

Application note
June 4, 2007

CD1a / CD1k servo drive

SinCos tracks motor feedback

1) INTRODUCTION

This application note is dedicated to the commissioning of the CD1-a and CD1-k amplifier ranges running a motor equipped with a specific position sensor. The position sensor output signals (SinCos tracks) are analog and differential sine and cosine signals. They are electrically similar to a standard SinCos encoder. The Sin and Cos signal period is generally equal to the motor pole pitch or a multiple. Only the specific information regarding the SinCos tracks feedback sensor setting are described in this document. The complete information for the CD1-a or CD1-k amplifier commissioning and parameterization can be found in the appropriate manuals. CD1-a applications with SinCos tracks feedback requires amplifier version 12.3C or higher. CD1-k application with SinCos tracks feedback requires amplifier version 112.33 or higher. The parameterization for an application with SinCos tracks motor feedback requires the VDSetup software version 4.0 or an higher release.

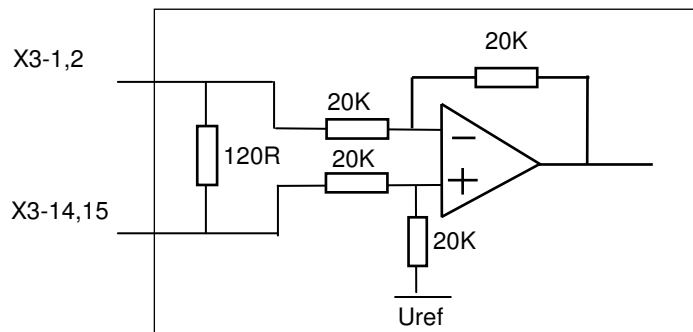
2) X3 CONNECTOR FOR SINCOS TRACKS MOTOR FEEDBACK (Sub D 25 pins female)

The "SinCos tracks motor feedback" configuration is software selectable and stored in the amplifier EEPROM.

The corresponding X3 connector pin functions are described below.

PIN	FUNCTION	REMARKS
14	Sin-	Differential input of the position sensor Sin track
1	Sin+	Differential input of the position sensor Sin track
15	Cos-	Differential input of the position sensor Cos track
2	Cos+	Differential input of the position sensor Cos track
8	+5V	Encoder supply voltage: max 300 mA available
21	GND	Encoder supply GND
9	TC+	Motor thermal sensor input
22	TC-	Motor thermal sensor input
others	reserved	

SIN AND COS CHANNELS SPECIFICATION



3) POSITION SENSOR CABLES

The analog Sin and Cos signals require a pair twisted and shielded cable. The shield must have a "360°" connection via metallic collars at both ends. If the shield is connected by means of a pig tail, it must be connected at one end to the GND pin of the connector on the amplifier side with a connection as short as possible.

Check that the voltage drop in the power supply lines of the position sensor cable is complying with the sensor technical specifications. The voltage drop value for a given cable is calculated as follows:

$$\Delta U[V] = 40 \cdot 10^{-6} \cdot \frac{L_c[m] \cdot I[mA]}{S[mm^2]}$$

With

ΔU:	voltage drop in volts
Lc:	cable length in meters
I:	sensor current in milliamps (see technical specifications)
S:	cross section in squared millimeters

If the voltage drop in the cable is too high, the user has to increase the supply lines cross section or to power the position sensor by an external power supply.

4) OFFSET COMPENSATION ON THE SIN AND COS CHANNELS

For the compensation of the measurement offsets on the CD1 servo drive Sin and Cos channels, proceed as described below. This operation is necessary for the CD1 servo drive operation with SinCos tracks motor feedback. It must be executed before the servo drive commissioning.

- Switch on the servo drive logic supply (+24V)
- Disconnect the position sensor cable from the X3 connector
- Deactivate the **Enable** input (CD1-a) or activate the **Inhibit** input (CD1-k) on the command connector
- Connect the serial link RS-232 and start the Windows ASCII terminal
- Send the **OX3** ASCII command to start the offset compensation procedure
- Send the **OX** ASCII command and check that the returned value is 0.
- If the value returned by the **OX** ASCII command is different from 0, the procedure has not been correctly executed. In this case, check that the position sensor cable is really disconnected from the X3 connector. Check also that the **Enable** input (CD1-a) is deactivated or the **Inhibit** input (CD-1k) activated. Send again the **OX3** ASCII command in order to start the offset compensation procedure and check that the procedure has been correctly executed by reading the **OX** ASCII command value.
- When the procedure has been correctly executed, the Sin and Cos channel offset values are automatically saved in the amplifier internal memory.
- Connect the position sensor cable on the X3 connector.

5) APPLICATION WITH SIN/COS TRACKS MOTOR FEEDBACK

5-1. AMPLIFIER CONFIGURATION

Proceed as described below for the SinCos tracks motor feedback configuration:

Start the VDSetup software (release 4.0 or higher).

Select "SinCos tracks" feedback in the "Position sensor configuration" window. Click on "OK" to validate the amplifier sensor feedback configuration.

5-2. AMPLIFIER SETTING AND OPERATION

The CD1 servo drive operation with SinCos tracks motor feedback is similar to the resolver feedback operation. Refer to the appropriate Installation and User manuals for the servo drive commissioning and parameterization.

Execute the command "Save parameters to EEPROM" before switching off the logic supply (+24V).



When using the VDSetup software with a release lower than 4.0, the servo drive parameters are not correctly loaded and saved in a parameter file (*.PAR) because the "SinCos tracks feedback" configuration is not supported. These operations may involve uncontrolled motor movements that may be dangerous for operator and machine.

