FREQUENCY INVERTER
FOR INTERFERENCE-FREE, QUIET AND DEPENDABLE MOTOR CONTROL

NFO Sinus® G2

User Guide
NFO Sinus

fieldbus supplement

Profibus, Devicenet & Modbus RTU

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Contents

1 Preface

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2 Introduction

This user guide is a supplement to the regular user and installation manual for the inverter NFO Sinus. It deals with the installation, configuration and management of the inverters delivered with fieldbus option.

Communication over the fieldbus in NFO Sinus is solved by using different Fieldbus modules of type AnyBus DataTransfer from HMS Fieldbus Systems. Some information in this guide, Ch. 3.2, is taken from documentation from HMS.

Regardless of the Fieldbus selected, NFO Sinus control works in the same way. It follows the "PROFIBUS Profile for variable speed drives", PROFIDRIVE. The profile describes the various types PPO (Parameter Process Data Object), which indicates different levels of control complexity. At present, NFO Sinus only supports the simplest type PPO, PPO 3, which merely describes the transfer of command, status data, actual values and set-points for speed.

3 Inverter settings

3.1 General settings

The following parameters affect the functionality of the fieldbus connection.

- The parameter "OpMode" should have the value "AnyBus" to allow the inverter to be controlled from the fieldbus.
- Choose the PPO type to be used with the parameter "AnyBus". At present only PPO3 is supported.

With the right adjustment of these parameters, the inverter will, when restarted, automatically go into the mode of control from the fieldbus. Inverters equipped with fieldbus option will on delivery have such a configuration.

The display showing the inverters status is, when controlled via the fieldbus, "Bus Run" or "Bus Stby" depending on whether motor run is activated or not. The display also shows the current motor frequency.

Fieldbus control can be cancelled by pressing <STOP> on the keypad, this will immediately release the motor, where after "Stop" shows on the display. Return to fieldbus control by pressing <SHIFT> + <STOP>.

Please note that signal RUN must be active and connected to make control through the fieldbus possible.

Information on how to set the parameters and activate the RUN signal is given in the ordinary user's guide.

3.2 Fieldbus specific settings

The bus connection of the fieldbus module is located on the left side of the inverter (seen from the front). Next to the bus connection are switches for setting the address etc. and LEDs for status indication. This is specific for each fieldbus system.

3.2.1 Profibus

3.2.1.1 Fieldbus connector

The fieldBus connector consists of a 9-pole female DSUB linked according to Table 1.

Contact pin nr	Signal name	Description
3	B-Line	Data line
4	RTS	Request To Send
5	GND	Supply voltage, ground
6	Vcc	Supply voltage
8	A-Line	Data line
Contact shield	SHIELD	Screen connection

Table 1 Fieldbus connector

3.2.1.2 Termination of fieldbus

Fieldbus should be terminated at both ends. If the actual inverter is placed in one end point of the bus, put the switch between fieldbus connection and light-emitting diodes(LEDs) in the ON position, otherwise leave it in OFF position.

3.2.1.3 LED indication

Three LEDs are stacked in vertical order to the right of the fieldbus connector according to the following table. See function list in Table 2.

ERROR
DIA
POWER

LED	COLOUR	FUNCTION
POWER	Turned off	Power is off
	Green	Power is on
DIA (Data exchange)	Turned Off	No communication
	Green	Data Exchange
ERROR	Turned Off	Normal operation
	Red	Bus off/error

Table 2 LED description

3.2.1.4 Setting address

Two turn switches, located to the right of the LEDs set the unit's node address. The address may be set in the range 1-99 with steps of ten (10) on the left switch and one (1) on the right switch.

3.2.2 DeviceNet

3.2.2.1 Fieldbus connector

The fieldbus connector consists of a terminal with five connections numbered from left to right according to Table 3.

Terminal nr	Signal name	Description
1	V-	Supply 0V
2	CAN_L	Data line , low
3	SHIELD	Screen connection
4	CAN_H	Data line , high
5	V+	Supply +24V DC

Table 3 Fieldbus connector

3.2.2.2 Termination of fieldbus

Fieldbus should be terminated at both ends. If the actual inverter is placed in one endpoint of the bus, mount a termination resistor in the fieldbus contact between connector 2 and 4, with the value of 120 Ohm.

3.2.2.3 LED indication

Three square LEDs are vertically aligned to the right of the fieldbus connector according to the following table. See function list in Table 4.

NETWORK
MODULE
POWER

LED	COLOUR	FUNCTION
POWER	Turned off	Power is off
	Green	Power is on
MODULE STATUS	Red, flashing	Recoverable fault
	Red, solid	Critical module fault
	Green, flashing	Configuring
	Green, solid	Configured and NO module Errors
NETWORK STATUS	Red, flashing	Recoverable fault
	Red, solid	Critical module fault
	Green, flashing	On-line but not connected
	Green, solid	On-line, link OK, connected

Table 4 LED description

3.2.2.4 DIP switches

- Baudrate is set by DIP switch 1 and 2 according to Table 5.
- Address is set by DIP switch 3 to 8 according to Table 5.

