Kollmorgen伺服驱动器AKD产品介绍

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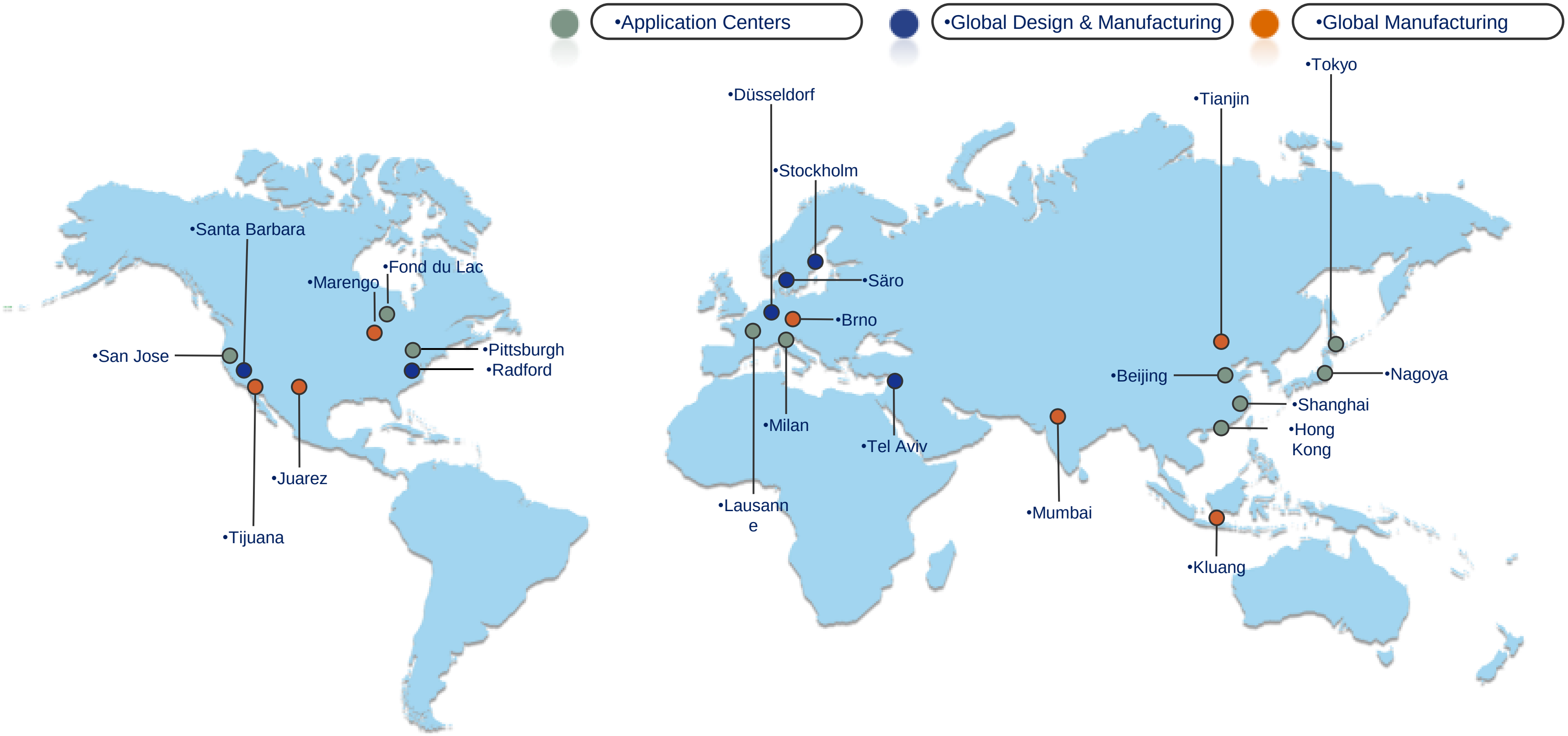
KOLLMORGEN CHINA
2011.10

KOLLMORGEN®

Because Motion Matters™

科尔摩根：Danaher旗下运动控制品牌


● •Application Centers
● •Global Design & Manufacturing
● •Global Manufacturing
•Santa Barbara
•Marengo
•Fond du Lac
•San Jose
•Pittsburgh
•Radford
•Juarez
•Tijuana
•Düsseldorf
•Stockholm
•Säro
•Brno
•Milan
•Tel Aviv
•Lausanne
•Mumbai
•Tianjin
•Tokyo
•Beijing
•Nagoya
•Shanghai
•Hong Kong
•Kluang

•Americas

- 50+ Direct Sales & Application Engineers
- 1,800 Distribution Branches

•Europe

- 40 Direct Sales & Application Engineers
- 300+ Distribution Branches

•Asia

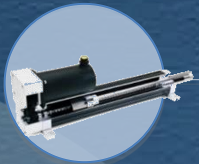
- 36 Direct Sales & Application Engineers
- 45 Distribution Branches

科尔摩根：我们服务的一些行业

科尔摩根：运动控制主推产品家族

KOLLMORGEN

Because Motion Matters.™



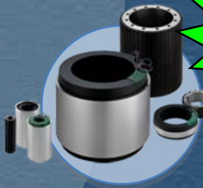
- IDC 电推杆

- Micron 齿轮减速机

- AKM 交流伺服电机

- Goldline 直驱旋转马达

•新品



- KBM 无框无刷直取旋转马达

- Cartridge 直驱旋转马达

- Platiuum 直线马达

•新品

- AKD™ 伺服驱动器

- S700 S300™/ 伺服驱动器

•2012

- Kollmorgen Automation Suite
  - KAS

- Synqnet 多轴运动控制器

- IEC 61131 多轴运动控制器

AKD简介

- *Advanced Kollmorgen Drive*

- AKD 是Kollmorgen最新研发的全球主推的一种高性能伺服驱动器.具有如下主要优点：

- 速度快
- 功能丰富
- 应用灵活
- 使用快速简单

CE

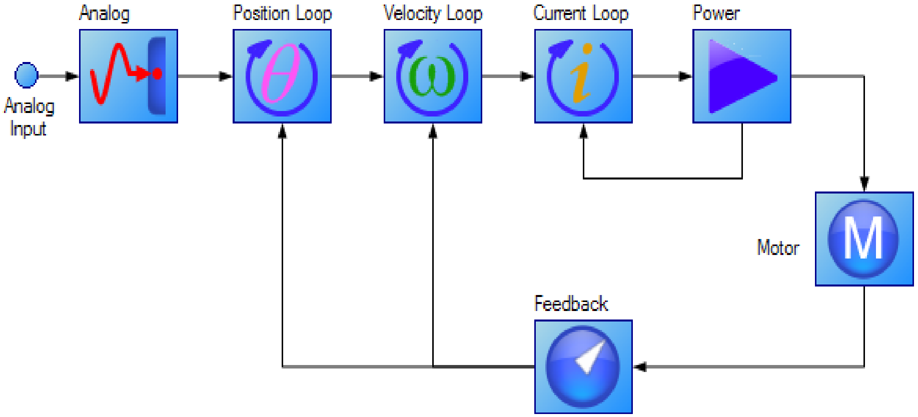
c UL us
LISTED
IND. CONT. EQ.
86F2

RoHS conform 2002/95/EC

AKD关键特性—伺服控制

双处理器设计，实现高性能伺服控制环，
最大化系统调节速度和扩展带宽

- 670 ns 扭矩环更新率(1.5 MHz)
- 62.5 µs 速度环更新率(16 kHz)
- 125 µs 位置环更新率(8 kHz)


Analog
Position Loop
Velocity Loop
Current Loop
Power
Analog Input
Motor
Feedback

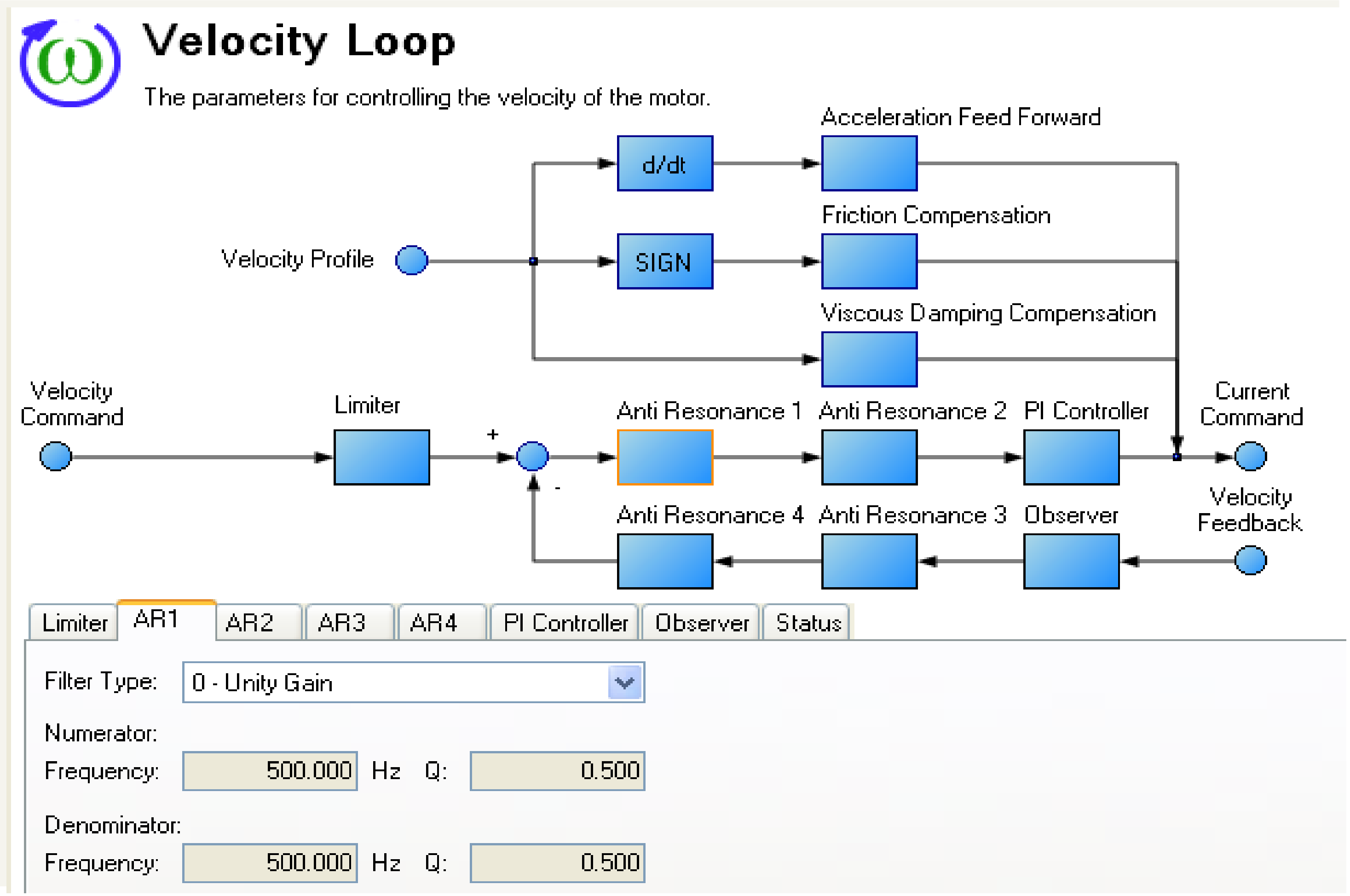
高阶观测器和4个双二阶滤波器

先进的自动调节功能，减少调试和所需的培训时间

- 可以点击一个自动调节按钮即可完成伺服调节；
- 也可以根据向导自动调节；
- 或根据手册指导手动调节；

AKD关键特性—伺服控制

AKD速度环控制器结构图：4Bi-quad



Velocity Loop

The parameters for controlling the velocity of the motor.

Acceleration Feed Forward
d/dt
Friction Compensation
Velocity Profile
SIGN
Viscous Damping Compensation
Velocity Command
Limiter
+
-
Anti Resonance 1
Anti Resonance 2
PI Controller
Current Command
Anti Resonance 4
Anti Resonance 3
Observer
Velocity Feedback
Limiter
AR1
AR2
AR3
AR4
PI Controller
Observer
Status

Filter Type: 0 - Unity Gain

Numerator:

Frequency: 500.000 Hz Q: 0.500

Denominator:

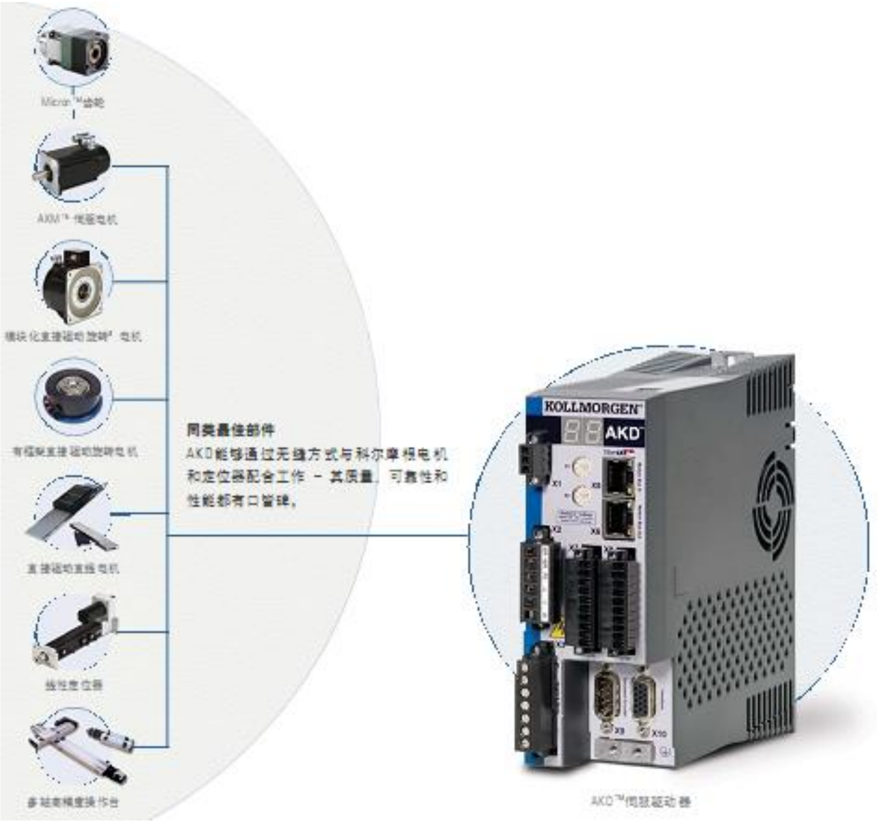
Frequency: 500.000 Hz Q: 0.500

AKD关键特性－电机类型/反馈种类

支持各种反馈装置

最高分辨率为$2^{27} = 134,217,728$

- Smart Feedback Device(SFD)
- Incremental Encoder w/wo Hall
- Sine Encoder w/wo Hall
- Resolver
- EnDat 2.1 and 2.2
- BiSS B/ C
- HIPERFACE


