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Product Notice

Use of MAX-100 Drives

MAX-100 drives are intended for use as transistorized electronic amplifiers powering servo motors in machinery. As such, they must be part of a controlled system that includes a controlling device. They are not intended to independently control a motor. Instructions in the motor and control system manuals must be observed; this document does not replace those instructions.

Unless specified otherwise, MAX-100 drives are intended for use in a normal industrial environment, installed in a suitable electrical cabinet without exposure to excessive or corrosive moisture or abnormal ambient temperatures. The exact operating conditions may be established by referring to the data for the drive. The connection and control of drives in machinery is a skilled operation, disassembly or repair must not be attempted. In the event that a drive fails to operate correctly, contact the place of purchase for return instructions.

Safety Notes

There are some possible hazards associated with the use of drives. The following precautions should be observed. Specific Warnings and Cautions are listed in the manual.

Installation and Maintenance: Installation and maintenance or replacement must be carried out by suitably qualified service personnel, paying particular attention to possible electrical and mechanical hazards.

Weight: Large drives are heavy, the center of gravity may be offset and removable covers shield internal components. When handling, take appropriate precautions and lift the equipment using permanent, fixed surfaces, such as the base; avoid lifting the device using protective cover shields that may be loose. Beware of sharp edges; use protective gloves when handling such assemblies.

Flying Leads and Loose Cables: Ensure that flying leads or loose cables are suitably restrained, to prevent snagging or entanglement, or are disconnected before carrying drives with such leads or cables.

Generation: If a motor is driven mechanically, it may generate hazardous voltages which are conducted from its power input terminals to the drive. The power connector must be suitably guarded to prevent a possible shock hazard.

Loose Drives: When running an unmounted drive, ensure that the cooling fan is adequately guarded and sufficient airflow is provided around the drive to ensure adequate cooling. The mounting surface of the drive is a heatsink and its surface temperature may increase when the drive is operating. If a motor is connected to the drive, remove the key which otherwise could fly out and restrain the motor before applying power to the drive.

Damaged Cables: Damage to cables or connectors may cause an electrical hazard. Ensure there is no damage before energizing the system.

Supply: Drives connect to a permanent main power source; not a portable power source. Suitable fusing and circuit protection devices are required. Consult the instructions and adhere to local and national regulations before connecting and energizing the drive. Current limits must be set correctly when operating a DDM-075 using a single phase power source.

Safety Logic Signals: Logic signals from the drive are interruptible signals; they are removed when power is removed from the drive. Consult the manual for information on auxiliary power connections that may be employed when these signals are used for safety purposes.

Safety Requirements: The safe incorporation of MAX-100 products into a machine system is the responsibility of the machine designer, who should comply with the local safety requirements at the place where the machine is to be used. In Europe this is likely to be the Machinery Directive, the ElectroMagnetic Compatibility Directive and the Low Voltage Directive. In the United States this is likely to be the National Electrical Code.

Mechanical Connection: Drives must be installed inside an electrical cabinet that provides environmental controls and protection. Installation information for the drive is provided in the manual and list the minimum installation requirements for the drive are provided in the manual. Motors and controlling devices that connect to the drive should have specifications that complement the capabilities of the drive.

Motors: Motors controlled by the drive should only connect to the drive; they should not connect directly to the AC line. Use of custom motors requires the entering of a valid thermal time constant, otherwise the motor overload protection will not function properly.

Disposal: MAX-100 drives do not contain hazardous substances. They may be disposed of as mechanical scrap. You may return the drive at your cost for disposal by us.

MAX-100
Instruction Manual for PWM Servo Drive

P/N 0013-1015-001 Rev E

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WARNING

Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

WARNING

The user must provide an external, hardwired emergency stop circuit outside the controller circuitry. This circuit must disable the system in case of improper operation. Uncontrolled machine operation may result if this procedure is not followed. Failure to observe this precaution could result in severe bodily injury.

Information contained in this manual is subject to change without notice.

