A	00	RO	string	1.00	Manufacturer software version Application software version VF-S15: parameter F E 0 8
100C	00	R/W	u16	0x0000	Guard Time: *1 By default, the Node Guarding protocol is deactivated (0); the unit for this object is 1 ms. If use this protocol (Guard Time > 0), make sure that the Heartbeat protocol is deactivated on the drive (Object 1017: Producer Heartbeat Time > 0). When not receive the Remote frame message in term of this, the drive generate the Network disconnect error.
100D	00	R/W	u8	0x00	Life Time Factor: Multiplier coefficient applied to the Guard Time to obtain the Life Time. The value 0 deactivates the Node Guarding service in respect of the drive.
1010	00	RO	u8	0x01	Save all parameter – Number of entries
	01	R/W	U32	0x00000003	Save all parameter: Set ‘e’,’v’,’a’,’s’ (0x65, 0x76, 0x61, 0x73) to this sub-index, from C 7 0 0 to C 7 8 9 and Object 60xx (except for 0x6060) parameters data are store to EEPROM.

Index (Hex)	Sub index	Access	Type	Default value	Description
1011	00	RO	u8	0x01	Restore default parameter – Number of entries
	01	R/W	U32	0x00000001	Restore default parameter: Set 'd','a','o','l' (0x64, 0x61, 0x6f, 0x6c) to this sub-index, from C703 to C789 and Object 60xx parameters data are restore to factory setting data. Restore data are available after power On/Off reset or Rest command from Network.
1014	00	RO	u32	0x00000080 +Node-ID	COB-ID Emergency message: (EMCY) Bit 31=0: EMCY exist / is valid. Bit 30: Reserved Bit 29=0: frame is 11bit-CAN-ID valid = 1 bit 0-10: 11bit CAN-ID of the CAN base frame.
1016	00	RO	u8	0x01	Consumer Heartbeat Time – Number of entries
	01	R/W	u32	0x00000000	Bits 24-31 = Resaved (00) Bits 16-23 = Node-ID of Heartbeat Producer Bits 00-15 = Max. duration of Consumer Heartbeat (unit = 1 ms) *1 Note: A single Heartbeat Producer can be configured here. By default, no producers are monitored (value = 0). When not receive the Heartbeat message in term of this, the drive generate the Network disconnect error.
1017	00	R/W	u16	0x0000	Producer Heartbeat Time *1: Heartbeat messages; the unit of this object is 1 ms. If you use this protocol (Producer Heartbeat Time > 0), make sure that the Node Guarding protocol is deactivated on the drive (Guard Time = 0).
1018	00	RO	u8	0x01	ID object: Number of objects
	01	RO	u32	0x00000284	ID object: Supplier ID 0x00000284 : Toshiba Schneider Inverter Co.

*1: If VF-AS3 is used, the upper value is 0x7FFF.

5.1.2. SDO sever object

SDO COB-ID object type is only read.

Index (Hex)	Sub index	Access	Type	Default value	Description
1200	00	RO	u8	0x02	Server SDO : Number of entries
	01	RO	u32	0x00000600 + Node-ID	Server SDO : COB-ID Client -> Drive (receive)
	02	RO	u32	0x00000580 + Node-ID	Server SDO : COB-ID Client <- Drive (transmit)

5.1.3. PDO object

PDO1 to PDO3 and PDO21.

PDO set	RPDO	TPDO	Note
PDO1	Controlword	Statusword	COB-ID is variable mapping. TPDO1 : 0x00000180+Node-ID RPDO2 : 0x00000200+Node-ID
	vl_target_velocity	vl_velocity_actual_value	
	variable mapping	variable mapping	
	variable mapping	variable mapping	
PDO2	variable mapping	variable mapping	COB-ID is variable mapping. TPDO2 : 0x00000280+Node-ID RPDO2 : 0x00000300+Node-ID
	variable mapping	variable mapping	
	variable mapping	variable mapping	
	variable mapping	variable mapping	
PDO3	variable mapping	variable mapping	COB-ID is variable mapping. TPDO3 : 0x00000380+Node-ID RPDO3 : 0x00000400+Node-ID
	variable mapping	variable mapping	
	variable mapping	variable mapping	
	variable mapping	variable mapping	
PDO21	variable mapping	variable mapping	COB-ID is variable mapping. TPDO21 : 0x00000480+Node-ID RPDO21 : 0x00000500+Node-ID
	variable mapping	variable mapping	
	variable mapping	variable mapping	
	variable mapping	variable mapping	

5.1.4. RPDO object

Index (Hex)	Sub index	Access	Type	Default value	Description
1400	00	R	u8	0x02	Receive PDO1: Number of objects
	01	R/W	u32	0x00000200 + Node-ID	Receive PDO1: COB-ID entry The default value is 0x00000200 (parameter data C711) +Node-ID. If set other than 0x00000200 except bit31, new set data is used for COB-ID (=new data). Bit31 is an enable/disable flag of RPDO1 data set.
	02	R	u8	0x0FF	Receive PDO1: Transmission type “asynchronous” (254 or 255), “synchronous” (0 - 240).
1401	00	R	u8	0x02	Receive PDO2: Number of objects
	01	R/W	u32	0x80000300 + Node-ID	Receive PDO2 COB-ID entry The default value is 0x80000300 (parameter data C721) +Node-ID. If set other than 0x80000300 except bit31, new set data is used for COB-ID (=new data). Bit31 is an enable/disable flag of RPDO2 data set.
	02	R/W	u8	0x0FF	Receive PDO2: Transmission type “asynchronous” (254 or 255), “synchronous” (0 -240).
1402	00	R	u8	0x02	Receive PDO3: Number of objects
	01	R/W	u32	0x80000400+ Node-ID	Receive PDO3 COB-ID entry The default value is 0x00000400 (parameter data C731) +Node-ID. If set other than 0x80000400 except bit31, new set data is used for COB-ID (=new data). Bit31 is an enable/disable flag of RPDO3 data set.
	02	R/W	u8	0x0FF	Receive PDO3: Transmission type “asynchronous” (254 or 255), “cyclic synchronous” (0 -240).
1414	00	R	u8	0x02	Receive PDO21: Number of objects
	01	R/W	u32	0x80000500 + Node-ID	Receive PDO21 COB-ID entry The default value is 0x80000500 (parameter data C741) +Node-ID. If set other than 0x80000500 except bit31, new set data is used for COB-ID (=new data). Bit31 is an enable/disable flag of RPDO21 data set.
	02	R/W	u8	0x0FF	Receive PDO21: Transmission type “asynchronous” (254 or 255), “synchronous” (0 -240).

Index (Hex)	Sub index	Access	Type	Default value	Description
1600	00	R/W	u8	0x02	Receive PDO1 assignment: Number of objects assigned Set 0(=Disable) before changing Sub-index 01-04 of this Object, and set Sub-index 01-04 value of the corresponding sub-indices then set the number of mapped objects (=Enable).
	01	R/W	u32	0x60400010	Receive PDO1 assignment: 1st object assigned Control word “CMD” (Object 6040, Sub-index 00, 16bit)
	02	R/W	u32	0x60420010	Receive PDO1 assignment: 2nd object assigned vl target velocity (Object 6042, Sub-index 00, 16bit)
	03	R/W	u32	0x00000000	Receive PDO1 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Receive PDO1 assignment: 4th object assigned
1601	00	R/W	u8	0x01	Receive PDO2 assignment: Number of objects assigned
	01	R/W	u32	0x60400010	Receive PDO2 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Receive PDO2assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Receive PDO2 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Receive PDO2 assignment: 4th object assigned
1602	00	R/W	u8	0x01	Receive PDO3 assignment: Number of objects assigned
	01	R/W	u32	0x60400010	Receive PDO3 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Receive PDO3assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Receive PDO3 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Receive PDO3 assignment: 4th object assigned
1614	00	R/W	u8	0x01	Receive PDO21 assignment: Number of objects assigned
	01	R/W	u32	0x60400010	Receive PDO21 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Receive PDO21assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Receive PDO21 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Receive PDO21 assignment: 4th object assigned

