

TOSVERT VF-FS1 series

APOGEE® FLN option unit Function Manual

APG002Z

NOTICE

1. Make sure that this instruction manual is delivered to the end user of APOGEE® FLN option unit.
2. Read this manual before installing or operating the APOGEE® FLN option unit. Keep it in a safe place for reference.
3. All information contained in this manual are subject to change without notice. Please confirm the latest information on our web site "www.inverter.co.jp".

Table of Contents

1. INTRODUCTION	2
2. NAMES AND FUNCTIONS OF MAIN PARTS	3
2.1. Outline view.....	3
2.2. Use of RS485 communication port.....	3
2.3. LED indicator.....	4
2.4. Command & Setpoint selection (Local/Remote).....	5
3. VFFS1 PARAMETERS	6
3.1. Communication parameters.....	6
3.2. Communication setting between option board.....	7
3.3. Communication error detection between inverter and option board.....	7
3.4. Selection of the communication protocol (<i>F B 2 9</i>).....	7
3.5. Network address (<i>F B 9 0</i>).....	7
3.6. Use the serial communication option.....	7
4. APG002Z POINT SUMMARIES	8
4.1. Logical Analog Input (LAI) Summary.....	10
4.1.1. LAI Point Descriptions.....	11
4.2. Logical Analog Output (LAO) Summary.....	12
4.2.1. LAO Point Descriptions.....	13
4.3. Logical Digital Input (LDI) Summary.....	14
4.3.1. LDI Point Descriptions.....	15
4.4. Logical Digital Output (LDO) Summary.....	16
4.4.1. LDO Point Descriptions.....	17
4.5. FLN P1 Error Codes.....	18
5. MAILBOX FUNCTION POINTS	19
6. FRAME COUNTER MONITOR	20
7. VFFS1 ALARM CODE	21
8. VFFS1 FAULT CODE	22
9. SPECIFICATIONS	23

1. Introduction

Thank you for purchasing the APOGEE® FLN option unit (APG002Z) for VFFS1 series inverter.

Before using APOGEE® FLN option unit, 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.

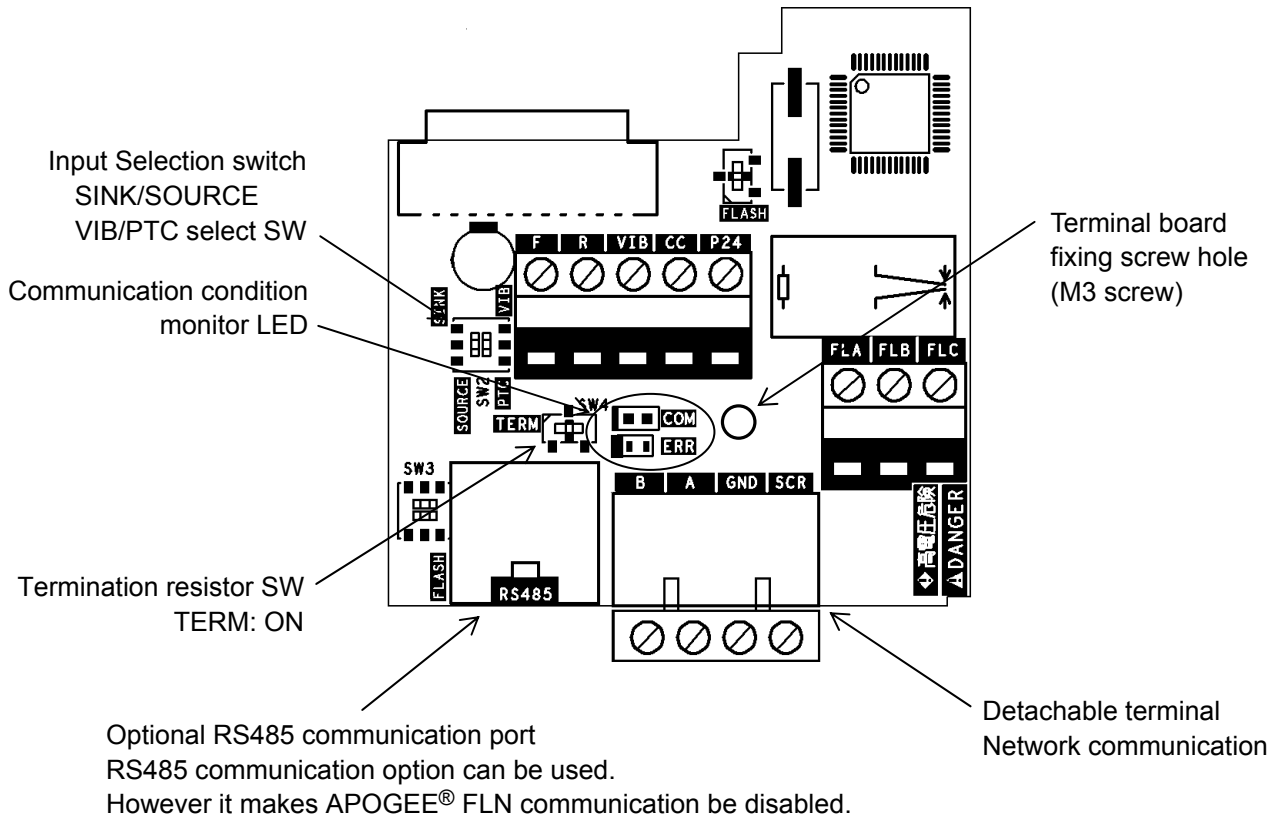
For details of its general handling, see an instruction manual attached with the option unit.

