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TECO Frequency Inverter

7300PA LonWorks

Communication Interface

Application Manual

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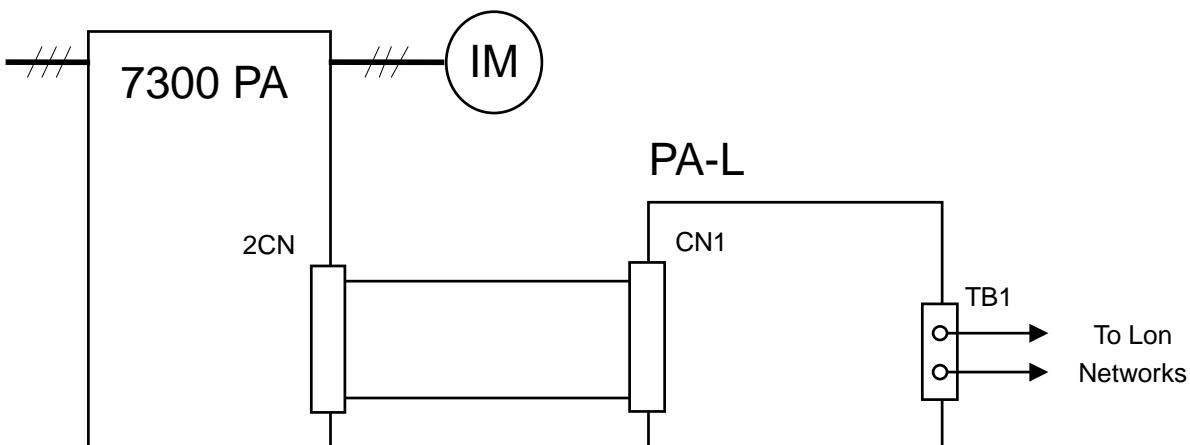
1 Introduction

The manual covers communication between PA-L interface card and 7300PA inverter installed with such card with other modules in LonWorks network.

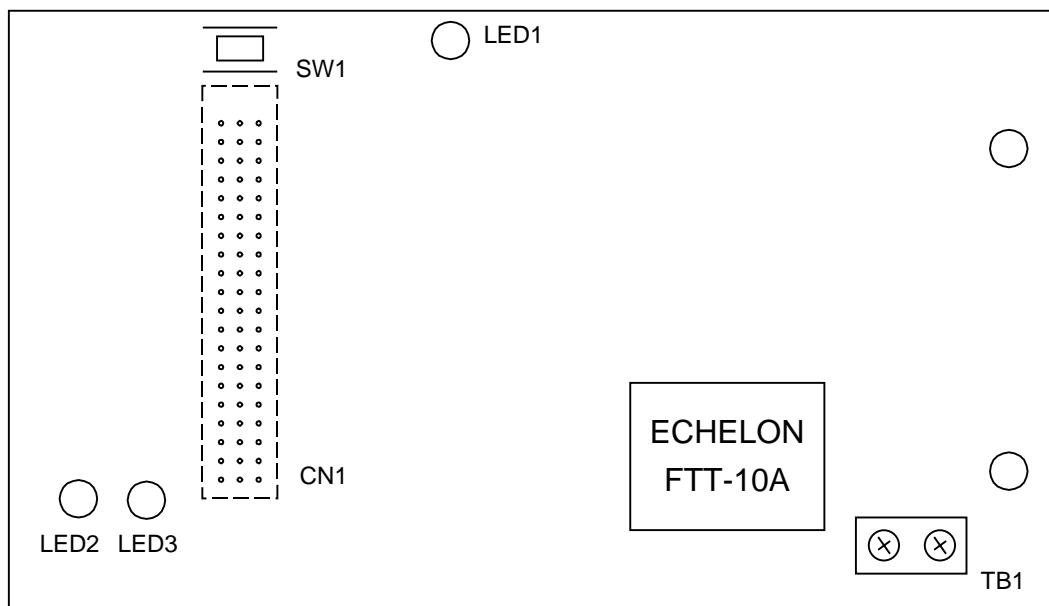
2 Specification

Part Number		4H300D5960002
Communication Specification	Transceiver	Echelon free topology transceiver (FTT-10A).
	Baud Rate	78 kps
	Connect Medium	Twisted wire
Product Features	Communication Status	3 LED indicators
	Outline Dimension	63mm x 86mm
	Network Variables and Configuration Properties	20 Network Variables and 26 Configuration Properties
	Controlling Functions	Inverter RUN/STOP, Forward/Reverse RUN, Frequency Command, External Fault, Fault Reset. 4 Multi-Function Commands. All the Output of Analog, Digital Output Terminal.
	Monitoring Function	Inverter status, Fault Content, Output Frequency, Voltage, Current and DC voltage. All Outputs of Digital Output Terminal. All Inputs of the Analog, Digital terminal, PID Feedback Value.
	Setting Function	AUX Function Setting, PID Gain, 3 Jump Frequency, 2 Group Acceleration and Deceleration Time, Stall prevention Level during Running and Acceleration. Number of Auto Restart Attempt. Energy saving.

