Variateur analogique courant continu série AZ et AZB

AZ Analog Drives for servo systems - AMC Advanced Motion Control

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This document is intended as a guide and general overview in selecting, installing, and operating an AZ servo drive. Contained within are instructions on system integration, wiring, drive-setup, and standard operating methods.

2.1 AZ Drive Family Overview

The family of AZ analog drives are designed to offer the same high performance and accuracy of larger drives, but in a space-saving PCB-mount architecture. By utilizing high density power devices, dual sided PCB boards, and creative design AZ drives are ideal for applications with limited size and weight constraints.

The AZ drive family contains drives that can power Single Phase (brushed) and Three Phase (brushless) motors. AZ drives are powered off a single unregulated DC power supply, and provide a variety of control and feedback options. The drives accept either a ±10V analog signal or a PWM and Direction signal as input. A digital controller can be used to command and interact with AZ drives, and a number of input/output pins are available for parameter observation and drive configuration.

TABLE 2.1 Standard AZ Drive Family Part Numbers

	Voltage	10-80V				40-175V	
	Peak Current	6A	12A	20A	40A	10A	25A
Single Phase (Brushed)	Analog ±10V Command	AZ6A8	AZ12A8	AZ20A8	AZ40A8	AZ10A20	AZ25A20
	PWM / Dir Command	AZ6A8DDC	AZ12A8DDC	AZ20A8DDC	AZ40A8DDC	AZ10A20DDC	AZ25A20DDC
Three Phase (Brushless)	Analog ±10V Command	AZB6A8	AZB12A8	AZB20A8	AZB40A8	AZB10A20	AZB25A20
	PWM / Dir Command	AZBDC6A8	AZBDC12A8	AZBDC20A8	AZBDC40A8	AZBDC10A20	AZBDC25A20
	Hall Velocity, Analog ±10V Command	AZBH6A8	AZBH12A8	AZBH20A8	AZBH40A8	AZBH10A20	AZBH25A20
	Encoder Velocity, Analog ±10V Command	AZBE6A8	AZBE12A8	AZBE20A8	AZBE40A8	AZBE10A20	AZBE25A20

2.1.1 Drive Datasheet

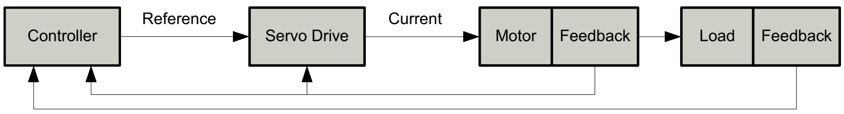
Each AZ analog drive has a separate datasheet that contains important information on the modes and product-specific features available with that particular drive. The datasheet is to be used in conjunction with this manual for system design and installation.

2.2 Analog PWM Servo Drive Basics and Theory

Analog servo drives are used extensively in motion control systems where precise control of position and/or velocity is required. The drive transmits the low-energy reference signals from the controller into high-energy signals (motor voltage and current). The reference signals can be either analog or digital, with a ±10 VDC signal being the most common. The signal can represent either a motor torque or velocity demand.

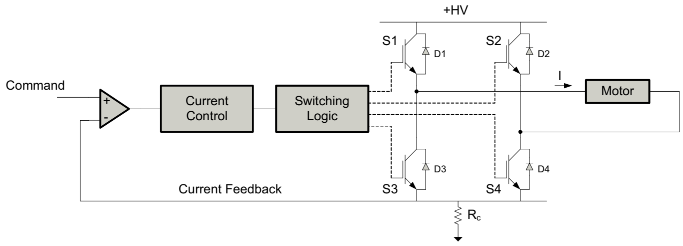
Figure 2.1 shows the components typically used in a servo system (i.e. a feedback system used to control position, velocity, and/or acceleration). The controller contains the algorithms to close the desired servo loops and also handles machine interfacing (inputs/outputs, terminals, etc.). The drive represents the electronic power converter that drives the motor according to the controller reference signals. The motor (which can be of the brushed or brushless type, rotary, or linear) is the actual electromagnetic actuator, which generates the forces required to move the load. Feedback elements are mounted on the motor and/or load in order to close the servo loop.