- TOSVERT VF-FS1 Instruction Manual.....E6581381
- TOSVERT VF-FS1 Serial Communication Manual.....E6581393
- APG002Z Instruction ManualE6581496

* APOGEE® FLN is a registered trademark of Siemens Building Technologies, Inc.

2. Names and functions of main parts

2.1. Outline view



2.2. Use of RS485 communication port

Serial communication (2-wire RS485) option can be used. However, while it is connected, the internal communication line is switched to RS485 then the communication via APOGEE® FLN network is disabled. In this case, communication error trip time ($F8Q3$) is also active. Use RS485 serial communication option specified by Toshiba.

2.3. LED indicator

The option has two LEDs. Those function are below table.

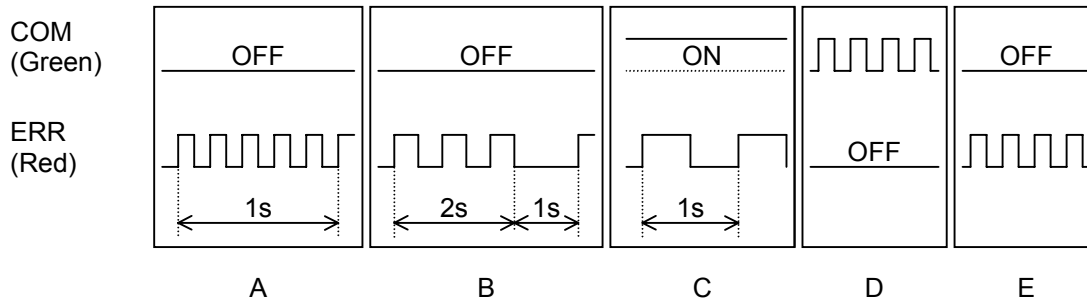


Table 1 LEDs Indication Table

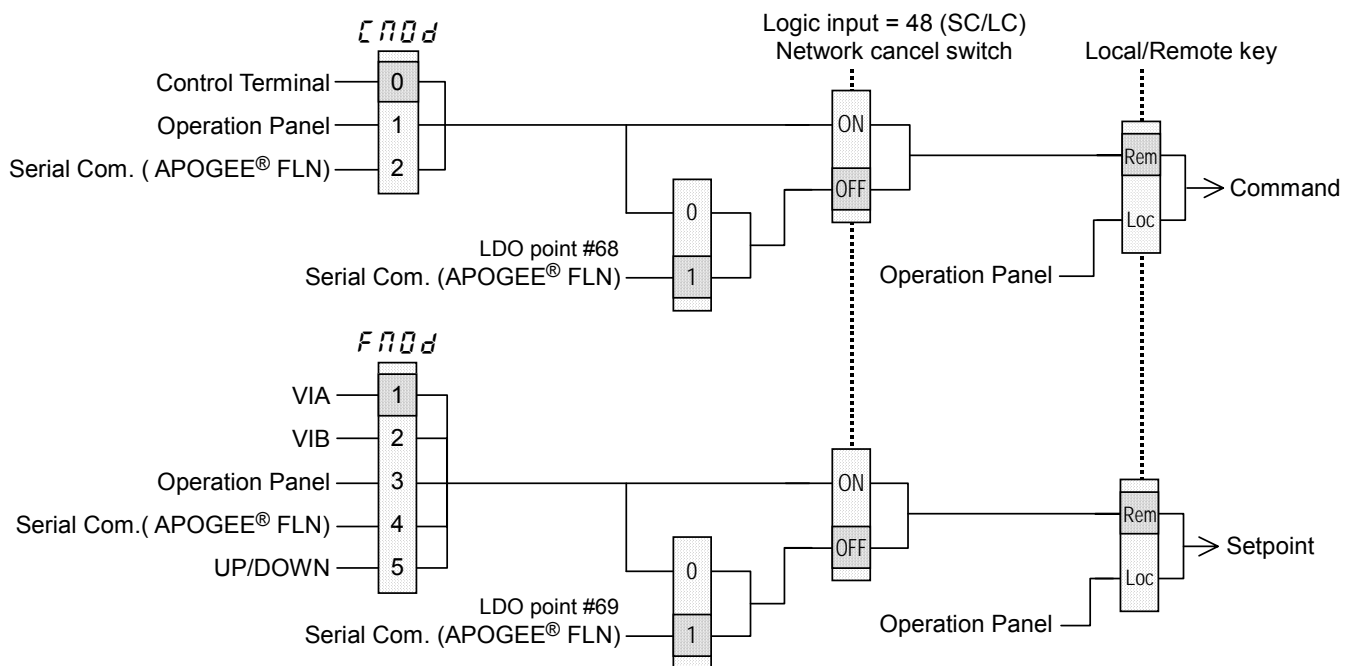
State	LEDs	Comment
A	COM LED: OFF ERR LED: Flashing 5 times in 1 second	APG002Z failure.
B	COM LED: OFF ERR LED: 3 times in 2 seconds, Off for 1 second	Communication loss was detected. Confirm the network condition and connection of the cable.
C	COM LED: ON ERR LED: OFF 0.5s, ON 0.5s	Invalid configuration was detected, or a option is connected to RJ45.
D	COM LED: Flashing ERR LED: -	Valid message was received for this node
E	COM LED: - ERR LED: Flashing	Invalid message was received (any node)

2.4. Command & Setpoint selection (Local/Remote)

Indication to display Local/Remote mode is on the inverter unit (Refer to the inverter instruction manual for details). APOGEE® FLN option command and setpoint are activated on Remote mode*.

Inverters have some switches to select the command and setpoint location. Following figure shows the diagram. Refer to the inverter instruction manual for the parameter in detail.

* Be careful that *CNOd* command and *FNOd* setpoint are activated for a short time just after the inverter power turned on. Set *CNOd* and *FNOd* to “network” (“Serial communication” for APG002Z) to prevent this problem.



