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Compumotor

OEM-AT6400
Installation Guide

Compumotor Division
Parker Hannifin Corporation
p/n 88-014587-01A May 1995

Parker

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IMPORTANT

User Information

⚠ WARNING ⚠

6000 Series products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

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Purpose of This Book

This book describes how to install and troubleshoot the OEM-AT6400 hardware. Programming related issues are covered in the *6000 Series Programmer's Guide* and the *6000 Series Software Reference Guide*.

What You Should Know

To install and troubleshoot the OEM-AT6400, you should have a fundamental understanding of:

- IBM PC-compatible computer hardware and software operations
- Basic electronics concepts such as voltage, switches, current, etc.
- Basic motion control concepts (such as torque, velocity, distance and force)

Related Publications

- *6000 Series Software Reference Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-012966-01
- *6000 Series Programmer's Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-014540-01
- *Motion Architect User Guide*, Parker Hannifin Corporation, Compumotor Division; part number 88-013056-01
- Current *Parker Compumotor Motion Control Catalog*
- Operations user guide for the IBM-compatible PC-AT computer
- Schram, Peter (editor). *The National Electric Code Handbook (Third Edition).* Quincy, MA: National Fire Protection Association

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CHAPTER ONE

1 Installation

IN THIS CHAPTER
• Product ship kit list • General specifications table • PC card installation procedures • Mounting procedures • Electrical connection procedures (including specifications) • Installation test procedures • Preparation for what to do next

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What You Should Have

If an item is missing, call the factory (see phone numbers on inside front cover).

Part Name		Part Number
OEM-AT6400		**OEM-AT6400**
Ship kit: Must be specifically ordered		OEM-AT6400 Shipkit
Includes items below		
Installation Guide for OEM-AT6400		88-014587-01
Response card for manuals		88-010867-01
6000 Series Software Reference Guide		88-012966-01
6000 Series Programmer's Guide		88-014540-01
Motion Architect User Guide		88-013056-01
Motion Architect diskettes:	Disk 1	95-013070-01
	Disk 2	95-013070-02
Operating system/DOS Support diskette:		95-013069-01
Warranty registration card		88-013468-01
Options VM60 Screw Terminal Adaptor		VM60
60-pin Ribbon cable, 5-foot (w/ connector)		71-014579-01

Before You Begin

⚠ WARNINGS ⚠

The OEM-AT6400 is used to control your system's electrical and mechanical components. Therefore, you should test your system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

Always remove power to the computer before:

- Installing or removing the OEM-AT6400 PC card
- Adjusting the DIP switches on the OEM-AT6400 PC card after it is installed in the computer
- Connecting electrical devices to the OEM-AT6400 PC card after it is installed in the computer

Electrical Noise

The OEM-AT6400 does not have the I/O optical isolation circuitry that is standard for most of the 6000 Series indexers/controllers. Special care must be taken to minimize electrical noise in the immediate environment to ensure proper operation of the OEM-AT6400. The guidelines listed below should help you minimize the potential for electrical noise.

- Do not route high-voltage wires and low-level signals in the same conduit, noise considerations.
- Ensure that all components are properly grounded.
- Ensure that all wiring is properly shielded.
- Noise suppression guidelines for I/O cables are provided on page 14.

Airborne Contaminants

Contaminants that may come in contact with the OEM-AT6400 should be carefully controlled. Particulate contaminants, especially electrically conductive material such as metal shavings, can damage the OEM-AT6400.