5.1.5. TPDO object

Index (Hex)	Sub index	Access	Type	Default value	Description
1800	00	R	u8	0x05	Transmit PDO1: Number of entries
	01	R/W	u32	0x00000180 + Node-ID	Transmit PDO1: COB-ID The default value is 0x00000180 (parameter data C713) +Node-ID. If set other than 0x00000180 except bit31, new set data is used for COB-ID(=new data). Bit31 is an enable/disable flag of TPDO1 data set.
	02	R/W	u8	0x0FF	Transmit PDO1: Transmission type: “asynchronous” (254 or 255), “cyclic synchronous” (0~240).
	03	R/W	u16	0x0064	Transmit PDO1: Inhibit time: unit = 100us Minimum time between two transmissions
	04	R/W	u8	0x00	Transmit PDO1: Reserved
	05	R/W	u16	0x0000	Transmit PDO1: Event timer: 0=Disable, unit = 1 ms When Transmission type=254 or 255, this object defines a transmission frequency for this PDO.
1801	00	R	u8	0x05	Transmit PDO2: Number of entries
	01	R/W	u32	0x80000280 + Node-ID	Transmit PDO2: COB-ID The default value is 0x80000280 (parameter data C723) +Node-ID. If set other than 0x80000280 except bit31, new set data is used for COB-ID(=new data). Bit31 is an enable/disable flag of TPDO2 data set.
	02	R/W	u8	0x0FF	Transmit PDO2 : Transmission type: “asynchronous” (254 or 255), “cyclic synchronous” (0~240).
	03	R/W	u16	0x0064	Transmit PDO2: Inhibit time: unit = 100us Minimum time between two transmissions
	04	R/W	u8	0x00	Transmit PDO2: Reserved
	05	R/W	u16	0x0000	Transmit PDO2: Event timer: 0=Disable, unit = 1 ms When Transmission type=254 or 255, this object defines a transmission frequency for this PDO.
1802	00	R	u8	0x05	Transmit PDO3: Number of entries
	01	R/W	u32	0x80000380 + Node-ID	Transmit PDO3: COB-ID The default value is 0x80000380 (parameter data C733) +Node-ID. If set other than 0x80000380 except bit31, new set data is used for COB-ID(=new data). Bit31 is an enable/disable flag of TPDO3 data set.
	02	R/W	u8	0x0FF	Transmit PDO3: Transmission type: “asynchronous” (254 or 255), “cyclic synchronous” (0~240).
	03	R/W	u16	0x0064	Transmit PDO3: Inhibit time: unit = 100us Minimum time between two transmissions
	04	R/W	u8	0x00	Transmit PDO3: Reserved
	05	R/W	u16	0x0000	Transmit PDO3: Event timer: 0=Disable, unit = 1 ms When Transmission type=254 or 255, this object defines a transmission frequency for this PDO.
1814	00	R	u8	0x05	Transmit PDO21: Number of entries
	01	R/W	u32	0x80000480 + Node-ID	Transmit PDO21: COB-ID The default value is 0x80000480 (parameter data C743) +Node-ID. If set other than 0x80000480 except bit31, new set data is used for COB-ID(=new data). Bit31 is an enable/disable flag of TPDO21 data set.
	02	R/W	u8	0x0FF	Transmit PDO21: Transmission type: “asynchronous” (254 or 255), “cyclic synchronous” (0~240).
	03	R/W	u16	0x0064	Transmit PDO21: Inhibit time: unit = 100us Minimum time between two transmissions
	04	R/W	u8	0x00	Transmit PDO21: Reserved
	05	R/W	u16	0x0000	Transmit PDO21: Event timer: 0=Disable, unit = 1 ms When Transmission type=254 or 255, this object defines a transmission frequency for this PDO.

Index (Hex)	Sub index	Access	Type	Default value	Description
1A00	00	R/W	u8	0x02	Transmit PDO1 assignment: Number of objects assigned Set 0(=Disable) before changing Sub-index 01-04 of this Object, and set Sub-index 01-04 value of the corresponding sub-indices then set the number of mapped objects (=Enable).
	01	R/W	u32	0x60410010	Transmit PDO1 assignment: 1st object assigned Statusword (Object 6041, Sub-index 00, 16bit)
	02	R/W	u32	0x60440010	Transmit PDO1 assignment: 2nd object assigned vl velocity actual value (Object 6044, Sub-index 00, 16bit)
	03	R/W	u32	0x00000000	Transmit PDO1 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Transmit PDO1 assignment: 4th object assigned
1A01	00	R/W	u8	0x01	Transmit PDO2 assignment: Number of objects assigned
	01	R/W	u32	0x60410010	Transmit PDO2 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Transmit PDO2 assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Transmit PDO2 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Transmit PDO2 assignment: 4th object assigned
1A02	00	R/W	u8	0x01	Transmit PDO3 assignment: Number of objects assigned
	01	R/W	u32	0x60410010	Transmit PDO3 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Transmit PDO3 assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Transmit PDO3 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Transmit PDO3 assignment: 4th object assigned
1A14	00	R/W	u8	0x01	Transmit PDO21 assignment: Number of objects assigned
	01	R/W	u32	0x60410010	Transmit PDO21 assignment: 1st object assigned
	02	R/W	u32	0x00000000	Transmit PDO21 assignment: 2nd object assigned
	03	R/W	u32	0x00000000	Transmit PDO21 assignment: 3rd object assigned
	04	R/W	u32	0x00000000	Transmit PDO21 assignment: 4th object assigned

5.2. Manufacturer specific profile

All of the parameters are defined as manufacturer specific objects.

Each parameter of inverter can be assigned to each Index No. per following table.

For example, the Comm.No.0x0100 (Title: F 100) is defined as Index No.0x2100.

⚠ Warning	
Prohibited	▼ Do not use application of writing into same parameter more than 100,000 times. The Life of EEPROM is approximately 100,000 times. Do not write to the user parameter area of inverter by SDO to avoid EEPROM broken. No problem by PDO, because it makes only RAM access.

Title	Comm. No. (Hex)	⇒ (Hex)	Index No. (Hex)	Trans. type	Note
AU 1 ~ F999	0000 ~ 0999	+2000	2000 ~ 2999	SDO	User parameter area
FA00 ~ FF99	FA00 ~ FF99	-D000	2A00 ~ 2F99	SDO PDO	Disclosed command and monitor communication No. can be mapped. Refer to the communication manual.
A000 ~ A999	A000 ~ A999	-7000	3000 ~ 3999	SDO	User parameter area
C000 ~ C999	C000 ~ C999	-8000	4000 ~ 4999	SDO	User parameter area

5.3. Device Profile (CiA402)

VF-S15 / VF-AS3 supports CiA402 drives and motion control device profile, velocity mode objects.

Index (Hex)	Sub index	Access	Type	PDO Mapping	Default value	Description
603F	00	R	u16	Yes	0x0000	Error code
6040	00	R/W	u16	Yes	0x0000	Controlword
6041	00	R	u16	Yes	0x0000	Statusword
6042	00	R/W	i16	Yes	0x0000	Vl_Target_Velocity (min^{-1})
6043	00	R	i16	Yes	0x0000	Vl_Velocity_Demand (min^{-1})
6044	00	R	i16	Yes	0x0000	Vl_Velocity_Actual_Value (min^{-1})
6046	00	R	u8	No	0x02	Vl Velocity Min Max Amount
	01	R/W	u32	No	0x00000000	Vl_Velocity_Min_Amount (min^{-1})
	02	R/W	u32	No	0x000005DC	Vl_Velocity_Max_Amount (min^{-1})
6048	00	R	u8	No	0x02	Vl Velocity Acceleration: Highest sub-index supported
	01	R/W	u32	No	0x000005DC	Vl_Velocity_Acceleration Delta_Speed (min^{-1})
	02	R/W	u16	No	0x000A	Vl_Velocity_Acceleration Delta_Time (s)
6049	00	R	u8	No	0x02	Vl Velocity Deceleration: Highest sub-index supported
	01	R/W	u32	No	0x000005DC	Vl_Velocity_Deceleration Delta_Speed (min^{-1})
	02	R/W	u16	No	0x000A	Vl_Velocity_Deceleration Delta_Time (s)
604A	00	R	u8	No	0x02	Vl Velocity Quick Stop: Highest sub-index supported
	01	R/W	u32	No	0x00000D5C	Vl_Velocity_Quick_Stop Delta_Speed (min^{-1})
	02	R/W	u16	No	0x0006	Vl_Velocity_Quick_Stop Delta_Time (s)
605A	00	R/W	i16	No	0x0002	Quick Stop Option Code
6060	00	R/W	i8	No	0x00	Modes of operation
6061	00	R	i8	No	0x02	Modes of operation display
6502	00	R	u32	No	0x00000002	Support drive mode

6. Running by CiA402 drive profile

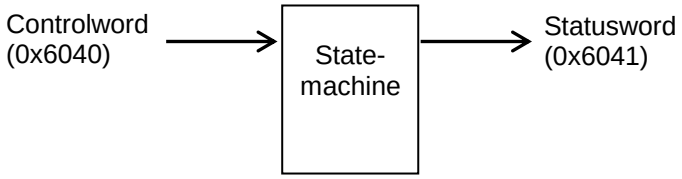
Using CiA402 drive profile, form CANopen network, the drive can be controlled. When using the drive profile command, please set the command mode selection to CANopen (CMOd=3 [VF-S15], 5 [VF-AS3]), Frequency setting mode selection 1 to CANopen (FMOd=6 [VF-S15], 23 [VF-AS3]) and Number of motor poles for communication (F856) parameters. It needs to set only one time at first setting.