Micron™齿轮
AKM™伺服电机
模块化直接驱动旋转电机
有框架直接驱动旋转电机
直接驱动直线电机
线性定位器
多轴高精度操作台
KOLLMORGEN
AKD
AKD™伺服驱动器

同类最佳部件

AKD能够通过无缝方式与科尔摩根电机和定位器配合工作 – 其质量、可靠性和性能都有口皆碑。

AKD关键特性－控制方式

支持基本的模拟量、数字量和各种现场总线控制方式，使系统性能最优化和具备灵活性。

- Analog
- Electrical Gearing
- Modbus
- Motion Task

CANopen

EtherCAT®

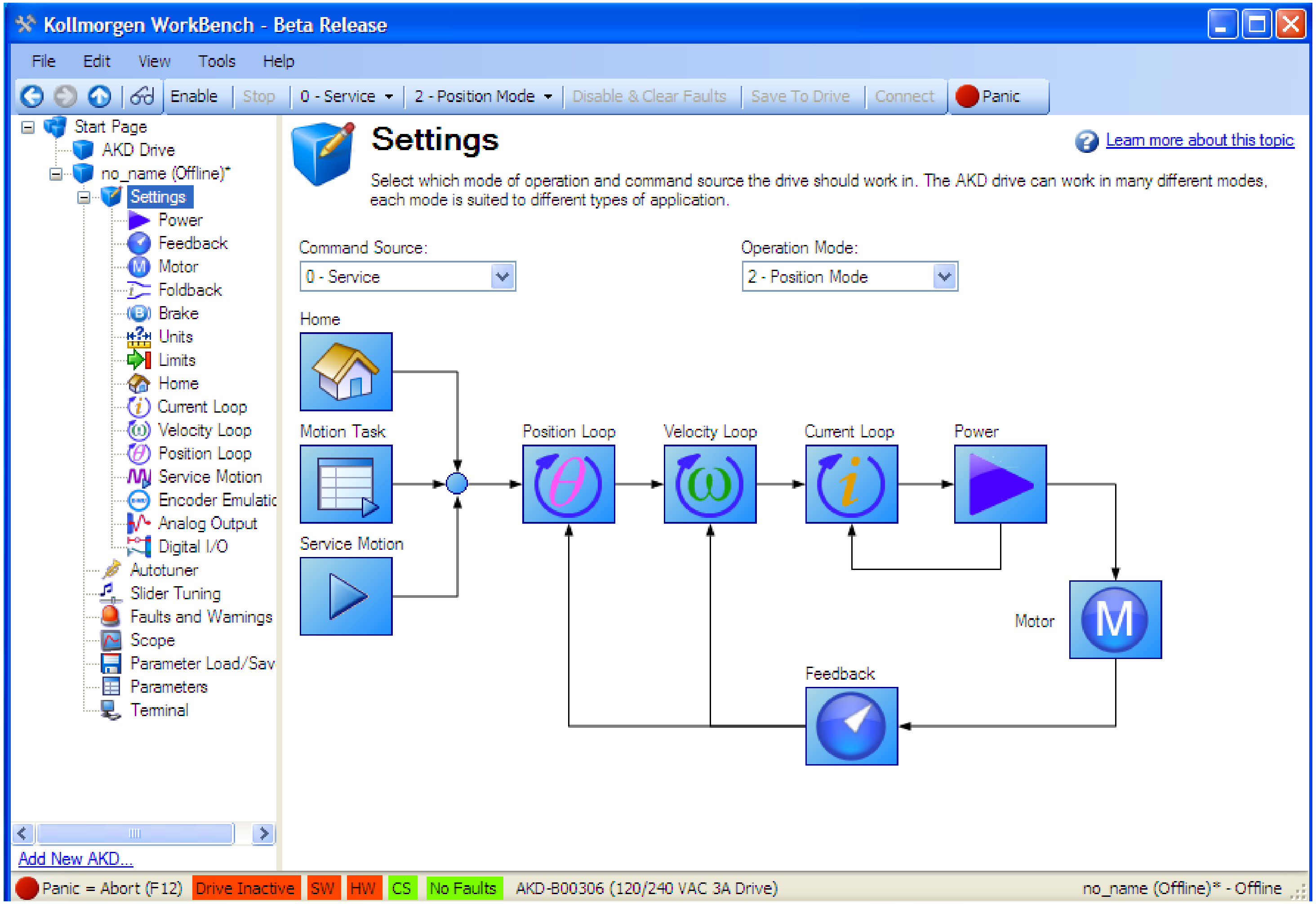
SynqNet™

PROFINET®

Ethernet IP

KOLLMORGEN
AKD

AKD 直观,功能强大的操作软件Workbench,使驱动器的设置,调试,编程更快速和简单


Kollmorgen WorkBench - Beta Release
File
Edit
View
Tools
Help
Enable
Stop
0 - Service
2 - Position Mode
Disable & Clear Faults
Save To Drive
Connect
Panic
Start Page
AKD Drive
no_name (Offline)*
Settings
Power
Feedback
Motor
Foldback
Brake
Units
Limits
Home
Current Loop
Velocity Loop
Position Loop
Service Motion
Encoder Emulatic
Analog Output
Digital I/O
Autotuner
Slider Tuning
Faults and Warnings
Scope
Parameter Load/Sav
Parameters
Terminal
Add New AKD...
Learn more about this topic
Home
Motion Task
Service Motion
Position Loop
Velocity Loop
Current Loop
Power
Motor
M
Feedback
Panic = Abort (F12)
Drive Inactive
SW
HW
CS
No Faults
AKD-B00306 (120/240 VAC 3A Drive)
no_name (Offline)* - Offline

Settings

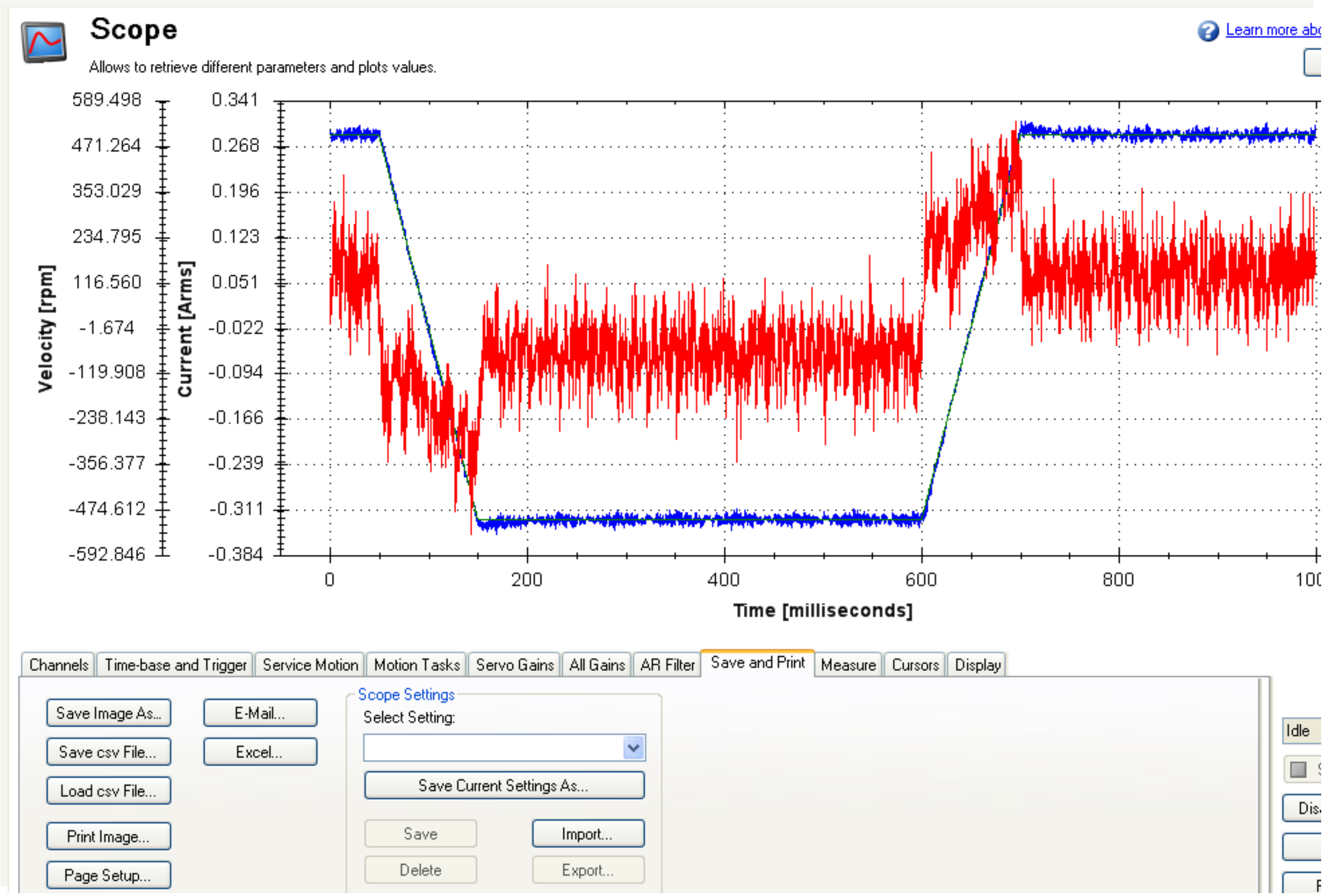
Select which mode of operation and command source the drive should work in. The AKD drive can work in many different modes, each mode is suited to different types of application.

Command Source: 0 - Service

Operation Mode: 2 - Position Mode

AKD关键特性－Workbench易用性

功能强大的六通道示波器 —— 分析时域性能



Scope

Allows to retrieve different parameters and plots values.

Learn more abo
Velocity [rpm]
589.498
471.264
353.029
234.795
116.560
-1.674
-119.908
-238.143
-356.377
-474.612
-592.846
Current [Arms]
0.341
0.268
0.196
0.123
0.051
-0.022
-0.094
-0.166
-0.239
-0.311
-0.384
0
200
400
600
800
100
Time [milliseconds]
Channels
Time-base and Trigger
Service Motion
Motion Tasks
Servo Gains
All Gains
AR Filter
Save and Print
Measure
Cursors
Display
Save Image As...
E-Mail...
Save csv File...
Excel...
Load csv File...
Print Image...
Page Setup...
Scope Settings
Select Setting:
Save Current Settings As...
Save
Import...
Delete
Export...
Idle
Dis

AKD关键特性－Workbench易用性

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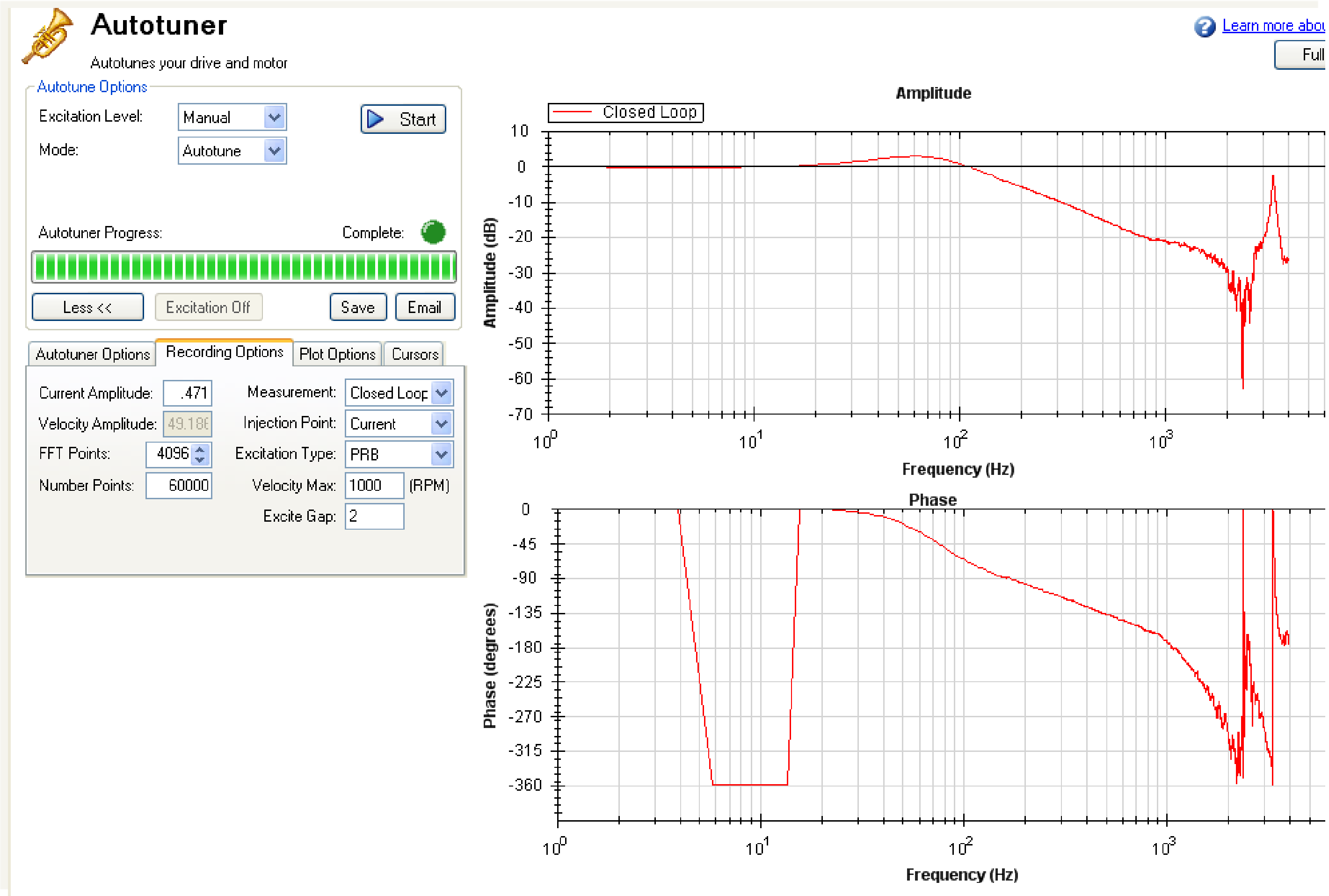
先进的自动调节功能、Bode Plot提供频域分析功能