5-3. APPLICATION LIMITATIONS

When the CD1 servo drive is configured for SinCos tracks motor feedback, Sin/Cos encoder types and Hiperface / Endat encoder types cannot be connected to the servo drive as "second position sensor" for electronic gearing or for loading position feedback applications. Only TTL incremental encoder types can be used for this purpose. Stepper emulation applications are still available when the CD1 servo drive is configured for SinCos tracks motor feedback.

6) SINCOS TRACKS ERROR COMPENSATION

For the compensation of the position sensor errors (offsets and amplitude difference between the Sin and Cos tracks), proceed as described below. This operation allows to reduce the motor speed ripples at high speed and improve the positioning accuracy. It is required when the application performances must be optimized. In this case, the SinCos tracks error compensation operation must be renewed if the motor position sensor is changed for maintenance.

- Start the servo drive commissioning and parameterization according to the appropriate CD1 amplifier Installation and User manuals.
- Connect the serial link RS-232 and start the Windows ASCII terminal.
- Deactivate the **Enable** input (CD1-a) or activate the **Inhibit** input (CD1-k).
- Send the **MS1** and **AR** ASCII commands.
- Activate the **Enable** input (CD1-a) or deactivate the **Inhibit** input (CD1-k).
- Check that the motor shaft is free and that its displacement in the positive direction over 2 revolutions (or 2 pole pitches for a linear motor), is not dangerous for operator and machine.
- Send the **OC** ASCII command for starting the execution of the sensor compensation procedure. The motor displacement during the procedure execution is about 2 revolutions (or 2 pole pitches for a linear motor). Do not disable the drive before the end of the procedure (CD1 front panel LEDs are flashing during the procedure execution).
- If the **BUSY** fault is continuously displayed after the execution of the compensation procedure, the procedure has failed because of an external cause and the compensation is not valid. Check that the **Enable** input (CD1-a) is activated or the **Inhibit** input (CD1-k) is deactivated. Check that the limit switches inputs are not activated. Send again the **OC** ASCII command to start the compensation procedure and check that the procedure has been correctly executed.
- The compensation parameters are automatically saved in the amplifier internal memory at the end of the procedure.

7) CD1-k CANOPEN COMMUNICATION PROFILE

7-1. MOTOR FEEDBACK SENSOR SELECTION

The motor feedback sensor is used to close the servo motor torque and speed control loops. The servo motor position loop can be closed by the motor feedback sensor or with the second sensor (see object 306Ah).

Index	3070h
Name	Motor Feedback Selection
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	eprom

SD0 3070 value	Description
0	Resolver input selection for the motor feedback
1	Encoder input selection for the motor feedback
2	SinCos tracks input selection for the motor feedback

Various encoder types can be used with the CD1 servo drive range (TTL, SinCos, incremental, absolute, single-turn, multi-turn). The Encoder Input Selection object is set according to the encoder type that must be connected on the X3 connector.

Index	3080h
Name	Encoder Input Selection
Object Code	VAR
Data Type	Unsigned16
Object Class	all
Access	rw
PDO Mapping	No
Default Value	eprom

Value	Description
0	TTL incremental encoder configuration
1	TTL incremental encoder + 60° HES configuration
2	TTL incremental encoder + 120° HES configuration
3	SIN/COS incremental encoder configuration
4	SIN/COS incremental encoder + 60° HES configuration
5	SIN/COS incremental encoder + 120° HES configuration
6	Absolute single-turn SIN/COS encoder (ERN1085 compatible)
7	Absolute multi-turn / single-turn SIN/COS encoder with ENDAT protocol
8	Absolute multi-turn / single-turn SIN/COS encoder with HIPERFACE protocol
9	Absolute linear SIN/COS encoder with HIPERFACE protocol
F	Pulse and Direction input configuration for stepper emulation

The Motor Feedback Programming procedure modifies the encoder input selection and the motor feedback selection according to the parameters defined by objects 3072, 3070 and 3080.

Index	3098h
Name	Motor Feedback Programming Procedure
Object Code	VAR
Data Type	Unsigned32
Object Class	all
Access	wo
PDO Mapping	No

In order to avoid running the motor feedback programming procedure by mistake, it is only executed when a specific signature is written to this object. The signature is 'fdbk'.

Signature	MSB			LSB
	ASCII	k	b	d
hex	6Bh	62h	64h	66h

7-2. SINCOS TRACKS ERROR COMPENSATION

Writing to this object will execute the SinCos tracks error compensation procedure. This procedure allows to reduce the motor speed ripples at high speed and improve the positioning accuracy. It is only required when the application performances must be optimized. In this case, the SinCos tracks error compensation operation must be renewed if the motor position sensor is changed for maintenance. The compensation parameters are automatically saved in the amplifier internal memory at the end of the procedure.

Index	3496h
Name	SinCos tracks error compensation procedure
Object Code	VAR
Data Type	Unsigned32
Object Class	-
Access	wo
PDO Mapping	No

In order to avoid running the SinCos tracks error compensation procedure by mistake, the procedure is only executed when a specific signature is written to this object. This signature is 'scmp'. The procedure must be started with amplifier disabled and **Inhibit** input deactivated.

Signature	MSB			LSB
	ASCII	p	m	c
hex	70h	6Dh	63h	73h

Appendix : CD1 range hardware indexes for SinCos tracks motor feedback

The following hardware indexes are required in the CD1-a and CD1-k amplifiers in order to support the SinCos tracks motor feedback functionality.

Drive rating	230 / 2.25 to 16.5	400 / 1.8 to 7.2	400 / 14	400 / 30 and 45	400 / 70	400 / 90
CD1-a version	α H or greater	α J or greater	α D or greater	R or greater	all values	all values
CD1-k version	α D or greater	α D or greater	α F or greater	α R or greater	all values	all values