P/N 0013-1015-001 Rev E

INTRODUCTION 1

Figure 1-1 MAX-100 Series DC Servo Amplifier

1.1 Purpose

This manual describes the function and theory and application of Electro-Craft MAX-100 servo amplifiers and provides information related to their performance, operation and maintenance. This manual is addressed to the customer engineer or technician involved in the installation and maintenance of the MAX-100 amplifier. It is assumed that the customer personnel are trained in the use of mechanical and electronic test equipment and are familiar with basic servo system maintenance procedures.

1.2 Introduction

Fig. 1-1 shows the Electro-Craft MAX-100 amplifier. MAX-100 series amplifiers are designed to drive permanent magnet, brushtype, DC servomotors. The amplifiers and motors are intended for use in a broad range of industrial servo applications, including machine tool and robotic applications, and are used in both velocity ad position type servo systems. Each amplifier is a self-contained unit, ready for mechanical installation and electrical inter-connections to the AC power line, motor-tachometer, and controller.

1.3 Recommended Reference Material

The handbook listed below is a useful reference source and may be ordered from Reliance Motion Control if desired.

DC Motors, Speed Controls, Servo Systems, an engineering handbook, Electro-Craft Corporation, 5th edition, 1980.

Figure 1-2 System Functional Diagram

1.4 Functional Description

The Electro-Craft MAX-100 is a controllable power source for brushtype, DC servomotors. Usually configured as a controlled velocity system, the amplifier interfaces with a controller, which provides an analog voltage signal proportional to the desired motor velocity. Refer to Fig. 1-2 for a functional diagram. The MAX-100 amplifier contains circuitry for protection of both motor and amplifier from effects of various overload and short circuit conditions. The MAX-100 is a 25 kHz pulse-width modulation (PWM), switching type amplifier that minimizes system power losses. Motor speed is precisely controlled down to a maximum torque, low velocity condition.

The MAX-100 amplifier also contains automatic current foldback if the RMS current exceeds r-current conditions.

SPECIFICATIONS 2

2.1 Performance Specifications

Peak Motor Current	
Maximum continuous motor current	
Motor supply voltage	36 VDC

2.2 Electrical Specifications

Automatic current foldback	Approx. 50%
Foldback time constant	0.05 Sec. at 6 Amps
Recovery time constant	1.0 Sec. at 1.5 Amps
Switching frequency	25 kHz nominal
Typical signal input voltage	Max.)
Input impedance	22 K ohms
Typical input amplifier drift	10 uV/°C
Dead band	Zero
Power dump current	4 Amps at 40 volts
Maximum continuous dump power	5 Watts
Motor current output (1K ohm output impedance)	0.5V/amp
Auxiliary	

2.3 Input Power Requirements

U.S. Power (Single-phase volts)	120 VAC	47-440 Hz
Outside U.S. (Single-phase volts)	240 VAC	47-440 Hz

2.4 Physical Specifications

Height	10.25 in.(260 mm)
Width	2.80 in.(71 mm)
Length	7.25 in.(184 mm)
Weight	3.0 lbs.(1.4 kg)

Ambient Temperature	- Operating	32° to 122°F (0° to 50°C)
	- Storage/Shipping	-40° to 158°F (-40° to 70°C)
Relative Humidity		5% to 95% non-condensing

INSTALLATION 3

3.1 General Information

All wiring and mechanical instructions described in this section should be made with reference to the MAX-100 hardware drawings 9078-0115 and 120 or 240 VAC input power / motor wiring diagrams, Fig. 3-1 or 3-2 (which ever is applicable).

3.2 Mounting

The drive may be mounted either horizontally or vertically away from other heat producing devices. The drive should be mounted with the heat sink in the vertical position if the chassis is mounted horizontally. In multiple axis applications, a minimum of 0.5" separation between each chassis is recommended.

3.3 AC Input

AC input power must be connected to E1, E2 and E3 as shown in Figures 3-1 or 3-2.

Refer to drawing number 9078-0115 for location of E1 - E4 and for fuse size requirements refer to drawing number 9078-0128.

3.4 Grounding Connections

The grounding connections for AC power, chassis and motor must be connected as shown in Figure 3-1 or 3-2 (which ever is applicable).

