AKD™
sercos® III Communication

Edition July 2013, A - Beta Version

Valid for firmware version 1.9

Part Number 903-200020-00

Original Documentation

Keep all manuals as a product component during the life span of the product.
Pass all manuals to future users/owners of the product.

Revision History

Revision	Remarks
A, 07/2013	Beta version

Trademarks

- AKD is a registered trademark of Kollmorgen Corporation
- sercos$^®$ is a registered trademark of sercos$^®$ international e.V.
- WINDOWS is a registered trademark of Microsoft Corporation
- EnDat is a registered trademark of Dr. Johannes Heidenhain GmbH
- HIPERFACE is a registered trademark of Max Stegmann GmbH

Current patents

- US Patent 5,162,798 (used in control card R/D)
- US Patent 5,646,496 (used in control card R/D and 1 Vp-p feedback interface)
- US Patent 6,118,241 (used in control card simple dynamic braking)
- US Patent 8,154,228 (Dynamic Braking For Electric Motors)
- US Patent 8,214,063 (Auto-tune of a Control System Based on Frequency Response)

1 Table of Contents

2 General

2.1 About this Manual

This manual, *AKD sercos® III Communication*, describes the installation, setup, IDNs, and software protocol for the AKD sercos® III product series. All AKD sercos® III drives have built-in sercos® III functionality. An additional option card is not required.

A digital version of this manual (pdf format) is available on the disk included with your drive. Manual updates can be downloaded from the Kollmorgen website.

Related documents for the AKD series include:

- *AKD Quick Start* (also provided in hard copy). This guide provides instructions for initial drive setup and connection to a network.
- *AKD Installation Manual* (also provided in hard copy for EU customers). This manual provides instructions for installation and drive setup.
- *AKD User Guide*. This manual includes completeWorkBench instructions, faults and warnings, and parameter descriptions.

2.2 Target Group

This manual addresses personnel with the following qualifications:

- Installation: only by electrically qualified personnel.
- Setup: only by qualified personnel with extensive knowledge of electrical engineering and drive technology
- Programming: software developers, project-planners

The qualified personnel must know and observe the following standards:

- ISO 12100, IEC 60364 and IEC 60664
- National accident prevention regulations

⚠ WARNING	During operation there are deadly hazards, with the possibility of death, severe injury or material damage. The operator must ensure that the safety instructions in this manual are followed. The operator must ensure that all personnel responsible for working with the servo drive have read and understand the manual.

2.3 Symbols Used

Warning Symbols

Symbol	Indication
⚠ **DANGER**	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **WARNING**	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION**	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	This is not a safety symbol. Indicates situations which, if not avoided, could result in property damage.
NOTE	This is not a safety symbol. This symbol indicates important notes.
⚠	Warning of a danger (general). The type of danger is specified by the text next to the symbol.
⚠	Warning of danger from electricity and its effects.
⚠	Warning of hot surfaces
⚠	Warning of suspended loads.

Drawing symbols

Symbol	Description	Symbol	Description
	Signal ground		Diode
	Chassis ground		Relays
	Protective earth		Relays switch off delayed
	Resistor		Normal open contact
	Fuse		Normal closed contact

3 Safety

3.1 Safety Instructions

| ⚠ **DANGER**	Never disconnect any electrical connections to the drive while the drive is live. There is a danger of electrical arcing with damage to contacts and serious personal injury. Wait at least seven minutes after disconnecting the drive from the main supply power before touching potentially live sections of the equipment (e.g. contacts) or undoing any connections.
	Capacitors can still have dangerous voltages present up to 7 minutes after switching off the supply power. To be sure, measure the voltage in the DC Bus link and wait until it has fallen below 40 V.
	Control and power connections can still be live, even if the motor is not rotating.
⚠ **DANGER**	During operation there are deadly hazards, with the possibility of death, severe injury or material damage. Do not open or touch the equipment during operation. Keep all covers and cabinet doors closed during operation. Touching the equipment is allowed during installation and commissioning for properly qualified persons only.
	During operation, drives may have uncovered live components, depending on their level of enclosure protection.
	Control and power connections may be live, even though the motor is not rotating.
	Drives may have hot surfaces during operation. Heat sink can reach temperatures above 80°C.
⚠ **WARNING**	Electronic equipment can fail. The user is responsible for ensuring that in the event of a failure of the servo amplifier, the drive is set to a state that is safe for both machinery and personnel, for instance with the aid of a mechanical brake.
	Drives with servo amplifiers and sercos® III are remote-controlled machines. They can start to move at any time without previous warning. Take appropriate measures to ensure that the operating and service personnel is aware of this danger.
	Implement appropriate protective measures to ensure that any unintended start-up of the machines cannot result in dangerous situations for personnel or machinery. Software limit-switches are not a substitute for the hardware limit-switches in the machine.