⚠ Warning	
Mandatory action	▼ If use and set RS485 communication command parameter, the infinite state machine of drive profile can not work expected behavior and may be damage the drive or cause danger. So when use RS485 command parameter, do not access the drive object profile.

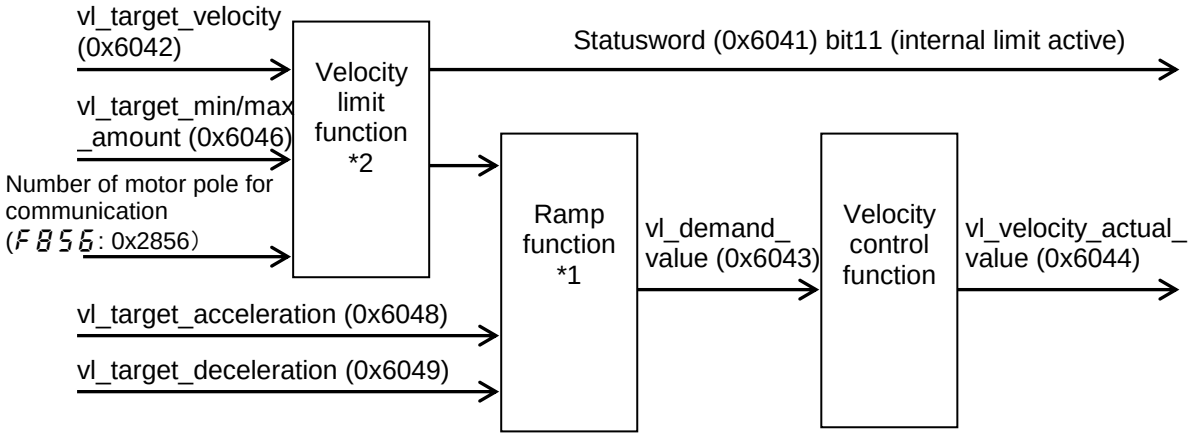
6.1. CiA402 drive profile

Below figure describes the object relation. See “8.Example communication” for the running.

Control diagram:



Simplified diagram of speed control in “Velocity” mode:



Function	CANopen Protocol
Velocity limit function	Limit the target velocity command (0x6042) regarding to min/max (0x6046). And set to drive frequency command. If target velocity command is over or less than 0x6046 value, set limit value to the drive.
Ramp function	Ramp function is provided by the drive. CANopen protocol read the demand value and set to 0x6043.
Velocity control function	CANopen protocol read demand value and set to 0x6044.

*1: Do not change the acceleration/deceleration time unit (parameter F519), if change the parameter, the setting value range will be different from above range. In this case, set 0(Linear) to acceleration/ deceleration 1 pattern (F502: 0x2502). (S-pattern isn’t supported.)

*2: Set Maximum frequency (FH) to the right max value. See “6.1.7.Object 0x6046: vl_velocity_min_max_ amount” for the detailed information.

6.1.1. Object 0x603F: Error Code

Below table describes the relations of the error code and drive error.

Error code *1	Meaning	Drive trip code *2	Drive error name	Drive condition
0x0000	No error	0x00	---	---
0x1000	Generic error	0x0E	OL2	Motor overload
		0x15	Err2	Main unit RAM fault
		0x16	Err3	Main unit ROM fault
		0x17	Err4	CPU fault 1
		0x19	Err6	Gate array fault [VF-AS3] *3
		0x1A	Err7	Current detector fault
		0x1C	Err9	Remote keypad disconnection fault
		0x24	OCr	Overcurrent (Braking resistor) [VF-AS3] *3
		0x28	Etn	Auto-tuning error
		0x2B	E-11	Brake answer error [VF-AS3] *3
		0x2C	E-12	PG error
		0x35	E-21	CPU fault 2
		0x38	E-24	Option fault (slot B) [VF-AS3] *3
		0x39	E-25	Option fault (slot C) [VF-AS3] *3
		0x3A	E-26	CPU fault 3
		0x3C	Ut	Undertorque [VF-AS3] *3
		0x3D	E-29	Control power option failure [VF-AS3] *3
		0x3F	E-31	Rush current suppression relay fault [VF-AS3] *3
		0x55	Etn2	Auto-tuning error
		0x56	Etn3	Auto-tuning error
0x2230	Short circuit/earth leakage (device internal)	0x05	OCA	Short circuit in arm [VF-S15]
			OCA1	Overcurrent (U-phase arm) [VF-AS3] *3
		0x06	OCA2	Overcurrent (V-phase arm) [VF-AS3] *3
		0x07	OCA3	Overcurrent (W-phase arm) [VF-AS3] *3
0x2310	Continuous over current	0x01	OC1	Overcurrent during acceleration
		0x02	OC2	Overcurrent during deceleration
		0x03	OC3	Overcurrent during constant speed operation
0x2311	Continuous over-current No. 1	0x20	Ot	Over-torque trip 1
		0x41	Ot2	Over-torque trip 2
		0x48	OtC3	Over-torque / Overcurrent fault
0x2320	Short circuit/earth leakage (motor-side)	0x04	OCL	Overcurrent (An overcurrent on the load side at start-up)
0x2330	Earth leakage	0x22	EF2	Ground fault
0x3110	Mains over-voltage	0x0A	OP1	Overvoltage during acceleration
		0x0B	OP2	Overvoltage during deceleration
		0x0C	OP3	Overvoltage during constant speed operation

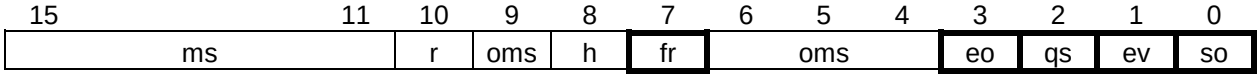
Error code *1	Meaning	Drive trip code *2	Drive error name	Drive condition
0x3120	Mains under-voltage	0x1E	UP 1	Undervoltage fault (main circuit)
0x3130	Phase failure	0x08	EPH 1	Ground fault
0x3310	Output over-voltage	0x09	EPHO	Output phase failure
		0x0F	OLr	Dynamic braking resistor overload trip
		0x47	E-39	Auto-tuning error (PM motor)
0x4130	Ambient temperature	0x4A	E-42	Cooling fan fault [VF-AS3] *3
0x4210	Excess temperature device	0x0D	OL 1	Drive overload
		0x10	OH	Overheat
		0x3E	OL3	Main module overload
0x5140	Battery failure	0x4C	E-44	Battery of panel failure [VF-AS3] *3
0x5500	Unit internal fault	0x50	E-48	A6 Brake Unit internal fault [VF-AS3] *3
0x5530	Control EEPROM failure	0x12	EEP 1	EEPROM fault 1
		0x13	EEP2	EEPROM fault 2
		0x14	EEP3	EEPROM fault 3
		0x29	EtyP	Drive type error
0x6100	Internal software	0x33	E-19	CPU communication error
		0x37	E-23	Optional unit fault 2 [VF-S15], Option fault (slot A) [VF-AS3]
0x7300	Sensor	0x2E	OH2	Thermal fault stop command from external device
		0x32	E-18	Analog input break detection fault
		0x40	E-32	PTC fault
0x7310	Speed	0x2D	E-13	Over speed fault
0x7500	External communication fault	0x36	E-22	Embedded Ethernet fault [VF-AS3] *3
		0x46	E-38	Communication time-out of A6 Brake Unit
		0x4b	E-43	Communication time-out (embedded Ethernet) [VF-AS3] *3
0x7510	Serial interface No. 1	0x18	ErrS	Communication error
0x7520	Serial interface No. 2	0x1B	Err8	Optional unit fault 1
0x8331	Torque fault	0x2F	SOUt	PM Step-out
		0x34	E-20	Over torque boost fault
0x8501	Servo lock failure	0x45	E-37	Servo lock fault
0x9000	External malfunction	0x11	E	Emergency stop
		0x58	E-99	Trip for test [VF-AS3] *3
0xFF00	Additional functions - generic error	0x54	Etn 1	Auto-tuning error
		004D	E-45	GD2 auto-tuning error
0xFF03	Device specific - generic error	0x1D	UC	Low-current operation Trip
		0x3B	PrF	Safe torque switching check alarm
		0x49	UtC3	Undertorque / Undercurrent [VF-AS3] *3
		0x57	E-27	Power removal fault [Only VF-S15]