3. VFFS1 Parameters

3.1. Communication parameters

Set up the inverter parameters as follows. To update, reset the power of inverter. If these parameters are not set to correct value, this unit can not work normally.

Table 2 VFFS1 Parameters Table

Title	Function	Description	APG002Z
<i>F803</i>	Emergency stop selection	0: Coast stop 1: Slowdown stop 2: Emergency DC braking	-
<i>F800</i>	Communication rate	Set "1: 19200bps" (default).	1
<i>F801</i>	Parity	Set "1: Even" (default).	1
<i>F803</i>	Communication error trip time	Set communication time out period.	-
<i>F829</i>	Communication protocol	0: Toshiba inverter protocol 1: Modbus protocol 2: Metasys [®] N2 protocol 3: APOGEE [®] FLN protocol 4: BACnet protocol	3
<i>F851</i>	Operation at communication error by disconnection	0: Inverter stop, communication command, frequency mode open (by <i>ENOd</i> , <i>FNod</i>) 1: None (continued operation) 2: Deceleration stop 3: Coast stop 4: Network error (<i>ErrB</i> trip)	-

Title	Function	Description	APG002Z
<i>F890</i>	Address	Set FLN device (APG002Z) address	1 - 99
<i>F891</i>	Network baud rate	0: 9600bps 1: 4800bps 2: 9600bps 3: 19200bps 4: 38400bps 5: 57600bps 6: 76800bps Other parameters are fixed. 8bit, no parity, 1stop	-
<i>F892</i>	Network Time-Out	0: No action Unit 0.1 sec, Setting range: 1 – 65535	-
<i>F893</i>	Factory setting	At startup the board, if the value is not 172(ACh), all point data will be set to default value.	172 (ACh)
<i>F897</i>	Version	The software version of APG002Z	(100)

* When *FNod* or *ENOd* is set to "Serial Communication", VFFS1 drives without FLN LOC REF (point #69 = 1) or FLN LOC CTL (point #68 = 1) at each Objects.

3.2. Communication setting between option board

Do not change communication rate (*F800*) and parity (*F801*) from shipment setting. If change the setting, the option board does not work properly.

3.3. Communication error detection between inverter and option board

Set the communication loss action time to *F803* between the inverter and the option board. And the network communication loss action time to *F892*. The network loss action function starts from receiving the properly frame message. The action of the network communication loss is set by *F851*.

When set the communication loss action time *F803* and connect the option to the RJ45 connector, the communication between the inverter and the option is disabled, so the communication loss may be detected. The action of the inverter and the option board communication loss is set by *F603*.

3.4. Selection of the communication protocol (*F829*)

Set the communication protocol *F829* to “3: APOGEE® FLN protocol”.

The communication protocol of RJ45 is set to MODBUS, so when communicate with PC, use MODBUS protocol.

3.5. Network address (*F890*)

Set the network address of this node. Do not set same address number in the APOGEE® FLN network. If set wrong number, the option board does not work properly.

3.6. Use the serial communication option

Serial communication (2-wire RS485) option can be used. However, while it is connected, the internal communication line is switched to RS485 then the communication via APOGEE® FLN network is disabled. In this case, communication error trip time (*F803*) is also active.

Use RS485 serial communication option specified by Toshiba.

Caution



Mandatory

- ▼ Set up “Communication error trip function (*F803*, see the inverter instruction manual for details)” to stop the inverter when this option unit is deactivated by an unusual event such as tripping, an operating error, power outage, failure, etc. Deactivated option unit may cause an accident, if the “Communication error trip function” is not properly set up.

4. APG002Z Point Summaries

This database features 63 logical points: 19 Logical Analog Inputs (LAI), 16 Logical Analog Outputs (LAO), 16 Logical Digital Inputs (LDI) and 12 Logical Digital Outputs (LDO). These points configure, control or monitor the operation of the Drive.

