

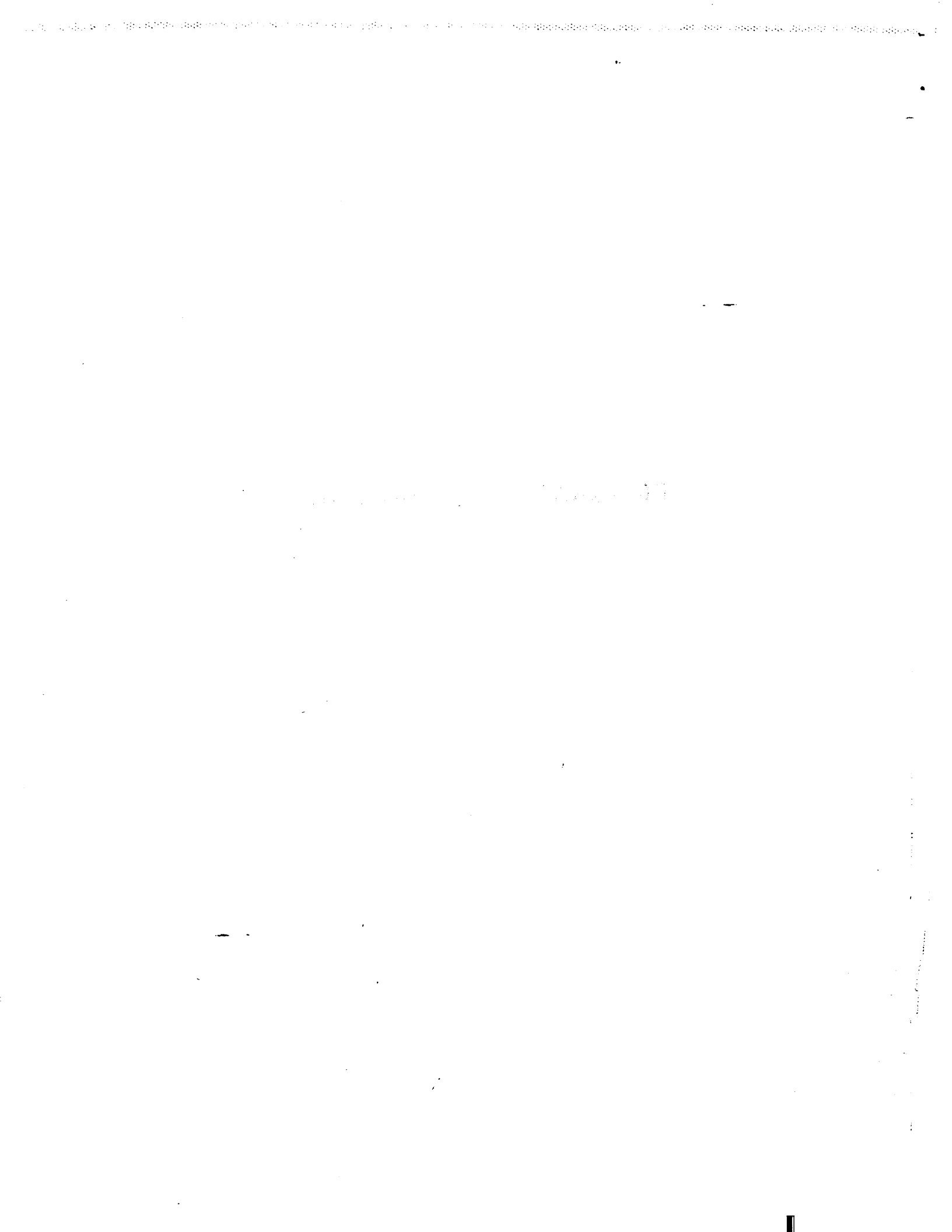
ACR1000

VERSION 3.1

PROGRAMMING MANUAL

PART# YPM01300

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ACR1000 PROGRAMMING MANUAL

VERSION 3.1 - RELEASED 5/1/95

This manual applies to the following hardware:

1. **ACR1000/12**
with OPTIONS: /MS 2nd Encoder input.
 /CON Allows contouring
 /PC PC bracket for PC-AT bus operation.