Autotuner

Autotunes your drive and motor

Autotune Options

Excitation Level: Manual

Mode: Autotune

Autotuner Progress:

Complete:

Current Amplitude: .471

Velocity Amplitude: 49.18

FFT Points: 4096

Number Points: 60000

Measurement: Closed Loop

Injection Point: Current

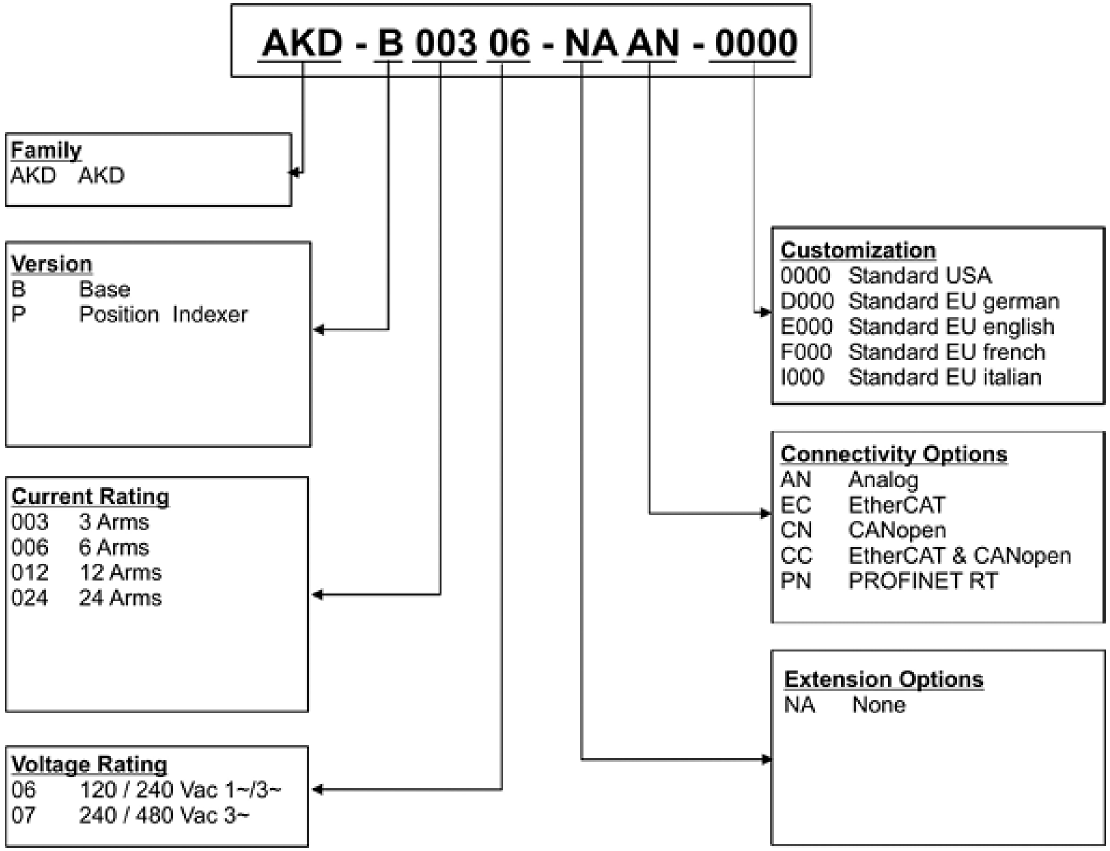
Excitation Type: PRB

Velocity Max: 1000 (RPM)

Excite Gap: 2

Learn more abou
Full
Start
Less <<
Excitation Off
Save
Email
Autotuner Options
Recording Options
Plot Options
Cursors
Amplitude
Closed Loop
Amplitude (dB)
10
0
-10
-20
-30
-40
-50
-60
-70
10^0
10^1
10^2
10^3
Frequency (Hz)
Phase
Phase (degrees)
0
-45
-90
-135
-180
-225
-270
-315
-360
10^0
10^1
10^2
10^3
Frequency (Hz)

AKD 型号定义



AKD - B 003 06 - NA AN - 0000

Family

AKD	AKD

Version

B	Base
P	Position Indexer

Current Rating

003	3 Arms
006	6 Arms
012	12 Arms
024	24 Arms

Voltage Rating

06	120 / 240 Vac 1~/3~
07	240 / 480 Vac 3~

Customization

0000	Standard USA
D000	Standard EU german
E000	Standard EU english
F000	Standard EU french
I000	Standard EU italian

Connectivity Options

AN	Analog
EC	EtherCAT
CN	CANopen
CC	EtherCAT & CANopen
PN	PROFINET RT

Extension Options

NA	None

- ***NOTICE***

•B版本能够支持模拟量控制和电子齿轮功能，不能够进行其他位置控制。

- 除AN后缀，其他后缀的AKD自动升级为P版本（Position Indexer）；
- 使用最新版本固件，07电压等级AKD可以在240VAC条件下试运行；
- CC后缀的AKD支持EtherCAT和CANopen，但每一时刻只能使用一种总线，由固件中的参数 DRV.TYPE 选择。

AKD产品路线图

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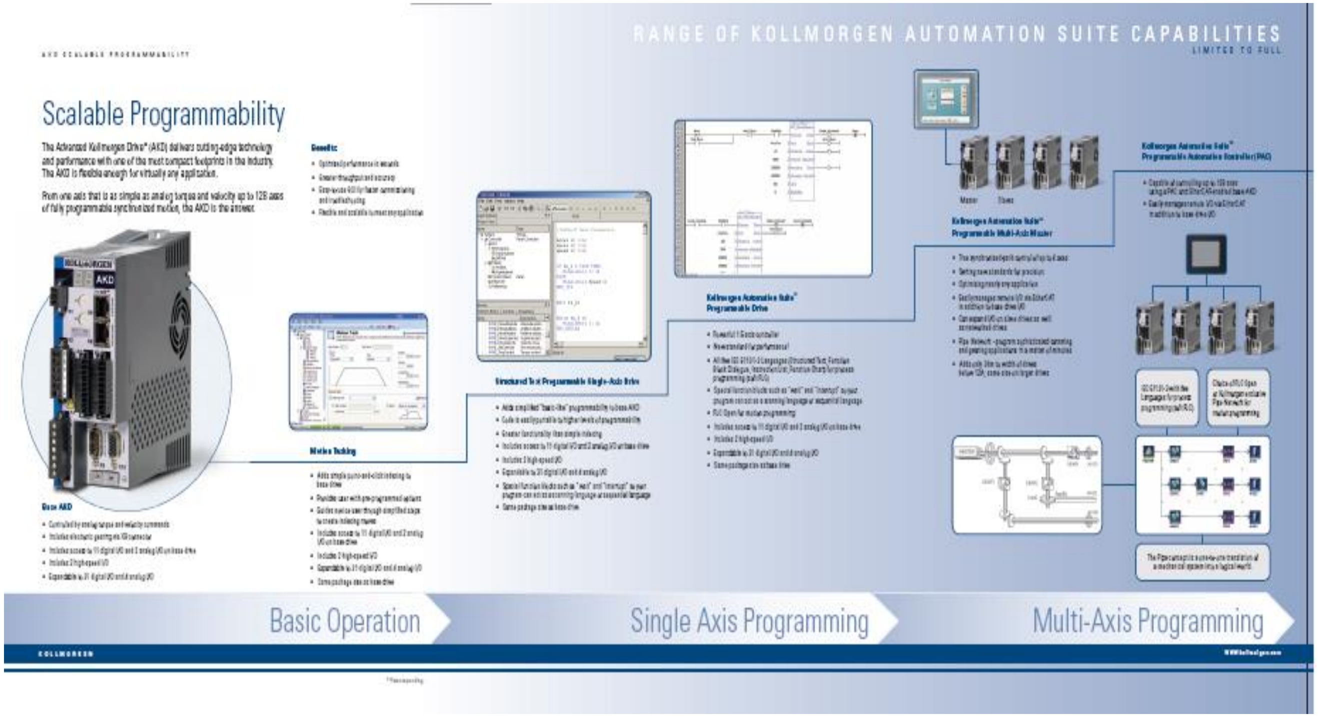


AKD SCALABLE PROGRAMMABILITY

Scalable Programmability

The Advanced Kollmorgen Drive™ (AKD) delivers cutting-edge technology and performance with one of the most compact footprints in the industry. The AKD is flexible enough for virtually any application.

From one axis that is as simple as analog torque and velocity up to 128 axes of fully programmable synchronized motion, the AKD is the answer.

RANGE OF KOLLMORGEN AUTOMATION SUITE CAPABILITIES

LIMITED TO FULL

Benefits:
Base AKD
Motion Tasking
Structured Text Programmable Single-Axis Drive
Kollmorgen Automation Suite™ Programmable Drive
Master
Slaves
Kollmorgen Automation Suite™ Programmable Multi-Axis Master
Kollmorgen Automation Suite™ Programmable Automation Controller (PAC)
Basic Operation
Single Axis Programming
Multi-Axis Programming
KOLLMORGEN

Available AKD versions

- B - Base drive is controlled by analog torque and velocity commands (electronic gearing).
- P - Position Indexer drive adds the ability to command multiple motions, process I/O, make decisions, add time delays, and modify drive process variables to the base drive.
- T - (in process) Structured Text drive adds simple programmability (similar to Basic) to the base drive.
- S - (in process) Single Axis KAS is a one-axis programmable drive features KAS software built in to the drive. Includes all five IEC 61131 languages, PLC Open and Pipes Network.
- M - (in process) Multi Axis KAS master drive runs two to four axes. Includes all five IEC 61131 languages, PLC Open and Pipes Network.

AKD产品路线图

AKD-BASIC

- Production Release Q1 2011

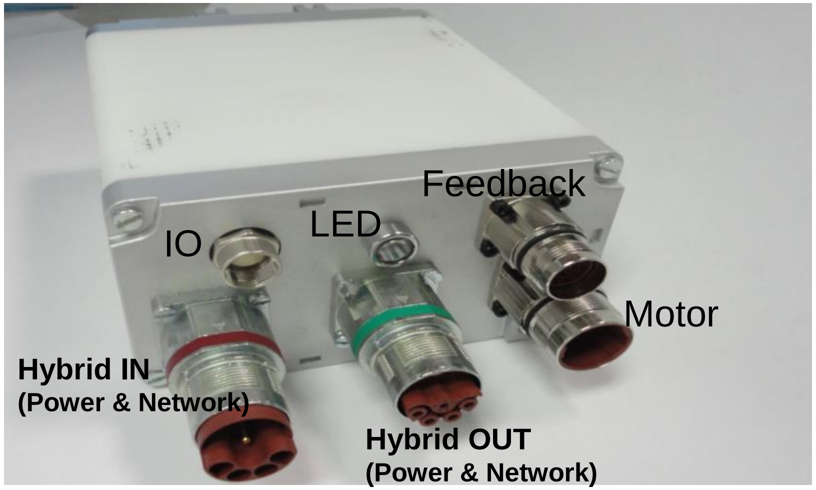
Near Servo Drive, 3/6/12 amp

- Production Release Q1 2012

480VAC, 48amp and 96amp

- Production Release Q2 2012

AKD-PDMM


Feedback
LED
IO
Motor
Hybrid IN
(Power & Network)
Hybrid OUT
(Power & Network)

KOLLMORGEN
AKD HV 48
KOLLMORGEN
AKD HV 96

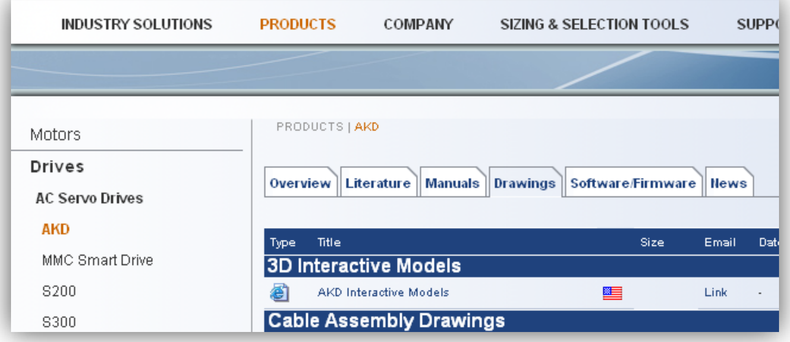
AKD文档资源

- Kollmorgen系统手册（中文）
- AKD Installation Manual
- AKD User Guide
- AKD Quick Start
- AKD Fault Card
- AKD Accessories manual
- AKD CANopen Communication Manual
- AKD EtherCAT Communication Manual
- AKD HMI Modebus manual
- AKD SynqNet Communication Manual
- AKD Profinet Communication Manual
- AKD EtherNet/IP Communication Manual
- AKD Firmware Release Notes(V01-05-00-000)