3 Wire Connection Diagram



4 Terminals, LED and Button Description



(1) Terminals

	Description
CN1	Connect with 7300PA 2CN terminal on control board
TB1	Lon Network terminal

(2) LED

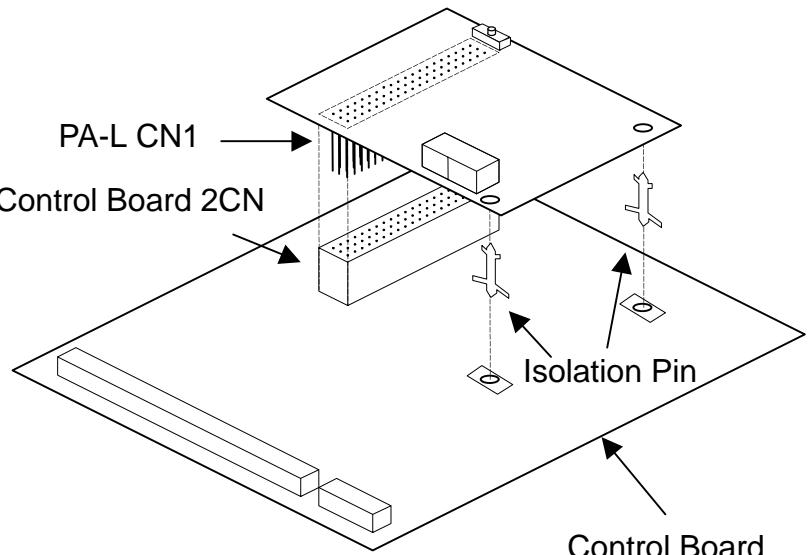
LED	Function	Description
LED1	SERVICE Indicator	Blinking indicates PA-L card without configuration.
LED2	Send Indicator	Blinking indicates sending the data of inverter to communication interface card.
LED3	Receive Indicator	Blinking indicates the inverter receiving data from communication interface card.

(3) Button

SW1: LonWorks Service Pin

5 Installation Method

- (1) Cut off inverter power supply
- (2) Plug two inside isolation pins in holes on 7300PA control board.
- (3) Set up PA-L interface card on the control board. The two installation holes should be right to isolation pins, CN1 to 2CN of the control board.
- (4) Connect the LonWorks net wire to terminal TB1 on PA-L interface card.



6 Inverter Setting

1. Set method

- (1) Start inverter 7300PA, and switch to PRGM mode, then set the following parameters.

Sn-08 = 1100 (Frequency and RUN/STOP command provided by RS-485, continuously running in communication error.)

Sn-23 = 1 (Inverter Address: 1)

Sn-24 = 1100 (Baud Rate 19200 BPS, without parity check)

Cn-31 = 01.0 s (communication checkout time: 1s)

Restarting power supply after setting the parameters ensures normally communication between Inverter 7300PA and PA-L interface card .
- (2) In stop mode, switch inverter 7300PA to PRGM mode and set the following parameters.

Sn-02 = 4 (V/f pattern set by parameter)

Cn-03 = Cn-01 set value

It is also available for setting parameters provided by PA-L using Config. software now.

- (3) Then, switching 7300PA inverter to DRIVE mode, It is available for controlling the inverter 7300PA by LonWorks network.

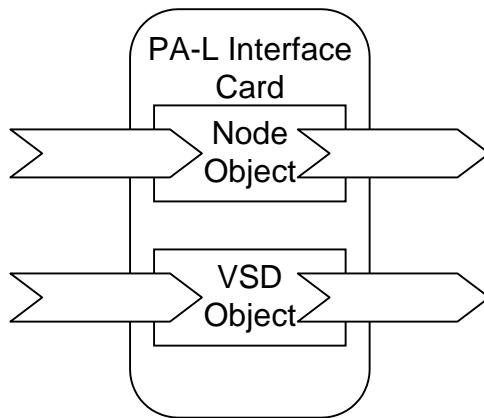
2. Inverter Communication Status

If there is error in communication between PA-L inverter card and 7300PA, the digital operator will show the warning message. Follow is the description:

- (1) The digital operator will blink 'RS-485 comm Ready' or 'CALL' while receiving no data in 1s after inverter start. Such message will disappear in receiving data.
- (2) The digital operator will display warning 'RS-485 comm Fault 1' or 'CPF21' if receiving no data in 1s after communication succeed.
- (3) If the baud rate, data bits, stop bit or parity of data received by the inverter is not correct, the digital operator will blink 'RS-485 comm Fault 2' or 'CPF22'.