2. **ACR1000/16**
with OPTIONS: /MS 2nd Encoder input.
 /CON Allows contouring.
 /PC PC bracket for PC-AT bus operation.
 /AAO 2nd D/A output for 2-axis operation.
 /AI1 12 bit Analog input channel 1.
 /AI2 12 bit Analog input channel 2.
 /AE1 Aux Encoder board (3rd Encoder Input).
 /AE2 Aux Encoder board (4th Encoder Input).

And to ACR1000 Firmware Versions

- v2.6.x (ACR1000/12 Point-To-Point)
- v2.7.x (ACR1000/12 Interpolation)
- v3.x (ACR1000/16 Point-To-Point)
- v4.x (ACR1000/16 Interpolation)
- v5.x (ACR1000/16/MS/AA0 - 2 axis Point-To-Point Controller)

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Chapter 1 Introduction

This manual describes the operation of the ACR1000/12(12MHz) 1 axis and ACR1000/16 (16MHz) 1 or 2 axes controller boards. Throughout this manual, the term ACR1000 will refer to both type of boards. ACR1000/12 or ACR1000/16 will be used whenever applicable.

General Description

The ACR1000 is a microprocessor based motion controller that can operate as a stand-alone unit or accept information from a host computer. It supplies the necessary signals to drive a D.C servo-amplifier for closed loop or a stepper-motor controller for OPEN LOOP (or CLOSED LOOP) applications. For closed loop feedback it takes input from a square wave encoder. This encoder **MUST** have complementary outputs. These outputs may be TTL, line driver, or open collector, depending on the configuration of the card.

The ACR1000 can also be used for multi-axis applications by arranging multiple cards in parallel. Each card has its own address number, and multiple cards can perform independent or coordinated motion under host control.

The ACR1000 is designed to fit into a large area of industrial applications. Applications include: transfer line, cut to length, master/slave shaft synchronization, X-Y tables, robotics parts load/unload, grinding machines, printing machines, material handling system, production welding equipment, screw machines and coil winding machines.

Unlike most controllers, the ACR1000 also has a small, built-in, P.L.C. (Programmable Logic Controller) with 12 inputs and 13 outputs. Each input can be utilized for a specific purpose chosen by the user. This can be achieved by using the PLC or direct addressing of I/O from within the program. Since none of the I/O is dedicated, the number of inputs available to the user are maximized.

The ACR1000 is modular in design, making it possible to configure the final system in many ways. For dedicated applications, the card can control a servo amplifier or a stepper drive (via an optional interface) as well as interface to the operator all by itself. It can also be a part of a larger system, interfacing the servo amp/stepper controller to a host computer via the RS232 port. For non-dedicated applications, the board can be part of a complete ACR1000 system, offering the operator an interactive keyboard and display (MODEL OPS1000, OPS8000, OPS9000, ARP1000) or Thumbwheel station (MODEL THS16) along with necessary power supply, enclosures, push buttons, etc. for the interface. This provides a complete turnkey system.

As a stand-alone card, the ACR1000 can be programmed serially via the RS232 port with full use of the AcroBASIC command set. For applications involving a PC, the card can be plugged directly into an IBM XT or AT card slot. This configuration saves an external power supply and allows the card to be commanded via the PC BUSS (ISA bus). Bus communication is faster than serial and speeds up system throughput. This manual will describe both methods of interfacing to the ACR1000.

The ACR1000's behavior can be customized by defining key system parameters (Chapter 6). In this way the user can define such things as maximum velocity, feedback resolution, home sequence parameters, in position band, excess error window, feed-forward gain, tachometer gain, backlash comp, etc.

The ACR1000 (v2.7.x for /12, v4.x for /16) firmware is offered with full Linear, Circular and Elliptical interpolation capabilities for up to 16 axes. Interpolation is very useful for applications that require axes to move along a precise two or three-dimensional path. In the metal cutting industry, the ACR1000 is very useful in milling, grinding, and welding etc. A full 3-axis milling machine control with 36-inputs and 36-outputs is possible with three ACR1000 boards. Linear, Circular, Elliptical and Helical interpolation allows a wide variety of parts to be cut.

Running Two Motors With One ACR1000 Card

There are two methods for running two motors with the ACR1000 card.