FIGURE 2.1 Typical Motion Control System



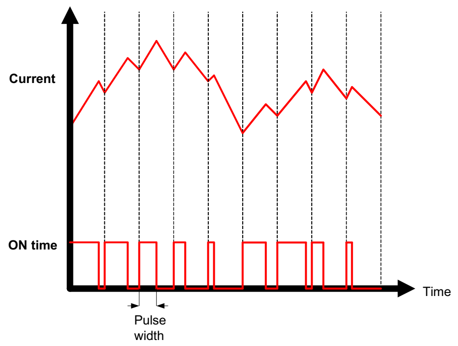
Although there exist many ways to "amplify" electrical signals, pulse width modulation (PWM) is by far the most efficient and cost-effective approach. At the basis of a PWM servo drive is a current control circuit that controls the output current by varying the duty cycle of the output power stage (fixed frequency, variable duty cycle). Figure 2.2 shows a typical setup for a single phase load.

FIGURE 2.2 PWM Current Control Circuit



S1, S2, S3, and S4 are power devices (MOSFET or IGBT) that can be switched on or off. D1, D2, D3, and D4 are diodes that guarantee current continuity. The bus voltage is depicted by +HV. The resistor R_c is used to measure the actual output current. For electric motors, the load is typically inductive due to the windings used to generate electromagnetic fields. The current can be regulated in both directions by activating the appropriate switches. When switch S1 and S4 (or S2 and S3) are activated, current will flow in the positive (or negative) direction and increase. When switch S1 is off and switch S4 is on (or S2 off and S3 on) current will flow in the positive (or negative) direction and decrease (via one of the diodes). The switch "ON" time is determined by the difference between the current demand and the actual current. The current control circuit will compare both signals every time interval (typically 50 µsec or less) and activate the switches accordingly (this is done by the switching logic circuit, which also performs basic protection functions). Figure 2.3 shows the relationship between the pulse width (ON time) and the current pattern. The current rise time will depend on the bus voltage (+HV) and the load inductance. Therefore, certain minimum load inductance requirements are necessary depending on the bus voltage.

FIGURE 2.3 **Output Current and Duty Cycle Relationship**



2.2.1 Single Phase (Brushed) Servo Drives

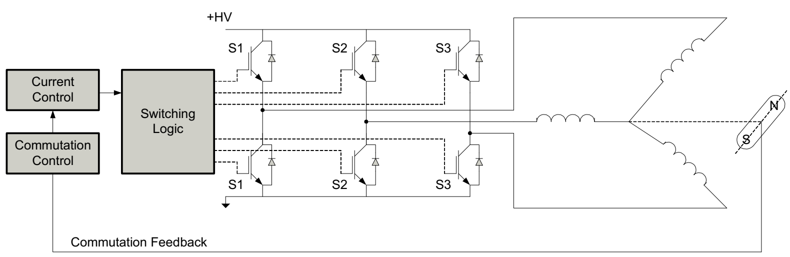
Brush type servo drives are designed for use with permanent magnet brushed DC motors (PMDC motors). The drive construction is basically as shown in Figure 2.2. PMDC motors have a single winding (armature) on the rotor, and permanent magnets on the stator (no field winding). Brushes and commutators maintain the optimum torque angle. The torque generated by a PMDC motor is proportional to the current, giving it excellent dynamic control capabilities in motion control systems.

Brushed drives can also be used to control current in other inductive loads such as voice coil actuators, magnetic bearings, etc.

2.2.2 Three Phase (Brushless) Servo Drives

Three Phase (brushless) servo drives are used with brushless servo motors. These motors typically have a three-phase winding on the stator and permanent magnets on the rotor. Brushless motors require commutation feedback for proper operation (the commutators and brushes perform this function on brush type motors). This feedback consists of rotor magnetic field orientation information, supplied either by magnetic field sensors (Hall Effect sensors) or position sensors (encoder or resolver). Brushless motors have better power density ratings than brushed motors because heat is generated in the stator, resulting in a shorter thermal path to the outside environment. Figure 2.4 shows a typical system configuration.