*1: Error code: same information as lower 16-bit of the pre-defined error code field (1003h sub-index 01h)

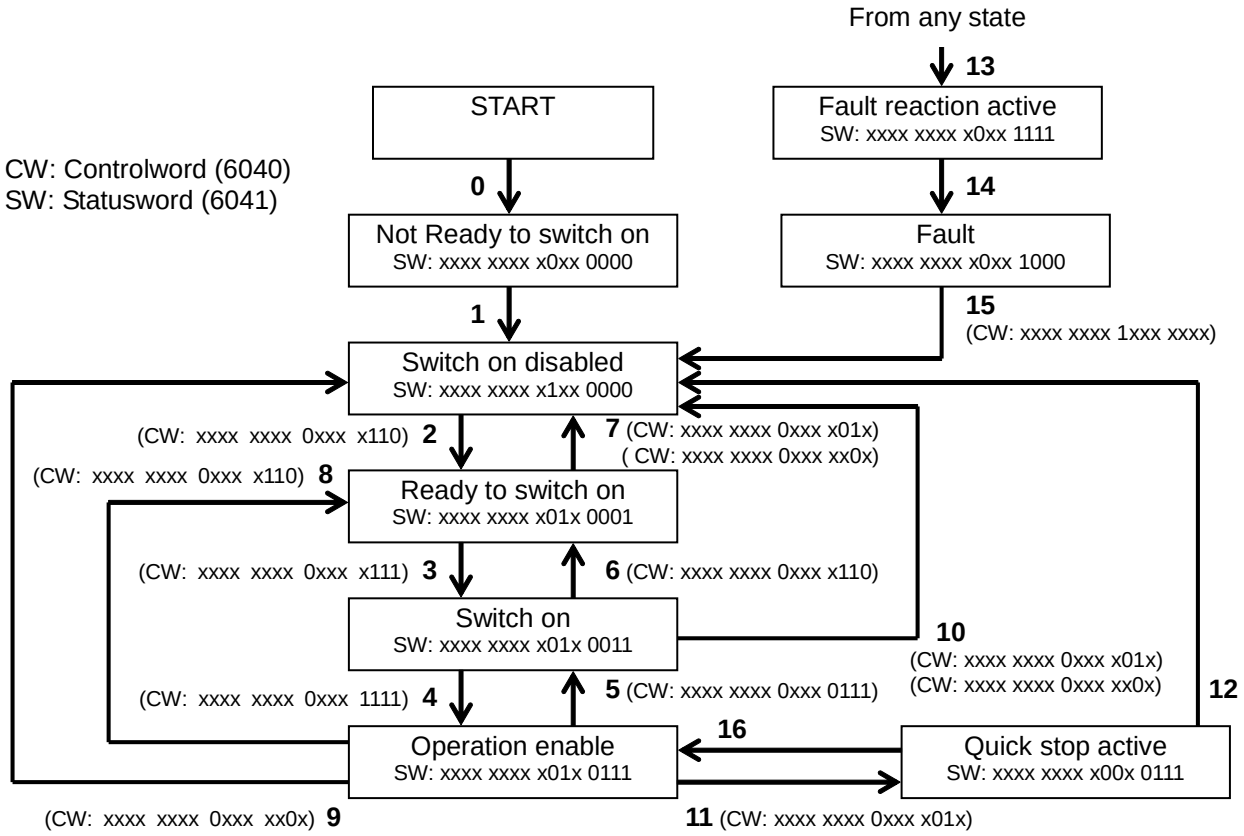
*2: Drive trip code: Drive internal error code

*3: These errors are for VF-AS3.

6.1.2. Object 0x6040: Controlword



ms = manufacturer-specific;
r = reserved;
oms = operation mode specific;
h = halt;
fr = fault reset;
eo = enable operation;
qs = quick stop;
ev = enable voltage;
so = switch on **Bold bits shall be supported, other may be supported.**



Command coding (CiA DS402-2 DSP V3.0 Table 27)

Command	Bits of the Controlword					Transitions
	fault reset	enable operation	Quick stop	enable voltage	switch on	
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	x	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 Note
Disable voltage	0	x	x	0	x	7, 9, 10, 12
Quick stop	0	x	0	1	x	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	↑	x	x	x	x	15

NOTE Automatic transition to Enable operation state after executing SWITCHED ON state functionality. When detects main power loss or not release main power loss in 3 sec after change to “Switch on state”, the state is changed to “Switch on disable”.

Transition events and action (CiA DS402-2 DSP V3.0 Table 26)

Transition	Event(s)	Action(s)
0	Automatic transition after power-on or reset application	Drive device self-test and/or self initialisation shall be performed.
1	Automatic transition	Communication shall be activated.
2	Shutdown command from control device or local signal	None
3	Switch on command received from control device or local signal	The high-level power shall be switched on, if possible.
4	Enable operation command received from control device or local signal	The drive function shall be enabled and all internal set-points cleared.
5	Disable operation command received from control device or local signal	The drive function shall be disabled.
6	Shutdown command received from control device or local signal	The high-level power shall be switched off, if possible.
7	Quick stop or disable voltage command from control device or local signal	None
8	Shutdown command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
9	Disable voltage command from control device or local signal	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
10	Disable voltage or quick stop command from control device or local signal	The high-level power shall be switched off, if possible.
11	Quick stop command from control device or local signal	The quick stop function shall be started.
12	Automatic transition when the quick stop function is completed and quick stop option code (605A) is 1, 2, 3 or 4, or disable voltage command received from control device (depends on the quick stop option code)	The drive function shall be disabled, and the high-level power shall be switched off, if possible.
13	Fault signal (see also /CiA402-3/)	The configured fault reaction function shall be executed.
14	Automatic transition	The drive function shall be disabled; the high-level power shall be switched off, if possible.
15	Fault reset command from control device or local signal	A reset of the fault condition is carried out, if no fault exists currently on the drive device; after leaving the Fault state, the Fault reset bit in the controlword shall be cleared by the control device.
16	Enable operation command from control device, if the quick stop option code (605A) is 5, 6, 7, or 8	The drive function shall be enabled.

6.1.3. Object 0x6041: Statusword

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ms				oms		ila	tr	rm	ms	w	sod	qs	ve	f	oe	so	rtso

MSB LSB

ms = manufacturer-specific;
oms = operation mode specific;
ila = internal limit active;
tr = target reached;
rm = remote;
w = warning;
sod = switch on disabled;
qs = quick stop;
ve = voltage enabled;
f = fault;
oe = operation enabled;
so = switched on;
rtso = ready to switch on

PDS FSA state	Statusword
Not ready to switch on	xxxx xxxx x0xx 0000
Switch on disabled	xxxx xxxx x1xx 0000
Ready to switch on	xxxx xxxx x01x 0001
Switched on	xxxx xxxx x01x 0011
Operation enabled	xxxx xxxx x01x 0111
Quick stop active	xxxx xxxx x00x 0111
Fault reaction active	xxxx xxxx x0xx 1111
Fault	xxxx xxxx x0xx 1000

6.1.4. Object 0x6042: vl_target_velocity

This object shall indicate the required velocity of the system. The value is given in revolutions per minute (min^{-1}). Positive value indicates forward direction and negative value indicates reverse direction.
At changing to “Operation enable” state, this target velocity is cleared. So set this target velocity data after change the state to “Operation enable”.