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General Specifications

Parameter	Specification
Power	
OEM-AT6400 PC Card	5VDC @ 3.5A from the PC-AT bus
Status LED/fault detection	Refer to *Status LED* in Chapter 2
Environmental	
Operating Temperature	32-122°F (0-50°C)
Storage Temperature	-22-185°F (-30-85°C)
Humidity	0-95% non-condensing
Performance	
Position Range	±2,147,483,648 steps
Velocity Range	1-1,600,000 steps/sec
Acceleration Range	1-24,999,975 steps/sec^2
Stepping Accuracy	±0 steps from preset total
Velocity Accuracy	±0.02% of maximum rate
Velocity Repeatability	±0.02% of set rate
Motion Algorithm Update Rate	2 ms
Calculation to determine contouring deviation from an arc (due to straight-line approximation to a curve):	Error in steps = $\frac{(v_p * \frac{t}{2})^2}{r}$ Where: v_p = steps/sec, r = radius in steps, t = system update period (2 msec)
Inputs	
Home, POS/NEG Limits, Trigger	HCMOS compatible*; internal 6.8 KΩ pull-ups to AUX-P terminal (connect to internal +5V or external power supply); Voltage range is 0-24V.
6 General-Purpose Programmable	HCMOS compatible* with internal 6.8 KΩ pull-ups to IN-P terminal (connect to internal +5V or external power supply);. Voltage range = 0-24V.
Outputs	
4 General-Purpose Programmable	Open collector output with 4.7 KΩ pull-ups. Can be pulled up by connecting OUT-P to +5V, or to user-supplied voltage of up to 24V. Max. voltage in the OFF state (not sinking current) = 24V, max. current in the ON state (sinking) = 30mA..
Step, Direction	Differential line driver output. Signal high ≥ 3.5VDC @ +30mA, signal low ≤ 1.0VDC @ -30mA. **+output** for each differential driver is active high; **-output** for each driver is active low. Step pulse width range is 0.3 µs to 20 µs (depends on the value of the PULSE command–default is 0.3 µs).
+5V Output	+5V terminals are available on the 60-pin connector. Load limit (total load for all I/O connections) is typically 1.0A , and depends on the internal power supply of your PC.

* HCMOS-compatible switching voltage levels: Low ≤ 1.00V, High ≥ 3.25V.
TTL-compatible switching voltage levels: Low ≤ 0.4V, High ≥ 2.4V.

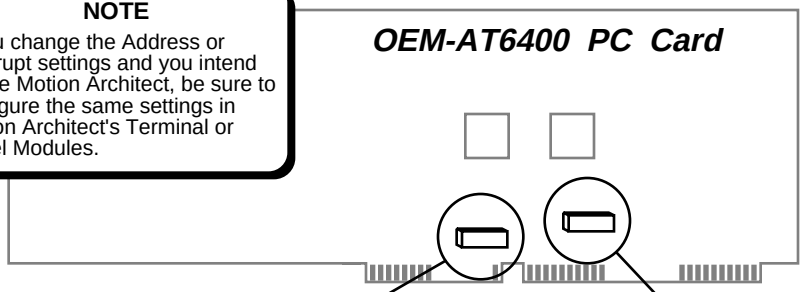
NOTE: The OEM-AT6400 does **not** have any optical isolation circuity for the Input/Output connections. See Appendix A for information on reducing electrical noise.

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Configuration/Customization–Optional DIP Switch Settings

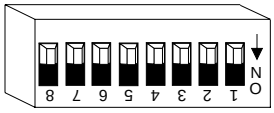
Default Settings
Address = 300 Hex (768 Decimal)
Transfer Mode = 16-Bit
Interrupts Selected = None

NOTE
If you change the Address or Interrupt settings and you intend to use Motion Architect, be sure to configure the same settings in Motion Architect's Terminal or Panel Modules.

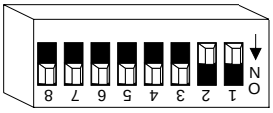


= ON position

DIP Switch SW2
Factory Default Setting Shown



DIP Switch SW1
Factory Default Setting Shown



Switch #8

INTERRUPTS (SW2)

Switch #	Interrupt	Description	Default Setting
1	IRQ3	Serial Port (COM4)	OFF
2	IRQ4	Serial Port (COM3)	OFF
3	IRQ5	Parallel Printer	OFF
4	IRQ7	Parallel Printer	OFF
5	IRQ10	Unassigned	OFF
6	IRQ11	Unassigned	OFF
7	IRQ12	Unassigned	OFF
8	IRQ15	Unassigned	OFF

Switches are positive-true (ON selects the interrupt setting). Only one switch may be ON at one time.