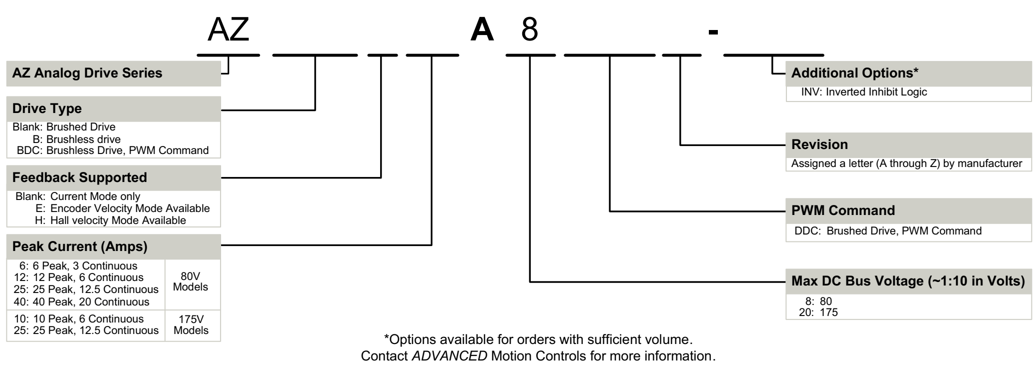
FIGURE 2.4 **Brushless Servo System**



2.3 Products Covered

The products covered in this manual adhere to the following part numbering structure. However, additional features and/or options are readily available for OEM's with sufficient ordering volume. Feel free to contact *ADVANCED* Motion Controls for further information.

FIGURE 2.5 AZ Part Numbering Structure



In general, the AZ family of analog drives can be divided into top-level categories based on the peak current rating of the drive. These categories can be further separated into subdivisions based on specifications such as whether a drive uses analog or PWM input, the type of motor(s) supported, and the feedback available on the drive.

TABLE 2.2 Power Specifications

Power Specifications							
Description	Units	AZ_6A8	AZ_12A8	AZ_20A8	AZ_40A8	AZ_10A20	AZ_25A20
DC Supply Voltage Range	VDC	20-80		10-80		40-175	
DC Bus Over Voltage Limit	VDC	88				195	193
DC Bus Under Voltage Limit	VDC	18		9		36	
Maximum Peak Output Current	A	6	12	20	40	10	25
Maximum Continuous Output Current	A	3	6	12	20	6	12.5
Maximum Power Dissipation at Continuous Current	W	12	24	48	80	53	110
Minimum Load Inductance	µH	100				250	
Switching Frequency[1]	kHz	31				20.7	

1. Switching frequency for AZBE/AZBH_40A8 drive models is 33 kHz. Switching frequency for AZBE/AZBH_10A20 and AZBE/AZBH_25A20 is 22 kHz.

TABLE 2.3 Control Specifications

Control Specifications						
Description	AZ	AZB	AZ_DDC	AZBDC	AZBE	AZBH
Command Sources	± 10V Analog	± 10V Analog	PWM and Direction	PWM and Direction	± 10V Analog	± 10V Analog
Commutation Methods	-	Trapezoidal	-	Trapezoidal	Trapezoidal	Trapezoidal
Control Modes	Current	Current	Current	Current	Current, Duty Cycle, Encoder Velocity, Tachometer Velocity	Current, Duty Cycle, Hall Velocity, Tachometer Velocity
Motors Supported	Single Phase	Three Phase Single Phase	Single Phase	Three Phase Single Phase	Three Phase Single Phase	Three Phase Single Phase

2.4 Control Modes

The AZ family of analog drives offers a variety of different control methods. While some drives in the series are designed to operate solely in one mode, on other drives it is possible to select the control method by DIP switch settings. Consult the datasheet for the drive in use to see which modes are available for use.