6.1.5. Object 0x6043: vl_velocity_demand

This object provides the instantaneous velocity generated by the ramp function. It is an internal object of the drive device. The value is given in the same unit as the vl target velocity. Positive value indicates forward direction and negative value indicates reverse direction.

6.1.6. Object 0x6044: vl_velocity_actual_value

This object provides the velocity at the motor spindle or load. Depending on the implementation (simple drive device, without sensor, with sensor, etc.), the drive provides the appropriate image of the actual velocity (velocity demand, velocity control effort, calculated velocity, measured velocity).
The value is given in the same unit as the vl_target_velocity. A positive value indicates forward direction and negative value indicates reverse direction.

6.1.7. Object 0x6046: vl_velocity_min_max_amount

This object indicates the configured minimum and maximum amount of velocity (unit min^{-1}). The vl_velocity_max amount sub-object is mapped internally to the vl_velocity_max positive and vl_velocity_max negative value. The vl_velocity_min amount sub-object is mapped internally to the vl_velocity_min positive and vl_velocity_min negative value.
At initial configuration, the Upper limit frequency (UL) and Lower limit frequency (LL) of the drive may be not same value with Object 0x6046 setting value. And when change the Upper limit frequency and the lower limit frequency of the drive parameter, Object 0x6046 value is different with the drive parameters.
To correspond these limit value, set Object 0x6046. And if need, execute Store Parameters command (Object 0x1010) to save the parameter to EEPROM.

6.1.8. Object 0x6048: vl_velocity_acceleration

This object indicates the configured delta speed and delta time of the slope of the acceleration ramp. Unit is min^{-1}.

[VF-S15]

Velocity acceleration delta speed : 225 to 30,000 min^{-1}
Velocity acceleration delta time : 0 to 3,600 s

[VF-AS3]

Velocity acceleration delta speed : 225 to 32,700 min^{-1}
Velocity acceleration delta time : 0 to 6,000 s

Note: Do not change the acceleration/deceleration time unit (parameter F519), if change the parameter, the setting value range will be different from above range. In this case, set 0(Linear) to acceleration/ deceleration 1 pattern (F502: 0x2502). (S-pattern isn't supported.)

6.1.9. Object 0x6049: vl_velocity_deceleration

This object shall indicate the configured delta speed and delta time of the slope of the deceleration ramp. Unit is min^{-1}.

[VF-S15]

Velocity deceleration delta speed: 225 to 30,000 min^{-1}
Velocity deceleration delta time : 0 to 3,600 s

[VF-AS3]

Velocity deceleration delta speed: 225 to 32,700 min^{-1}
Velocity deceleration delta time : 0 to 6,000 s

Note: Do not change the acceleration/deceleration time unit (parameter F519), if change the parameter, the setting value range will be different from above range. In this case, set 0(Linear) to acceleration/ deceleration 1 pattern (F502: 0x2502). (S-pattern isn't supported.)

6.1.10. Object 0x604A: vl_velocity_quick_stop

This object indicates the configured delta speed and delta time of the slope of the deceleration ramp for quick stop. Unit is min^{-1}.

6.1.11. Object 0x605A: Quick stop option code

This object shall indicate what action is performed when the quick stop function is executed.
The slow down ramp is the deceleration value of the used mode of operations.

Value	Definition
-32768 to -1	No function
0	Disable drive function
+1	Slow down on slow down ramp and transit into Switch On Disabled
+2	Slow down on quick stop ramp and transit into Switch On Disabled
+3	Do not set
+4	Slow down on voltage limit and transit into Switch On Disabled
+5	Slow down on slow down ramp and stay in Quick Stop Active
+6	Slow down on quick stop ramp and stay in Quick Stop Active
+7	Do not set
+8	Slow down on voltage limit and stay in Quick Stop Active
+9 to +32 767	Reserved

6.1.12. Object 0x6060: Modes of operation

This object shall indicate the requested operation mode.
With the drive, only velocity mode is supported as the operation mode, therefore any request to this object would make no sense.

Value	Definition
-128 to -1	Manufacture-specific operation modes
0	No mode change/no mode assigned
+1	Profile position mode
+2	Velocity mode
+3	Profile velocity mode
+4	Torque profile mode
+5	reserved
+6	Homing mode
+7	Interpolated position mode
+8	Cyclic sync position mode
+9	Cyclic sync velocity mode
+10	Cyclic sync torque mode
+11 to +127	Reserved

6.1.13. Object 0x6061: Modes of operation display

This object shall provide the actual operation mode.
With the drive, only velocity mode is supported as the operation mode, therefore only 0x02 can be displayed.

Value	Definition
+2	Velocity mode

6.1.14. Object 0x6502: Supported drive mode

This object shall provide the information on the supported drive mode.
With the drive, only velocity mode is supported as the operation mode, therefore only 0x00000002 can be provided.

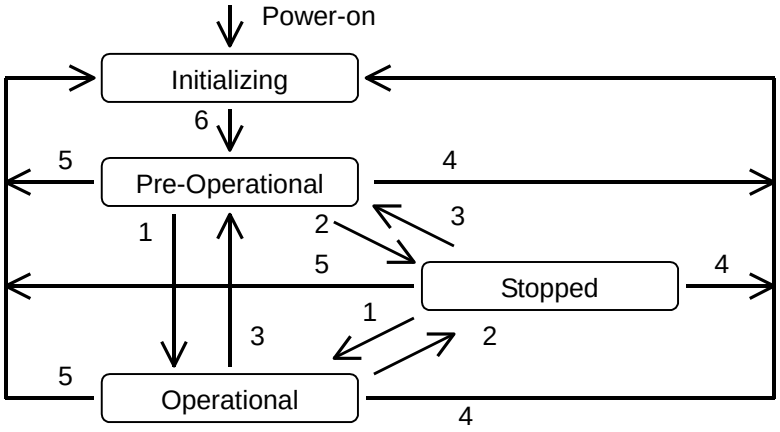
31 16	15 10	9	8	7	6	5	4	3	2	1	0
Manufacture-specific	reserved	cst	csv	csp	ip	hm	r	tq	pv	vl	pp
0 0	0 0	0	0	0	0	0	0	0	0	1	0

MSB LSB

7. Control from CANopen Network

7.1. NMT state machine

Below figure describes NMT state machine.



State No.	NMT Service	COB-ID	RTR	DLC	Data0	Data1	Data2 ~ 7
1	Start Remote Node	0x000	0	2	0x01	Node-ID	0x00,…,0x00
2	Stop Remote Node	0x000	0	2	0x02	Node-ID	0x00,…,0x00
3	Enter Pre-Operational State	0x000	0	2	0x80	Node-ID	0x00,…,0x00
4	Reset Node	0x000	0	2	0x81	Node-ID	0x00,…,0x00
5	Reset Communication	0x000	0	2	0x82	Node-ID	0x00,…,0x00
6	Device initialization finished, enter Pre-Operational state automatically, send Boot-up message	0x700+ Node-ID	0	1	0x00	0x00,…,0x00	

7.2. SDO communication

Using SDO (Service Data Object) communication, the drive parameters and CANopen object data can be read or wrote. When write Communication profile data, please confirm the NMT state machine is Pre-Operational state.

NMT State	SDO			PDO
	Communication Profile 0x1000 ~ 0x1FFF	Manufacturer Specific Profile 0x2000 ~ 0x5FFF	Standard Device Profile 0x6000 ~ 0x9FFF	
Stopped	---	---	---	---
Initializing	---	---	---	---
Pre-Operational	Read / Write	Read / Write *1	Read / Write	---
Operational	Read	Read / Write *1	Read / Write	Read / Write

*1: Write access is depending on each parameter.

7.2.1. Read object (Upload object)

Sending below data, the object data can be read.

Send data to read object

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x600+ Node-ID	0	4	40	Obj. No. L	Obj. No. H	Sub index	---	---	---	---

Response data for read object (byte)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	4f	Obj. No. L	Obj. No. H	Sub index	Data	---	---	---

Response data for read object (word)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	4b	Obj. No. L	Obj. No. H	Sub index	Data L	Data H	---	---

Response data for read object (long)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	43	Obj. No. L	Obj. No. H	Sub index	Data LL	Data LH	Data HL	Data HH

Error response (Refer to 7.2.3)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	43	Obj. No. L	Obj. No. H	Sub index	Data LL	Data LH	Data HL	Data HH

7.2.2. Write object (Download object)

Sending below data, the object data can be wrote.