7 LonWorks Communication Illustration

PA-L interface card applies LonMark object and LonWorks communication. LonMark object of PA-L interface card consists of two objects: Node and VSD (S/N: 6010 LonMark Functional Profile Definition), as following figure:



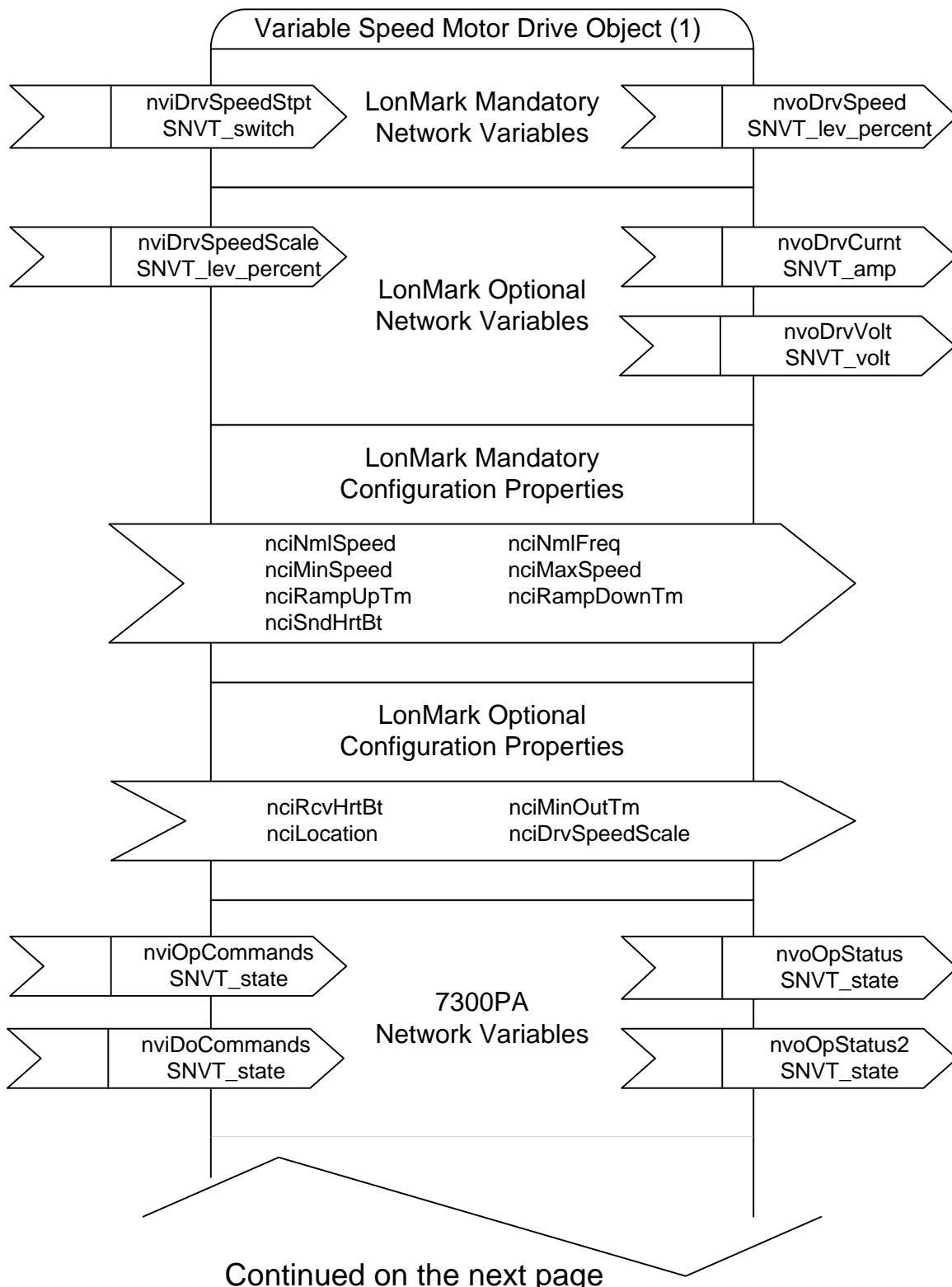
Data of node and VSD objectors divided into two sorts:

- (1) Network Variable (NV): also divided into Input Network Variable (NVI) and Output Network Variable (NVO). The former (NVI) can control status of LonWorks interface card and inverter, while the later (NVO) can monitor the status of them.
Each network variable has individual type. On the LonWorks network, network variables with same type can bind with each other. When one of them is changed, the others will correspondingly adjust.
- (2) Configuration Property: to control inverter configuration and save the parameters and data. Configuration Property can be modified by LonWorks network configuration software (as LonMaker Integration Tool, etc) only. Other devices can not modify them.

VSD object content will be illustrated in the next section.

