

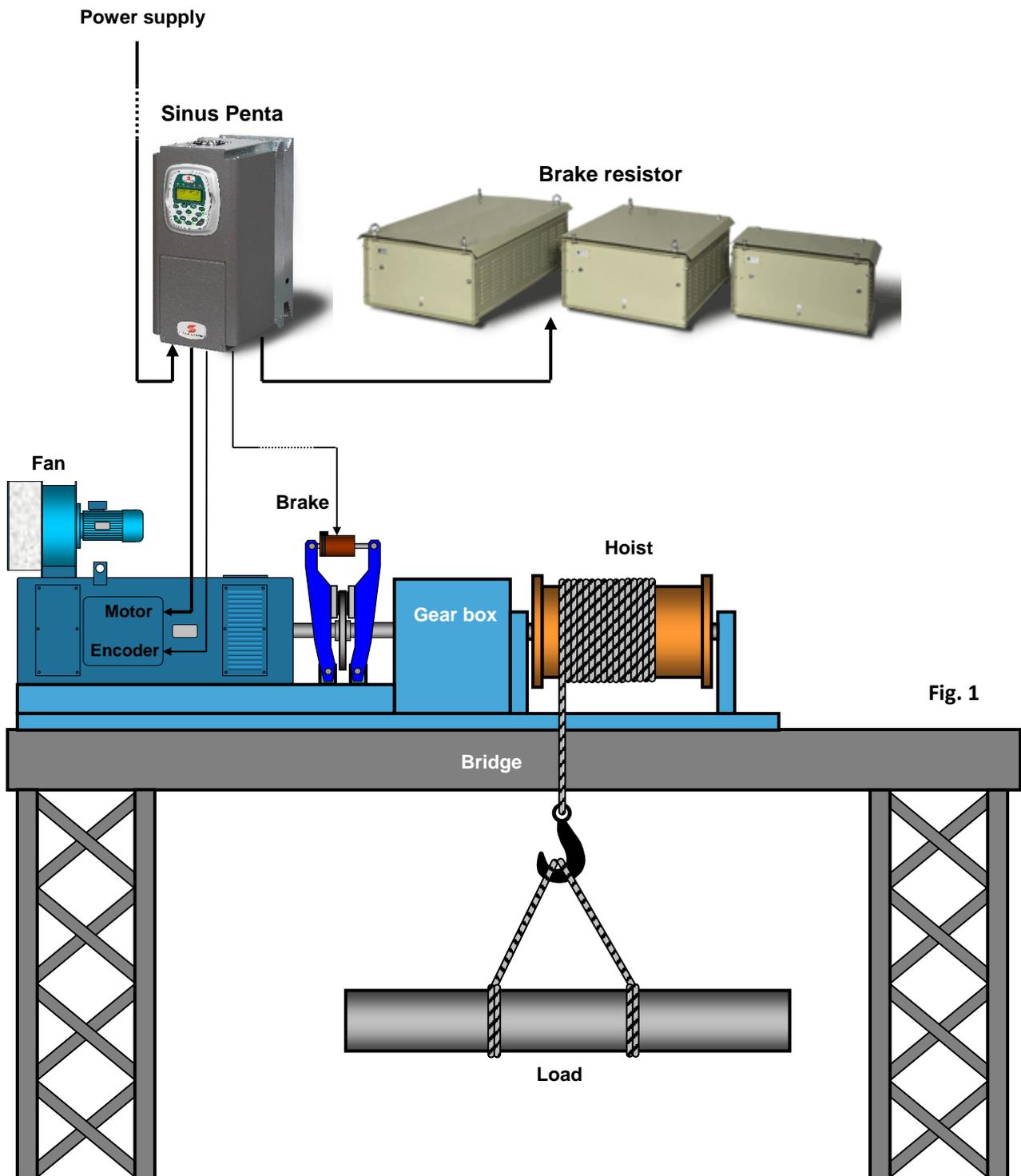
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SINUS PENTA winch for hoisting – R01

Functional example of a simple winch for hoisting with 3 fixed speeds and vector control with open and closed loop, “VTC” and “FOC”.

30/11/2017

SW Version: PD413x



Electric diagram of the command section

Electric wirings, settings of jumpers and DIP switches on the ES836/2 - ES913 option boards can change with different encoders.

For the correct settings, see the Accessories manual.