Note: Power connector E4 is not used on the MAX-100

Figure 3-1 115 VAC Input Power Wiring for USA Installation

Note: Power connector E4 is not used on the MAX-100

Figure 3-2 240 VAC Input Power Wiring for non-USA Installation

INTERFACE CIRCUITRY 4

4.1 External Interface

For connection details see Figure 4-1 and 4-2.

4.1.1 Velocity Command Signal (VCS)

This input signal is conditioned through a differential amplifier to minimize noise, and enters the amplifier module through P1 pins 1 and 2. Proper shielding is recommended, as indicated in Figure 4-1.

4.1.2 System Status Output (SSO)

This output signal on P1 pin 6 provides information on the operational status of the MAX-100 amplifier. This signal is assigned a logic level "1" value to indicate "amplifier ready" status. A logic level "0" value of this signal indicates a detected fault condition (with simultaneously inhibited output stage). This output is an open-collector NPN transistor. P1 pin 5 has been provided with a 1K resistor that may be connected to P1 pin 6, to provide a +15 volt pull-up signal to this transistor.

DSI (red) on the amplifier also turns on when a fault condition occurs.

4.1.3 Forward and Reverse Clamps (FAC, RAC)

The forward amplifier clamp (FAC) and reverse amplifier clamp (RAC) are directional clamps which when activated stop the operation of the motor in the corresponding direction, allowing operation in the opposite direction.

To activate or clamp the FAC or RAC, remove the logic "1" level. The input connection for the FAC is P1 pin 9, and the RAC is P1 pin 10.

Figure 4-1 illustrates the suggested method of connecting these inputs to the logic level "1". P1 pin 7 is a common pull-up resistor (1.0 K-ohm) for the FAC, RAC and INH, removal of this level will clamp the amplifier.

Example:1 (15V) = OK
0 (0V) = Clamped

4.1.4 Inhibit Clamp (INH)

This input signal inhibits or enables the output stage. This signal is also a logic level "0" for the active status, and enters the drive through P1 pin 8. P1 pin 7 is the pull-up resistor for this input also. This input is also used to reset the SSO fault circuit. The (INH) input must be put in the "0" condition to clear the SSO fault.

Example:1 (15V) = OK
0 (0V) = Clamped

4.1.5 Motor Current Output (MCO)

The motor current output is a DC voltage which is proportional in magnitude to the motor current output magnitude. The scaling of this DC signal is = 2 pin 7.

4.1.6 Auxiliary DC Power

The output from P2 pins 9 (+15 VDC) and 10 (-15 VDC) may be used to power a external VCS control. The available current from these pins are

4.1.7 Optional External Current Limit (ECL)

This input may be used to program the current limit externally. A 2.5K ohm resistor connected between P2 pin 5 and 6 will reduce the available current by approximately 50%. The exact degree of reduction is a function of the internal current limit for the motor being used.

4.1.8 Optional Remote Velocity Gain Reduction

A jumper connected between P2 pin 1 and 2 will reduce the gain of the velocity amplifier to approximately 0.3A / volt from the normal 7000A / volt. The amplifier will then function as a torque (current) amplifier.

4.1.9 Motor Velocity Output (MVO)

The motor velocity output (MVO) signal is an analog voltage signal which is proportional to the actual instantaneous motor speed. In the standard amplifier-motor inter-connection, this voltage is negative for clockwise rotation of the motor, and positive for counter-clockwise rotation. Its output is P2 pin 8.

Figure 4-1 External Interface Connections

Figure 4-2 Typical MAX-100/Controller Interface Wiring

5.1 Steps For Set-Up

AC POWER MUST BE TURNED OFF UNTIL STEP 5.3.3. The following steps must be performed in the specified order.

5.2 Motor/Tachometer Connections

(Reference: Fig.3-1,Fig. 3-2)

5.2.1 Motor Leads

Connect the motor leads to P3 on the amplifier card. Pin 4 is MT + and Pin 5 is MT- for CW rotation of the motor.

5.2.2 Tachometer Leads

Connect the tachometer leads to P3 on the amplifier card. Pin 3 is TG+ and pin 2 is TG- for CW rotation of the motor.