The name of the mode refers to which servo loop is being closed in the drive, not the end-result of the application. For instance, a drive operating in Current (Torque) Mode may be used for a positioning application if the external controller is closing the position loop. Oftentimes, mode selection will be dependent on the requirements and capabilities of the controller being used with the drive as well as the end-result application.

2.4.1 Current (Torque)

In Current (Torque) Mode, the input command voltage controls the output current. The drive will adjust the output duty cycle to maintain the commanded output current. This mode is used to control torque for rotary motors (force for linear motors), but the motor speed is not controlled. The output current can be monitored through an analog current monitor output pin. The voltage value read at the "Current Monitor Output" can be multiplied by a scaling factor found on the drive datasheet to determine the actual output current. All AZ drives are able to operate in Current (Torque) Mode.

Note

While in Current (Torque) Mode, the drive will maintain a commanded torque output to the motor based on the input reference command. Sudden changes in the motor load may cause the drive to be outputting a high torque command with little load resistance, causing the motor to spin rapidly. Therefore, Current (Torque) Mode is recommended for applications using a digital position controller to maintain system stability.

2.4.2 Duty Cycle (Open Loop)

In Duty Cycle Mode, the input command voltage controls the output PWM duty cycle of the drive, indirectly controlling the output voltage. However, any fluctuations of the DC power supply voltage will affect the voltage output to the motor. This mode is available as a DIP switch selectable mode on AZBE and AZBH drives.

Note

This mode is recommended as a method of controlling the motor velocity when precise velocity control is not critical to the application, and when actual velocity feedback is unavailable.

2.8 Three Phase (Brushless) Drives

2.8.1 AZB

- Designed to drive brushless motors with a ±10 V analog input
- Current (Torque) Mode
- Hall Sensor trapezoidal Commutation

2.8.2 AZBDC

- Designed to drive brushless motors with a PWM input command
- Current (Torque) Mode
- Hall Sensor trapezoidal Commutation

2.8.3 AZBE

- Designed to drive brushless motors with a ±10 V analog input
- DIP Switch selectable modes - Current (Torque), Duty Cycle, Encoder Velocity, Tachometer Velocity
- Hall Sensor trapezoidal commutation
- Single-ended incremental encoder feedback for velocity control
- External potentiometer input pin for command offset adjustment

2.8.4 AZBH

- Designed to drive brushless motors with a ±10 V analog input
- DIP Switch selectable modes - Current (Torque), Duty Cycle, Hall Velocity, Tachometer Velocity
- Hall Sensor trapezoidal commutation
- Single-ended Hall Sensor feedback for velocity control
- External potentiometer input pin for command offset adjustment