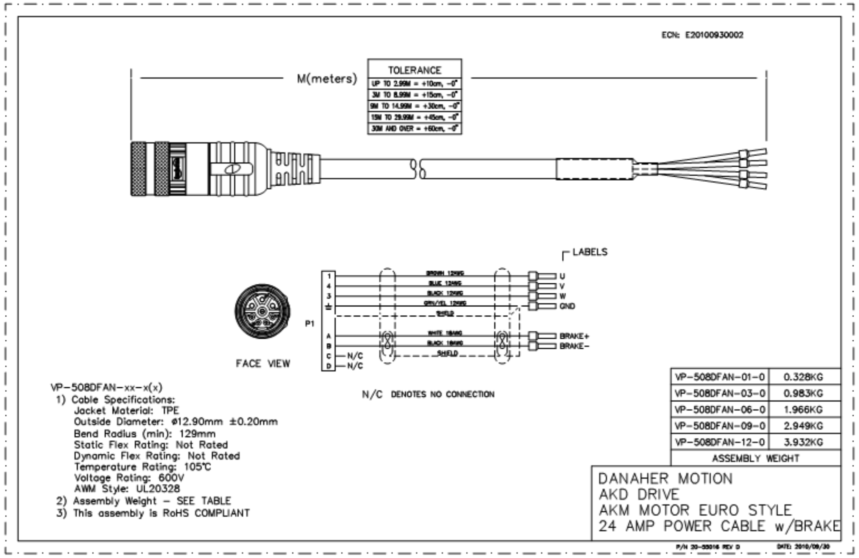
AKD文档资源

- AKD WorkBench (1.5.0.22676)
- AKD 各型号对应固件Firmware
- AKD CANopen EDS
- AKD EtherCAT Device Description

- AKD外形尺寸2D、3D多种格式图纸
- AKD各型号动力、反馈电缆图纸


INDUSTRY SOLUTIONS
PRODUCTS
COMPANY
SIZING & SELECTION TOOLS
SUPP
Motors
Drives
AC Servo Drives
AKD
MMC Smart Drive
S200
S300
PRODUCTS | AKD
Overview
Literature
Manuals
Drawings
Software/Firmware
News

Type	Title	Size	Email	Dat
3D Interactive Models				
	AKD Interactive Models		Link	-
Cable Assembly Drawings				


ECN: E20100930002
M(meters)
LABELS
BROWN 12AWG
BLUE 12AWG
BLACK 12AWG
GRN/YEL 12AWG
SHIELD
WHITE 18AWG
BLACK 18AWG
SHIELD
U
V
W
GND
BRAKE+
BRAKE−
P1
1
4
3
A
B
C
D
N/C
N/C
FACE VIEW
P/N 20-55016 REV D
DATE: 2010/09/30

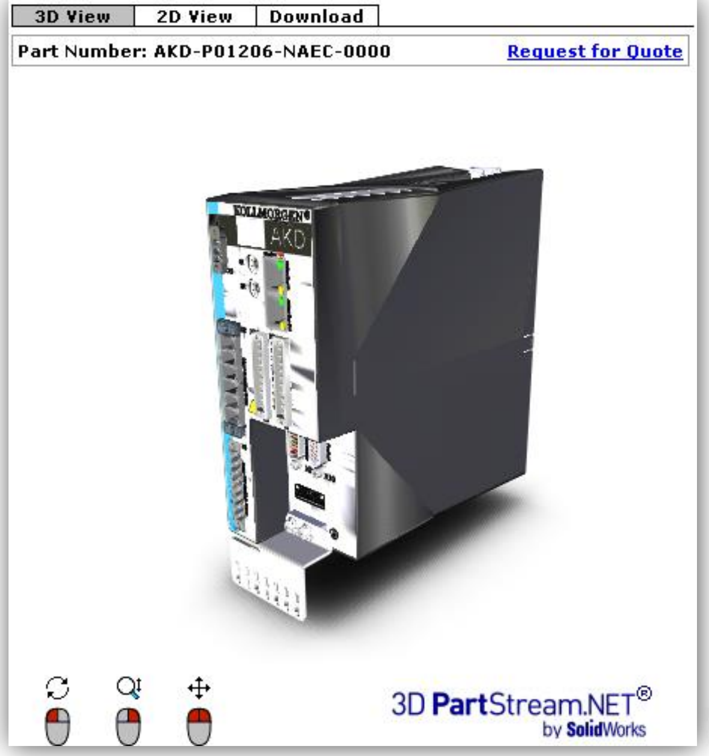
TOLERANCE
UP TO 2.99M = +10cm, -0"
3M TO 8.99M = +15cm, -0"
9M TO 14.99M = +30cm, -0"
15M TO 29.99M = +45cm, -0"
30M AND OVER = +60cm, -0"

N/C DENOTES NO CONNECTION

VP−508DFAN−xx−x(x)
1) Cable Specifications:
   Jacket Material: TPE
   Outside Diameter: ø12.90mm ±0.20mm
   Bend Radius (min): 129mm
   Static Flex Rating: Not Rated
   Dynamic Flex Rating: Not Rated
   Temperature Rating: 105℃
   Voltage Rating: 600V
   AWM Style: UL20328
2) Assembly Weight − SEE TABLE
3) This assembly is RoHS COMPLIANT

VP−508DFAN−01−0	0.328KG
VP−508DFAN−03−0	0.983KG
VP−508DFAN−06−0	1.966KG
VP−508DFAN−09−0	2.949KG
VP−508DFAN−12−0	3.932KG
ASSEMBLY WEIGHT	

DANAHER MOTION
AKD DRIVE
AKM MOTOR EURO STYLE
24 AMP POWER CABLE w/BRAKE

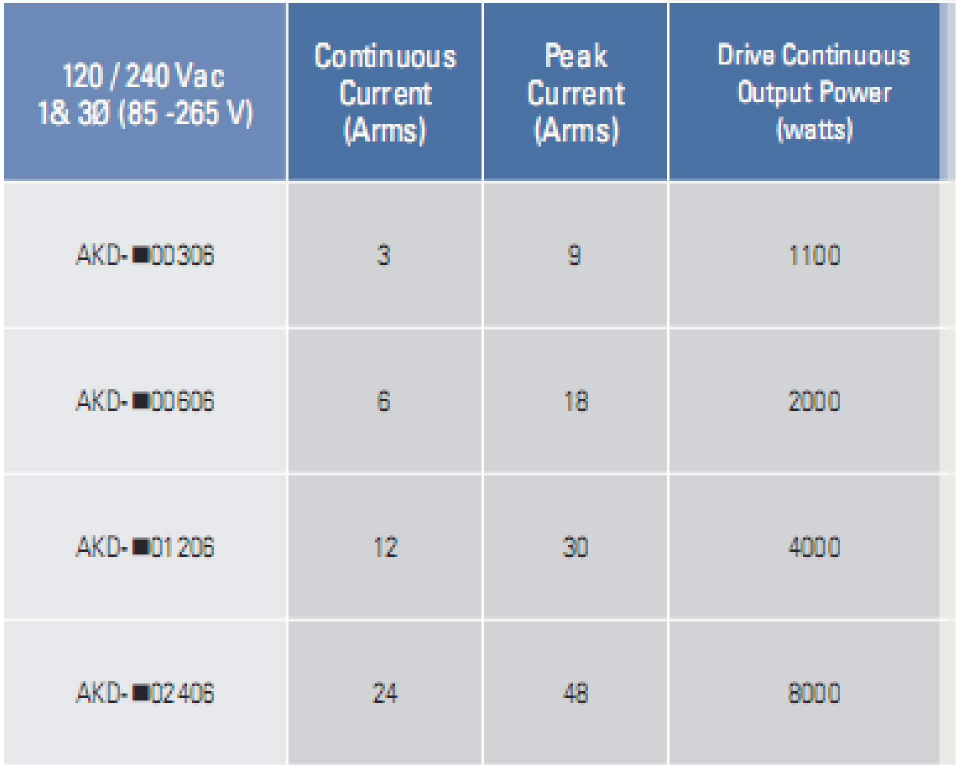

3D View
2D View
Download
Request for Quote
KOLLMORGEN
AKD
3D PartStream.NET®
by SolidWorks

Part Number: AKD-P01206-NAEC-0000

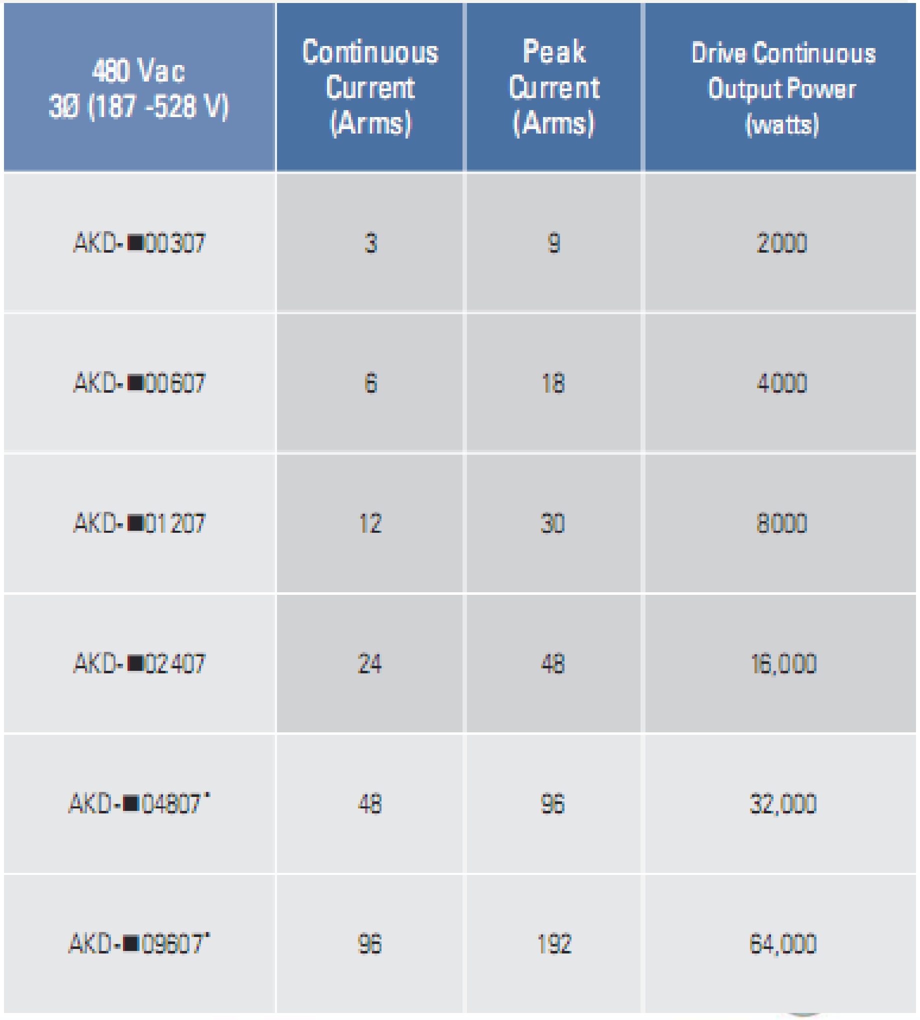
AKD物理特性介绍

AKD功率范围

- 3-24Arms @ 120/240Vac 1 phase and 3 phase
- 3-24Arms @ 480Vac 3 phase

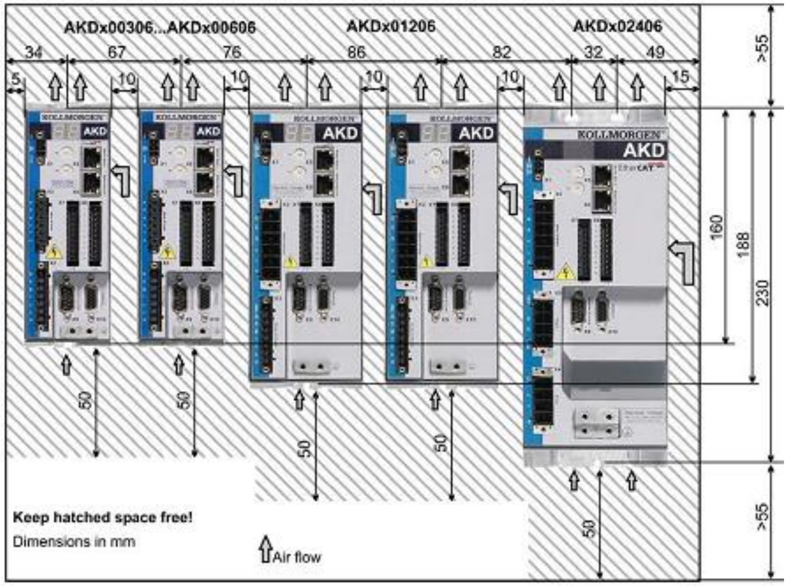


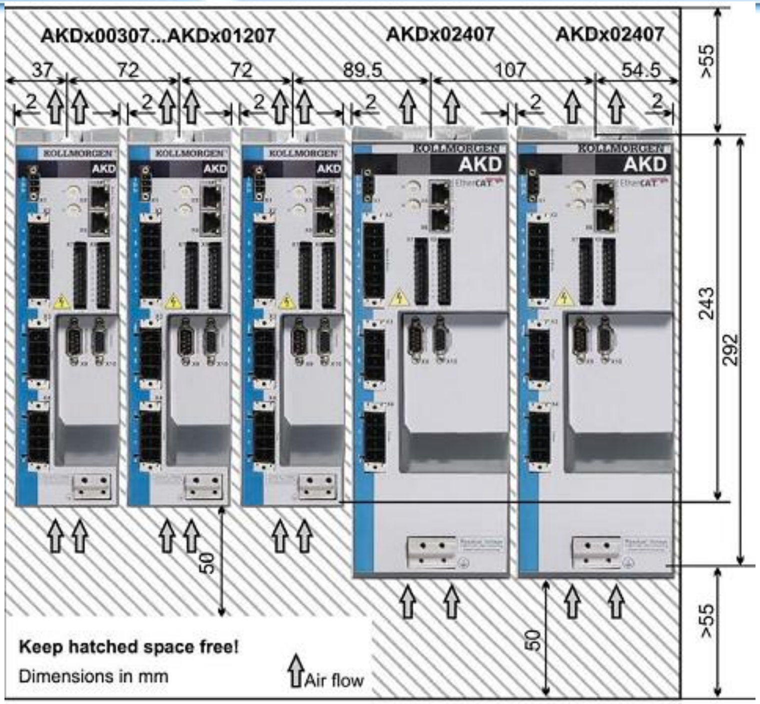
120 / 240 Vac 1& 3Ø (85 -265 V)	Continuous Current (Arms)	Peak Current (Arms)	Drive Continuous Output Power (watts)
AKD-■00306	3	9	1100
AKD-■00606	6	18	2000
AKD-■01206	12	30	4000
AKD-■02406	24	48	8000