Table 3 Point Summary

Point Number	Point Type	Point Name	Factory Default	Eng. Units	Slope	Intercept	ON Text	OFF Text
01	LAO	CTLR ADDRESS	99	-	1	0	-	-
02	LAO	APPLICATION	2738	-	1	0	-	-
{03}	LAI	FREQ OUTPUT	0	HZ	0.1	0	-	-
{04}	LAI	PCT OUTPUT	0	PCT	0.1	0	-	-
{05}	LAI	SPEED	0	RPM	1	0	-	-
{06}	LAI	CURRENT	0	A	0.1	0	-	-
{07}	LAI	TORQUE	2000	PCT	0.1	-200	-	-
{08}	LAI	POWER	0	KW	0.1	0	-	-
{09}	LAI	DRIVE TEMP	0	PCT	0.1	0	-	-
{10}	LAI	DRIVE KWH	0	KWH	1	0	-	-
{11}	LAI	DRIVE MWH	0	MWH	1	0	-	-
{12}	LAI	RUN TIME	0	H	1	0	-	-
{13}	LAI	DC BUS VOLT	0	V	1	0	-	-
{14}	LAI	OUTPUT VOLT	0	V	1	0	-	-
{15}	LAI	PRC PID FBCK	0	PCT	0.1	0	-	-
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20	LAO	OVRD TIME	1	H	1	0	-	-
{21}	LDI	FWD.REV	FWD	-	1	0	REV	FWD
{22}	LDO	CMD FWD.REV	FWD	-	1	0	REV	FWD
{23}	LDI	STOP.RUN	STOP	-	1	0	RUN	STOP
{24}	LDO	CMD STP.STRT	STOP	-	1	0	RUN	STOP
{25}	LDI	EXT1.2 ACT	EXT1	-	1	0	EXT2	EXT1
{26}	LDO	EXT1.2 CMD	EXT1	-	1	0	EXT2	EXT1
{27}	LDI	DRIVE READY	NOTRDY	-	1	0	READY	NOTRDY
{28}	LDI	AT SETPOINT	NO	-	1	0	YES	NO
{29}	LDO	DAY.NIGHT	DAY	-	1	0	NIGHT	DAY
30	LAO	CURRENT LIM	0	A	0.1	0	-	-
31	LAO	ACCEL TIME 1	300	S	0.1	0	-	-
32	LAO	DECEL TIME 1	300	S	0.1	0	-	-
{33}	LDI	HANDAUTO ACT	AUTO	-	1	0	HAND	AUTO
34	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{36}	LDI	FLN LOC ACT	AUTO	-	1	0	FLN	AUTO
{37}	LDI	CTL SRC	NO	-	1	0	YES	NO
{38}	LDI	FLN REF1 SRC	NO	-	1	0	YES	NO
{39}	LDI	FLN REF2 SRC	NO	-	1	0	YES	NO
{40}	LDO	DO 1 COMMAND	OFF	-	1	0	ON	OFF
41	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
42	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Point Number	Point Type	Point Name	Factory Default	Eng. Units	Slope	Intercept	ON Text	OFF Text
46	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
47	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
48	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{49}	LDO	RESET KWH	NO	-	1	0	RESET	NO
50	LAO	PRC PID GAIN	10	PCT	0.1	0	-	-
51	LAO	PRC PID ITIM	600	S	0.1	0	-	-
52	LAO	PRC PID DTIM	0	S	0.1	0	-	-
53	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
54	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
56	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
59	LDO	LOCK PANEL	UNLOCK	-	1	0	LOCK	UNLOCK
{60}	LAO	INPUT REF1	0	PCT	0.1	0	-	-
{61}	LAO	INPUT REF2	0	PCT	0.1	0	-	-
62	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
66	LAO	SPD OUT MIN	0	PCT	0.1	0	-	-
67	LAO	SPD OUT MAX	1000	PCT	0.1	0	-	-
{68}	LDO	FLN LOC CTL	AUTO	-	1	0	FLN	AUTO
{69}	LDO	FLN LOC REF	AUTO	-	1	0	FLN	AUTO
{70}	LDI	DI 1 ACTUAL	OFF	-	1	0	ON	OFF
{71}	LDI	DI 2 ACTUAL	OFF	-	1	0	ON	OFF
72	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
73	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{76}	LDI	DO 1 ACTUAL	OFF	-	1	0	ON	OFF
{77}	LDI	DO 2 ACTUAL	OFF	-	1	0	ON	OFF
78	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
79	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
80	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{82}	LAI	AI 1 ACTUAL	0	PCT	0.1	0	-	-
83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
85	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{86}	LDI	OK.ALARM	OK	-	1	0	ALARM	OK
87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
{88}	LAI	ALARM WORD 1	-	-	1	0	-	-
{89}	LAI	ALARM WORD 2	-	-	1	0	-	-
{90}	LAI	LAST FAULT	-	-	1	0	-	-
{91}	LAI	PREV FAULT 1	-	-	1	0	-	-
{92}	LAI	PREV FAULT 2	-	-	1	0	-	-
{93}	LDI	OK.FAULT	OK	-	1	0	FAULT	OK
{94}	LDO	RESET FAULT	NO	-	1	0	RESET	NO
{95}	LAO	MBOX PARAM	-	-	1	0	-	-
{96}	LAO	MBOX DATA	-	-	1	0	-	-
{97}	LDO	MBOX READ	DONE	-	1	0	READ	DONE
{98}	LDO	MBOX WRITE	DONE	-	1	0	WRITE	DONE
{99}	LAO	ERROR STATUS	0	-	1	0	-	-

4.1. Logical Analog Input (LAI) Summary

Logical Analog Input (LAI) points are used for monitoring drive status items such as output frequency, current and voltage. The APG002Z supports 19 different logical analog input points. Change of value (COV) of LAI points can be enabled (LAI points are capable of being characterized). LAI points will respond to write point and memorize point commands, but will not change their actual values or indicate override active.

Table 4 Logical Analog Input (LAI) Summary

Point Number	Point Name	Factory Default	Eng. Units	Slope	Intercept	Min	Max
03	FREQ OUTPUT	0	HZ	0.1	0	0	32767
04	PCT OUTPUT	0	PCT	0.1	0	0	32767
05	SPEED	0	RPM	1	0	0	32767
06	CURRENT	0	A	0.1	0	0	32767
07	TORQUE	2000	PCT	0.1	-200	0	32767
08	POWER	0	KW	0.1	0	0	32767
09	DRIVE TEMP	0	PCT	0.1	0	0	32767
10	DRIVE KWH	0	kWH	1	0	0	32767
11	DRIVE MWH	0	MWH	1	0	0	32767
12	RUN TIME	0	H	1	0	0	32767
13	DC BUS VOLT	0	V	1	0	0	32767
14	OUTPUT VOLT	0	V	1	0	0	32767
15	PRC PID FBCK	0	PCT	0.1	0	0	32767
82	AI 1 ACTUAL (VIB)	0	PCT	0.1	0	0	32767
88	ALARM WORD 1*	-	-	1	0	0	32767
89	ALARM WORD 2*	-	-	1	0	0	32767
90	LAST FAULT**	-	-	1	0	0	32767
91	PREV FAULT 1**	-	-	1	0	0	32767
92	PREV FAULT 2**	-	-	1	0	0	32767

* Refer to section 7 about the alarm code of VFFS1.