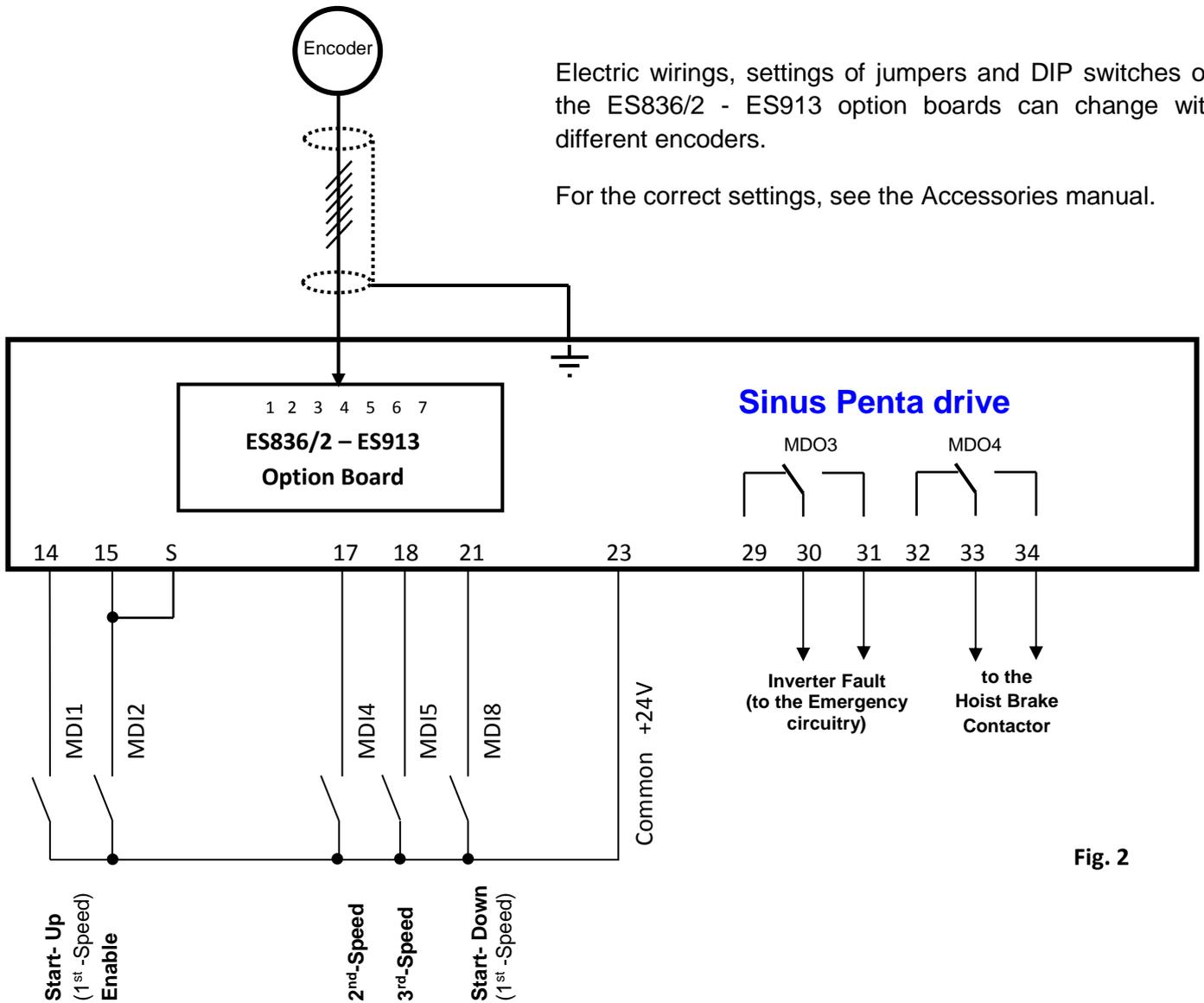


Fig. 2

Note:

The above-mentioned diagrams and parameter values represent a mere example of how the application can be used and they may be modified according to the User requirements and the technical specifications of the system. Therefore, it is the installer's responsibility to ensure a correct implementation.

Compliance with the current safety regulations and successful installation are responsibility of the installer; please refer to the application manual of the product.

General description

In this example, (fig 1) a winch for hoisting with 3 speeds and induction motor is shown. It is controlled by an inverter with mechanical brake and a braking resistor.

The Sinus Penta drive with vector control can keep the motor always fluxed even when this is in holding torque and the winch is not running. For this reason, it is recommended to set an automatic disabling time of the fluxing current in order to save energy.

This automatic time must be long enough to allow rapid positioning operations and to guarantee the mechanical brake closing. For these reasons, we recommend to set C183 parameter to a few seconds.

Enabling the mechanical brake.

The brake of the winch must be controlled by the inverter through a digital output.

It must not be enabled by other external direct commands.

Fall arrester protection

Sinus Penta inverter with vector control in closed loop (FOC) is safe through the feedback of the encoder against every speed slip out of range or in the opposite direction; in fact, if a slip occurs the inverter immediately blocks the mechanical brake and displays the A080 speed tracking alarm.