Baudrate bit/s	DIP 1-2
125k	00
250k	01
500k	10
Reserved	11

Adress	DIP 3-8
0	000000
1	000001
2	000010
-	-
-	-
61	111101
63	111110
63	111111

Table 5 DIP switch settings (ON = 1)

3.2.3 Modbus RTU

Modbus RTU is a fieldbus system from the company Modicon, a part of the Schneider Automation.

3.2.3.1 Specifications

The media for the fieldbus is a copper cable composed of one twisted pair. The baudrate is as standard 19200 Bit/s but can be modified on the card between 1200 Bit/s to 50 000 Bit/s. The Modbus RTU network can consist of 247 slaves but only one Master. The master always initiates the communication with a question (called a query) and the slave with the right slave address answers the question with a response.

3.2.3.2 Fieldbus connector

The fieldbus connector consists of a 9-pole female DSUB linked according to Table 6.

Dsub:	Function:
1	DE [RS485]
2	RS232 – RX
3	RS232 – TX
4	+ 5V Bus
5	Ground Bus
6	RS485 A-line
7	RS485 B-line
8	Not used
9	Not used
PE	Shield

Table 6 Fieldbus connector

3.2.3.3 Termination of fieldbus

When terminating RS485 you have to set the switch located to the right of the fieldbus connector to ON. This is only required when the slave acts as the last slave on the bus and this will prevent an echo of the signal to propagate back on the bus.

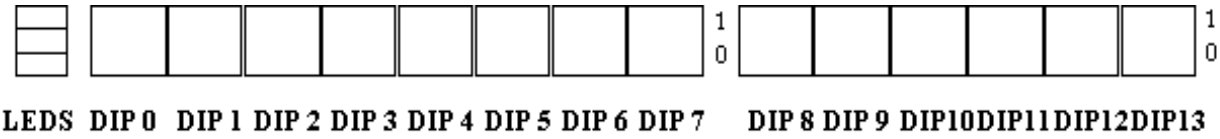
3.2.3.4 LED indication

Three square LEDs are vertically aligned to the right of the termination switch according to the following table. See function list in Table 7.

BUS ERROR	Red
BUS ACTIVE	Green
POWER	Green

Table 7 LED description

3.2.3.5 DIP switches



Figur 1

The figure above shows the dip switches on the ModBus RTU module. Table 8 describes the function ('ON' is 'logic zero' and 'OFF' is 'logic one').

Switch no	Function:	Set value:	Function of set value:
0	Electrical communication mode	0	RS485
		1	RS232
1 - 8	Slave address	MSB - LSB	Valid slave addresses are1 – 247. Addresses outside this range should not be used
9 - 11	Baudrate	000	1200
		001	2400
		010	4800
		011	9600
		100	19200
		101	38400
		110	50000
		111	Not supported
12 - 13	Parity mode	00	None
		01	Odd
		10	Even
		11	Not used

Table 8 DIP switch settings

4 Configuration of control system

A configuration file is included for the control system, for fieldbus systems which support this. The bus node is to be configured to support the installed PPO-type, see chap. 2.

At this time, there is only support for PPO 3 which corresponds to 2 word (4 bytes) cyclical output data and 2 word (4 bytes) cyclical input data.

5 Cyclic data

The inverter only supports cyclic data transfer. Data quantity varies after installation of PPO-type and is always of the same size in both output direction (from control system to Inverter) as in input direction (from Inverter to control system).

The transferred data quantity consists of parameter data and process data, of which the PPO-type describes the composition. For PPO 3 exsists only process data.

5.1 Process Data

Process data is transferred per byte, which are set in pairs to a number of 16-bit words, where the first byte is the most significant (big endian).

The first word out, from control system to inverter, is always a so-called "control word" and the next word indicates the set-point value.

The first word, from Inverter to control system, describes actual inverter status and the next word is the actual value.

4.1.1 Control word

The control word consist of 16 bits in which bit 0 is the least significant, and bit 15 is the most significant bit. See Table 9.