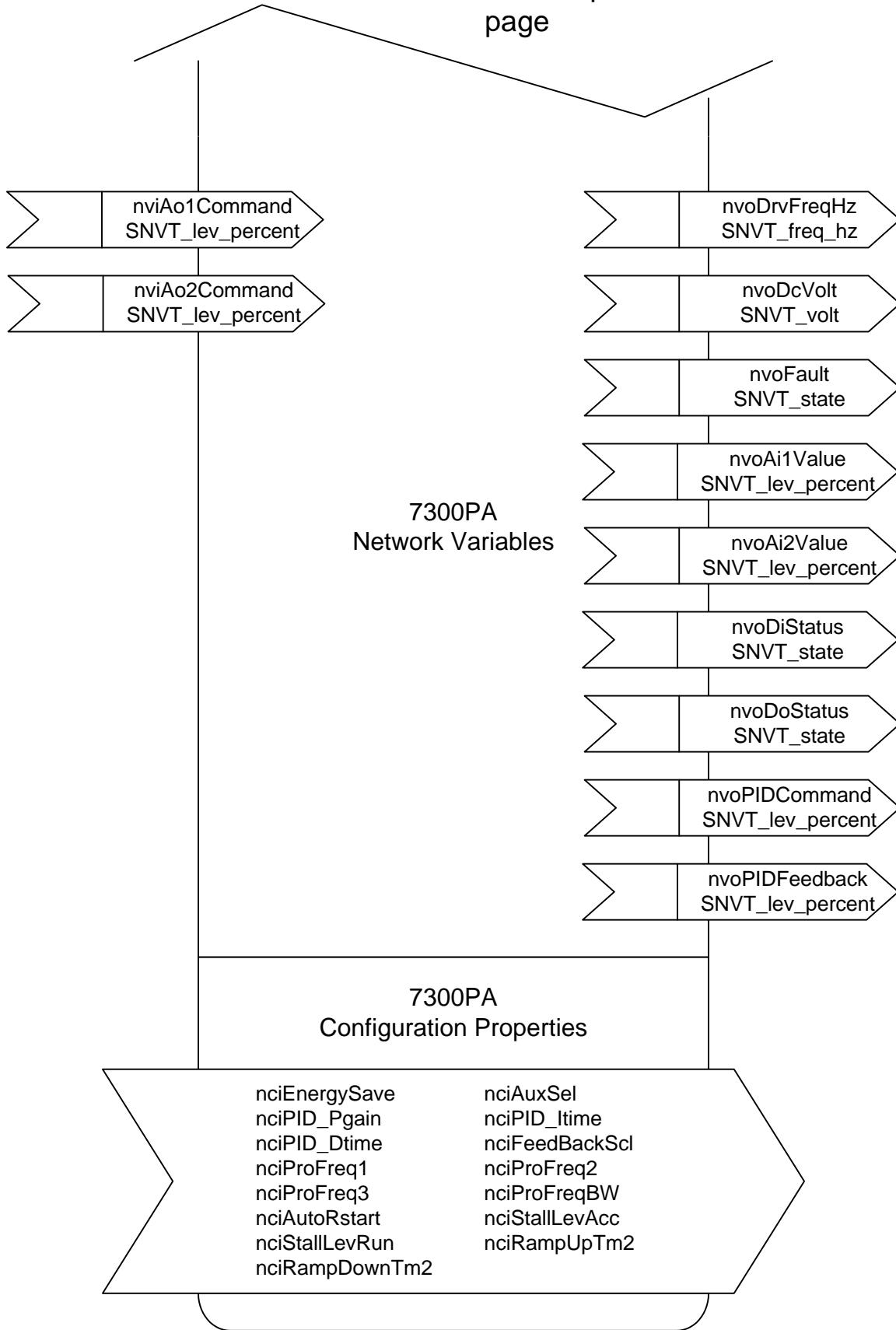
8 VSD Illustration

VSD object provides 20 network variables (6 input network variables and 14 output network variables) and 26 configuration properties. The function of VSD object is briefly described:



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page



1. Configuration Property Description

The following are the configuration properties provided by PA-L interface card. The property type will be listed below the parameter name. If the type begins with SNVT, such property can be used as network variable.

Some of the configuration property has the one corresponding to inverter 7300PA. Such property has two adjusting methods.

Refresh Method	Inverter Parameter	LonWorks Network Data
Adjusting via LonWorks Network	Refreshed right away	Refreshed right away
Adjusting via inverter operation panel	Refreshed right away	Refreshed in the next start.

The parameters Cn, Sn in inverter 7300PA only can be modified in PRGM mode. If the configuration property corresponding to parameter Cn, Sn is required modifying, such action should be done after switching to PRGM mode when the inverter is in stop mode.

Parameter Name	Description	Range	7300PA Parameter	Refer to page
nciNmISpeed (SCPTnomRPM)	Configure rated speed of the motor with default 1800 RPM.	0 - 65535RPM	—	Page 10
nciNmIFreq (SCPTnomFreq)	Configure rated frequency of the motor with default 60.0Hz.	0 - 100.0Hz	Cn-02 ^{*1}	Page 10
nciMinSpeed (SCPTminSetPoint)	Configure lower frequency limit on percentage of rated frequency.	0 - 40.000%	Cn-15 ^{*1}	—
nciMaxSpeed (SCPTmaxSetPoint)	Configure upper frequency limit on percentage of rated frequency.	100.000 - 109.000%	Cn-14 ^{*1}	—
nciRampUpTm (SCPTrampUpTm)	Configure acceleration time of the motor.	0.0 - 6000.0 sec	Bn-01	Page 10
nciRampDownTm (SCPTrampDownTm)	Configure deceleration time of the motor.	0.0 - 6000.0 sec	Bn-02	Page 10
nciSndHrtBt (SCPTmaxSendTime)	Configure max send time of nvoDrvCurnt, nvoDrvSpeed and nvoDrvVolt. Default 0 s.	0.0 - 6553.4 sec	—	Page 10
nciRcvHrtBt (SCPTmaxRcvTime)	Configure max receive time of nviDrvSpeedStpt, nviDrvSpeedScale. Default 0 s.	0.0 - 6553.4 sec	—	Page 11
nciMinOutTm (SCPTminSendTime)	Configure min send time of nvoDrvCurnt, nvoDrvSpeed, and nvoDrvVolt. Default 0.5 s.	0.0 - 6553.4 sec	—	Page 11
nciLocation (SCPTlocation)	Label the location of the motor or inverter.	String length: 31 characters.	—	—
nciDrvSpeedScale (SCPTdefScale)	Configure nviDrvSpeedScale default value.	-163.84% - 163.83%	—	—