Commissioning procedure

Predisposition

All electric wirings as power supply, motor, braking resistor, commands and references must be carried out?? as shown in the installation manual HW:

- 1) Disconnect the wirings of terminals 15 or S (Enable) to avoid accidental operations.
- 2) Make sure that the inverter supply cannot be interrupted during the tuning and setting procedure possibly excluding timers, protections or other commands.
- 3) Supply the inverter.

Programming procedure

The commissioning shall start from a basic setting of the parameters.

If the inverter used was already programmed, please reset the inverter to factory default through the function "RESTORE DEFAULT" available in group "CF" → "EEPROM".

At first starting or after this default, "START-UP MENU" will appear. Please, push "ENTER", select the right language and confirm. In the next step, "When does the Start-Up Menu activate?" will appear, push "ENTER" select "NEVER" and confirm with "ENTER".

Programming the parameters of the "PAR" Group

Password and access level

P001 - Programming level = Engineering (max programming level)

Ramps

P009 - Acceleration ramp 1	= 2.00 s	(Motor acceleration ramp from 0 to max speed)
P010 - Deceleration ramp 1	= 2.00 s	(Motor deceleration ramp from max speed to 0)
P022 - Initial Acceleration S ramp	= 1%	(rounding on starting acceleration ramp)
P023 - Final Acceleration S ramp	= 1%	(rounding on ending acceleration ramp)
P024 - Initial Deceleration S ramp	= 1%	(rounding on starting deceleration ramp)
P025 - Final Deceleration S ramp	= 1%	(rounding on ending deceleration ramp)

Multispeed

P080 - Multispeed mode = 2: Exclusive preset speed

P081 - Output speed Mspd1	= ... rpm	(setting the second speed closing terminals 14+17 up or 21+17 down)
P083 - Output speed Mspd2	= ... rpm	(setting of the third speed closing terminals 14+18 up or 21+18 down)

Enter the values in rpm according to the parameters of the system.

Motor configuration M1

C015 - Motor1 rated frequency	= ... Hz	(Rated frequency)
C016 - Motor1 rated speed	= ... rpm	(Rated speed)
C017 - Motor1 rated power	= ... kW	(Rated power)
C018 - Motor1 rated current	= ... A	(Rated current)
C019 - Motor1 rated voltage	= ... V	(Rated voltage)
C028 - Motor1 min speed	= ... rpm	(setting of the first speed closing terminals 14 "Start-up" or 21 "Start-down")
C029 - Motor1 max speed	= ... rpm	(Enter the maximum desired rpm value)

Digital inputs

C151 - Digital input for REVERSE	= MD18	(Reverse function assigned to terminal 21)
C155 - Digital input for multispeed 0	= MD14	(Multispeed 0 function assigned to terminal 17)
C156 - Digital input for multispeed 1	= MD15	(Multispeed 1 function assigned to terminal 18)

Braking unit and ramp extension

C210 - Automatic ramp extension in dec.	= "With resistor"
C212 - Duty Cycle braking (Ton/Ton+Toff)	= 100%

Preliminary functional check

During the check, we recommend keeping the inverter disabled (terminals 15 or S open) to avoid running the motor in the wrong way.

The actual closing of the "Start-up", "Start-down" preset speeds, Enable inputs can be checked before running the motor through the MEA → Digital input → M032 parameter.

It is recommended to test the preset speed references too. These are available on the first page of the display switching the up/down commands and the different speeds. A negative sign "-" must be checked with a down command.

Motor Autotune

Attention

To execute next operations, connect the inverter to the motor that will be used for the desired application and not to a temporary motor.

To obtain the best performance, the motor shaft must be kept without load during the autotune; the best is free shaft condition.

If these conditions cannot be satisfied, it will be necessary to keep the brake open to avoid every type of friction and to remove the winch ropes. Anyway, the tuning obtained in this way could not be precise, so manual adjustments may be necessary.

No load current estimation

In IFD mode, close both “Enable” terminals 15 and S then run the motor up to 80% of the rated speed (for example, if you have a 4 poles motor that works at 1500 rpm, run the motor up to 1200 – 1300 rpm). Now, read the value of the absorbed current “...A” on the measure page on the display.

If it is not possible to run the motor through the terminals, it is possible to do this through the “local” mode directly on the keypad (key “LOC/REM”) pressing START/STOP and rising the speed up to the desired value with the arrow keys. From the value read from the keypad, it is possible to obtain the percentage current with the formula:

$$\text{Current \%} = \frac{\text{Current read [A]}}{\text{Rated current of the motor}} * 100$$

Enter the result of this formula in C021 parameter.

Only for FOC CONTROL MODE

An encoder as feedback is mandatory to use the vector FOC control mode.

On this application guide, the encoder is connected to the ES836/2 or ES913 option board.

For the board mounting, setting and wirings the instructions on the related manual must be followed.