** Refer to section 8 about the trip code of VFFS1.

4.1.1. LAI Point Descriptions

Table 5 Logical Analog Input (LAI) Point Descriptions

Point Number	Point Name	Description
03	FREQ OUTPUT	The output frequency applied to the motor, in Hertz.
04	PCT OUTPUT	The ratio of output frequency or speed to the corresponding ω (base frequency), depending on control mode.
05	SPEED	The calculated speed of the motor, in RPM.
06	CURRENT	The measured output current.
07	TORQUE	The calculated output torque of the motor as a percentage of nominal torque.
08	POWER	The measured output power in kW.
09	DRIVE TEMP	The calculated thermal state of the drive.
10	DRIVE KWH	The drive's cumulative power consumption in kilowatt-hours. This value may be reset by commanding FLN point 49, RESET KWH.
11	DRIVE MWH	The drive's cumulative power consumption in megawatt-hours. This value may be reset by commanding FLN point 49, RESET KWH.
12	RUN TIME	The drive's cumulative run time in hours.
13	DC BUS VOLT	The DC bus voltage level of the drive.
14	OUTPUT VOLT	The AC output voltage applied to the motor.
15	PRC PID FBCK	The ratio of PID feedback signal to the corresponding ω (base frequency).
82	AI 1 ACTUAL	Indicates the input level of VIB terminal.
88	ALARM WORD 1 *	This point is a bit-field indicating active alarms in the drive.
89	ALARM WORD 2 *	This point is a bit-field indicating active alarms in the drive.
90	LAST FAULT **	This point is first in the drive's fault log and indicates the most recent fault declared.
91	PREV FAULT 1 **	This point is second in the drive's fault log and indicates the previous fault declared.
92	PREV FAULT 2 **	This point is last in the drive's fault log and indicates the oldest fault in the log.

* About the ALARM code of VFFS1, refer to section 7.

** About the FAULT code of VFFS1, refer to section 8.

4.2. Logical Analog Output (LAO) Summary

Logical Analog Output (LAO) points are used for setting and monitoring control points such as the drive's frequency command and configuration parameters.

The APG002Z supports 16 different logical analog output points (12 of them are for the VFFS1's parameters and commands, while another 4 special ones are reserved for maintaining compliance). The values of all logical analog output points can be modified by write point or memorize point commands. Release commands will not cause the logical analog output points to automatically return to their pre-override values. LAO points do not support COV.

Table 6 Logical Analog Output (LAO) Summary

Point Number	Point Name	Factory Default	Eng. Units	Slope	Intercept	Min	Max
01	CTLR ADDRESS	99	-	1	0	0	99
02	APPLICATION	2738	-	1	0	0	32767
20	OVRD TIME	1	H	1	0	0	255
30	CURRENT LIM ***	0	A	0.1	0	0	32767
31	ACCEL TIME 1	300	S	0.1	0	0	32767
32	DECEL TIME 1	300	S	0.1	0	0	32767
50	PRC PID GAIN	10	PCT	0.1	0	0	255
51	PRC PID ITIM ***	600	S	0.1	0	0	32767
52	PRC PID DTIM	0	S	0.1	0	0	32767
60	INPUT REF1 *	0	PCT	0.1	0	0	32767
61	INPUT REF2 *	0	PCT	0.1	0	0	32767
66	SPD OUT MIN	0	PCT	0.1	0	0	32767
67	SPD OUT MAX	1000	PCT	0.1	0	0	32767
95	MBOX PARAM **	-	-	1	0	0	32767
96	MBOX DATA **	-	-	1	0	0	32767
99	ERROR STATUS	-	-	1	0	0	255

* $100\% = \frac{F}{L}$ (Base frequency), F H (Maximum frequency) limits this value.

** About MBOX function, refer to section 5.

*** The rounded error between Point value and the drive parameter cause some difference between write value and set value.

Ex. Write Pno.50 to 600, but set value is 500.

4.2.1. LAO Point Descriptions

Table 7 Logical Analog Output (LAO) Point Descriptions

Point Number	Point Name	Description
01	CTLR ADDRESS	The FLN address of the drive. It can be set from the FLN network and by the panel.
02	APPLICATION	The Application ID for APG002Z.
20	OVRD TIME	1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application.
30	CURRENT LIM	Sets the output current limit of the drive.
31	ACCEL TIME 1	Sets the acceleration time for ramp 1.
32	DECEL TIME 1	Sets the deceleration time for ramp 1.
50	PRC PID GAIN	Sets the proportional gain of the PID.
51	PRC PID ITIM	Sets the integration time of the PID.
52	PRC PID DTIM	Sets the derivation time of the PID.
		$y = Pno.50 \cdot \Delta x + \frac{1}{Pno.51} \int_0^t \Delta x dt + Pno.52 \frac{d\Delta x}{dt}$
60	INPUT REF1	Sets setpoint 1. This setpoint is enabled at #26 EXT1.2 CMD = 0. For being available, some parameter(s) of the drive command require(s) a specific configuration (setpoint channel 1).
61	INPUT REF2	Sets setpoint 2. This setpoint is enabled at #26 EXT1.2 CMD = 1. For being available, some parameter(s) of the drive command require(s) a specific configuration (setpoint channel 2).
66	SPD OUT MIN	Sets the minimum output speed of the drive as a percentage of the motor nominal rating.
67	SPD OUT MAX	Sets the maximum output speed of the drive as a percentage of the motor nominal rating.
95	MBOX PARAM	Sets the parameter to be used by the mailbox function. Refer to section 5.
96	MBOX DATA	Sets or indicates the data value of the mailbox function. Refer to section 5.
99	ERROR STATUS	1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application.