Send data to write object (byte)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x600+ Node-ID	0	8	2f	Obj. No. L	Obj. No. H	Sub index	Data	---	---	---

Send data to write object (word)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x600+ Node-ID	0	8	2b	Obj. No. L	Obj. No. H	Sub index	Data L	Data H	---	---

Send data to write object (long)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x600+ Node-ID	0	8	23	Obj. No. L	Obj. No. H	Sub index	Data LL	Data LH	Data HL	Data HH

Response data for write object

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	60	Obj. No. L	Obj. No. H	Sub index	---	---	---	---

Error response (Refer to 7.2.3)

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x580+ Node-ID	0	8	80	Obj. No. L	Obj. No. H	Sub index	Abort Code LL	Abort Code LH	Abort Code HL	Abort Code HH

7.2.3. Abort code

The abort code in the below table are set in the error response data.

Abort Code	Contents
0503 0000	Toggle bit not alternated.
0504 0000	SDO protocol timed out.
0504 0001	Client/server command specifier not valid or unknown.
0504 0002	Invalid block size (block mode only).
0504 0003	Invalid sequence number (block mode only).
0504 0004	CRC error (block mode only).
0504 0005	Out of memory.
0601 0000	Unsupported access to an object.
0601 0001	Attempt to read a write only object.
0601 0002	Attempt to write a read only object.
0602 0000	Object does not exist in the object dictionary.
0604 0041	Object cannot be mapped to the PDO.
0604 0042	The number and length of the objects to be mapped would exceed PDO length.
0604 0043	General parameter incompatibility reason.
0604 0047	General internal incompatibility in the device.
0606 0000	Access failed due to an hardware error.
0607 0010	Data type does not match, length of service parameter does not match
0607 0012	Data type does not match, length of service parameter too high
0607 0013	Data type does not match, length of service parameter too low
0609 0011	Sub-index does not exist.
0609 0030	Invalid value for parameter (download only).
0609 0031	Value of parameter written too high (download only).
0609 0032	Value of parameter written too low (download only).
0609 0036	Maximum value is less than minimum value.
060A 0023	Resource not available: SDO connection
0800 0000	General error
0800 0020	Data cannot be transferred or stored to the application.
0800 0021	Data cannot be transferred or stored to the application because of local control.
0800 0022	Data cannot be transferred or stored to the application because of the present device state.
0800 0023	Object dictionary dynamic generation fails or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of an file error).
0800 0024	No data available

7.3. PDO communication

Using PDO (Process Data Object) communication, send and receive command and monitor data with synchronously or asynchronously.

7.3.1. TxPDO and RxPDO communication type

TxPDO (Drive send PDO) can be set below condition in table.

TxPDO1 Transmission type : Object 0x1800 subindex 02
TxPDO2 Transmission type : Object 0x1801 subindex 02
TxPDO3 Transmission type : Object 0x1802 subindex 02
TxPDO21 Transmission type : Object 0x1814 subindex 02

TxPDO Transmission type

Transmission type	Condition to trigger PDO			PDO Transmission
	SYNC	RTR	Event	
0	✓	(✓)	✓	Send at the monitor value changes from last sending and received SYNC message (or sampling and send at RTR received [*1])
1 ~ 240	✓	(✓)	---	Send at n times SYNC message received (or sampling and send at RTR received [*1])
241 ~ 251	---	---	---	No function
252	✓	✓	---	Sampling at SYNC message and send at received RTR message
253	---	✓	---	Sampling and send at received RTR message
254	---	(✓)	✓	At the monitor value changes from the last sending and past the inhibit time. Or at past the event time setting. (or sampling and send at RTR received)
255	---	(✓)	✓	

RxPDO (Drive receive PDO) can be set below condition in table.

RxPDO1 Transmission type : Object 0x1400 subindex 02
RxPDO2 Transmission type : Object 0x1401 subindex 02
RxPDO3 Transmission type : Object 0x1402 subindex 02
RxPDO21 Transmission type : Object 0x1414 subindex 02

RxPDO Transmission type

Transmission type	Condition to trigger PDO			PDO Transmission
	SYNC	RTR	Event	
0 ~ 240 [*2]	✓	---	---	RxPDO updated at SYNC receive
241 ~ 253	---	---	---	No function
254	---	---	✓	RxPDO updated immediately
255	---	---	✓	RxPDO updated immediately

*1: If VF-AS3 is used, this under lined sentence is substituted to "or sampling at SYNC message and send at received RTR message".

*2: If VF-S15 is used, set 1 to transmission type.

7.3.2. RTR (Remote Transfer Request) communication

When set RTR setting into TxPDO Transmission type (0x1800, 0x1801, 0x1802, 0x1814 subindex 02), sending the RTR (Remote Transfer Request) message, Drive send TxPDO message.

TxPDO1 RTR message data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x180+ Node-ID	1	0	---	---	---	---	---	---	---	---

TxPDO2 RTR message data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x280+ Node-ID	1	0	---	---	---	---	---	---	---	---

TxPDO3 RTR message data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x380+ Node-ID	1	0	---	---	---	---	---	---	---	---

TxPDO21 RTR message data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x480+ Node-ID	1	0	---	---	---	---	---	---	---	---

7.3.3. SYNC communication

When set SYNC type into TxPDO Transmission type (0x1800, 0x1801, 0x1802, 0x1814 subindex 02) or RxPDO Transmission type (0x1400, 0x1401, 0x1402, 0x1414 subindex 02), update command or send monitor data synchronously to the SYNC message.

And send SYNC message with count data, the drive SYNC counter are preset with SYNC counter data.

When the drive is reset, the SYNC count data in the drive is cleared.

SYNC send data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x080	0	0	---	---	---	---	---	---	---	---

SYNC send data with count data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x080	0	1	Count *1	---	---	---	---	---	---	---

*1: [VF-S15] If the value is set more than the transmission type of PDO, the PDO is updated after next SYNC.
[VF-AS3] If the value is set more than the transmission type of PDO, the PDO is updated at the same time.

7.3.4. Emergency object

The drive sends the Emergency message at the drive detects fault condition or CANopen communication node state is changed.*1 About Error code, refer to the ”6.1.1 Object 0x603F: Error Code”

Emergency send data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x080+ Node-ID	0	8	Emergency Error Code		Error Register	Manufacture specific error field				
			L	H						

*1: If VF-AS3 is used, this under lined sentence is substituted to “or first connection or after reset, after Reset Node, after Reset Communication.

7.4. Communication disconnection detection function

VF-S15 / VF-AS3 CANopen supports Heartbeat service and Node Guarding service to detect the communication disconnection.
Heartbeat service and Node Guarding service function can not be active at the same time.

- Heartbeat service
  - Heartbeat Consumer
    Watching the heartbeat message of the specific Node-ID, and checking the interval time, the drive can detect the network abnormal condition.
  - Heartbeat Producer
    Sending the heartbeat message of own Node-ID, the drive can inform its node status.

- Node Guarding service
  NMT master polling the Guarding message, NMT master can detect each mode state and network abnormal condition.

Recommend to use Heartbeat service to reduce the network traffic.

7.4.1. Heartbeat Consumer

Heartbeat consumer node can detect abnormal condition by watching the heartbeat message configured specific Node-ID and interval time of Object 0x1016.
When the drive detects the network abnormal condition, the drive changes the drive condition according to the parameter setting (C 100 ~ C 103)

7.4.2. Heartbeat producer

Heartbeat producer function sends the heartbeat message with object 0x1017 interval setting.

Heartbeat message send data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x700+ Node-ID	0	1	State	---	---	---	---	---	---	---

State	Comments
0	Boot up
4	Stooped
5	Operational
127	Pre-operational

7.4.3. Node Guarding

When the Node Guarding message is received, the drive sends the Node Guarding message with the node state.

When the drive does not receive the Node Guard message in the interval time (=Guard Time x Time Factor, Max time is limited internally 1 hour.) set by Object 0x100C (Guard Time) and 0x100D (Time Factor), the drive detects the network error and changes the drive condition according to the parameter setting (C 100 ~ C 103). If Heartbeat function is used, Node Guarding function doesn't work.