5.3 Motor Selection

Select the motor to be used from the motor selection chart (page 13, Section 5.4.4.) and position R37, R78, W3, W4, and W5 as indicated in the chart. Disconnect P3 and P1 when adjusting R37 and R78.

5.3.1 Interface Connections

Make the required interface connections as required to P1 and P2 as outlined in Section IV.

5.3.2 AC Power Connections

Connect AC power as shown on page 6 of Section III.

5.3.3 Apply AC Power

Apply AC power and check that the fault LED on the amplifier card is not turned on.

NOTE 1:If the amplifier is enabled when AC power is applied, an audible click will be heard as the flyback power supply turns on, then approximately 1 second later the output stage to the motor will turn on.

5.3.4 Motor/Amplifier Operation

Enable the amplifier and verify that the zero control (R31) will cause the motor shaft to remain stationary. The motor and amplifier are now ready for system level operations.

NOTE 2:If more precise speed and response performance is required from the motor / amplifier combination, perform the following MAX-100 calibration procedures:

1. Step 1Connect a jumper between P1 pin 7 and P1 pins 9 and 10 (FAC and RAC)
2. Step 2Apply 0.00 volts to P1 pins 1 and 2 (velocity command).

3. Step 3Connect AC power to the amplifier as shown on page 3-2.
4. Step 4Apply AC power to the amplifier.
5. Step 5Enable the amplifier by installing a jumper from P1 pin 7 to P1 pin 8 (INH).
6. Step 6Adjust R31 (zero) until the motor shaft remains stationary.
7. Step 7Apply a +10.00 volt DC voltage to P1 pin 1 (high) and pin 2 (common).
8. Step 8Monitor the motor speed with a tachometer and adjust R78 (tach) for the speed indicated on the motor selection chart.

5.4 System Response Adjustment

5.4.1 Equipment Needed

Use a signal generator and an oscilloscope to perform the following steps.

5.4.2 VCS Signal Input

Connect the output of the function generator to the amplifier card VCS and VCS common input (P1 pin 1 and pin 2), and connect the oscilloscope between common and tach signal (P2-4 and P2-8). Set the function generator for a frequency of 0.5 Hz, with an amplitude of

5.4.3 Lag Adjustment

Make adjustments with R37 (Lag) as required to obtain optimum system response as shown in Figure 5-1.

5.4.4 Motor Selection Table

Table 5-1 Motor Selection Table

MOTOR TYPE	RPM	PEAK TORQUE OZ-IN	CONT. TORQUE OZ-IN	W3	W4	W5	R37[1]	R78[2]
ES0284-15-000	5000	29	16	2	1	2	2080 (	3000 (
ES0286-32-008	5000	40	20	2	1	3	800 (	3136 (
ES0288-33-004	3000	60	30	2	1	3	500 (	4700 (
ES0352-10-500	7500	7.0	3.5	2	2	1	FULL CCW	7150 (
ES0372-13-012	6200	24	8	2	1	1	330 (	7730 (
ES-0552-10-500	5000	24.0	12.0	2	2	2	2000 (	6900 (
ES0586-30-500	5000	40.0	20.0	2	1	3	800 (	3136 (
ES0588-31-502	3000	60.0	30.0	2	1	3	500 (	4700 (
ES0652-31-500	2000	80.0	40.0	2	1	3	500 (	4750 (

Note 1. For this adjustment, connect an Ohmmeter between common and TP1. Adjust R37 (LAG) for the reading indicated on the chart. Refer to Drawing 9078-0128 for the location of adjustments and jumpers on the Amplifier

board.

Note 2. For this adjustment, connect and Ohmmeter between common and TP2. Adjust R78 (TACH) for the reading indicated on the chart. Refer to Drawing 9078-0128 for the location of adjustments and jumpers on the Amplifier board.

Figure 5-1 System Response To a Step VCS Input

MAINTENANCE 6

6.1 Scheduled Maintenance

Periodic preventive maintenance is recommended to prevent industrial contaminants from interfering with proper system operation. Dust build-up should be prevented, especially on the power MOS-FET heatsinks.