ADDRESS (SW1, switches 1-7)

Switch #	Binary Value *Decimal*	Binary Value *Hex*	Default Setting
1	512	200	OFF
2	256	100	OFF
3	128	80	ON
4	64	40	ON
5	32	20	ON
6	16	10	ON
7	8	8	ON

Switches are negative-true (OFF selects the address value). The sum of the binary values of DIP switches 1-7 comprise the PC card's device address. The device address must be an even multiple of eight.

Computer I/O Address Space Map

Address Range *Decimal*	Address Range *Hex*	Description
000-255	000-0FF	Used by AT mother-board
496-511	1F0-1FF	Hard Disk (AT)
512-527	200-20F	Game Controller
528-543	210-21F	Expansion Unit
568-571	238-23B	Bus Mouse
572-575	23C-23F	Alternate Bus Mouse
624-639	270-27F	Parallel Printer Port
688-734	2B0-2DF	EGA Card
736-743	2E0-2E7	GPIB
744-751	2E8-2EF	Serial Port (4)
760-767	2F8-2FF	Serial Port (2)
768-799	**300-31F**	**Prototype Card**
800-815	320-32F	Hard Disk (XT)
888-895	378-37F	Parallel Printer
896-911	380-38F	SDLC
928-943	3A0-3AF	SDLC
944-955	3B0-3BB	Monochrome Card
956-959	3BC-3BF	Parallel Printer
960-975	3C0-3CF	EGA Card
976-991	3D0-3DF	CGA Card
1000-1007	3E8-3EF	Serial Port (3)
1008-1015	3F0-3F7	Floppy Disk
1016-1023	3F8-3FF	Serial Port (1)

TRANSFER MODE (SW1, switch 8)

Switch #8 ON = 16-Bit Transfer Mode (default)
Switch #8 OFF = 8-Bit Transfer Mode

The 16-bit transfer mode offers higher performance than the 8-bit mode.

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PC Card Installation

Step 1 Turn off the power to the computer.

Step 2 Remove the computer's cover to access the internal slots where peripheral cards are added.

Step 3 Remove the sheet metal bracket that covers the external access slot. *Save the screw.* On IBM AT and IBM AT-compatible computers, this is at the rear access panel where all external connections are made. This bracket is replaced by the bracket on the end of the OEM-AT6400 card.

Step 4 Select a 16-bit slot to install the OEM-AT6400 card.

> **CAUTION**
> While handling the OEM-AT6400 card, be sure to observe proper grounding techniques to prevent electro-static discharge (ESD).

Step 5 Make sure that there are two empty slots immediately next to the right side (when you are facing the front of the computer) of this slot. (This is to allow enough room to maneuver when attaching the 60-pin ribbon cable.) Temporarily remove cards from adjacent slots, if necessary.

Step 6 ***-FOR VM60 OPTION ONLY-***

Orienting the 60-pin ribbon connector with the **stripe on top** and the holes of the connector facing to the left (when you are facing the front of the computer), insert the connector into the computer chassis through the access slot for the designated card slot. Pull several inches of the cable through the slot, folding it to the right (when you are facing the front of the computer) and flat against the back of the chassis to get it out of the way. Secure the cable and connector temporarily to leave both hands free for installation of the OEM-AT6400 card. (The connector can be temporarily pushed back through one of the empty adjacent access slots to secure it.) See the drawing on the next page.

Step 7 Insert the bottom corner of the OEM-AT6400 PC card into the card guide slot near the front of the computer. Ease both ends of the card simultaneously down into the computer until the card's edge connector reaches the computer's mating connector (see drawing below). (If using the VM60, make sure that the ribbon cable is properly seated with the bracket on the OEM-AT6400 card.) Adjust the card until the edge connectors align and press it down into the mating connector.