3.2 Use as directed

Drives are components that are built into electrical plants or machines and can only be operated as integral components of these plants or machines. The manufacturer of the machine used with a drive must generate a risk assessment for the machine and take appropriate measures to ensure that unforeseen movements cannot cause personnel injury or property damage.

- Observe the chapters "Use as directed" and "Prohibited use" in the *AKD Installation Manual*.
- The sercos® III interface serves only for the connection of the *AKD* to a master with sercos® III connectivity.

3.3 Prohibited use

Use other than that described in chapter "Use as directed" is not intended and can lead to personnel injuries and equipment damage. The drive may not be used with a machine that does not comply with appropriate national directives or standards. The use of the drive in the following environments is also prohibited:

- potentially explosive areas
- environments with corrosive and/or electrically conductive acids, alkaline solutions, oils, vapors, dusts
- ships or offshore applications

The connectors X5 and X6 of the AKD sercos® III drive may not be used for any ethernet protocol except sercos® III.

4 Installation and Setup

4.1 Important Notes

⚠ WARNING	Electronic equipment can fail. The user is responsible for ensuring that, in the event of a failure of the servo amplifier, the drive is set to a state that is safe for both machinery and personnel, for instance with the aid of a mechanical brake.

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Implement appropriate protective measures to ensure that any unintended start-up of the machines cannot result in dangerous situations for personnel or machinery. Software limit-switches are not a substitute for the hardware limit-switches in the machine.

NOTICE Install the drive as described in the *Installation Manual*. The wiring for the analog setpoint input and the positioning interface, as shown in the wiring diagram in the *Installation Manual*, is not required. Never break any of the electrical connections to the drive while it is live. This action can result in destruction of the electronics.

NOTICE The drive's status must be monitored by the PLC to acknowledge critical situations. Wire the FAULT contact in series into the emergency stop circuit of the installation. The emergency stop circuit must operate the supply contactor.

NOTICE Do not connect the Ethernet line for the PC with the set up software to the sercos® III interface X5/X6. The set up Ethernet cable must be connected to the service interface on X11.

NOTE Use WorkBench to alter drive settings. Any other alterations will invalidate the warranty.

NOTE Because of the internal representation of the position-control parameters, the position controller can only be operated if the final limit speed of the drive does not exceed:**rotary**
at sinusoidal² commutation: 7500 rpm
at trapezoidal commutation: 12000 rpm.
linear
at sinusoidal² commutation: 4 m/s
at trapezoidal commutation: 6.25 m/s

NOTE All the data on resolution, step size, positioning accuracy etc. refer to calculatory values. Non-linearities in the mechanism (backlash, flexing, etc.) are not taken into account. If the final limit speed of the motor must be altered, then all the parameters that were previously entered for position control and motion blocks must be adapted.

4.2 sercos® III Onboard

Connection to the sercos® III Network is made using X5 (in port) and X6 (out port).
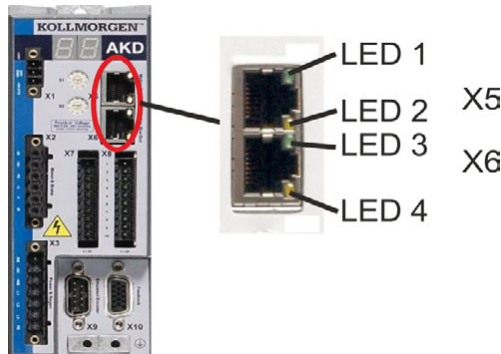
4.2.1 LED functions

The communication status is indicated by built-in LEDs.

Connector	LED#	Name	Function
X5	LED1	IN port Link	ON = active OFF= not active
	LED2	RUN	ON = running OFF = not running
X6	LED3	OUT port Link	ON = active OFF = not active
	LED4	-	-

4.2.2 Connection technology

Connect to the sercos® III network using RJ-45 connectors.