6.2 Malfunction Diagnosis

Table 6-1 MAX-100 System Problem Symptoms and Possible Causes

Symptoms	Possible Causes
Motor Inoperative	1. No AC power to the amplifier 2. Fuse F1 open
No	Defective 2. defective
Relay K1 continues to pull in and drop out	1. Flyback power supply defective 2. Defective amplifier
No voltage between MT+, MT- terminals	1. INH clamp activated 2. Defective amplifier
Motor responds to commands only in one direction	1. FAC or RAC clamp activated 2. Defective output stage or amplifier board
Voltage measured between motor terminals but motor does not rotate	1. Motor or load mechanically jammed 2. Motor brushes worn or improperly seated 3. Open motor winding
Motor runs only at a a high, constant speed	1. Faulty wiring to the tachometer 2. Tachometer brushes worn or improperly seated 3. Open tachometer winding 4. Tachometer leads reversed

REPLACEMENT PARTS 7

The following is a list of replacement parts and assemblies for the MAX-100 amplifier / motor combinations. Use the following part numbers listed below when ordering or consulting the factory.

7.1 List of Replacement Parts

Item	Part Number	Description
MAX-100 PWM Servo Drive	9078-0121	115 VAC Power Input (VS)
MAX-100 PWM Servo Drive	9078-0123	240 VAC Power Input (Outside VS)
E284 Motor	ES0284-13-012	284 Motor and Tachometer
E286 Motor	ES0286-32-008	286 Motor and Tachometer
E288 Motor	ES0288-43-004	288 Motor and Tachometer
E352 Motor	ES0352-10-500	352 Motor and Tachometer
E372 Motor	ES0372-13-012	372 Motor and Tachometer
E552 Motor	ES0552-10-500	552 Motor and Tachometer
E586 Motor	ES0586-30-500	586 Motor and Tachometer
E588 Motor	ES0588-31-502	588 Motor and Tachometer
E652 Motor	ES0652-31-500	652 Motor and Tachometer

REFERENCE DRAWINGS 8

8.1 Listing of Drawings

Drawing Number	Description
9078-0128	Adjustment Locations
9078-0115	Outline and Connector Locations
ES0284-13-012	E284 Motor Outline
ES0286-32-008	E286 Motor Outline
ES0288-43-004	E288 Motor Outline
ES0352-10-500	E352 Motor Outline
ES0372-13-012	E372 Motor Outline
ES0552-10-500	E552 Motor Outline
ES0586-30-500	E586 Motor Outline
ES0588-31-502	E588 Motor Outline
ES0652-31-500	E652 Motor Outline

APPLICATION INFORMATION 9

9.1 Application Information

Figure 9-1 Application Information

9.2 Application Information

Figure 9-2 Application Information

DANGEROUS VOLTAGES ARE PRESENT IN THIS EQUIPMENT!

CONTACT WITH LIVE PARTS COULD CAUSE SERIOUS INJURY OR DEATH!

REFER CONNECTION, INSTALLATION, MAINTENANCE, ADJUSTMENTS, SERVICING AND OPERATION TO COMPETENT PERSONNEL.

Progress is an ongoing commitment at Reliance Motion Control. We continually strive to offer the most advanced products in the industry, and, therefore specifications within this manual are subject to change.

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Electro-Craft product support is available over the phone. When you call, you should be at your computer and have the hardware and software manuals at hand. Be prepared to give the following information:

- The version numbers of the hardware and software products.
- The type of hardware that you are using.
- The fault indicators and the exact wording of any messages that appears on your screen.
- How you tried to solve the problem.

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In the United States you can reach the Electro-Craft factory based support staff by phone between 7:00 AM and 5:00 PM (CST) Monday through Friday at 1-800-328-3983. The applications engineers can assist you with programming difficulties as well as ideas for how to approach your automation task. Should your problem require on-site assistance, field service is available.

The applications engineers can also be reached via fax at 1-612-942-3636. The fax machine is open 24 hours 7 days a week. Faxes will be answered during regular business hours only.

In Europe, support can be obtained through Electro-Craft Limited. The support staff may be reached by telephone between 8:30 and 17:30 local time, Monday through Friday at [44] 1270-580142, or via fax at [44] 1270-580141.

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MAX-100

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