Step 8 ***-FOR VM60 OPTION ONLY-***

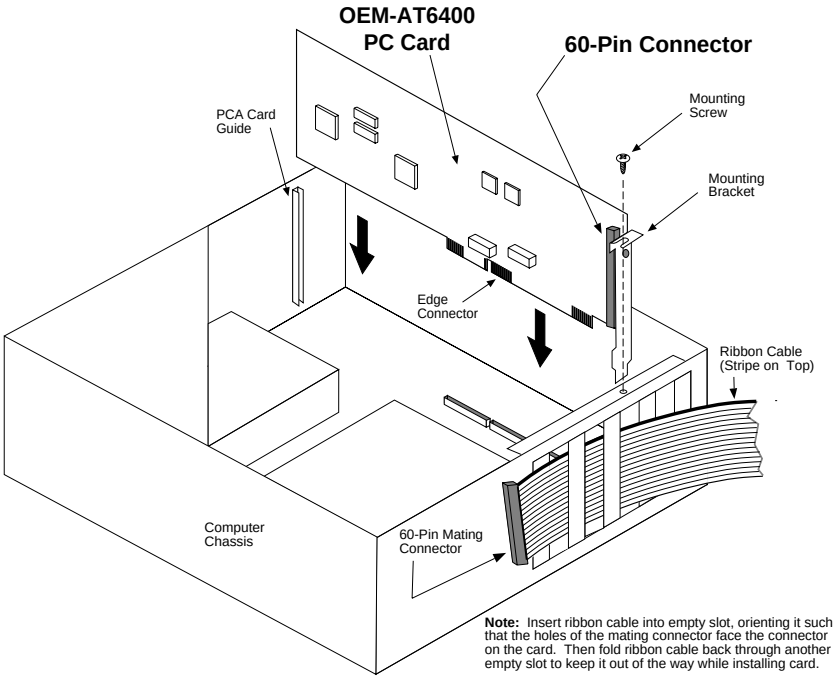
Adjust the 60-pin ribbon cable to align the mating connector with the 60-pin connector on the OEM-AT6400. (The 60-pin ribbon cable can be somewhat stiff. Bend it gently when aligning the connectors.) When properly aligned, gently press the connector until it seats with the mating connector. If the connectors need to be separated for troubleshooting or repair purposes, insert a small slot-head screw driver into the slot on the top of the mating connector (looking down into the chassis), between the connector body and the metal tab, and twist.

NOTE: Make sure that the 60-pin ribbon cable is installed with the **stripe on top** before attempting to use the OEM-AT6400. Also, make sure the cable end installed on the VM60 has the stripe oriented towards the pin-1 side of the VM60. Improper installation of this cable can severely damage the OEM-AT6400.

Step 9 Using the screw that secured the original access slot cover bracket, fasten the OEM-AT6400 mounting bracket to the computer chassis (see drawing above).

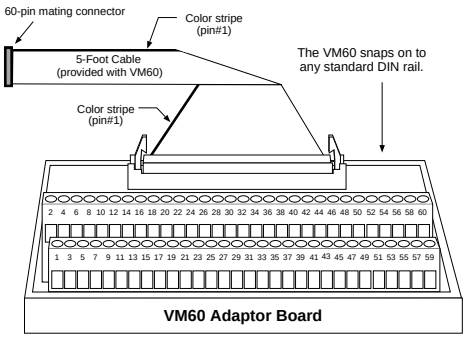
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System Electrical Connections



Note: Insert ribbon cable into empty slot, orienting it such that the holes of the mating connector face the connector on the card. Then fold ribbon cable back through another empty slot to keep it out of the way while installing card.