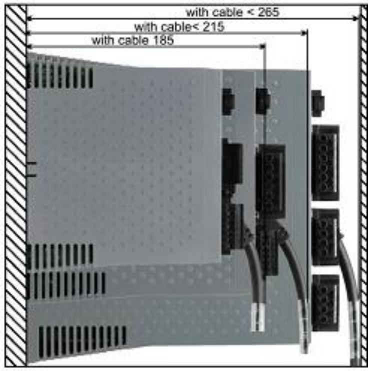


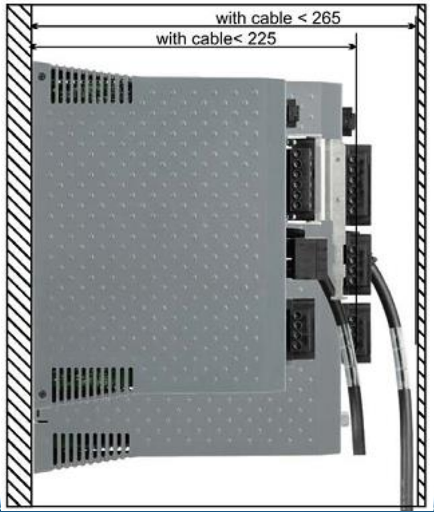
480 Vac 3Ø (187 -528 V)	Continuous Current (Arms)	Peak Current (Arms)	Drive Continuous Output Power (watts)
AKD-■00307	3	9	2000
AKD-■00607	6	18	4000
AKD-■01207	12	30	8000
AKD-■02407	24	48	16,000
AKD-■04807*	48	96	32,000
AKD-■09607*	96	192	64,000

AKD外形尺寸


AKDx00306...AKDx00606
AKDx01206
AKDx02406
34
67
76
86
82
32
49
5
10
10
10
10
15
>55
160
188
230
50
50
50
50
50
>55
Keep hatched space free!
Dimensions in mm
Air flow


AKDx00307...AKDx01207
AKDx02407
AKDx02407
37
72
72
89.5
107
54.5
2
2
2
2
2
2
>55
243
292
50
50
>55
Keep hatched space free!
Dimensions in mm
Air flow


with cable < 265
with cable< 215
with cable 185

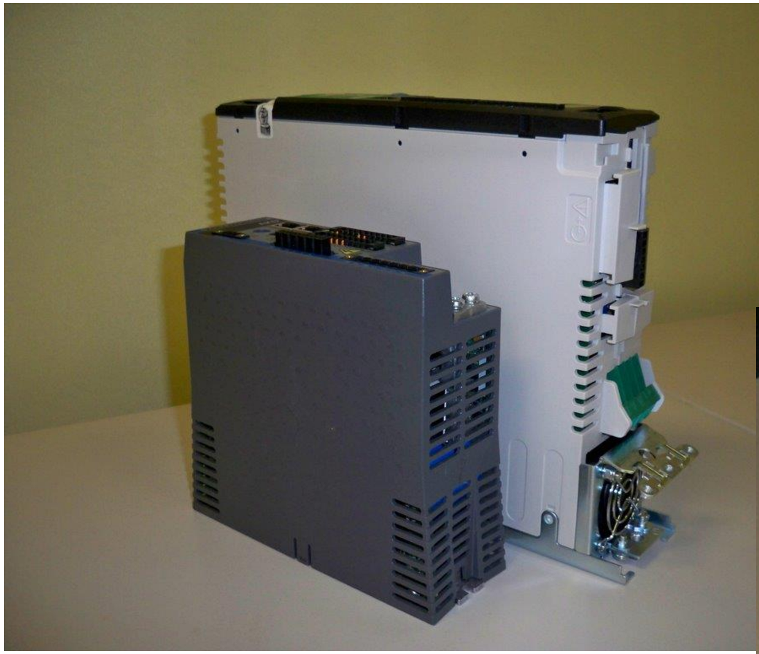

with cable < 265
with cable< 225

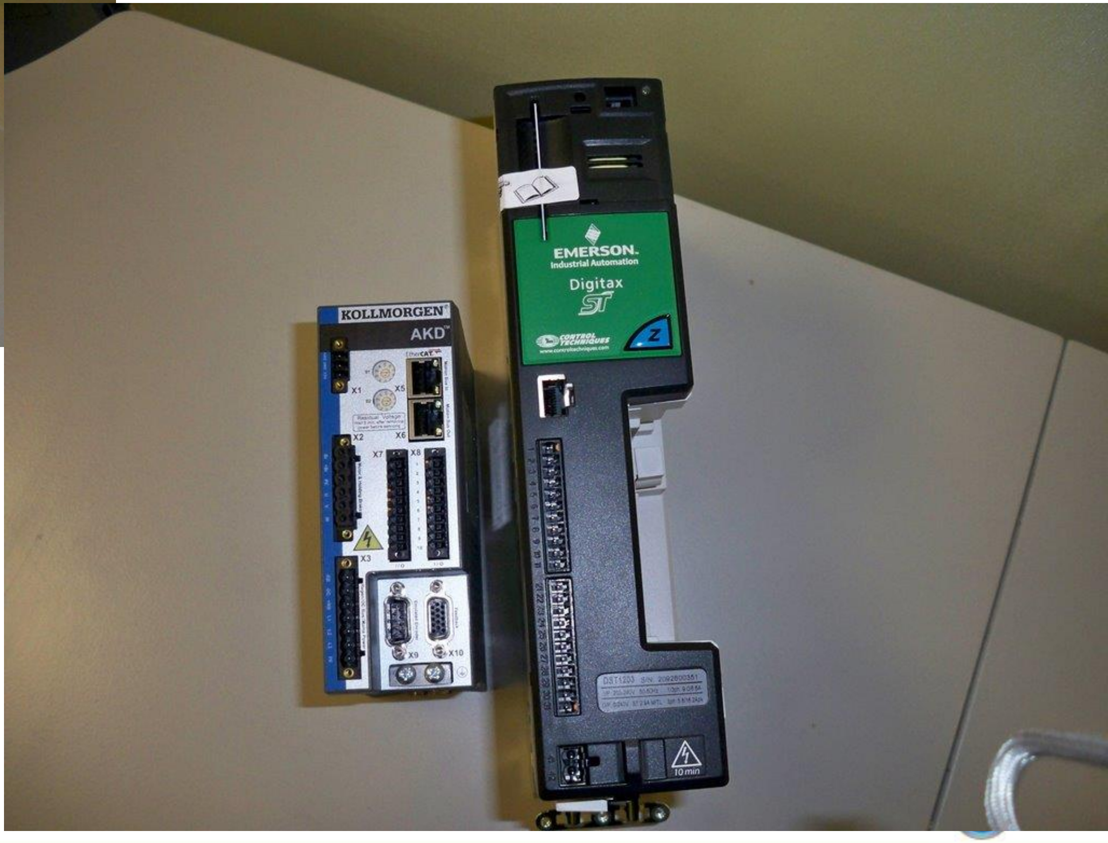
•07系列AKD内置:

- EMI滤波器
- 制动电阻

功率密度大、尺寸小

- Emerson Digitax 6 amp continuous
- Vs.
- AKD 6 amp continuous

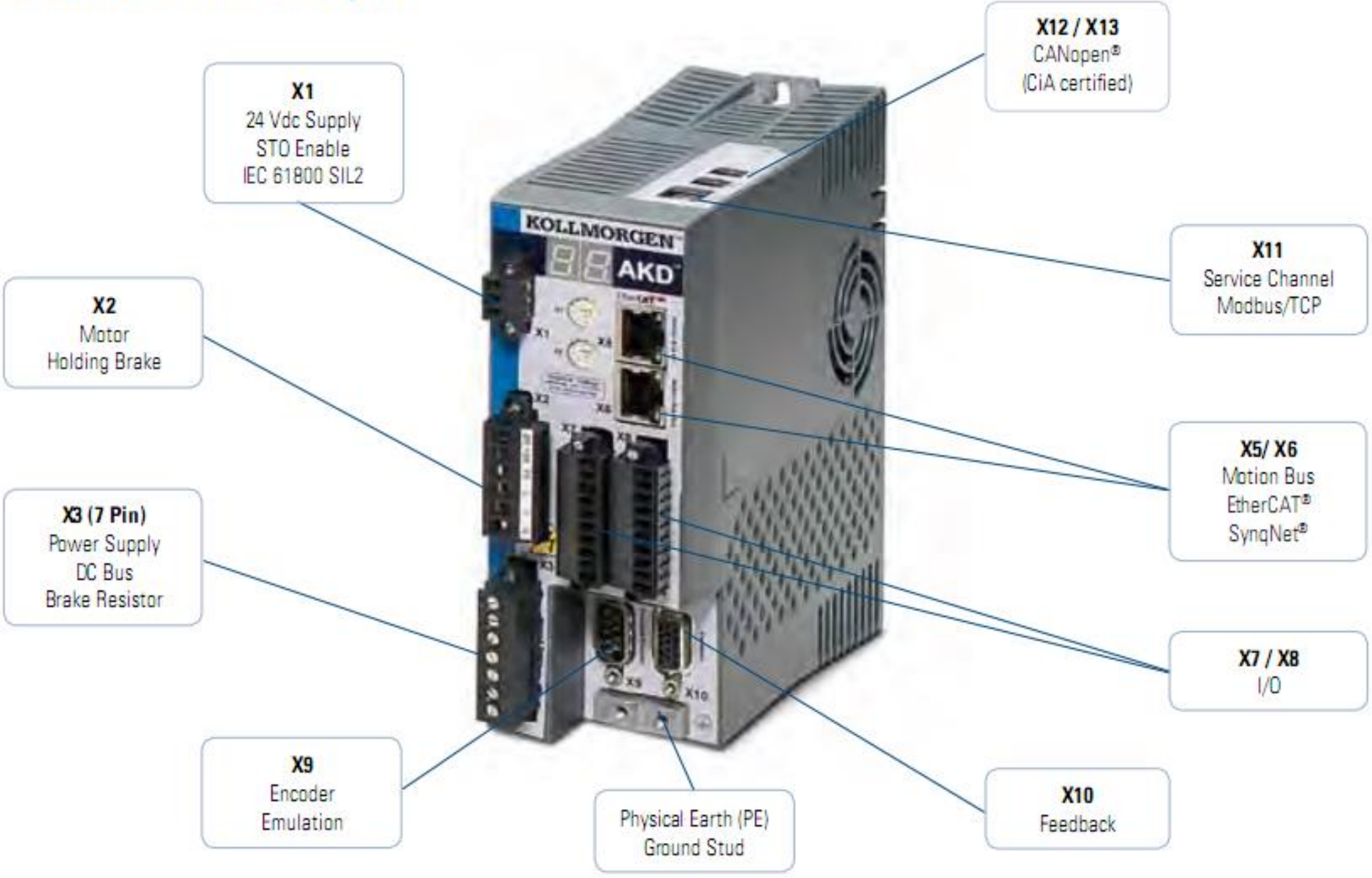



KOLLMORGEN
AKD
EMERSON
Industrial Automation
Digitax
ST

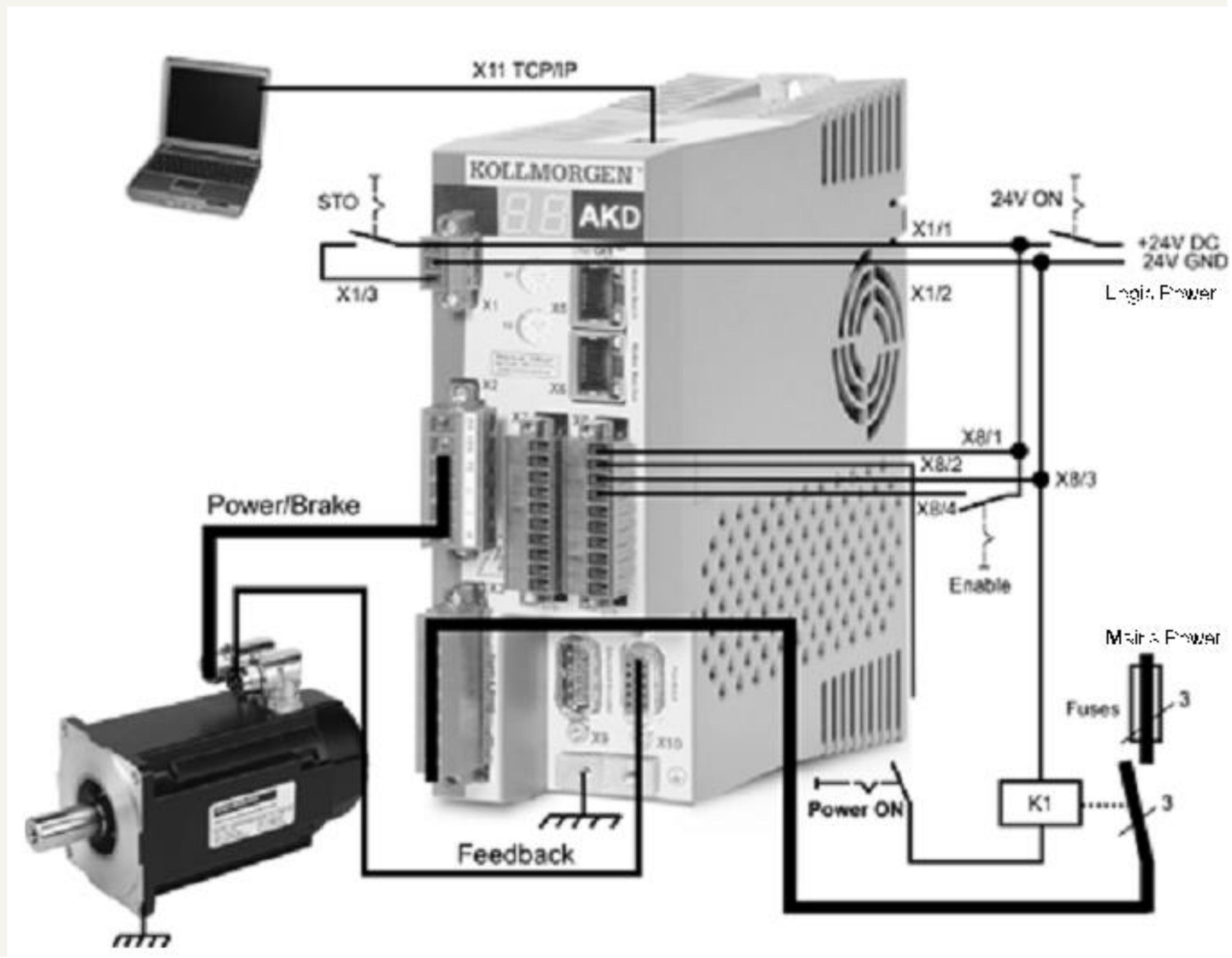
- Digitax has shorter
- time for peak current
- .

