Variateur analogique courant continu - AMC

Analog Series Servo Drives

Advanced Motion Control

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

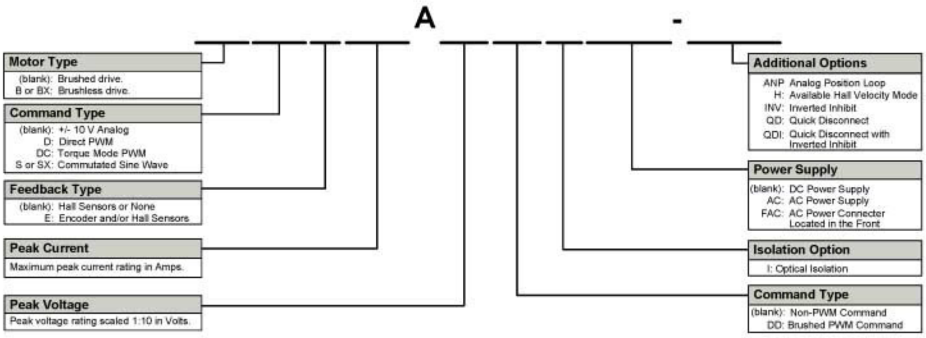
2.1 Analog Drive Family Overview

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

2.1.1 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 2.1 Analog Product Family Part Numbering Structure



Drive Datasheet Each analog drive has a separate datasheet that contains important information on the modes and product-specific features available with that particular drive, including the functional block diagram of the specific drive's operation. The datasheet is to be used in conjunction with this manual for system design and installation.

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Standard and Custom Models

The drives in the tables below are the standard product line of *ADVANCED* Motion Controls analog servo drives. Note that not all possible part number combinations from the product family numbering structure (Figure 2.1) are offered as standard drives. Please contact *ADVANCED* Motion Controls Sales Department for further information and details on custom drive solutions.

TABLE 2.1 Brushed ±10V Analog DC Drives

Drive Number	VDC (Nominal)	Peak Current (A)	Cont. Current (A)
12A8	20-80	12	6
25A8	20-80	25	12.5
30A8	20-80	30	15
50A8	20-80	50	25
120A10	20-80	120	60
20A20	40-190	20	10
25A20I	40-190	25	12.5
50A20I	40-190	50	25
100A40	80-400	100	50

TABLE 2.2 Brushless ±10V Analog DC Drives

Drive Number	VDC (Nominal)	Peak Current (A)	Cont. Current (A)
B15A8	20-80	15	7.5
BE15A8	20-80	15	7.5
BE15A8-H	20-80	15	7.5
B30A8	20-80	30	15
BE30A8	20-80	30	15
BX30A8	20-80	30	15
B25A20I	40-190	25	12.5
BE25A20I	40-190	25	12.5
BX25A20	60-200	25	12.5
B40A20I	40-190	40	20
BE40A20I	40-190	40	20
B30A40	60-400	30	15
B40A40	60-400	40	20

TABLE 2.3 Brushed ±10V Analog AC Drives

Drive Number	VAC (Nominal)	Peak Current (A)	Cont. Current (A)
16A20AC	30-125	16	8
30A20AC	30-125	30	15

TABLE 2.4 Brushless ±10V Analog AC Drives

Drive Number	VAC (Nominal)	Peak Current (A)	Cont. Current (A)
B25A20AC	30-125	25	12.5
BE25A20AC	30-125	25	12.5
BX25A20AC	45-125	25	12.5
B30A40AC	45-270	30	15
B40A40AC	45-270	40	20

TABLE 2.5 Brushed PWM Input DC Drives

Drive Number	VDC (Nominal)	Peak Current (A)	Cont. Current (A)
30A8DD	20-80	30	15
50A8DD	20-80	50	25
25A20DD	40-190	25	12.5
50A20DD	40-190	50	25

TABLE 2.6 Brushless PWM Input DC Drives

Drive Number	VDC (Nominal)	Peak Current (A)	Cont. Current (A)
BD15A8	20-80	15	7.5
BD30A8	20-80	30	15
BDC30A8	20-80	30	15
BD25A20	40-190	25	12.5
BD25A20I	40-190	25	12.5
BDC40A20	60-190	40	20

TABLE 2.7 Brushless PWM Input AC Drives

Drive Number	VAC (Nominal)	Peak Current (A)	Cont. Current (A)
BD25A20AC	30-125	25	12.5

TABLE 2.8 Sinusoidal Input DC Drives

Drive Number	VDC (Nominal)	Peak Current (A)	Cont. Current (A_{rms})
S16A8	20-80	16	8
SX30A8	20-80	30	15
S60A8	20-80	60	30
S100A8	20-80	100	50
SX25A20	60-190	25	12.5
S30A40	60-400	30	15
S60A40	60-400	60	30
S100A40	60-400	100	50

TABLE 2.9 Sinusoidal Input AC Supply Drives

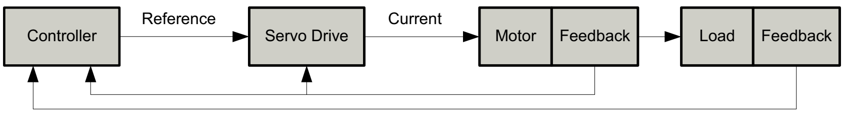
Drive Number	VAC (Nominal)	Peak Current (A)	Cont. Current (A_{rms})
S30A40AC	45-265	30	15
S60A40AC	45-270	60	30
S100A40AC	45-270	100	50

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.