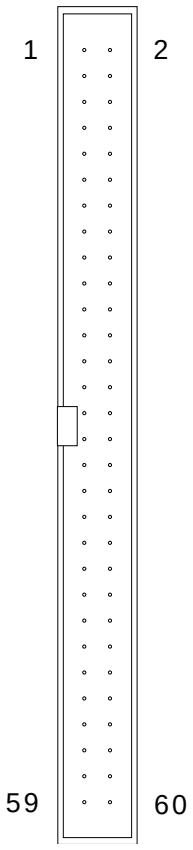
OPTIONAL VM60 ADAPTOR — for screw-terminal connections



Pin-outs for the VM60 are identical to the pin-outs for the 60-pin connector (only when the cable is connected as illustrated)

PIN-OUTS

Pin #	In/Out	Description	Pin #	In/Out	Description
1	Output	Step 1 +	2	Output	Step 1 –
3	Output	Direction 1 +	4	Output	Direction 1 –
5	Output	Step 2 +	6	Output	Step 2 –
7	Output	Direction 2 +	8	Output	Direction 2 –
9	Output	Step 3 +	10	Output	Step 3 –
11	Output	Direction 3 +	12	Output	Direction 3 –
13	Output	Step 4 +	14	Output	Step 4 –
15	Output	Direction 4 +	16	Output	Direction 4 –
17	Input	POS 1	18	Output	+5V
19	Input	NEG 1	20	-----	GND
21	Input	HOM 1	22	-----	GND
23	Input	POS 2	24	-----	GND
25	Input	NEG 2	26	-----	GND
27	Input	HOM 2	28	-----	GND
29	Input	POS 3	30	-----	GND
31	Input	NEG 3	32	Output	+5V
33	Input	HOM 3	34	Output	AUX-P
35	Input	POS 4	36	Output	+5V
37	Input	NEG 4	38	Output	IN-P
39	Input	HOM 4	40	Output	+5V
41	Input	TRIG-A	42	Output	OUT-P
43	Input	TRIG-B	44	Output	OUT 1
45	Input	TRIG-C	46	Output	OUT 2
47	Input	TRIG-D	48	Output	OUT 3
49	Input	IN 1	50	Output	OUT 4
51	Input	IN 2	52	-----	GND
53	Input	IN 3	54	-----	GND
55	Input	IN 4	56	-----	GND
57	Input	IN 5	58	-----	SHLD
59	Input	IN 6	60	-----	SHLD

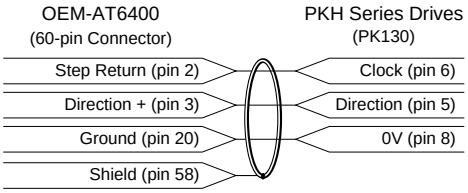


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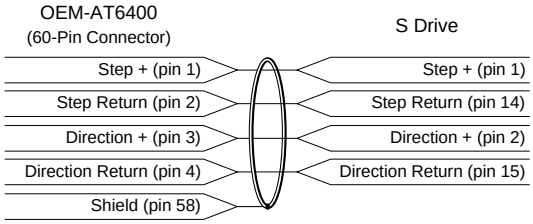
Motor Drivers

CONNECTIONS & INTERNAL SCHEMATICS

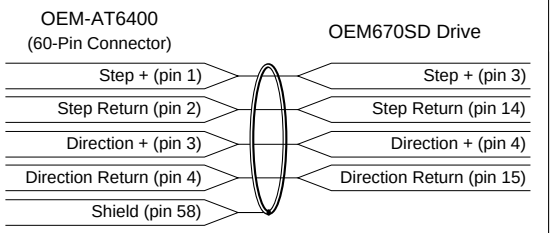
Connecting a PK130 Drive



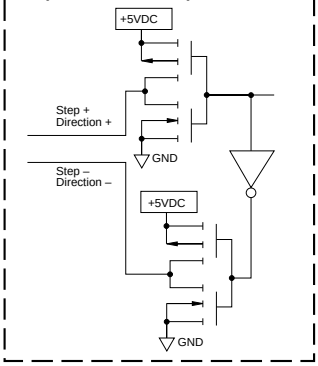
Connecting an S Drive or Equivalent



Connecting an OEM670SD Drive



Step & Direction Output Schematic



NOTE: Equivalent drives to the S Drive are considered to be those with the same pin-outs, suchs as Zeta, OEM350, OEM650, and PDS.