Parameter Name	Description	Range	7300PA Parameter	Refer to Page
nciEnergySave (SNVT_switch)	Configure energy-saving available or unavailable.	0 - 1	Sn-09 ^{*1}	Page 11
nciAuxSel (SNVT_count)	Configure the functions of analog input terminal Aux.	0 - 11	Sn-19 ^{*1}	Page 11
nciPID_Pgain (SNVT_multiplier)	Configure proportion gain of PID function.	0.01 - 10.00	Bn-14	Page 12
nciPID_Itime (SNVT_time_sec)	Configure integrate time of PID function.	0.0 - 100.0 sec	Bn-15	Page 12
nciPID_Dtime (SNVT_time_sec)	Configure differential time of PID function.	0.0 - 1.0 sec	Bn-16	Page 12
nciFeedBackScl (SNVT_multiplier)	Configure PID feedback value gain.	0.01 - 10.00	Bn-13	Page 12
nciProFreq1 (SNVT_freq_hz)	Configure prohibit frequency 1.	0.0 - 180.0 Hz	Cn-16 ^{*1}	Page 12
nciProFreq2 (SNVT_freq_hz)	Configure prohibit frequency 2.	0.0 - 180.0 Hz	Cn-17 ^{*1}	Page 12
nciProFreq3 (SNVT_freq_hz)	Configure prohibit frequency 3.	0.0 - 180.0 Hz	Cn-18 ^{*1}	Page 12
nciProFreqBW (SNVT_freq_hz)	Configure range of prohibit frequency.	0.0 - 25.5 Hz	Cn-19 ^{*1}	Page 12
nciAutoRstart (SNVT_count)	Configure number of auto restart attempt.	0 - 10	Cn-36 ^{*1}	Page 12
nciStallLevAcc (SNVT_count)	Configure acceleration stall prevention level.	30 - 170 (%)	Cn-28 ^{*1}	Page 12
nciStallLevRun (SNVT_count)	Configure running stall prevention level.	30 - 170 (%)	Cn-30 ^{*1}	Page 12
nciRampUpTm2 (SNVT_time_sec)	Configure 2nd acceleration time.	0.0 - 6000.0 sec	Bn-03	Page 10
nciRampDownTm2 (SNVT_time_sec)	Configure 2nd deceleration time.	0.0 - 6000.0 sec	Bn-04	Page 10

*1. These parameters only can be modified after switching to Program mode.

(1) Motor Rated Speed (nciNmISpeed)

- nciNmISpeed can configure the rated speed of motor. Please input the relevant data on the motor nameplate.

(2) Motor Rated Frequency (nciNmIFreq)

- nciNmIFreq can configure the rated frequency of motor, which is the base of the frequency command, output frequency, frequency lower limit and upper limit. Please input the data comply with the motor nameplate.
- It is available for setting this property under PRGM mode only.

(3) Acceleration Time 1(nciRampUpTm), Deceleration Time 1 (nciRampDownTm),

Acceleration Time 2 (nciRampUpTm2) and Deceleration Time 2 (nciRampDownTm2)

- nciRampUpTm and nciRampUpTm2 can configure the running time from zero speed to nominal speed.
- nciRampUpDown and nciRampUpDown 2 can configure the running time from nominal speed to zero speed.

Actual accelerate/ decelerate time is:

SET value of accel./ decel. time × nviDrvSpeedStpt × nviDrvSpeedScale

- Inverter 7300PA has two groups of acceleration and deceleration time. The multi-function input terminals ⑤-⑧ and multi-function 1-4 providing by nviOpCommands are both available for switching. Please refer to page 16 or Sn-15 ~ Sn-18 description in 'Inverter 7300PA user manual' for more information.

(4) Max Send Time (nciSndHrtBt)

- nciSndHrtBt sets Max send time of PA-L interface card sending data of nvoDrvCurnt, nvoDrvSpeed and nvoDrvVolt.
- If network variables in PA-L are bound with other network variables, PA-L interface card will inform the later to modify automatically as long as the former is modified. Setting nciSndHrtBt can compel Pa-L interface send network variables periodically, even the said variables is not modified.
- Setting 0 to nciSndHrtBt indicates that max. send time is invalid, and PA-L sends data only when the network variables are modified.