4.3. Logical Digital Input (LDI) Summary

Logical Digital Input (LDI) points are used for drive status monitoring such as terminal ON/OFF conditions and fault status. The APG002Z supports 16 different logical digital input points. All LDI points support COV (LDI points are capable of being characterized). LDI points will respond to write point and memorize point commands, but will not change their actual values or indicate override active.

Table 8 Logical Digital Input (LDI) Summary

Point Number	Point Name	Factory Default	Slope	Intercept	ON (1) Text	OFF (0) Text
21	FWD.REV	FWD	1	0	REV	FWD
23	STOP.RUN	STOP	1	0	RUN	STOP
25	EXT1.2 ACT	EXT1	1	0	EXT2	EXT1
27	DRIVE READY	NOTRDY	1	0	READY	NOTRDY
28	AT SETPOINT	NO	1	0	YES	NO
33	HANDAUTO ACT	AUTO	1	0	HAND	AUTO
36	FLN LOC ACT	AUTO	1	0	FLN	AUTO
37	CTL SRC	NO	1	0	YES	NO
38	FLN REF1 SRC	NO	1	0	YES	NO
39	FLN REF2 SRC	NO	1	0	YES	NO
70	DI 1 ACTUAL (F)	OFF	1	0	ON	OFF
71	DI 2 ACTUAL (R)	OFF	1	0	ON	OFF
76	DO 1 ACTUAL (FL)	OFF	1	0	ON	OFF
77	DO 2 ACTUAL (RY)	OFF	1	0	ON	OFF
86	OK.ALARM	OK	1	0	ALARM	OK
93	OK.FAULT	OK	1	0	FAULT	OK

4.3.1. LDI Point Descriptions

Table 9 Logical Digital Input (LDI) Point Descriptions

Point Number	Point Name	Description
21	FWD.REV	Indicates the rotational direction of the motor, regardless of control source.
23	STOP.RUN	Indicates the run status of the drive, regardless of control source.
25	EXT1.2 ACT	Indicates whether channel 1 or channel 2 is the active control source.
27	DRIVE READY	Indicates the drive is ready to accept a run command.
28	AT SETPOINT	Indicates the drive has reached its commanded setpoint.
33	HANDAUTO ACT	Indicates whether the drive is in local (HAND) or remote (AUTO) control.
36	FLN LOC ACT	Indicates if the drive has been placed in "FLN LOCAL" mode by commanding either point 68 (FLN LOC CTL) or point 69 (FLN LOC REF). Commanding either of these points to FLN "steals" control from its normal source and places in under FLN control. Note that the HAND mode of the panel has priority over FLN local control.
37	CTL SRC	Indicates if the FLN network is a source for control inputs.
38	FLN REF1 SRC	Indicates if the FLN network is the source for setpoint 1.
39	FLN REF2 SRC	Indicates if the FLN network is the source for setpoint 2.
70	DI 1 ACTUAL	Indicates the status of digital Input 1. Depending on the status of the F terminal on the APG002Z.
71	DI 2 ACTUAL	Indicates the status of digital Input 2. Depending of the status of the R terminal on the APG002Z.
76	DO 1 ACTUAL	Indicates the status of digital output 1. Depending of the status of the FL terminal on the APG002Z.
77	DO 2 ACTUAL	Indicates the status of digital output 2. Depending of the status of the RY terminal of the APG002 (it may not exist).
86	OK.ALARM	Indicates the current alarm state of the drive.
93	OK.FAULT	Indicates the current fault state of the drive.

4.4. Logical Digital Output (LDO) Summary

Logical Digital Output (LDO) points are used for executing drive commands such as RUN/STOP and trip clear. The APG002Z supports 12 different logical digital output points (11 among them are for drive control, one special point is reserved for maintaining compliance). The values of all logical digital output points can be modified by write point or memorize point commands. Release commands will not cause the logical digital output points to automatically return to their pre-override values. LDO points do not support COV.

Table 10 Logical Digital Output (LDO) Summary

Point Number	Point Name	Factory Default	Slope	Intercept	ON (1) Text	OFF (0) Text
22	CMD FWD.REV	FWD	1	0	REV	FWD
24	CMD STP.STRT	STOP	1	0	RUN	STOP
26	EXT1.2 CMD	EXT1	1	0	EXT2	EXT1
29	DAY.NIGHT	DAY	1	0	NIGHT	DAY
40	DO 1 COMMAND (FL) *	OFF	1	0	ON	OFF
49	RESET KWH	NO	1	0	RESET	NO
59	LOCK PANEL	UNLOCK	1	0	LOCK	UNLOCK
68	FLN LOC CTL	AUTO	1	0	FLN	AUTO
69	FLN LOC REF	AUTO	1	0	FLN	AUTO
94	RESET FAULT	NO	1	0	RESET	NO
97	MBOX READ	DONE	1	0	READ	DONE
98	MBOX WRITE	DONE	1	0	WRITE	DONE

* Set the parameter $F 132$ (FL terminal) = 38 (39).