4.3 Network Toplogies

AKD sercos® III supports line and ring network topologies.

4.3.0.1 Line Toplogy

Form a line toplogy by connecting the master to the In port (X5) of the first sercos® III slave. Then connect the first slave's Out port (X6) to the In port of the next slave. The last slave is not connected back to the master and its Out port can be used to analyze sercos® traffic.
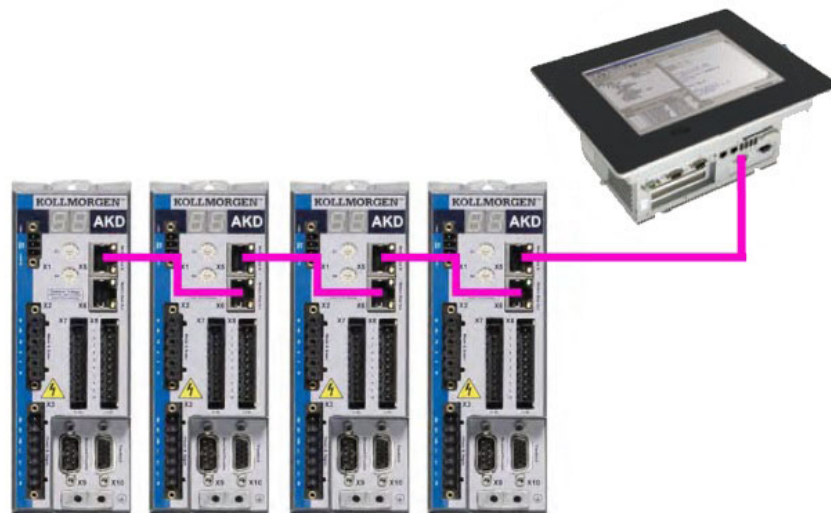
4.3.0.2 Ring Topology

Form a ring topology by connecting the master to the In port (X5) of the first sercos$^®$ III slave. Then connect the first slave's Out port (X6) to the In port of the next slave. When the last slave is reached, connect its Out port back to the master.
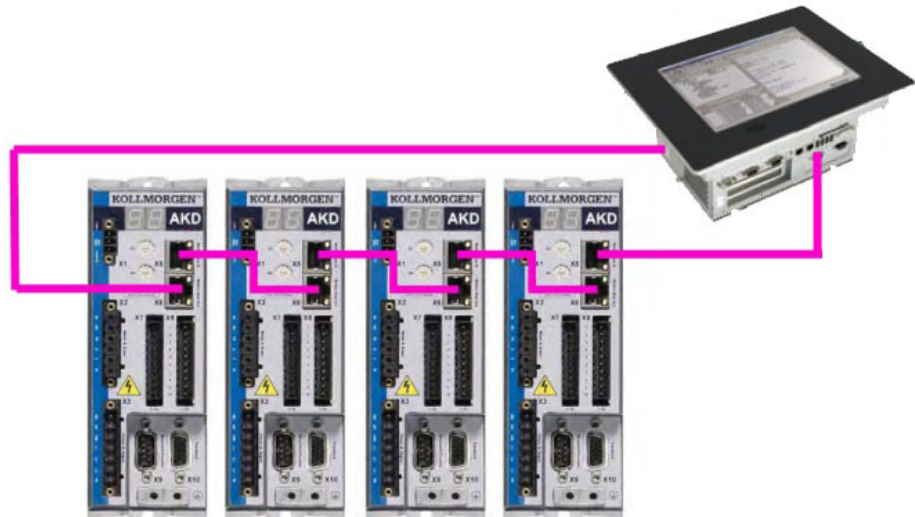
4.3.0.3 sercos$^®$ Addressing

Set the sercos$^®$ slave address using either IDN1040 (sercos address) or the ASCII command S3.ADDRESS.

A write procedure through the sercos service channel on IDN1040 also performs a "Save to Drive" command.

If the S3.ADDRESS (➜ p. 16) command is given through WorkBench, the new address will be stored in RAM. An explicit call of DRV.NVSAVE in the terminal is needed to save the parameter values to the non-volatile memory.