(5) Max Receive Time (nciRcvHrtBt)

- nciRcvHrtBt sets Max receive time of PA-L interface card receiving data of nviDrvSpeedStpt and nviDrvSpeedScale.
- If the said variables have still not been refreshed by other module in the LonWorks network in the specified time, the interface card will change them to default value and pause the communication with the inverter. If there is any module sending operation and frequency command periodically, such function will monitor the communication error of LonWorks network.
- Setting 0 to nciSndHrtBt indicates that max receive time is invalid. The inverter will run at the default speed as long as LonWorks network fault on communication.

(6) Min Send Time (nciMinOutTm)

- nciMinOutTm sets Min send time of PA-L interface card sending data of nvoDrvCurnt, nvoDrvSpeed and nvoDrvVolt.
- If network variables in PA-L are bounded with other network variables, PA-L interface card will inform the later to modify automatically as long as the former is modified. Setting nciSndHrtBt can avoid certain network variables densely sending to influence the performance of LonWorks network.
- Setting 0 to nciMinOutTm indicates that min send time is invalid.

(7) Energy-saving Selection (nciEnergySave)

- nciEnergySave divides into 'State' and 'Value', while can configure the energy saving function is available or not.
State = 0 or Value = 0%, such function is unavailable.
State = 1 or Value = 100%, such function is available.
- It is available for setting this property under PRGM mode only.

(8) Multi-function Analog Input Terminal Aux Selection (nciAuxSel)

- nciAuxSel can configure the inverter multi-function analog input terminal Aux function.
- If nciAuxSel is set to 9, which starts PID function, terminal Vin or Ain are set as PID feedback value.
- For more information on multi-function terminal Aux function, please refer to Sn-19 description in Inverter 7300PA user manual.
- For more information on PID function, please refer to PID function in Inverter 7300PA user manual.
- It is available for setting this property under PRGM mode only.

(9) PID Proportion Gain (nciPID_Pgain), Integrate Time (nciPID_ITime), Differential Time (nciPID_Dtime) and Feedback Scale (nciFeedBackScl)

- nciPID_Pgain can configure PID proportion gain.
- nciPID_ITime can configure PID integrate time.
- nciPID_Dtime can configure PID differential time.
- nciFeedBackScl can configure PID feedback scale.
- Before executing PID, please ensure that nciAuxSel is set to 9.

(10) Prohibit Frequency1 (nciProFreq1), Prohibit Frequency2 (nciProFreq2), Prohibit Frequency3 (nciProFreq3) and Prohibit Frequency Range (nciProFreqBW)

- Inverter 7300PA has three groups of prohibit frequency to prevent mechanical resonance frequency. After setting, the motor will accelerate/ decelerate in prohibit range frequency range, but not running in constant speed in the range.
- Any of the prohibit frequency setting to 0 means such function is invalid.
- Prohibit frequency range setting to 0 means all the prohibit frequencies are invalid.
- Setting of prohibit frequency should comply with the following regulation:
 $nciProFreq1 > nciProFreq2 > nciProFreq3$
- It is available for setting this property under PRGM mode only.

(11) Number of Auto Restart Attempt (nciAutoRstart)

- nciAutoRstart can configure number of auto restart attempt in particular faults. Such number set to 0 means auto-restart is unavailable.
- For more information on auto restart function, please refer to Cn-36 description in Inverter 7300PA user manual.
- It is available for setting this property under PRGM mode only.

(12) Stall Prevention Level during Acceleration (nciStallLevAcc),

Stall Prevention Level during Running (nciStallLevRun)

- nciStallLevAcc configure acceleration stall prevention level of Inverter (inverter nominal current: 100%).
- nciStallLevRun configure running stall prevention level of Inverter (inverter nominal current: 100%).
- Inverter nominal current is based on the one labeled on nameplate.
- Such parameter of Inverter 7300PA is available for setting under PROGRAM mode.

2. Network Variable Description

The following list on 20 network variables (6 input network variables and 14 network variables) providing by PA-L interface card is the detailed description.

Variable Name	Description	Refer to page
nviDrvSpeedStpt (SNVT_switch)	To control run, stop and provide low-resolution frequency command (frequency command is in nciNmIFreq percentage).	Page 15
nviDrvSpeedScale (SNVT_lev_percent)	To control (nviDrvSpeedStpt) fine scale of frequency command. Negative value is the reverse running command.	Page 16
nvoDrvCurnt (SNVT_amp)	To monitor the output current. Unit is 0.1A.	—
nvoDrvSpeed (SNVT_lev_percent)	To monitor the output frequency. Output frequency show in nciNmIFreq percentage.	—
nvoDrvVolt (SNVT_volt)	To monitor output voltage. Unit is 1V.	—
nviOpCommands (SNVT_state)	To control following command: • BIT 0: External Fault (EB). • BIT 1: Fault Clear (RESET). • BIT 2: Multi-function command 1. • BIT 3: Multi-function command 2. • BIT 4: Multi-function command 3. • BIT 5: Multi-function command 4. • BIT 6-15: Reserved.	Page 16
nviDoCommands (SNVT_state)	To control output of multi-function output terminals. • BIT 0: R2A-R2C output. • BIT 1: DO1 output. • BIT 2: R1A-R1C output. • BIT 3-15: Reserved	Page 16
nviAo1Command (SNVT_lev_percent)	To control the output of multi-function analog output terminal AO1. 100% is corresponding to 10V.	Page 17
nviAo2Command (SNVT_lev_percent)	To control the output of multi-function analog output terminal AO2. 100% is corresponding to 10V.	Page 17
nvoOpStatus (SNVT_state)	To monitor the inverter status: • BIT 0 : running • BIT 1 : reverse running • BIT 2 : operation is ready • BIT 3 : fault • BIT 4-15 : reserved	Page 18