PIN OUTS & SPECIFICATIONS -- *Drive Functions*

Pin #	In/Out	Name	Description
1	OUT	Step 1 +	Differential output. (Can be used as single-ended output with some drives, in conjunction with GND pin) Step (pulse) output to the drive for Axis 1. Step + signal is active high. Signal levels: Low ≤ 1.0VDC @ -30mA, High ≥ 3.5VDC @ +30mA.
2	OUT	Step 1 Return –	Differential output. Step (pulse) output to the drive for Axis 1. Step - signal is active low.
3	OUT	Direction 1 +	Differential output. (Can be used as single-ended output with some drives, in conjunction with GND pin) High signal on Direction 1 + specifies motion in the positive direction for Axis 1; Low signal on Direction 1 + specifies motion in the negative direction for Axis 1. Signal levels: Low ≤ 1.0VDC @ -30mA, High ≥ 3.5VDC @ +30mA.
4	OUT	Direction 1Return (–)	Differential output. Low signal on Direction 1 - specifies motion in the positive direction for Axis 1; High signal on Direction 1 - specifies motion in the negative direction for Axis 1.
5	OUT	Step 2 +	Step (pulse) output to the drive for Axis 2. Same specs as Step 1 +
6	OUT	Step Return 2 (–)	Step (pulse) output to the drive for Axis 2. Same specs as Step 1 –
7	OUT	Direction 2 +	Specifies direction of motion for Axis 2; Same specs as Direction 1 +
8	OUT	Direction 2 Return (–)	Specifies direction of motion for Axis 2; Same specs as Direction 1 –
9	OUT	Step 3 +	Step (pulse) output to the drive for Axis 3. Same specs as Step 1 +
10	OUT	Step 3 Return (–)	Step (pulse) output to the drive for Axis 3. Same specs as Step 1 –
11	OUT	Direction 3 +	Specifies direction of motion for Axis 3; Same specs as Direction 1 +
12	OUT	Direction 3 Return (–)	Specifies direction of motion for Axis 3; Same specs as Direction 1 –
13	OUT	Step 4 +	Step (pulse) output to the drive for Axis 4. Same specs as Step 1 +
14	OUT	Step Return 4 (–)	Step (pulse) output to the drive for Axis 4. Same specs as Step 1 –
15	OUT	Direction 4 +	Specifies direction of motion for Axis 4; Same specs as Direction 1 +
16	OUT	Direction 4 Return (–)	Specifies direction of motion for Axis 4; Same specs as Direction 1 –
18	OUT	+5V	+5V **from computer's power supply**
20	–	Ground	Logic ground
58	–	Shield	Connected to chassis (earth) ground within the computer chassis

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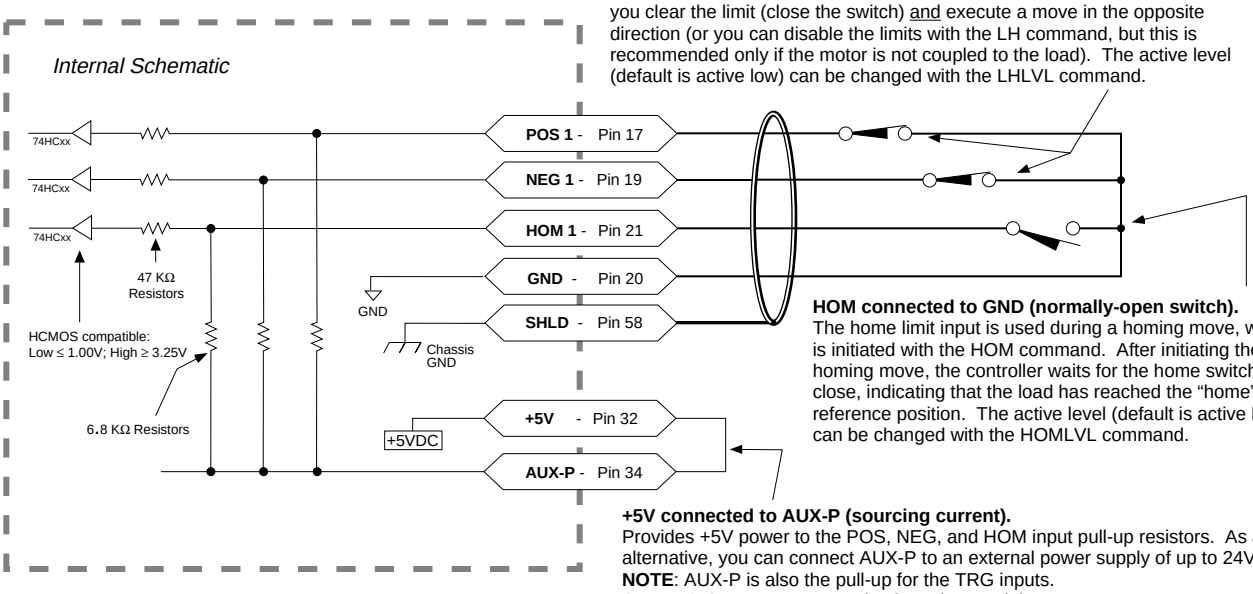
End-of-Travel and Home Limit Inputs