Control word	
Bit	Function
0	Run signal 1. A positive edge (0 to 1), provided that bit 1, 2 & 10 are 1-set, and possible errors are cleared, sets the inverter from STOP to RUN mode. If bit 0 is reset while running, the motor will BRAKE, according to the ramp, and after stop, release motor, inverter then goes from RUN to STOP mode.
1	Run signal 2. Must be 1 to enable inverter to go into RUN mode. If bit 1 is reset while in RUN mode, the motor will be RELEASED, and inverter goes from RUN to STOP mode. Then a positive edge (0 to 1) on bit 0 is required to bring the inverter into RUN mode again.
2	Run signal 3. Must be 1 to enable inverter to go into the run mode. If bit 2 is reset while in RUN mode, the motor will BRAKE, and inverter goes from RUN to STOP mode. Then a positive edge (0 to 1) on bit 0 is required to bring the inverter into RUN mode again.
3	Motor output active. Provided that the inverter is in RUN mode, "1" will activate the inverter output, the motor will start running with set-point determined by bit 4-6. If bit 3 is reset while running, motor will be RELEASED.
4	The motor is controlled from ramp generators output. If bit is 1, the set-point of the ramp generators output is used for speed regulation. If bit 4 is reset while running, the motor will decelerate to stop.
5	Ramp generator active. If the bit is 1, the ramp generators output will go towards the value of its input at a rate similar to that of the inverters ramp. If bit 5 is reset while running, the set-point is frozen, ongoing acceleration or deceleration is stopped and the motor continues to run at current speed.
6	The given set point value linked to ramp generator. If the bit is 1, the programmed set-point value is used as a start value for the ramp generator. If bit 6 is reset while running, the motor will decelerate to stop.
7	Acknowledge of error. If the inverter is blocked due to an error a positive edge (0 to 1) for this bit will acknowledge the error. Provided that the cause of the error is corrected the inverter will then be receptive again for control from the fieldbus.
8-9	8-9 Reserved. Currently not used.
10	Fieldbus control active, process data valid. This bit must be 1 when going from STOP to RUN mode, see bit 0. If the bit is reset during operation, any changes of other process data will be ignored, i.e. the motor continues to run according to previous settings.
11-15	Reserved. Currently not used.

Table 9 Control word

4.1.2 Status word

The status word consists of 16 bits in which bit 0 is the least significant, and bit 15 is the most significant bit. See Table 10.

Status word		
Bit	Value	Function
0	0	The inverter is in stop mode, not ready for run mode. Due to one of the following reasons: 1. The inverter is blocked due to error or is waiting for an error acknowledge, status bit 3 has value 1. 2. Run signal 2 not active; status bit 4 has value 0. 3. Run signal 3 not active; status bit 5 has value 0. 4. The inverter has stopped due to reason 1, 2 or 3 and run signal 1 has not been reset (control bit 0).
	1	The inverter is in run mode, or is ready for run mode on positive rise (0 to 1) on run signal 1 (control bit 0).
1	0	The inverter is not in run mode. If status bit 0 has value 1, then the inverter will go to run mode on positive rise on run signal 1.
	1	The inverter is in run mode.
2	0	The motor output is not activated. If status bit 1 has value 1 then the motor output will be activated by setting control bit 3 to value 1.
	1	The motor output is activated.
3	0	No errors.
	1	The inverter is blocked due to error or is waiting for an error acknowledge.
4	0	Run signal 2 is not active; control bit 1 has value 0.
	1	Run signal 2 is active; control bit 1 has value 1.
5	0	Run signal 3 is not active; control bit 2 has value 0.
	1	Run signal 3 is active; control bit 2 has value 1.
6	0	Run mode allowed.
	1	The inverter is stopped and is waiting for run signal 1 to be restored to 0 before the inverter can return to run mode.
7-8		Reserved, currently not used.
9	0	The inverter is not available for fieldbus control due to one of the following reasons: 1. Signal RUN on inverter terminal is not activated. 2. The inveter is stopped by pressing the button <STOP>. 3. The inverter is not configured for fieldbus control.
	1	The inverter is controlled from fieldbus.
10	0	Set-point not reached.
	1	Actual value and set-point coincide within some tolerance.
11-15		Reserved, currently not used.

Table 10 Status word

4.1.3 Set-point value/Actual value

Set-point and actual value is set as an integer in the range –32768 to +32767 which corresponds to –200% to +200% of the inverters maximum frequency, parameter ”Max-fr”.

6 Control example

This simple example shows how to control the inverter to start the connected motor with a set-point of 50 Hz.

After startup and a correct configuration of the inverter and control system, cyclical data are exchanged on the fieldbus, 4 bytes in each direction. The control system sends zeros in both the control word and as set-point value and the inverter responds with the status word 0x0200 and actual value 0. "1" in bit 9 of the status word indicates that input is receptive to control from the fieldbus.

Output (from the control system to the inverter)

1	2	3	4
00	00	00	00
MSB	LSB	MSB	LSB
Control word		Set point	

Input (from the inverter to the control system)

1	2	3	4
02	00	00	00
MSB	LSB	MSB	LSB
Status word		Actual value	

The control system accepts by setting bit 1, 2 and 10 of the control word and the inverter responses by setting bit 0, 4 and 5 of the status word, thus showing that it is ready to start the motor.

Output			
04	06	00	00

Input			
02	31	00	00

The control system now sets bit 0, 3, 4, 5 and 6 and enter set-point as 0x1FFF (8191) which represents 50% of the programmed maximal frequency, 100Hz. The inverter responds to set bit 1 and 2 of the status word. This starts the motor and accelerates it towards 50Hz in accordance with the programmed acceleration parameter.

Output			
04	7F	1F	FF

Input			
02	37	00	00

When the motor has reached the programmed frequency, bit 10 in the status word will get the value "1".

Output			
04	7F	1F	FF

Input			
06	37	1F	FF