Node Guarding send data

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x700+ Node-ID	1	0	---	---	---	---	---	---	---	---

Response data of Node Guard

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x700+ Node-ID	0	1	bit7:toggle bit6-0:State	---	---	---	---	---	---	---

Data0		State
bit7	bit6-0	
toggle	0	Initializing
	1	Disconnected
	2	Connecting
	3	Preparing
	4	Stooped
	5	Operational
	127	Pre-operational

7.4.4. NMT Boot-up

The drive sends the NMT Boot-up message at the drive power on or reset. When the controller received the NMT Boot-up message, should change the drive node state and send appropriate command data.

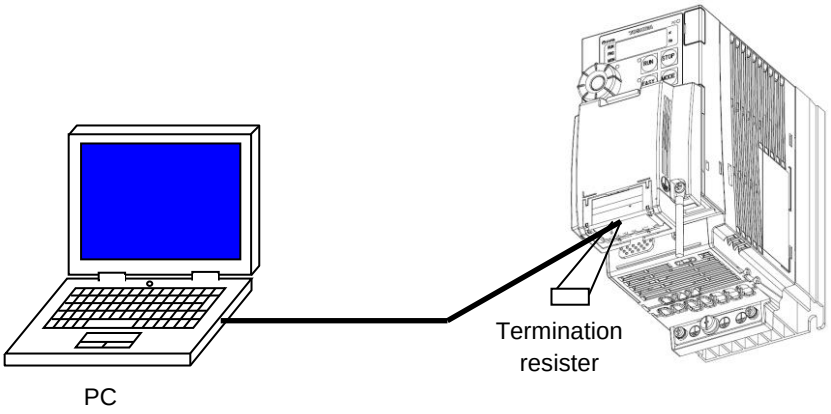
NMT Boot-up send data (NMT Master <- NMT Slave (Drive))

COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
0x700+ Node-ID	0	1	0	---	---	---	---	---	---	---

8. Example communication

8.1. ASYNC communication

This is an example communication to control run/stop the drive and set frequency command.



Parameter	Function		Setting	Comments
CMOd	Command mode setting		3 [VF-S15] 5 [VF-AS3]	Command from CANopen
FMOd	Frequency command selection		6 [VF-S15] 23 [VF-AS3]	Frequency from CANopen
C701	Node-ID		1	1 ~ 127
C702	Board rate 0: 20k 4: 500k 1: 50k 5: 800k 2: 125k 6: 1M 3: 250k		2 (125kbps)	CAN baud rate setting
C711	PDO1	Receive: COB-ID entry High word	0x00000201	0x1400 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID = 0x00000200+Node-ID
C712		Low word		
C713		RPDO transmission type	0x0FF	0x1400 subidx 02 Asynchronous
C714		Transmit :COB-ID High word	0x00000181	0x1800 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID = 0x00000180+Node-ID
C715		Low word		
C716		TPDO Transition type	0x0FF	0x1800 subidx 02 Asynchronous
C750	PDO1	Number of objects	0x02	0x1600 subidx 00 Receive PDO1 assignment: Number of objects assigned
C751		Command 1	0x6040	0x1600 subidx 01 Command Index No. 0x6040: Controlword
C752		Command 2	0x6042	0x1600 subidx 02 Command Index No. 0x6042: vl target velocity
C755		Number of objects	0x02	0x1A00 subidx 00 Transmit PDO1 assignment: Number of objects assigned
C756		Monitor 1	0x6041	0x1A00 subidx 01 Monitor Index No. 0x6041: vl Statusword
C757		Monitor 2	0x6044	0x1A00 subidx 02 Monitor Index No. 0x6044: vl velocity actual value

1. NMT Boot-up (Drive power on)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x701	0	1	0	---	---	---	---	---	---	---

*1: If VF-AS3 is used, EMCY (Drive power on) is sent.

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x81	0	8	0	0	0	0	0	0	0	0

2. NMT Module Control (Change Operational state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x000	0	2	1	1	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity _actual_value		---	---	---	---
				0x50	0x02	0	0				

3.RxPDO1 (Change to “Ready to switch on” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x06	0x00	0x00	0x00				

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x31	0x02	0x00	0x00				

4. RxPDO1 (Change “Switch on” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x07	0x00	0x00	0x00				

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x33	0x02	0x00	0x00				

5. RxPDO1 (Change “Operation enable” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x0f	0x00	0x00	0x00				

TxPDO1 (Send the response of the drive status and the output frequency)

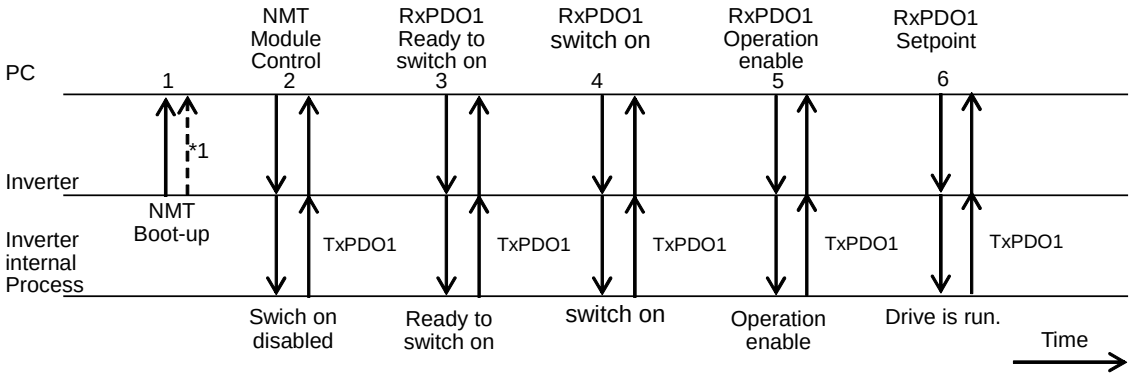
INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x37	0x02	0x00	0x00				

6. RxPDO1 (Set the speed to 1500min^{-1} (0x05dc))

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x0f	0x00	0xdc	0x05				

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x37	0x06	0xdc	0x05				



Communication between PC and Inverter

8.2. SYNC communication

This is a sample communication using SYNC message.

Parameter	Function		Setting	Comments
C00d	Command mode selection		3 [VF-S15] 5 [VF-AS3]	Command from CANopen
F00d	Frequency setting mode selection		6 [VF-S15] 23 [VF-AS3]	Frequency from CANopen
C701	Node-ID		1	1 ~ 127
C702	Board rate 0: 20k 4: 500k 1: 50k 5: 800k 2: 125k 6: 1M 3: 250k		2 (125kbps)	CAN baud rate setting
C711	PDO1	Receive: COB-ID entry High word	0x00000201	0x1400 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID=0x00000200+Node-ID
C712		Low word		
C713		RPDO transmission type	0x01	0x1400 subidx 02 Synchronous
C714		Transmit :COB-ID High word	0x00000181	0x1800 subidx 01 If the setting is default setting, COB-ID is below value. COB-ID=0x00000180+Node-ID
C715		Low word		
C716		TPDO Transition type	0xFF	0x1800 subidx 02 Synchronous
C750	PDO1	Number of objects	0x02	0x1600 subidx 00 Receive PDO1 assignment: Number of objects assigned
C751		Command 1	0x6040	0x1600 subidx 01 Command Index No. 0x6040: Controlword
C752		Command 2	0x6042	0x1600 subidx 02 Command Index No. 0x6042: vl target velocity
C755		Number of objects	0x02	0x1A00 subidx 00 Transmit PDO1 assignment: Number of objects assigned
C756		Monitor 1	0x6041	0x1A00 subidx 01 Monitor Index No. 0x6041: vl Statusword
C757		Monitor 2	0x6044	0x1A00 subidx 02 Monitor Index No. 0x6044: vl velocity actual value

1. NMT Boot-up (Drive power on)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x701	0	1	0	---	---	---	---	---	---	---

*1: If VF-AS3 is used, EMCY (Drive power on) is sent.