5   sercos® ASCII Parameters and Commands

5.1 S3.ADDRESS

General Information	
Type	NV Parameter
Description	Sets and reads the sercos® slave address.
Units	N/A
Range	0 to 511
Default Value	1
Data Type	Integer
Start Version	M_01-09-03-000

Variants Supported

Variant	Supported
AKD Base	No
AKD with Position Indexer	No
AKD EtherCAT	No
AKD CANopen	No
AKD BASIC	No
AKD SynqNet	No
AKD EtherNet/IP	No
AKD Profinet	No
AKD sercos® III	Yes
AKD-N	No
AKD-C	No

Description

Sets and reads the sercos® slave address.

6 sercos® Function Groups

The AKD sercos® III supports the basic function groups that are defined and specified by the sercos® Technical Working Group. Detailed definitions for the drive profile IDNs can be found at: https://wiki.sercos.org/rc/Main_Page.

Additional functionality can be executed using manufacture specific IDNs. For detailed information on the ASCII parameters and commands that are mapped to manufacture specific IDNs, see appendix A of the AKD User Guide on kollmorgen.com.

6.1 Drive State Machine

The AKD follows the drive state machine defined in the sercos[®] specifications (FG Drive State Machine). Use the control word (IDN134) and status word (IDN135) to control and verify the state transitions. Behavior for disabling the drive also depends on the configuration of the ASCII parameters DRV.DISMODE and DRV.DEC.

Drive On/Off (Bit 15)	Drive Enable (Bit 14)	Drive Halt (Bit 13)	Description
0	x	x	Write "Drive Off" (Bit 15 = 0) to disable the drive with the configured DRV.DISMODE.
1	0	x	Set "Drive Enable" from 1 to 0 to disable the drive with the configured DRV.DISMODE.
1	1	0	Set bit 14 and 15 to enable the power stage. If the "Drive Halt" bit changes from 1 to 0, the drive decelerates with DRV.DEC.
1	1	1	Set the "Drive Halt" bit from 0 to 1 to have the drive follow the master's set-point values.

6.2 Velocity Scaling

The sercos[®] velocity scaling is independent of the configured WorkBench unit scaling. Use the following IDNs to configure velocity scaling for all velocity scaling dependent sercos[®] signals:

- IDN44 Velocity data scaling type
- IDN45 Velocity data scaling factor
- IDN46 Velocity data scaling exponent

6.2.1 Default Settings

The default setting configuration for Velocity data is set to rev/min. This scaling is used for IDN 40 Velocity Feedback Value and IDN 36 Velocity Setpoint Value.

- Rotational scaling
- Data reference at the motor shaft
- Time units in minutes
- Units for rotational scaling in revolutions
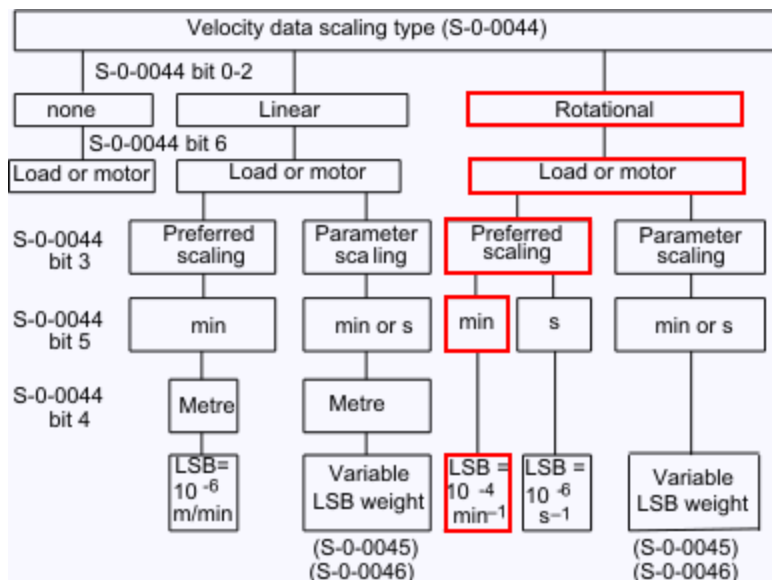
The IDN's default settings are:

S-0-0044: 0x02

S-0-0045: 1

S-0-0045: -4

6.3 Position Scaling

The sercos$^{®}$ position scaling is independent of the configured workbench unit scaling. Use the following IDNs to configure position scaling for all position scaling dependent sercos$^{®}$ signals:

- IDN55 Position polarity parameter
- IDN76 Position data scaling type
- IDN79 Rotational position resolution

If linear and parameter scaling is used:

- IDN77 Linear position data scaling factor
- IDN78 Linear position data scaling exponent

6.3.1 Default Scaling

- Rotational Scaling
- Data reference at the motor shaft
- Degrees
- 3,600,000 increments

The default IDN settings are:

IDN76: 0x02

IDN79: 3,600,000 increments
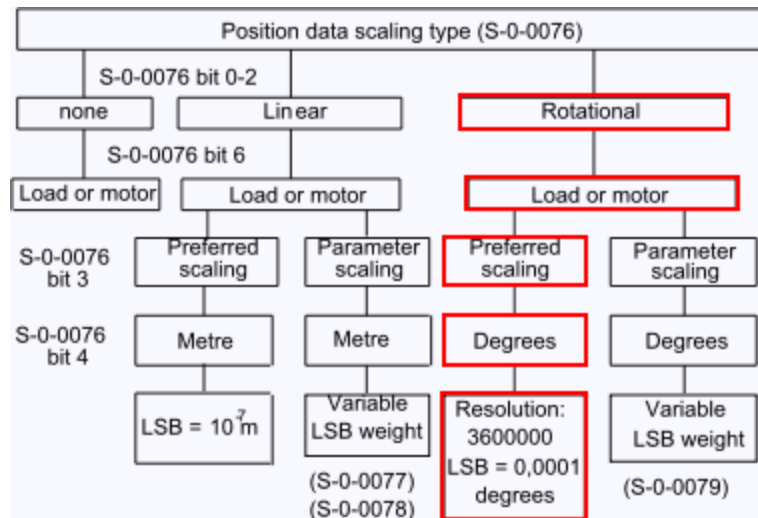
7 sercos® IDNs

7.1 IDN 17: List of All Operation Data

Shows all procedure commands and parameters which are supported.

7.2 IDN 33: Secondary operation mode 1

Defines the amplifier's operational mode when the AT status word bits 8 - 10 are 1. The master requests a particular operation mode through the MDT control word (bits 8-10). The opmode becomes active when the drive is enabled.

7.3 IDN 32: Primary Operation Mode

Defines the amplifier's operational mode when the AT status word bits 8 - 10 are 0. The master requests a particular operation mode through the MDT control word (bits 8 -10). The opmode becomes active when the drive is enabled.

Bit	Value	Description
3 to 0	0001	Torque control
	0010	Velocity control
	0011	Position control using motor feedback

7.4 IDN 76: Position Data Scaling Type

Different kind of scalings are supported. For using the rotational scaling, the IDN 79 is used to calculate the position scaling.

Bit 7 in IDN 76 enables and disables the modulo calculation (PL.MODPEN). The fieldbus command position values are now supporting the "Shortest Distance" mode if PL.MODPDIR is set to 3.

7.5 IDN 79: Rotational position resolution

This parameter defines the rotational position resolution for all position data.

7.6 IDN 92: Bipolar Torque limit

The value of bipolar torque is scaled in 0,1 % and a 100% (raw 1000) means a current limit of the continuous current of the drive (DRV.ICONT). The value can also be changed > 100% up to DRV.IPEAK. The bipolar torque limit will change the Workbench parameters IL.LIMITx.

7.7 IDN 99: Command: Reset Class 1 Diagnostic (clear fault)

If this procedure command is received by the sub-device via the service channel, then all diagnostic events with the class error (C1D) are deleted. If the cause of an diagnostic event with the class "error" is still active, then the corresponding event will be generated again.

7.8 IDN 103: Modulo value

IDN 103 shows the modulo range and sets ASCII parameters PL.MODP1 to zero and PL.MODP2 to modulo range -1.

7.9   IDN 116: Resolution feedback 1

The corresponding ASCII command is FB1.PSCALE and the resolution for feedback 1 is calculated through 2 ^ FB1.PSCALE. The default value is 2 ^ 20. The value can be set to other power of two resolutions.

7.10   IDN 134: Drive control

The drive control word within the MDT is stored within IDN134 as a diagnostic aid. More detailed information can be found in the sercos$^{®}$ standards.