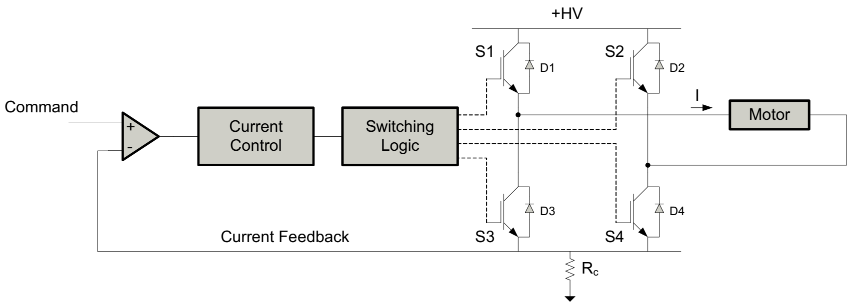
Figure 2.2 shows the components typically used in a servo system (i.e. a feedback system used to control position, velocity, and/or acceleration). The controller contains the algorithms to close the desired servo loops and also handles machine interfacing (inputs/outputs, terminals, etc.). The drive 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 2.2 Typical Motion Control System



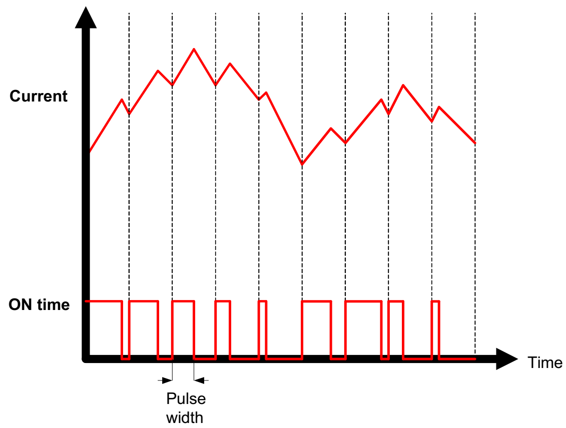
Although there exist many ways to "amplify" electrical signals, pulse width modulation (PWM) is by far the most efficient and cost-effective approach. At the basis of a PWM servo drive is a current control circuit that controls the output current by varying the duty cycle of the output power stage (fixed frequency, variable duty cycle). Figure 2.3 shows a typical setup for a single phase load.

FIGURE 2.3 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 2.4 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 2.4 **Output Current and Duty Cycle Relationship**



2.2.1 Single Phase (Brushed) Servo Drives

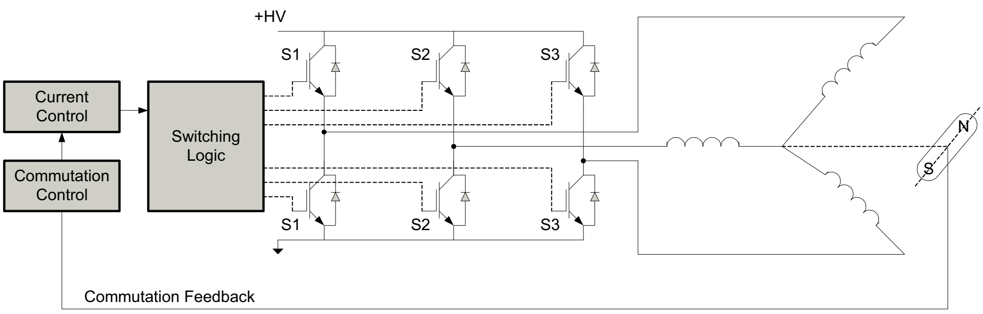
Brushed type servo drives are designed for use with permanent magnet brushed DC motors (PMDC motors). The drive construction is basically as shown in Figure 2.3. PMDC motors have a single winding (armature) on the rotor, and permanent magnets on the stator (no field winding). Brushes and commutators 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

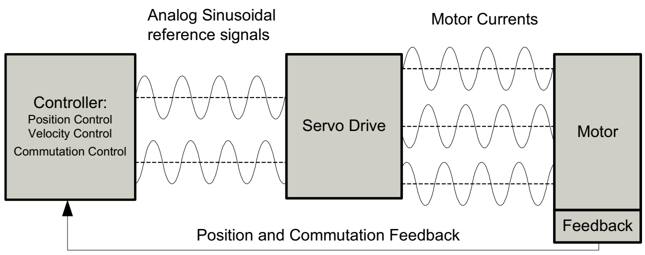
Three Phase (brushless) servo drives are used with brushless servo motors. These motors typically have a three-phase winding on the stator and permanent magnets on the rotor. Brushless motors require commutation feedback for proper operation (the commutators and brushes perform this function on brush 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 2.5 shows a typical system configuration.

FIGURE 2.5 Brushless Servo System



The commutation function can also be implemented in the motion controller, as in the case of *ADVANCED* Motion Controls sinusoidal command input drives. The drive merely amplifies the controller signals (2 analog sinusoidal signals that represent 2 of the 3 motor phase currents) and creates the third motor phase current (the sum of the 3 currents must be zero) and adjusts the phase angle to obtain maximum torque. No position feedback needs to be wired into the drive. The motor current amplitude is proportional to the reference signal amplitude, while the reference signal frequency depends on the motor velocity and the motor pole count.

FIGURE 2.6 Controller-based Commutation



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