AKD连接器定义

AKD 120/240 Vac Connector Layout

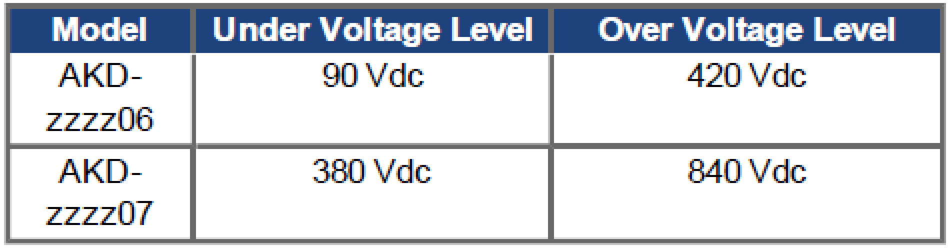

X12 / X13
CANopen®
(CiA certified)
X1
24 Vdc Supply
STO Enable
IEC 61800 SIL2
X11
Service Channel
Modbus/TCP
X2
Motor
Holding Brake
X5/ X6
Motion Bus
EtherCAT®
SynqNet®
X3 (7 Pin)
Power Supply
DC Bus
Brake Resistor
X7 / X8
I/O
X9
Encoder
Emulation
Physical Earth (PE)
Ground Stud
X10
Feedback
KOLLMORGEN
AKD

AKD系统最小接线图

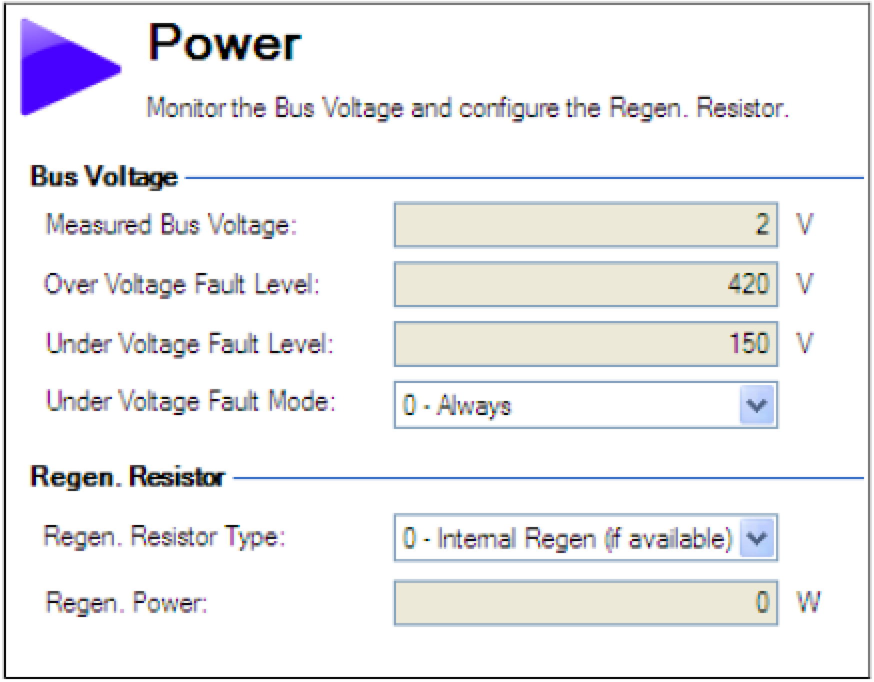

X11 TCP/IP
KOLLMORGEN
AKD
STO
X1/3
24V ON
X1/1
+24V DC
24V GND
Logic Power
X1/2
X8/1
X8/2
X8/3
X8/4
Enable
Power/Brake
Mains Power
Fuses
3
K1
3
Power ON
Feedback

AKD物理特性——DC直接供电

- 所有型号的AKD都可以直接使用直流供电；
- 直流供电的两级应该连入主供电端口（X3或X4）的L1和L2连个引脚，极性不要求；
- 直流供电的电压值需要与该型号驱动器的母线电压最高、最低报警值兼容；
- 可以通过Workbench的Power监视实时供电情况。



Model	Under Voltage Level	Over Voltage Level
AKD-zzzz06	90 Vdc	420 Vdc
AKD-zzzz07	380 Vdc	840 Vdc



Power

Monitor the Bus Voltage and configure the Regen. Resistor.

Bus Voltage

Measured Bus Voltage:	2	V
Over Voltage Fault Level:	420	V
Under Voltage Fault Level:	150	V
Under Voltage Fault Mode:	0 - Always	

Regen. Resistor

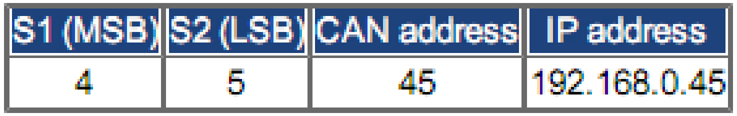
Regen. Resistor Type:	0 - Internal Regen (if available)	
Regen. Power:	0	W

AKD物理特性——网络连接

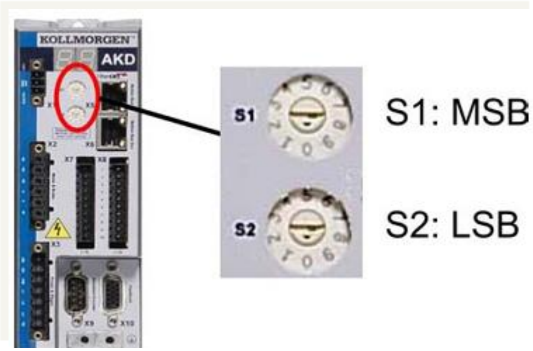
AKD 与PC网路连接方式

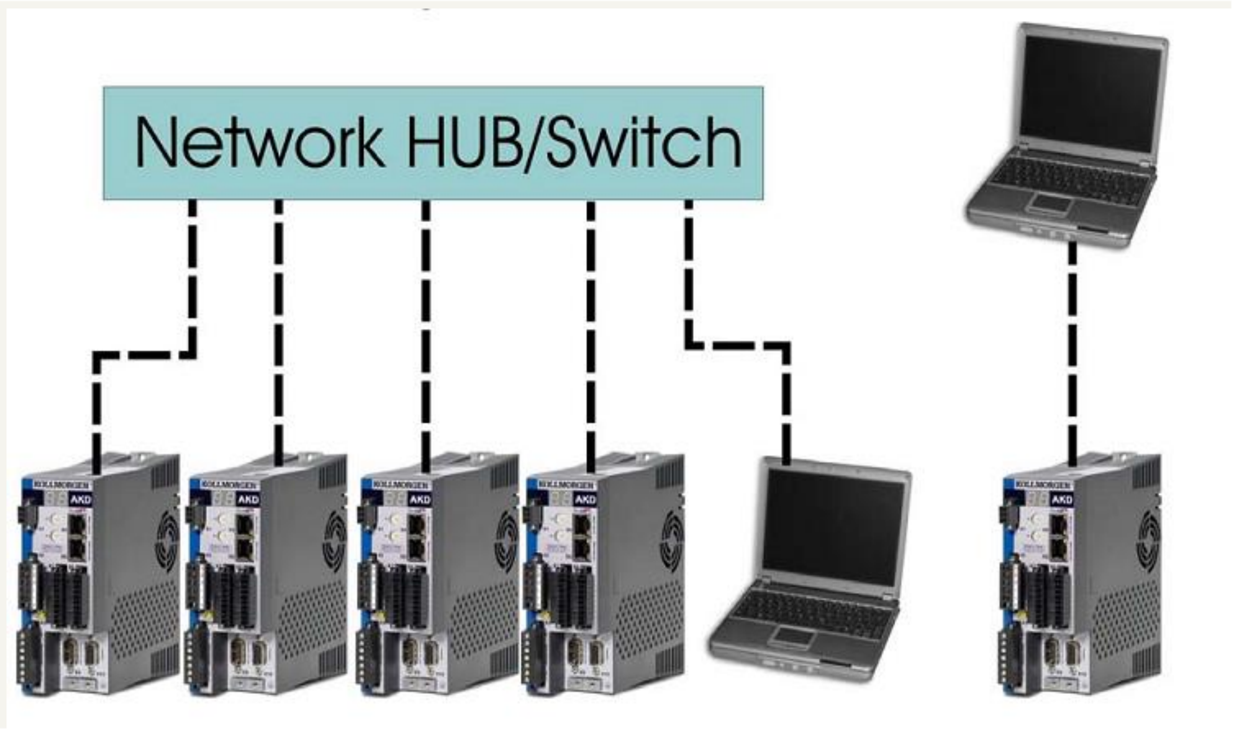
可使用标准CAT 5网线直接或通过ＨＵＢ／Ｓｗｉｔｃｈ间接连接PC和ＡＫＤ驱动器，进行ＡＫＤ的设置、调试和操作等；