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	n/a
Maximum:	n/a
Units:	n/a
Default:	n/a
Position after decimal point:	0
Scaling/Resolution LSB:	1
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.11   IDN135: Drive status

The AT drive status word is stored within IDN135 as a diagnostic aid.

Bit 13: Is set if an C1D error has occurred. The drive decelerates and disables. The fault reaction depends on the specific faults.

Bit 12: Is set if a warninig occurs. In case of no warning this bit is set to 0.

Bit 3:

0	Drive ignores the command values	For example, during drive halts, drive controlled functions, and programmed delay times.
1	Drive follows the command values	

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	n/a
Maximum:	n/a
Units:	n/a
Default:	n/a
Position after decimal point:	0
Scaling/Resolution LSB:	1
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.12   IDN 187: IDN-list of Configurable Data as Producer

List of all IDNs, which can be mapped into the AT telegram (e.g. position motor feedback (IDN 51)).

7.13   IDN 188: List of IDN-list of configurable data as consumer

List of all IDNs, which can be mapped into the MDT telegram (command values like velocity command (IDN 36))

7.14   IDN 189: Following distance

Following distance = position command value – position feedback value 1 or 2. Can be mapped into the AT telegram. Corresponds to PL.ERR.

7.15   IDN 1040: Slave address

The sercos® slave address can be stored via writing to S-0-1040. A write procedure to this IDN will also trigger a DRV.NVSAVE and the user should be aware that all NV parameter inclusive the sercos® slave address are stored.

See also S3.ADDRESS (➜ p. 16)

7.16   IDNP3050: Analogue Output User

Sets the analogue output value.

Data Length:	2 Bytes
Data Type:	Signed
Minimum:	-10
Maximum:	10
Units:	Volts
Default:	0
ASCII	AOUT.VALUEU
Scaling/Resolution LSB:	1
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.17   IDNP3051: Analogue Output Value

Reads the analogue output value.

Data Length:	2 Bytes
Data Type:	Signed
Minimum:	-10
Maximum:	10
Units:	Volts
Default:	0
ASCII	AOUT.VALUE
Scaling/Resolution LSB:	1

Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	AT

7.18   IDNP3036: Analogue Input Value

Reads the analogue input value.

Data Length:	2 Bytes
Data Type:	Signed
Minimum:	n/a
Maximum:	n/a
Units:	n/a
Default:	n/a
Position after decimal point:	0
Scaling/Resolution LSB:	1
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.19   IDNP3060: Digital Output 1 User

Sets the digital output state.

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	0
Maximum:	1
Units:	n/a
Default:	0
Position after decimal point:	0
ASCII	DOUT1.STATEU
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.20   IDNP3061: Digital Output 1 Value

Read the digital output state.

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	0
Maximum:	1
Units:	n/a
Default:	n/a

Position after decimal point:	0
ASCII	DOUT1.STATE
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	AT

7.21 IDNP3062: Digital Output 2 User

Sets the digital output state.

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	0
Maximum:	1
Units:	n/a
Default:	0
Position after decimal point:	0
ASCII	DOUT2.STATEU
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	MDT

7.22 IDNP3063: Digital Output 2 Value

Read the digital output state.

Data Length:	2 Bytes
Data Type:	Binary
Minimum:	0
Maximum:	1
Units:	n/a
Default:	n/a
Position after decimal point:	0
ASCII	DOUT2.STATE
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	AT

7.23 IDNP3030 Digital Inputs Value

Read the digital input state.

Data Length:	4 Bytes
Data Type:	Binary
Minimum:	0
Maximum:	0xFF

Units:	n/a
Default:	n/a
ASCII	DIN.STATES
Scaling/Resolution LSB	1
Non-Volatile:	No
Write Protection:	Always
Run-Up Check:	n/a
Cyclic Transfer:	AT

About KOLLMORGEN

Kollmorgen is a leading provider of motion systems and components for machine builders. Through world-class knowledge in motion, industry-leading quality and deep expertise in linking and integrating standard and custom products, Kollmorgen delivers breakthrough solutions that are unmatched in performance, reliability and ease-of-use, giving machine builders an irrefutable marketplace advantage.

For assistance with your application needs, visit www.kollmorgen.com or contact us at:

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