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x81	0	8	0	0	0	0	0	0	0	0

2. NMT Module Control (Change to Operational state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x000	0	2	1	1	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity _actual_value		---	---	---	---
				0x50	0x02	0	0				

3. RxPDO1 (Change to “Ready to switch on” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x06	0x00	0x00	0x00				

4. SYNC (Update RxPDO received data to control data)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x080	0	0	---	---	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity _actual_value		---	---	---	---
				0x31	0x02	0x00	0x00				

5. RxPDO1 (Change “Switch on” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x07	0x00	0x00	0x00				

6. SYNC (Update RxPDO received data to control data)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x080	0	0	---	---	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x33	0x02	0x00	0x00				

7. RxPDO1 (Change “Operation enable” state)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x0f	0x00	0x00	0x00				

8. SYNC (Update RxPDO received data to control data)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x080	0	0	---	---	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x37	0x02	0x00	0x00				

9. RxPDO1 (Set the speed to 1500min^{-1} (0x05dc))

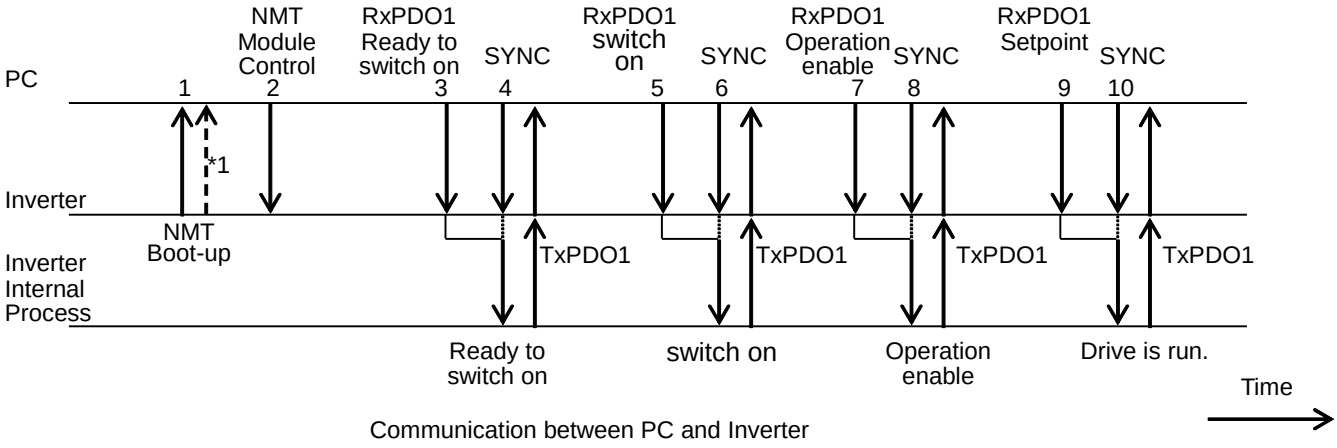
INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x201	0	4	Control word		vl_target_velocity		---	---	---	---
				0x0f	0x00	0xdc	0x05				

10. SYNC (Update RxPDO received data to control data)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
←	0x080	0	0	---	---	---	---	---	---	---	---

TxPDO1 (Send the response of the drive status and the output frequency)

INV - PC	COB-ID	RTR	DLC	Data0	Data1	Data2	Data3	Data4	Data5	Data6	Data7
→	0x181	0	4	Status word		vl_velocity…		---	---	---	---
				0x37	0x06	0xdc	0x05				



Communication between PC and Inverter

9. Specifications

9.1. Data and operating specification

Item	Specification
Communication Profile	CiA DS301 V4.02 CiA DR 303-3 V1.3 Indicator specification CiA DSP 402 Ver1.1 Drives and motion control device profile, Velocity mode
Communication medium	CAN (ISO 11898)

9.2. CANopen device specification

Item	Specification	Comments
Node-ID	1 ~ 127	Up to 64 node in one segment
Baud rate	20k, 50k, 125k, 250k 500k, 800k, 1M	Factory setting is 125kbps
LED indicator	RUN LED ERR LED	Green LED Red LED
Time stamp	No function	---
SDO	1 SDO server Expedited segment transfer	---
PDO	PDO1 PDO2 PDO3 PDO21	COB-IDs are variable mapping Objects are variable mapping
Translation Type (RPDO)	Synchronous and Asynchronous are supported	---
Translation Type (TPDO)	Acyclic synchronous Cyclic synchronous Synchronous RTR only Asynchronous RTR only Asynchronous, timer trigger	---
HEALTH Heartbeat	1 Producer 1 Consumer	---
Connector	Shielded RJ45 connector	---
Command reception time	About 5ms *1 *2	Baud rate = 125K

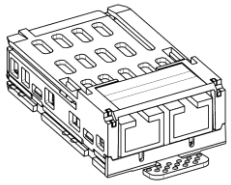
*1: Command reception time is the time until the drive is operated by RUN command on the cyclic communication.

*2: [VF-AS3] SDO is about 8ms when the correct value is downloaded to Manufacture special profile (object 2000 ~ 4FFF) or Drive profile (object 603F ~ 6044).

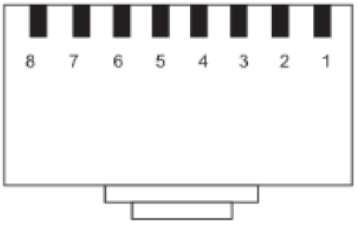
9.3. Connecting of CANopen communication option

■Connector diagram of CAN001Z

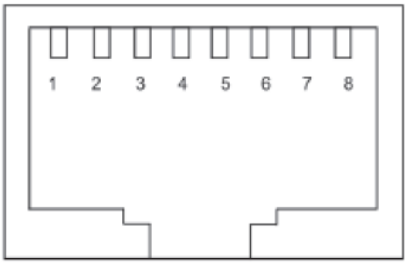
Type form	CAN001Z
Connector	2×RJ45



Plug



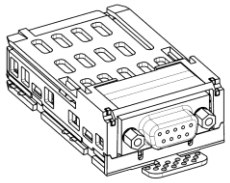
Socket



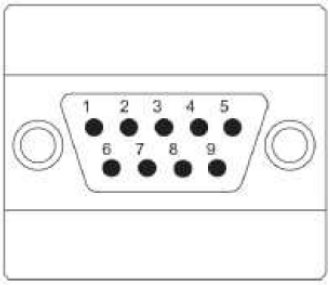
Pin	Signal	Description
1	CAN_H	Isolated from drive (Connected both RJ45 each other)
2	CAN_L	Isolated from drive (Connected both RJ45 each other)
3	CAN_GND	Isolated from drive (Connected both RJ45 each other)
4	NC	-
5	NC	-
6	NC	-
7	NC	-
8	NC	-
Frame	Shield	Earth (through SBP009Z grounding cable)

■Connector diagram of CAN002Z

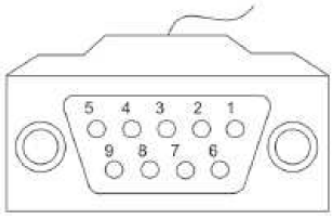
Type form	CAN002Z
Connector	9pin D-sub



Plug



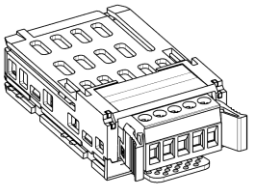
Socket

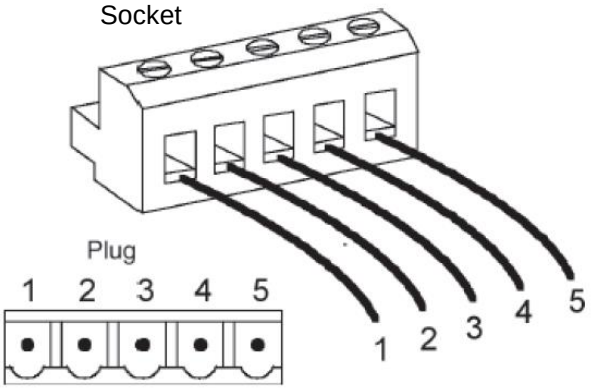


Pin	Signal	Description
1	NC	-
2	CAN_L	Isolated from drive
3	CAN_GND	Isolated from drive
4	NC	-
5	NC	-
6	CAN_GND	Isolated from drive
7	CAN_H	Isolated from drive
8	NC	-
9	NC	-
Frame	Shield	Earth (through SBP009Z grounding cable)

■Connector diagram of CAN003Z

Type form	CAN003Z
Connector	5 pin open type





Pin	Signal	Description
1	CAN_GND	Isolated from drive
2	CAN_L	Isolated from drive
3	Shield	Earth (through SBP009Z grounding cable)
4	CAN_H	Isolated from drive
5	NC	-