2-Axis control with ACR1000/12

There are some applications that require two motors to be controlled but the two motors are never moving at the same time. For these cases, one ACR1000/12 card can handle the two motors if the user provides some way of switching motor leads from the servo amplifier externally through a contactor. Since the ACR1000 has the ability to look at two encoders, it can internally maintain two positions. This comes into use in a dual motor operation. The firmware allows switching back and forth between running the "main" motor or the "auxiliary" motor. The main motor's feedback encoder is wired to the main encoder plug P2. The auxiliary motor's feedback port is wired to the aux encoder plug P9. To allow switching between the two motors, the commands REN and RES are provided. These commands are explained in chapter 7.

2-Axis control with the ACR1000/16

There are applications where two motors need to be controlled simultaneously without switching from one motor to the other. In this case the ACR1000/16 card with firmware v5.x will allow point to point independent control of two motors. Independent ACC/DEC, velocities, jog, and home sequences are provided for each axis. The ACR1000/16 for this purpose must be ordered with the /AAO (Auxilliary Analog Output) option and the /MS option. All commands can be prefixed by either an "X" or "Y" to apply to either the X or Y axis. See Chapter 14 for more details.

How to use this manual

It is a good idea to read through the complete manual before attempting to use the ACR1000. This will potentially save a lot of time and avoid costly mistakes. Before making any electrical connections or specifying encoders, drives, relays, power supplies, etc., read chapters 2 and 3 which describe details associated with interfacing to the ACR1000. Read chapters 4 and/or 5 before attempting to "talk" to the card. This will inform you as to the 2 varieties of communication interface available, and how to properly set up the card for each.

System Parameters, which are central to the operation of the ACR1000, are covered in chapter 6. Familiarity with these parameters is important in setting up the card for operation. Most importantly, the ACR1000 command set is covered in detail in chapter 7. A good understanding of these commands is a key to efficient programming. Linear & Circular Interpolation is detailed in chapter 8. Note the newer high-speed interfaces available to PC BUSS users.

Once you have a basic understanding of the capabilities of the commands, go on to chapter 9. This shows how an ACR1000 program is put together, and provides a few general tips. It is extremely important to have an understanding of how the ACR1000 interacts with various flags/relays. The ACR1000 includes a versatile PLC that runs simultaneously with the ACR1000 program, and knowing how to use it is key to efficient application of the card. Read chapter 10 and study the PLC relay address table. Chapter 11 explains the WEB control features available on the ACR1000. Chapter 12 shows a few example applications and how they are coded. This should show how the pieces fit together. Refer to chapter 13 when you are about to power up the drive/motor for the first time. Tips found there will get you going in short order. It is placed at the end of the manual, as it assumes knowledge of concepts from the preceding chapters.

Chapter 2 Technical Specifications

Power Consumption

- +5.0 VOLTS at 1.3AMPS.
- +12.0 VOLTS at 100mA.
- 12.0 VOLTS at 20mA.

The 12 inputs and 12 outputs require an external 24V power supply capable of supplying at least 200 mA.

Card Dimensions

- 13.2" X 4.1" IBM PC/AT Form Factor.
- ACR1000/12 requires 8 bit slot.
- ACR1000/16 can use 8 or 16 bit slot.

PLC Inputs

12 optically isolated 24 volts Inputs . Any device activating these inputs must be capable of sinking at least 15 mA to external ground.

PLC Outputs

12 optically isolated 24 volts Outputs. These are open collector outputs capable of sinking 30mA to external ground. Will drive OPTO-22 or 12-24v relay.

Servo Outputs & D/A Resolution

- One 14-Bit ± 10 Volt Analog Output for ACR1000/12.
- One 14-Bit ± 10 Volt Analog Outputs for ACR1000/16 standard.
- 2nd 14-Bit ± 10 Volt Analog Output for ACR1000/16 optional.

The D/A outputs are provided through OP-07 op-amps to drive most servo amplifiers. It is recommended that the servo amplifier should have a tachometer stabilized velocity loop. The ACR1000 system, however can work in tachless system. In this case the card generates its own tachometer via software.

Encoder Inputs

The interface is designed primarily to work with 5 volt powered, open-collector output type encoders. For best performance with long lines, this is preferable. Termination is through 1K pull-ups to +12V.