4.4.1. LDO Point Descriptions

Table 11 Logical Digital Output (LDO) Point Descriptions

Point Number	Point Name	Parameter
22	CMD FWD.REV	Commanded from the FLN network to change the rotational direction of the drive. This command is active only if the drive is configured for control from the FLN network.
24	CMD STP.STRT	Commanded from the FLN network to start the drive. This command is active only if the drive is configured for control from the FLN network.
26	EXT1.2 CMD	Commanded from the FLN network to select channel 1 or channel 2 as the active control source (0 = #60 INPUT REF1, 1 = #61 INPUT REF2).
29	DAY.NIGHT	1 of the 5 mandatory FLN points required for compatibility with Siemens control systems. It has no functionality in the drive application.
40	DO 1 COMMAND	Controls the output state of FL terminal. Set the parameter $F 132$ (FL terminal) = 38 (39).
49	RESET KWH	Commanded by the FLN network to reset the cumulative kilowatt-hour and megawatt-hours counter (1 = RESET, 0 = NO). The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued.
59	LOCK PANEL	Command from the FLN network to lock the panel and prevent parameter changes (1 = LOCK, 0 = UNLOCK).
68	FLN LOC CTL	Commanded from the FLN network to temporarily "steal" start/stop control of the drive from its normal source and place it under FLN network control. This functionality is analogous to placing the drive in HAND mode at the panel, with the control being taken by the FLN network instead. HAND mode at the panel has priority over this point. Thus, this point is only effective in temporarily taking control from the digital inputs or some other internal control functionality.
69	FLN LOC REF	Commanded from the FLN network to temporarily "steal" input setpoint control of the drive from its normal source and place it under the FLN network control. This functionality is analogous to placing the drive in HAND mode at the panel, with the setpoint control being taken from the FLN network instead. HAND mode at the panel has priority over this point. Thus, this point is only effective in temporarily taking control from the analog inputs or some other internal control functionality.
94	RESET FAULT	Command from the FLN network to reset a faulted drive (1 = RESET, 0 = NO). The control input is rising-edge sensitive, so, once the command is issued, this point automatically returns to its inactive state. This "momentary" operation avoids any need for an explicit command to clear the point before a subsequent reset can be issued.
97	MBOX READ	Refer to section 5.
98	MBOX WRITE	Refer to section 5.

4.5. FLN P1 Error Codes

When an operation as a result of a P1 command fails, an error code is returned with the NAK.

Below is a list of all possible error codes that can be returned by a FLN device.

Table 12 FLN P1 Error Code

Error Code	Description
D7 _H	Operator priority too low. A number of situations can return this error code.
F9 _H	Invalid point number.
FB _H	No COVs to report.
FC _H	Request Characterization.
FD _H	Invalid command.
FE _H	Invalid value. *

* Including the response for Dump Memory command (18_H) and Modify Memory command (19_H). APG002Z does not support these commands.

5. Mailbox Function Points

Using below APOGEE® FLN points, inverter parameters can be read and written.

Table 13 VFFS1 Parameter Access Point Table

Point Number	Point Type	Point Name	Note
95	LAO	MBOX PARAM	The communication number (hex.) of the access parameter is set.
96	LAO	MBOX DATA	The parameters data. The data unit is depend on the parameter specification. Refer to the inverter instruction manual.
97	LDO	MBOX READ	The parameter value specified by MBOX PARAM is read to MBOX DATA by setting 1(READ). When the data is read in normally this point is changed from 1 to 0, otherwise this point remains 1.
98	LDO	MBOX WRITE	When 1(WRITE) is set in MBOX WRITE, the data of MBOX DATA is written to the parameter of MBOX PARAM. When the data is written in normally, this point is changed from 1 to 0, otherwise this point remains 1.

Example 1) Read the deceleration time (dE , Comm. No. 0010)

- Write "16" as the communication number to MBOX PARAM (LAO #95).
* The communication number uses the value of a decimal number set to "10" by the hexadecimal number. 0x0010 = 16 dec.
- Write "1" to MBOX READ (LDO #97).
- Confirm whether MBOX READ(LDO #97) is "0". (finished normally)
- The read value is set to MBOX DATA (LAO #96). Its unit is 0.1s.

Example 2) Write "50.0Hz" to VIB input point 2 ($F2$, Comm. No. 0213)

- Write "531" as the communication number to MBOX PARAM (LAO #95).
* 0x0213 = 531 dec.
- Write "5000" to MBOX DATA (LDO #96).
* 5000 = 50.00Hz, unit is 0.01Hz
- Write "1" to MBOX WRITE (LDO #98).

* In case of parameter access, the time from receipt of the last character of a message to the transmission of the first character of the response is about 40ms.

* A response is "NAK (error code = FE_H)" when a communication number does not exist.

6. Frame counter monitor

Valid and invalid frame counter can be monitored by the drive monitor function.
Please refer to “Monitoring the operation status” of the drive instruction manual about the detail.

Press “MODE” key twice.

Item display	Key operation	LED display	Description
---	---	<i>60.0</i>	The operation frequency is displayed (Operation at 60Hz). (When standard monitor display selection <i>F710</i> is set at 0 [operation frequency])
Parameter setting mode	“MODE”	<i>RUF</i>	The first basic parameter “ <i>RUF</i> ” (Wizard function) is displayed.
Direction of rotation	“MODE”	<i>F_r - F</i>	The direction of rotation is displayed. (<i>F_r - F</i> : forward run, <i>F_r - r</i> : reverse run)
---	“UP”..”UP”	---	---
Frame counter	“UP”	<i>n 50</i>	Displays the frame counter numbers of communication through the network.
Invalid frame counter	“UP	<i>n 50</i>	Displays the invalid frame counter numbers of communication through the network.
Past trip 1	“UP”	<i>003 <-> 1</i>	Past trip 1 (displayed alternately)
---	“UP”..”UP”	---	---

7.VFFS1 Alarm code

Table 14 ALARM WORD 1 Table

Bit	Specifications	0	1	Remarks (Code displayed on the panel)
0	Over-current alarm	Normal	Alarming	\bar{L} flickering
1	Inverter overload alarm	Normal	Alarming	\bar{L} flickering
2	Motor overload alarm	Normal	Alarming	\bar{L} flickering
3	Overheat alarm	Normal	Alarming	\bar{H} flickering
4	Over-voltage alarm	Normal	Alarming	\bar{P} flickering
5	Main circuit under-voltage alarm	Normal	Alarming	-
6	(Reserved)	-	-	-
7	Low current alarm	Normal	Alarming	-
8	Over-torque alarm	Normal	Alarming	-
9	Braking resistor overload alarm	Normal	Alarming	-
10	Cumulative operation hours alarm	Normal	Alarming	-
11	(Reserved)	-	-	-
12	(Reserved)	-	-	-
13	Main-circuit voltage error alarm	Normal	Alarming	" \bar{NOFF} " flickering
14	At the time of the instant blackout, Forced deceleration/stop	-	Decelerating, stopping	Related: $F256$ setting
15	An automatic stop during the lower limit frequency continuance	-	Decelerating, stopping	Related: $F302$ setting