可用AKD前面板的旋转开关来设定驱动器在网络中的IP地址；



S1 (MSB)	S2 (LSB)	CAN address	IP address
4	5	45	192.168.0.45


KOLLMORGEN
AKD
S1
S2
S1: MSB
S2: LSB

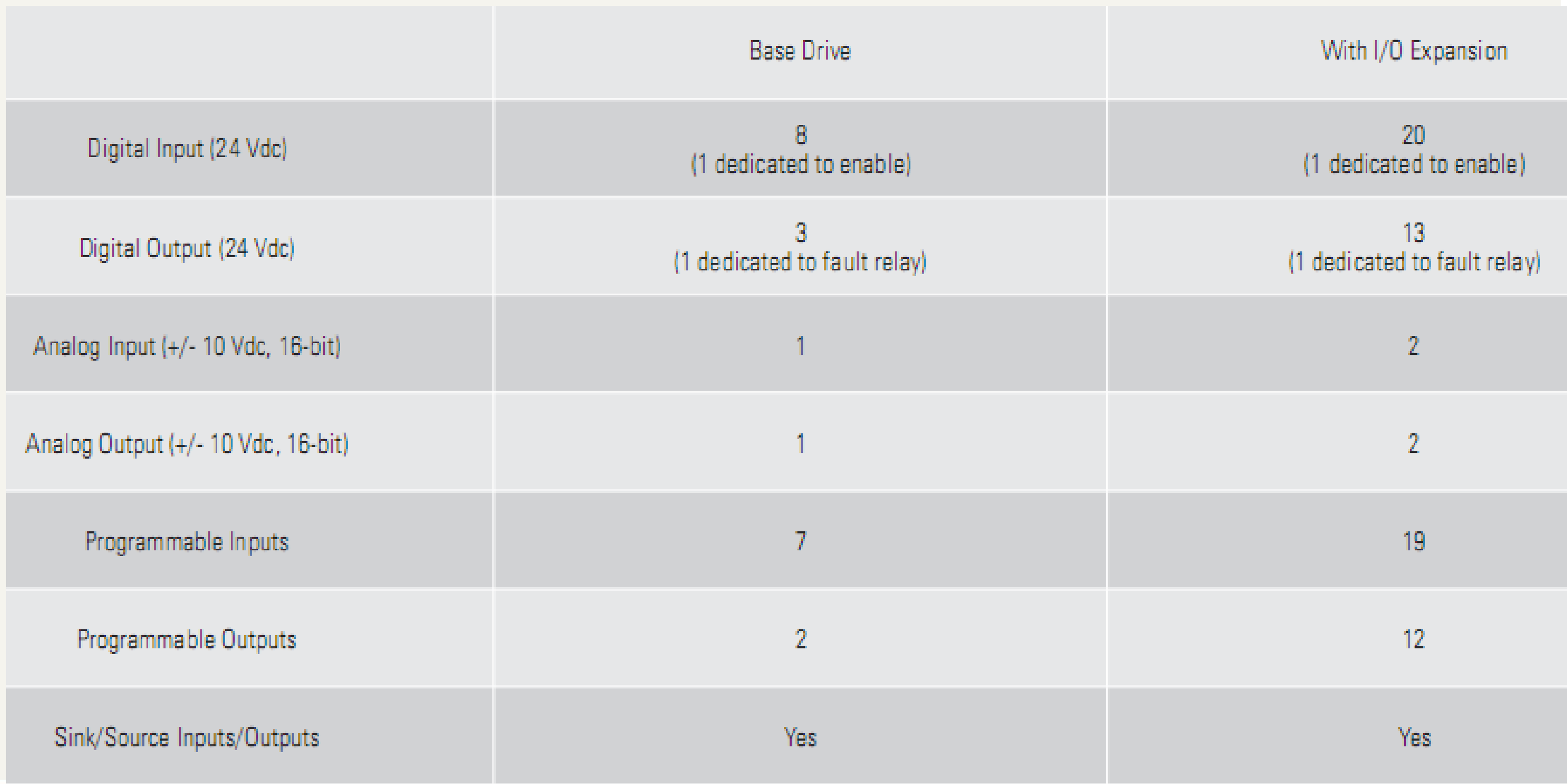

Network HUB/Switch

AKD物理特性－I/O

多点光电隔离数字输入输出,可扩展;数字输入速度16KHz。

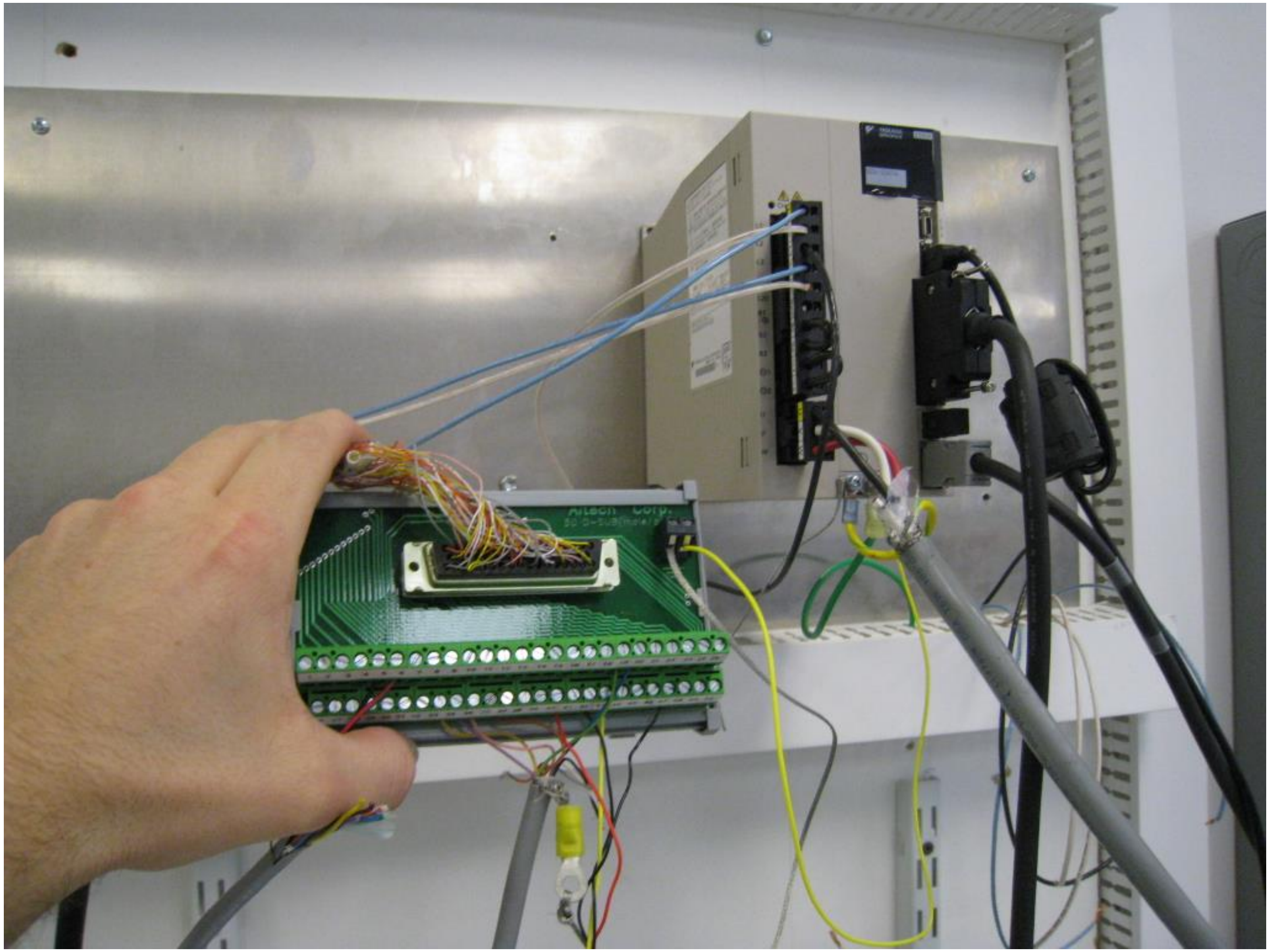
两个高速输入，硬件速度2μs

自带抱闸继电器，简化控制电路

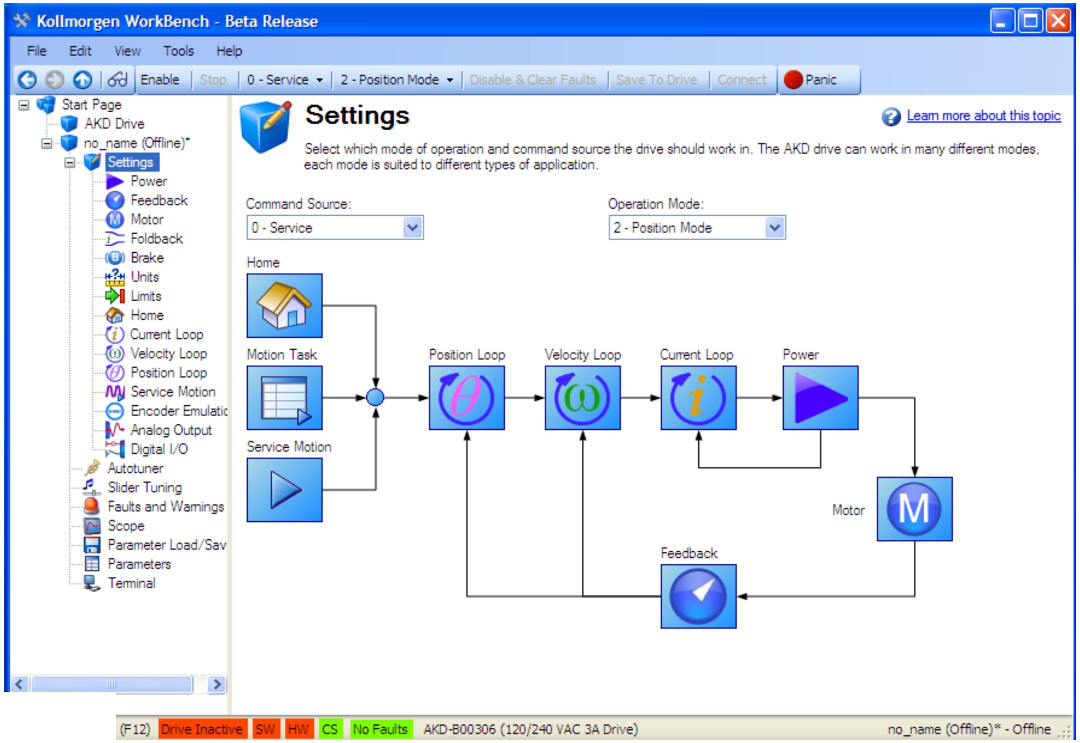


	Base Drive	With I/O Expansion
Digital Input (24 Vdc)	8 (1 dedicated to enable)	20 (1 dedicated to enable)
Digital Output (24 Vdc)	3 (1 dedicated to fault relay)	13 (1 dedicated to fault relay)
Analog Input (+/- 10 Vdc, 16-bit)	1	2
Analog Output (+/- 10 Vdc, 16-bit)	1	2
Programmable Inputs	7	19
Programmable Outputs	2	12
Sink/Source Inputs/Outputs	Yes	Yes

Competitor Solution


Altech Corp.

AKD Workbench介绍


Kollmorgen WorkBench - Beta Release
File
Edit
View
Tools
Help
Enable
Stop
0 - Service
2 - Position Mode
Disable & Clear Faults
Save To Drive
Connect
Panic
Start Page
AKD Drive
no_name (Offline)*
Settings
Power
Feedback
Motor
Foldback
Brake
Units
Limits
Home
Current Loop
Velocity Loop
Position Loop
Service Motion
Encoder Emulatic
Analog Output
Digital I/O
Autotuner
Slider Tuning
Faults and Warnings
Scope
Parameter Load/Sav
Parameters
Terminal
Learn more about this topic
Home
Motion Task
Service Motion
Position Loop
Velocity Loop
Current Loop
Power
Motor
M
Feedback

Settings

Select which mode of operation and command source the drive should work in. The AKD drive can work in many different modes, each mode is suited to different types of application.

Command Source: 0 - Service

Operation Mode: 2 - Position Mode

(F12) Drive Inactive SW HW CS No Faults AKD-B00306 (120/240 VAC 3A Drive) no_name (Offline)* - Offline

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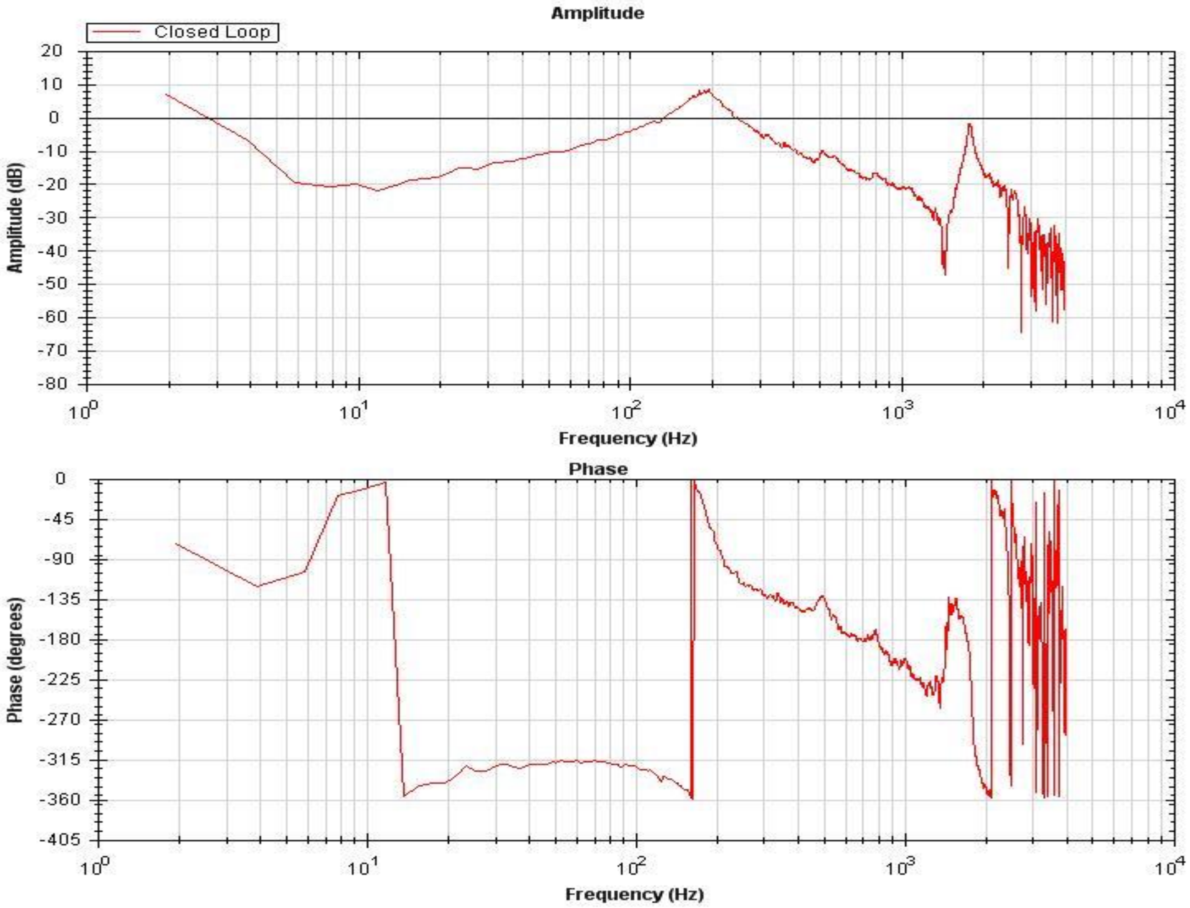
AKD

频域分析工具——Bode Plot



- 增益
- Gain/ Amplitude
- (dB)

- 相位
- Phase
- (degree)

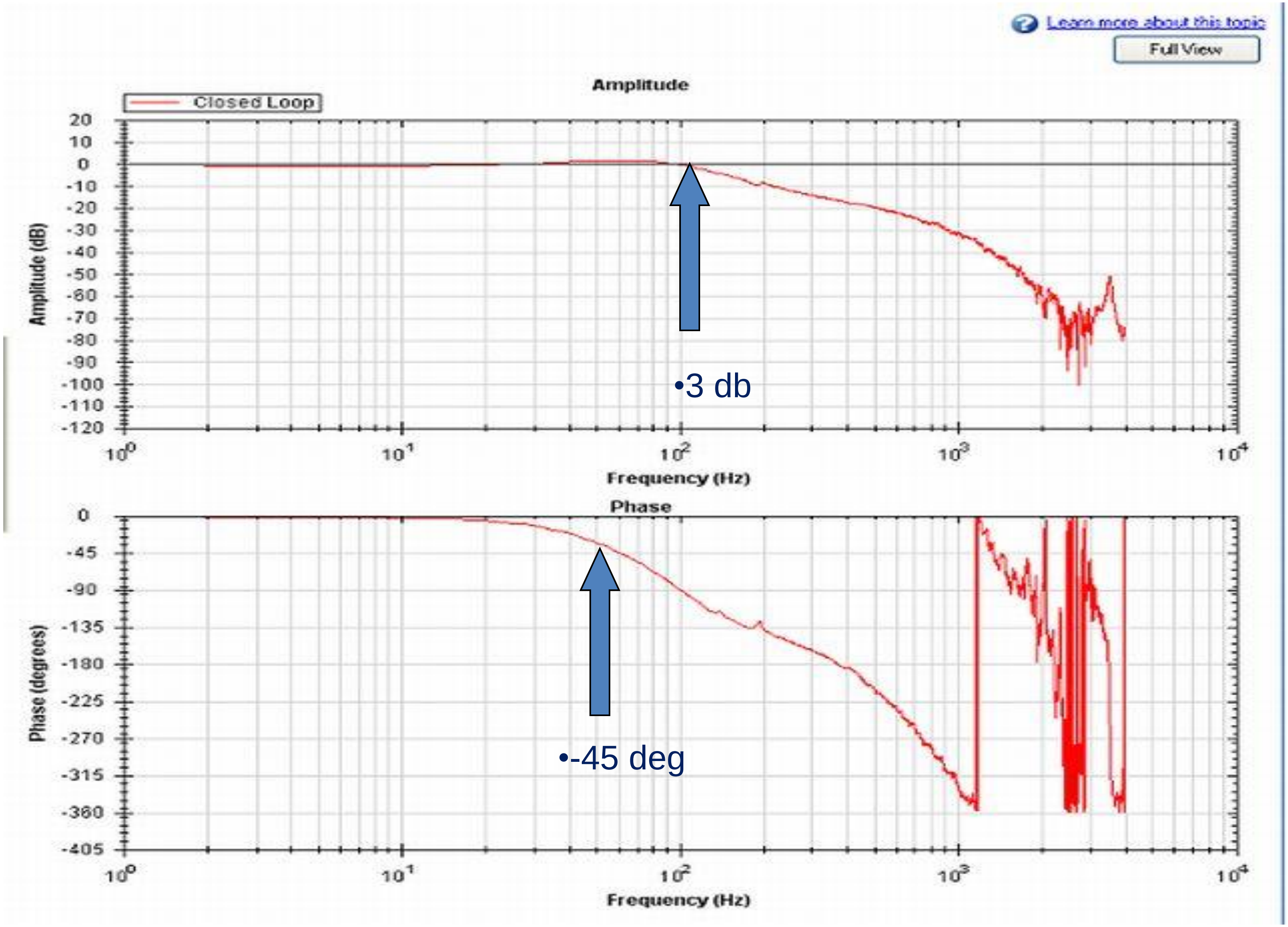
通过Bode Plot可以得到什么信息?