Encoder/frequency inputs

C189 - Operating mode	= 3: A=NO B=FBK	(feedback from ES836/2 or ES913 board)
C191 - Encoder B: pulses	= 1024	(Enter the number of pulses of the encoder)
C192 - Speed alarm timeout	= 3 sec	(Time for intervention of the alarm “speed tracking”)

Motor1 configuration

C012 -Type of feedback motor1	= Encoder	(it enables the speed feedback)
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Execute the operations in IFD mode to check if everything is ok with the set speeds and directions. Look the display if the actual speed of the motor reaches the speed setpoint and if the signs of the speed are the same. If these values are different, or if the actual speed is 0, A080 - Speed tracking alarm will appear after about 3 seconds.

If the encoder shows an opposite direction, it is possible to correct with tis parameter:

C199 - Encoder sign inversion	= 1: FBK=Yes Ref=No	(the direction as shown by the encoder is inverted)
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Autotune

First, install a temporary switch on terminals 15 and/or S to open and close the Enable input when necessary. Never use a permanent wiring without a switch on these terminals.

There are 3 tunings in sequence, in the first two the motor stays still, in the third one it will rotate so be careful during this tuning (free shaft condition).

Motor parameters tuning (no rotation)

Open the Enable, then enter the AUTOTUNE MENU:

I073 - Selecting type of tuning = Motor tune (motor parameters tuning)

I074 - Type motor tuning = 0: Motors Params (estimate the resistance and inductance values of the motor)

Once I074 parameter has been set, enter "ESC" to go back to the main screen, on the display will appear "TUNING". Now, close the temporary Enable and wait for "open enable" flashing on the display. When the display flashes open the Enable and go to the second tuning.

Current loop tuning (no rotation)

Enter the AUTOTUNE MENU again:

I073 - Selecting type of tuning = Motor tune (motor parameters tuning)

I074 - Type motor tuning = 1: Control NO rot. (parameters tuning of the FOC regulators)

Once I074 parameter has been set, enter "ESC" to go back to the main screen, on the display will appear "TUNING". Now, close the temporary Enable and wait for "open enable" flashing on the display. When the display flashes open the Enable and go to the third and last tuning.

Rotor time constant tuning (free shaft condition YES rotation)

WARNING : the shaft of the motor shall be left free to rotate also at high speed.

Enter the AUTOTUNE MENU:

I073 - Selecting type of tuning = Motor tune (motor parameters tuning)

I074 - Type motor tuning = 2: Control YES rot (parameters tuning "rotor constant")

Once I074 parameter has been set, enter "ESC" to go back to the main screen, on the display will appear "TUNING". Now, close the temporary Enable and wait for "open enable" flashing on the display. When the display flashes open the Enable. Procedure end.

Programming the control of the mechanical brake

Digital outputs

P297 – MDO4 Digital Output Mode	= ABS BRAKE	(brake function on terminals 33-34)
P298 - MDO4 Variable A	= A64: Torq.Dem%	(Variable to release the brake)
P299 - MDO4 Variable B	= A03: Ramp Out	(Variable to lock the brake)
P300 - MDO4 Testing on Variable A	= ABS >	
P301 - MDO4 Testing on Variable B	= ABS <	
P302 - MDO4 Threshold Value for Test A	= 30%	(Over this torque value the mechanical brake is opened)
P303 - MDO4 Threshold Value for Test B	= 100 rpm	(Under this speed the brake is closed, this value must always be less than the minimum speed "C028".)
P304 - Function applied to the result of the 2 Tests A B on MDO4 = 1:	(A) Set (B) Reset	Rising Edge

Enabling sensorless VTC mode

Motor1 configuration

C010 - Motor1 control algorithm = VTC. Vector Torq... (sensorless mode)
 C012 -Type of feedback motor1 = disable (NO speed feedback)

Digital Inputs

C183 - Maximum fluxing time = 6 sec (Maximum fluxing time before drive Disable)

Motor 1 limit

C048 - Maximum torque limit = 500% (Maximum instantaneous torque generated by the motor)

Now it is possible to connect mechanically the motor to the winch and close the brake that was open to make the tuning in the right way.

Execute some operations without load, check if the brake works perfectly in every operation. If everything is ok, it is possible to use the winch for your application.

Enabling FOC mode with closed loop

Motor1 configuration

C010 - Motor1 control algorithm = 2: FOC FieldOrient. (Field Oriented control mode)
 C012 -Type of feedback motor1 = Encoder (it enables the speed feedback)

Digital Inputs

C183 - Maximum fluxing time = 6 sec (Maximum fluxing time before drive Disable)

Motor 1 limit

C048 - Maximum torque limit = 500% (Maximum instantaneous torque generated by the motor)

Now it is possible to connect mechanically the motor to the winch and close the brake that was open to make the tuning in the right way.

Execute some operations without load, check if the brake works perfectly in every operation. If everything is ok, it is possible to use the winch for your application.