Optionally, the card will operate with TTL or Line Driver Type encoders by

1. ACR1000/12: Removal of resistor packs RP8,9,10 on the card. These are socketed for easy removal.
2. ACR1000/16: Jumper selection of either +5v or +12v for the pull-up voltage. If no pull-ups are required then the resistor pack must be removed.

All main feedback encoders must provide complementary outputs.

8820 differential line receivers are used for both the main and aux encoder ports.

! *Failure to properly match encoder outputs with the ACR1000 hardware will result in damage to the encoder or the ACR1000. Take the time to understand the variety of encoder output types available before attempting to connect an encoder to the ACR1000. For example, failure to remove RP8,9,10 (for ACR1000/12) when using TTL or Line Driver encoders will most likely result in a delayed failure of the encoder, with the symptom of either "crawling", lost accuracy in positioning, or runaway. In master/slave applications, it is necessary to use the same output type encoders for both the MAIN and AUX inputs (ACR1000/12 only).*

Serial Port

Serial RS-232 supports XON/XOFF protocol. TXD, RXD, GND are the only connections needed. baud rates can be set to any standard rate between 300 and 9600 baud. The default data format is 7 data bits, 1 stop bit, odd parity. Later versions of ACR1000/16 cards can be set to handle 8 data bits 1 stop bit, no parity. Onboard circuitry and software protocol allows multiple ACR1000 boards to be wired to a common

RS-232 bus. This allows one RS-232 port to control up to sixteen ACR1000 boards.

Battery Backup

User program and parameters will be retained in RAM for up to 10 years with no power to the board.

PC Buss (ISA bus) Port

In the IBM PC/XT/AT environment, a parallel port is used. Each card takes up 4 addresses in the I/O port address space. The IBM software talks to a Bi-directional port address. Port A is used for bi-directional data, Port C is used for handshaking status. Communication in this manner is very fast and efficient.

Watchdog Relay

An on board AROMAT RSD-5V relay has both normally open and normally closed contacts brought out to a plug. This relay energizes when the CPU is alive and well. Green LED on end of card indicates status of this relay. Contacts are DC. 1.0 Amps.

User Relay

On board AROMAT RSD-5V relay has both normally closed and normally open contacts brought out to a plug. This is a general purpose relay that can be assigned to any I/O in the PLC. The red LED indicates status of this relay. Contacts rated DC at 1.0 Amps.

Program Memory

The ACR1000 has 6K available program space. This is enough space to hold approximately 600 MOVE commands. As an option, an extra 24k of memory can be supplied.

Performance

Velocity Range

ACR1000/12

v2.6x 16.6 to 270,000 steps/sec.

v2.7x 1.6 to 109,000 steps/sec

ACR1000/16

v3.x 16.6 to 4,000,000 steps/sec

v5.x 16.6 to 4,000,000 steps/sec

v4.x 1.6 to 1,000,000 steps/sec

Position Range

±2,000,000,000 pulses. (32-bits)

Accel/Decel

Linear range in increments of

ACR1000/12

v2.6x 35555 pulses/second/second

v2.7x 4444 pulses/second/second

ACR1000/16

v3.x 4444 pulses/second/second

v5.x 4444 pulses/second/second

v4.x 1666 pulses/second/second

PLC Performance

Scan Time: 6msec max.

Scan Time: Special PLC code 468.75 microseconds max.

32 bit sequencer for state control. (Versions 2.6X, 2.7X, 3.X, 4.X.)

8 bit sequence for state control. (V5.x)

12 external inputs. 13 external outputs.

4 timers.

4 counters.

11 internal relay coils (ACR1000/12).

33 system coils that can be sensed.

Servo Amp Required

Any servo drive with high impedance inputs capable of using a $\pm 10\text{v}$ signal and driving a motor/tach combination.

Axis Feedback

Any incremental encoder or linear scale with complimentary outputs for chA, chB, Z. Preferably, the outputs should be open collector so that they can run on +12v. Otherwise, the board will also accept 5v signals by:

ACR1000/12

1. Remove pullups

ACR1000/16

1. Remove pullups
2. Move Jumper from +12v position to +5v position