- Bandwidth 带宽
  - -45 degrees phase shift
  - …and/or -3 db
- Phase Margin 增益裕度
  - The point where you will not oscillate 远离震荡的工作点

- Gain Margin 相位裕度

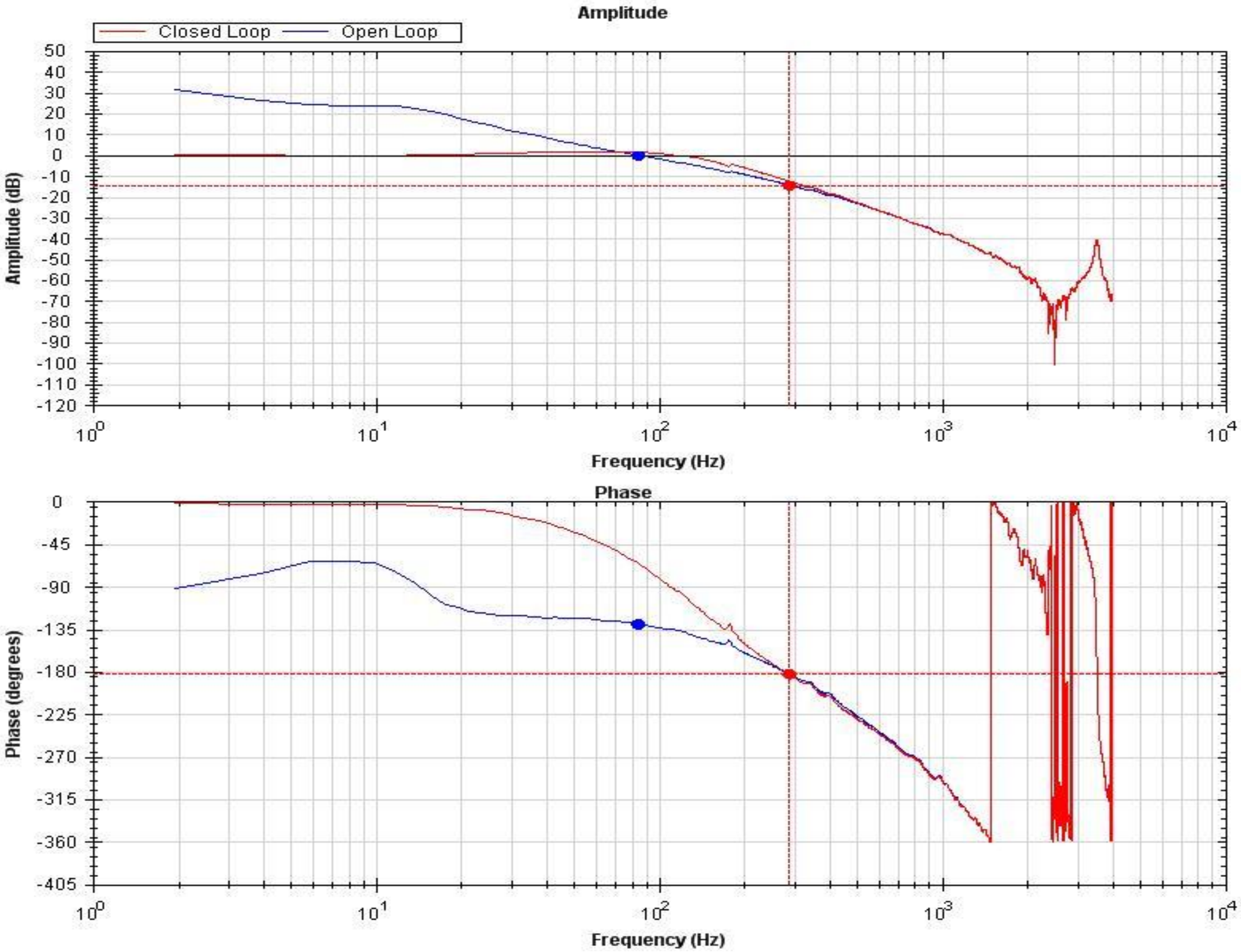
- Stiffness 刚性
  - Units/Radians (N-m/Radian)
  - Ks
- Friction 摩擦
- Stability 稳定性

Bandwidth

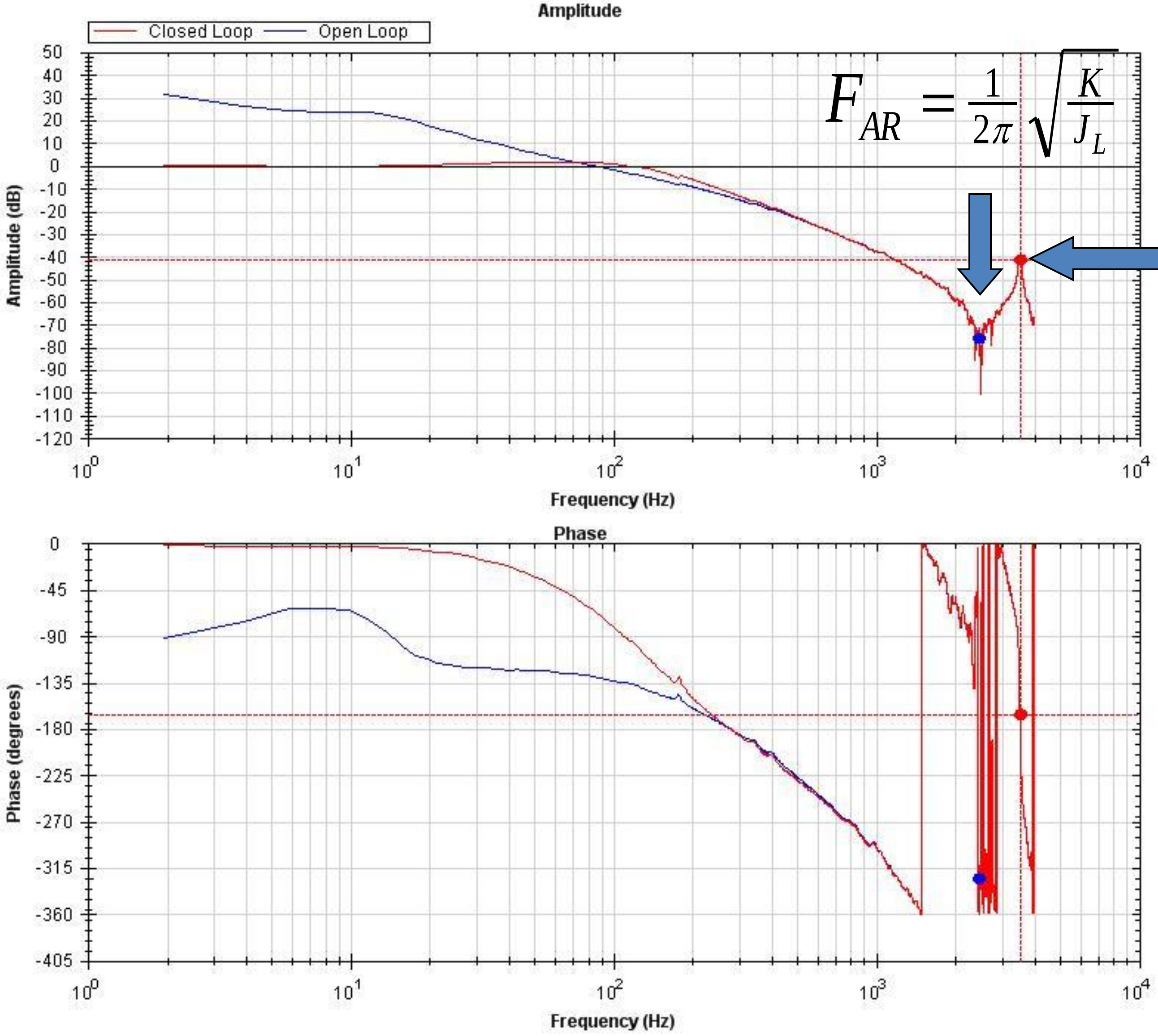


- 3 db
- -45 deg

Phase/Gain Margin



Resonance /Anti-Resonance



$$F_{AR} = \frac{1}{2\pi}\sqrt{\frac{K}{J_L}}$$

$$F_R = \frac{1}{2\pi}\sqrt{\frac{K}{J_L \| J_M}}$$

AKD 使用练习

KOLLMORGEN
AKD
EtherCAT

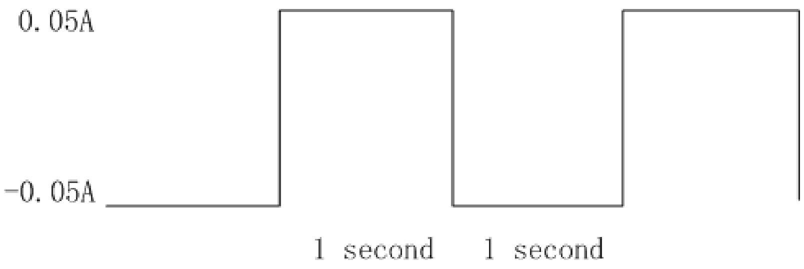
My machine is better than your machine.
KOLLMORGEN
Because Motion Matters™

AKD 使用练习

- 第一题：
- 计算机安装AKD Workbench软件，并连接驱动器；
- 查看当前驱动器固件版本，并**保存当前设置文档至**计**算机**；
- 恢复出厂设置；
- 刷新固件至v1.5.xxxx；
- 把保存至计算机的文件导入当前驱动器。

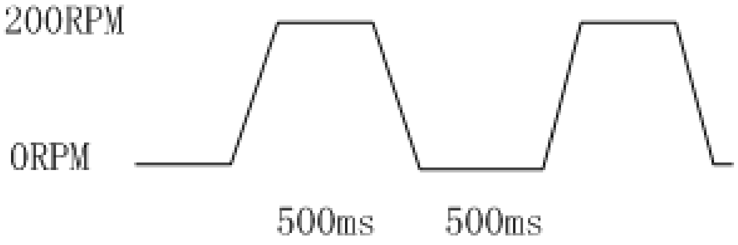
- 第二题：
- 配置DEMO上的AKM电机类型，反馈类型；
- 查看分辨率，定向方向是否正确；
- 保存设置。

- 第三题：
- 在转矩环下操作电机以右图的指令形式往复运动；
- 观察电机的电流、速度和位置反馈；



AKD 使用练习

- 第四题：
- 在速度环操作电机以右图的速度曲线往复运动；
- 加、减速度为2000RPM/S；
- 观察电机的电流、速度、位置反馈；

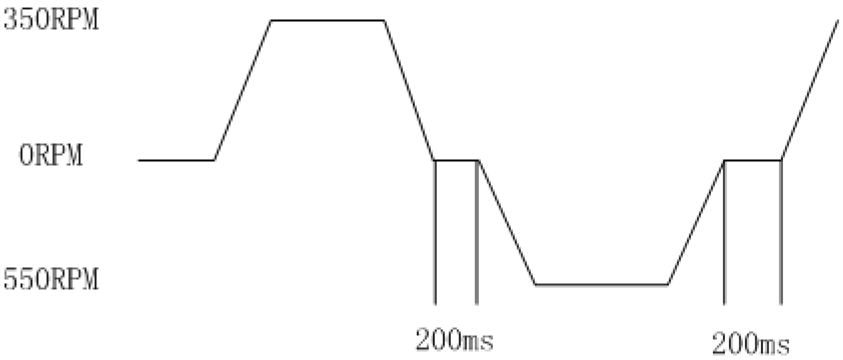


- 第五题：
- 使用模拟量速度控制正/反转；
- 10VDC对应3000RPM；
- 通过更改DIR变为正指令反转。

- 第六题：
- 配置回零操作，使用寻找Zero Angle的回零方式；
- 回零速度为5RPM，方向逆时针；
- 加速度为1000RPM/s；
- 使用Digital Input1触发回零运动。

AKD 使用练习

- 第七题:
- 配置两个运动任务，循环执行;
- 正转时加减速度为453RPM/s，反转时加减速度为1118RPM/s;
- 用Digital Input1触发，Digital Input2停止。



350RPM
0RPM
550RPM
200ms
200ms

- 第八题:
- 配置电子齿轮功能，A quad B方式;
- 分辨率2048线/转;
- 驱动电机跟随编码器信号旋转。

- 第九题:
- 在软件示波器中对第四题中的往复运动进行观察;
- 观察电流、速度的指令和反馈，公用4通道。

- 第十题:
- 使用Slide Tuner，感受刚性变化;
- 试用Performance Servo Tuner，激励方式：Noise。

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