NOTES

- Motion will not occur on a particular axis until you do one of the following:
  - Install end-of-travel (**POS** & **NEG**) limit switches
  - Disable the limits with the LHØ command (recommended only if load is not coupled)
  - Change the active level of the limits with the LHLVL command
- Refer to the *Basic Operations Setup* chapter in the *6000 Series Programmer's Guide* for in-depth discussions about using end-of-travel limits and homing.

CONNECTIONS & INTERNAL SCHEMATICS

POS & NEG connected to GND (normally-closed switches).
Mount each switch such that the load forces it to open before it reaches the physical travel limit (leave enough room for the load to stop). When the load opens the switch, the axis stops at the decel value set with the LHAD command. The motor will not be able to move in that same direction until you clear the limit (close the switch) and execute a move in the opposite direction (or you can disable the limits with the LH command, but this is recommended only if the motor is not coupled to the load). The active level (default is active low) can be changed with the LHLVL command.



HOM connected to GND (normally-open switch).
The home limit input is used during a homing move, which is initiated with the HOM command. After initiating the homing move, the controller waits for the home switch to close, indicating that the load has reached the "home" reference position. The active level (default is active low) can be changed with the HOMLVL command.

+5V connected to AUX-P (sourcing current).
Provides +5V power to the POS, NEG, and HOM input pull-up resistors. As an alternative, you can connect AUX-P to an external power supply of up to 24VDC.
NOTE: AUX-P is also the pull-up for the TRG inputs.
SINKING CURRENT: To make these inputs sink current, connect AUX-P to GND.

PIN OUTS & SPECIFICATIONS

Pin #	In/Out	Name, Axes 1 & 2	Description
17	IN	POS1	Positive-direction end-of-travel limit input
19	IN	NEG1	Negative-direction end-of-travel limit input
21	IN	HOM1	Home limit input
23	IN	POS2	Positive-direction end-of-travel limit input
25	IN	NEG2	Negative-direction end-of-travel limit input
27	IN	HOM2	Home limit input
29	IN	POS3	Positive-direction end-of-travel limit input
31	IN	NEG3	Negative-direction end-of-travel limit input
33	IN	HOM3	Home limit input
35	IN	POS4	Positive-direction end-of-travel limit input
37	IN	NEG4	Negative-direction end-of-travel limit input
39	IN	HOM4	Home limit input
18	OUT	+5V	+5VDC Supply
20	–	GND	Ground.
34	IN	AUX-P	Provides power to the POS, NEG, HOM and TRIG pull-up resistors.
58	–	SHLD	*Shield*–Internally connected to chassis ground (earth).