Variable Name	Description	Refer to Page
nvoOpStatus2 (SNVT_state)	To monitor the inverter status. <ul style="list-style-type: none"> • BIT 0 : Running • BIT 1 : Zero speed • BIT 2 : Frequency Agree • BIT 3 : Setting Frequency Agree • BIT 4 : Frequency Detection 1 • BIT 5 : Frequency Detection 2 • BIT 6 : Reserved • BIT 7 : Under Voltage detection • BIT 8 : Inverter no output • BIT 9-10 : Reserved • BIT 11 : Over Torque detection • BIT 12 : Frequency command loss • BIT 13-15 : Reserved 	Page 18
nvoDrvFreqHz (SNVT_freq_hz)	To monitor output frequency, unit is 0.1Hz.	—
nvoDcVolt (SNVT_volt)	To monitor DC voltage, unit is 1V.	—
nvoFault (SNVT_state)	To monitor present fault content. <ul style="list-style-type: none"> • BIT 0 : Over Current (OC) or ground fault (GF) • BIT 1 : Over Voltage (OV) • BIT 2 : Inverter Over Load (OL1, OL2) • BIT 3 : Inverter Over Heat (OH) • BIT 4 : Reserved • BIT 5 : Reserved • BIT 6 : Reserved • BIT 7 : External Fault (EFxx) • BIT 8 : Control Loop Fault (CPFxx) • BIT 9 : Motor Over Load (OL3) • BIT 10 : Reserved • BIT 11 : Reserved • BIT 12 : Under voltage or MC Damage (UVx) • BIT 13-15:Reserved 	Page 17
nvoAi1Value (SNVT_lev_percent)	To monitor multi-function terminal VIN+AIN input, in percentage.	Page 18
nvoAi2Value (SNVT_lev_percent)	To monitor multi-function terminal AUX input, 100% to input 10V.	—

Variable Name	Description	Refer to Page
nvoDiStatus (SNVT_state)	To monitor multi-function digital input terminal status: • BIT 0 : Terminal ① close • BIT 1 : Terminal ② close • BIT 2 : Terminal ③ close • BIT 3 : Terminal ④ close • BIT 4 : Terminal ⑤ close • BIT 5 : Terminal ⑥ close • BIT 6 : Terminal ⑦ close • BIT 7 : Terminal ⑧ close • BIT 8-15 : Reserved	—
nvoDoStatus (SNVT_state)	To monitor multi-function output terminal status: • BIT 0 : Multi-function terminal R2A-R2C output • BIT 1 : Multi-function terminal DO1 output • BIT 2 : Multi-function terminal R1A-R1C output • BIT 8-15 : Reserved	Page 17
nvoPIDCommand (SNVT_lev_percent)	Reserved	—
nvoPIDFeedback (SNVT_lev_percent)	To monitor input of PID feedback value, shown in percentage. 0 means PID does not start.	—

(1) RUN/STOP Command (nviDrvSpeedStpt.State)

- nviDrvSpeedStpt divides into 'State' and 'Value' to control RUN/STOP command and frequency command.
- nviDrvSpeedStpt.State content:
 nviDrvSpeedStpt.State = 0 : STOP command
 nviDrvSpeedStpt.State = 1 : RUN command
 nviDrvSpeedStpt.State = -1 : command idle (default)
- Under following circumstances, such variable will be default value.
 - After power on the machine and before reading the network variable.
 - No nviDrvSpeedStpt or nviDrvSpeedStpt commands received during the min. receiving time (nciRcvHrtBt).

(2) Frequency Command (nviDrvSpeedStpt.Value)

- nviDrvSpeedStpt.Value and nviDrvSpeedScale control the frequency command. The actual frequency command is as following:

$$\text{Command} = \text{nciNmlFreq} \times \text{nviDrvSpeedStpt.Value} \times \text{nviDrvSpeedScale}$$
- the 1 unit of nviDrvSpeedStpt.value shows 0.5%, which range from 0%~100%.
Thusly, 0 means to 0%, 200(and above 200) means 100%.