Table 15 ALARM WORD 2 Table

Bit	Specifications	0	1	Remarks (Code displayed on the panel)
0	(Reserved)	-	-	-
1	(Reserved)	-	-	-
2	Life Time Alarm	Normal	Alarming	-
3	OT alarm	Normal	Alarming	-
4	PTC thermistor alarm	Normal	Alarming	\bar{H} flickering
5	(Reserved)	-	-	-
6	(Reserved)	-	-	-
7	(Reserved)	-	-	-
7	(Reserved)	-	-	-
8	(Reserved)	-	-	-
9	(Reserved)	-	-	-
11	(Reserved)	-	-	-
12	(Reserved)	-	-	-
13	(Reserved)	-	-	-
14	(Reserved)	-	-	-
15	(Reserved)	-	-	-

8.VFFS1 Fault code

Table 16 VFFS1 Fault Code Table

Code		Description	Display
Data (Dec.)	Data (Hex.)		
0	0	No error	<i>nErr</i>
1	1	Over-current during acceleration	<i>OC1</i>
2	2	Over-current during deceleration	<i>OC2</i>
3	3	Over-current during constant speed operation	<i>OC3</i>
4	4	Over-current in load at startup	<i>OCL</i>
5	5	Short circuit in arm	<i>OCRA</i>
8	8	Input phase failure	<i>EPH1</i>
9	9	Output phase failure	<i>EPHO</i>
10	A	Over-voltage during acceleration	<i>OP1</i>
11	B	Over-voltage during deceleration	<i>OP2</i>
12	C	Over-voltage during constant speed operation	<i>OP3</i>
13	D	Over-LOAD in inverter	<i>OL1</i>
14	E	Over-LOAD in motor	<i>OL2</i>
16	10	Overheat trip	<i>OH</i>
17	11	Emergency stop	<i>E</i>
18	12	EEPROM fault 1 (writing error)	<i>EEP1</i>
19	13	EEPROM fault 2 (reading error)	<i>EEP2</i>
20	14	EEPROM fault 3 (internal fault)	<i>EEP3</i>
21	15	RAM fault	<i>Err2</i>
22	16	ROM fault	<i>Err3</i>
23	17	CPU fault	<i>Err4</i>
24	18	Communication error trip	<i>Err5</i>
26	1A	Current detector fault	<i>Err7</i>
27	1B	Optional circuit board type error	<i>Err8</i>
29	1D	Small-current trip	<i>UC</i>
30	1E	Fault due to under-voltage in main circuit	<i>UP1</i>
32	20	Over-torque trip	<i>Ot</i>
34	22	Ground fault trip (hardware detection)	<i>EF2</i>
37	25	Over-current flowing in element during acceleration	<i>OC1P</i>
38	26	Over-current flowing in element during deceleration	<i>OC2P</i>
39	27	Over-current flowing in element during operation	<i>OC3P</i>
41	29	Inverter type error	<i>EtYP</i>
46	2E	External thermal input	<i>OH2</i>
47	2F	Step-out (For PM motor only)	<i>SOUt</i>
50	32	Break in an analog signal cable	<i>E-18</i>
51	33	Communication error between control CPUs	<i>E-19</i>
52	34	Excess torque boost	<i>E-20</i>
53	35	CPU fault	<i>E-21</i>
84	54	Auto-tuning error	<i>Et n1</i>

9. Specifications

< Environmental specification >

Item	Specification
Service environment	Conforms to VFFS1
Operation temperature	Conforms to VFFS1
Storage temperature	-25 to +65°C
Relative humidity	20 to 93% (free from condensation and vapor)
Vibration	5.9m/s ² (0.6G) or less (10 to 55 Hz) (To be complied with JIS C0040.)

< APG002Z terminal specification >

Item	Specification	Note
Communication between inverter	VFFS1	Only one board connection is available.
Applicable model		
Communication method	MODBUS-RTU	Set the inverter parameter
Baud rate	19200bps	
Parity	Even number	
Control power supply	5 V _{DC}	Supplied from inverter
Logic input terminal	2 circuits (F,R) Slide switch (SW) enable to select logical configurations (Source/Sink).	Not isolated
Logic output terminal	Nothing	
Relay contact output terminal	1 circuit (FL): 30V _{DC} -0.5A 250V _{AC} -1A (cosφ = 1) 250V _{AC} -0.5A (cosφ = 0.4)	Isolated
Analog input terminals	1 circuit (VIB): 10V _{DC} (R _{IN} = 30kohm)	Not isolated
Analog output terminals	Nothing	
Power supply output	24V _{DC} -50mA	Current limit function

< APG002Z network specification >

Item	Specification
Maximum FLN device	32 FLN devices to each FLN port of the Field Cabinet.
Communication baud rate	4800, 9600, 19200, 38400, 57600, 76800bps
Bias resistor and termination	Local bias resistors are mounted. Termination resistor (120 ohm) can be select by SW.
Terminal block	Detachable terminal block 4-pole (5.08mm pitch) Manufacturer: PHOENIX CONTACT Type-Form : MSTB 2,5/4-ST-5.08