2.8.5 Block Diagrams

FIGURE 2.11 AZB Drive Structure

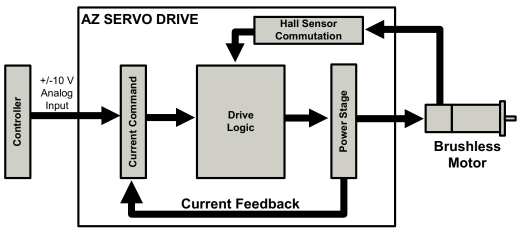


FIGURE 2.12 AZBDC Drive Structure

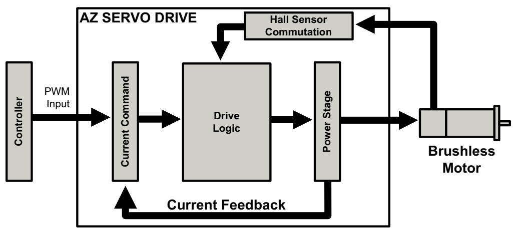


FIGURE 2.13 AZBE Drive Structure

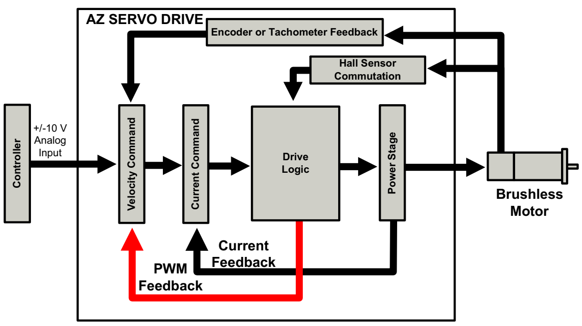
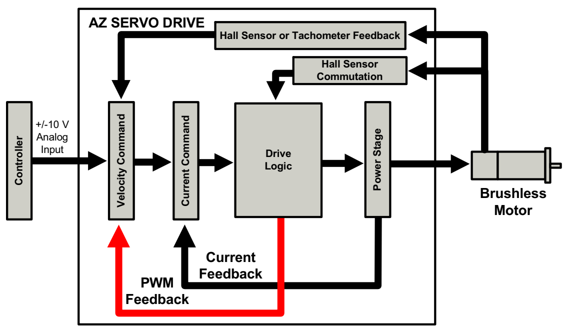


FIGURE 2.14 AZBH Drive Structure



2.8.6 Pinouts

TABLE 2.8 Three Phase Signal Connector

P1 Pin	Analog Input Description	PWM Input Description	Analog Input Encoder Vel. Description	Analog Input Hall Vel. Description
1	+REF IN	PWM IN	+REF IN	+REF IN
2	SIGNAL GROUND	SIGNAL GROUND	SIGNAL GROUND	SIGNAL GROUND
3	-REF IN	DIR IN	-REF IN	-REF IN
4	CURRENT MONITOR	CURRENT MONITOR	CURRENT MONITOR	CURRENT MONITOR
5	INHIBIT IN	INHIBIT IN	INHIBIT IN	INHIBIT IN
6	+V HALL OUT	+V HALL OUT	+V HALL OUT	+V HALL OUT
7	SIGNAL GROUND	SIGNAL GROUND	SIGNAL GROUND	SIGNAL GROUND
8	HALL 1	HALL 1	HALL 1	HALL 1
9	HALL 2	HALL 2	HALL 2	HALL 2
10	HALL 3	HALL 3	HALL 3	HALL 3
11	CURRENT REF OUT	CURRENT REF OUT	CURRENT REF OUT	CURRENT REF OUT
12	FAULT OUT	FAULT OUT	FAULT OUT	FAULT OUT
13	RESERVED	RESERVED	ENCODER-B	RESERVED
14	RESERVED	RESERVED	ENCODER-A	RESERVED
15	RESERVED	RESERVED	VEL. MON. OUT/TACH IN	VEL. MON. OUT/TACH IN
16	RESERVED	RESERVED	OFFSET	+REF IN

TABLE 2.9 Three Phase Power Connector(s)

AZ_6A8, AZ_12A8 - P2 Pin	Description
1	HIGH VOLTAGE
2	HIGH VOLTAGE
3	NC (KEY)
4	POWER GROUND
5	POWER GROUND
6	MOTOR C
7	MOTOR C
8	MOTOR B
9	MOTOR B
10	MOTOR A
11	MOTOR A

AZ_20A8, AZ_10A20 - P2 AZ_40A8, AZ_25A20 - P2,P3 Pin		Description
1b	1a	HIGH VOLTAGE
2b	2a	HIGH VOLTAGE
3b	3a	RESERVED (3b) NC - KEY (3a)
4b	4a	POWER GROUND
5b	5a	POWER GROUND
6b	6a	MOTOR C
7b	7a	MOTOR C
8a	8b	MOTOR B
9b	9a	MOTOR B
10b	10a	MOTOR A
11b	11a	MOTOR A

Note

If you are using an AZ drive to replace an *ADVANCED* Motion Controls panel mount drive, the same command input to the ±REF IN input pins on the AZ drive will result in the motor spinning in the opposite direction as with the panel mount drive. This can be changed by swapping the command input wiring (+REF IN to Pin 3 instead of Pin 1, and -REF IN to Pin 1 instead of Pin 3).

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