(3) Frequency Command Scale and Forward/ Reverse RUN (nviDrvSpeedScale)

- nviDrvSpeedScale range from -163.84% to 163.84%. Positive value represents forward running command while negative value reverse command.
- Default value of nviDrvSpeedScale is determined by nciDrvSpeedScale.
- Here is an illustration on the relationship between frequency command said variable and actual frequency command.

nciNmIFreq	nviDrvSpeedStpt.Value	nviDrvSpeedScale	Actual Frequency
60Hz	100%	100%	Forward Run 60Hz
60Hz	80%	-75%	Forward Run 36Hz
50Hz	80%	-100%	Reverse Run 40Hz

(4) Inverter Operation Command (nviOpCommands)

- nviOpCommands can configure inverter external fault, fault clear (reset) and multi-function command. Description is as following:

Bit	Function
0	Set external fault. Malfunction terminals R3A-R3C close as there is no output in inverter.
1	Fault clear (RESET), It can clear fault while nviDrvSpeedStpt.State = 0.
2	Multi-function command 1 (Actual function is determined by Sn-15, default is Multi-step speed 1).
3	Multi-function command 2 (Actual function is determined by Sn-16, default is Multi-step speed 2).
4	Multi-function command 3 (Actual function is determined by Sn-17, default is JOG command).
5	Multi-function command 4 (Actual function is determined by Sn-18, default is external fault).
6-15	Reserved

(5) Multi-function Terminal Output (nviDoCommands)

- nviDoCommands matching with 7300PA parameters setting can configure the output of multi-function terminal DO1, R1A-R1C and R2A-R2C.

Bit	Function
0	Set R2A-R2C action. (It is available while Sn-20=0F only.)
1	Set DO1 action. (It is available while Sn-21=0F only.)
2	Set R1A-R1C action. (It is available while Sn-22=0F only.)
3-15	Reserved

(6) Multi-function Analog Terminal Output (nviAo1Command, nviAo2Command)

- When Sn-26=0A, nviAo1Command is available for setting inverter analog input terminal Ao1.
100% compares to Ao1 output 10V.
- When Sn-27=0A, nviAo2Command is available for setting inverter analog input terminal Ao2.
100% compares to Ao2 output 10V.

(7) Inverter Fault Status (nvoFault)

- nvoFault can monitor the inverter fault status.

Bit	Function
0	Over current (OC) or ground fault (GF)
1	Over voltage (OV)
2	Inverter over load (OL1, OL2)
3	Inverter over heat (OH)
4-6	Reserved
7	External Fault (EF3, EF5, EF6, EF7, EF8)
8	Control loop exception (CPF02), EEPROM exception (CPF03), EEPROM code exception (CPF04) or A/D exception (CPF05).
9	Motor over load (OL3)
10-11	Reserved
12	Under voltage or instantaneous stop protection (UV1), control loop voltage over lower (UV2) or MC fault (UV3)
13-15	Reserved

(8) Inverter Multi-function Output Terminals Monitor (nvoDoStatus)

- The following is the nvoDoStatus bit and content description:

Bit	Function
0	Multi-function terminal R2A-R2C output. (Comply with Sn-20. Factory set: running)
1	Multi-function terminal DO1 output. (Comply with Sn-21. Factory set : zero Speed)
2	Multi-function terminal R1A-R1C output. (Comply with Sn-22. Factory set : frequency agree)
3-15	Reserved

(9) Inverter Status Monitor (nvoOpStatus, nvoOpStatus2)

- The following is the nvoOpStatus bit and content description:

Bit	Function
0	1: Running
1	1: Reverse, 0: Forward
2	1: Inverter is ready to operate. (DRIVE mode with no alarm, fault)
3	1: Exception but not CPF00, CPF01.
4-15	Reserved

- The following is the nvoOpStatus2 bit and content description:

Bit	Function
0	1 : Running
1	1 : Zero Speed
2	1 : Frequency Agree (Frequency Command - Cn-22) ≤ Output frequency ≤ (Frequency Command + Cn-22)
3	1 : Frequency Agree and (Cn-21 - Cn-22) ≤ output frequency ≤ (Cn-21 + Cn-22)
4	1 : Frequency detection 1 (Refer to right figure)
5	1 : Frequency detection 2 (Refer to right figure)
6	Reserved
7	1 : Under voltage detection
8	1 : Inverter has no output.
9-10	Reserved
11	1 : Over torque detection (Detection Level : Cn-26, Detection Time : Cn-27)
12	1 : Frequency command loss.
13-15	Reserved

The graph illustrates the frequency detection logic. The top part shows a trapezoidal frequency command signal (Cn-22 to Cn-21) and the output frequency (F out). The bottom part shows two digital signals: F detection 1 (top) and F detection 2 (bottom). F detection 1 is high during the rising edge of F out and low during the falling edge. F detection 2 is high during the falling edge of F out and low during the rising edge. The signals are aligned with the frequency command steps.

(10) Inverter Analog Input Monitor (nvoAi1Value)

- Monitor input of Multi-function analog terminal VIN, AIN, with range 0-100%.
- nvoAi1Value 0-100% compares to VIN input 0-10V, or AIN input 4-20mA. If both VIN, AIN are input, the inputs of VIN, AIN will be added before transferring to percentage.