Specification for all limit inputs

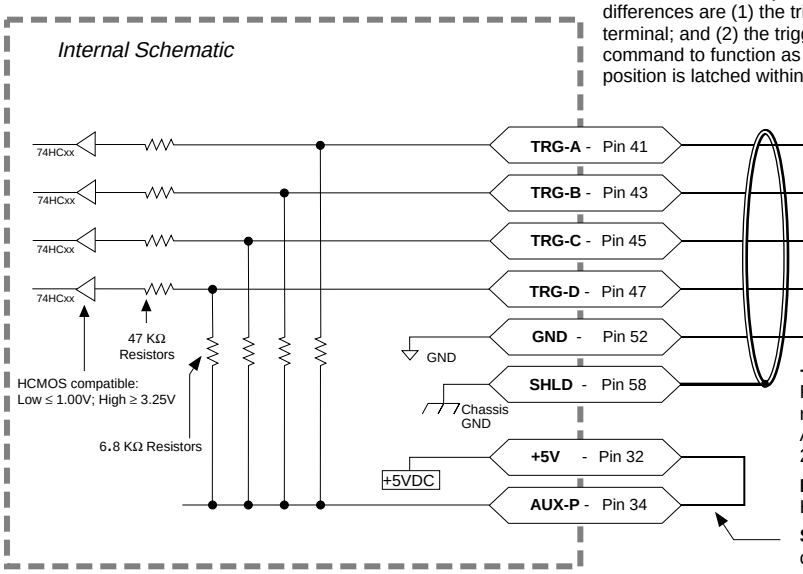
HCMOS compatible (voltage levels: Low ≤ 1.00V, High ≥ 3.25V); internal 6.8 KΩ pull-ups to AUX-P terminal; voltage range is 0-24V.

Active level for POS & NEG is set with the LHLVL command (default is active low, requiring normally-closed switch).

Active level for HOM is set with the HOMLVL command (default is active low, requiring normally-open switch).

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Trigger Connections



TRG-x connected to GND (normally-open switches).

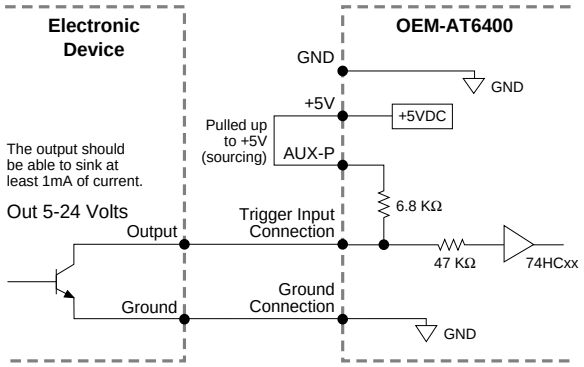
The active level (default is active low) can be changed with the INLVL command. These inputs are like the general-purpose inputs. The differences are (1) the triggers are pulled up via the AUX-P pull-up terminal; and (2) the triggers can be programmed with the INFNCi-H command to function as position capture inputs (encoder & motor position is latched within 50µs) and registration inputs.

+5V connected to AUX-P (sourcing current). Provides +5V power to the TRG input pull-up resistors. As an alternative, you can connect AUX-P to an external power supply of up to 24VDC.

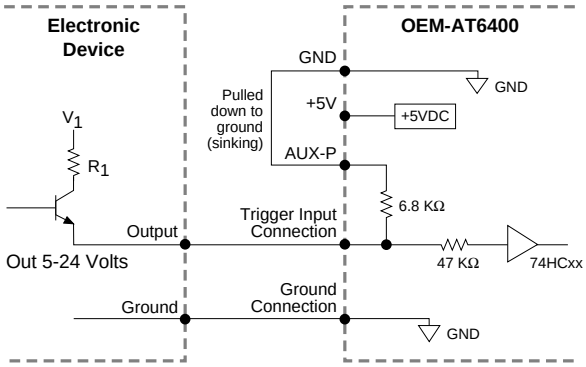
NOTE: AUX-P is also the pull-up for POS, NEG, & HOM inputs.

SINKING CURRENT: To make these inputs sink current, connect AUX-P to GND.

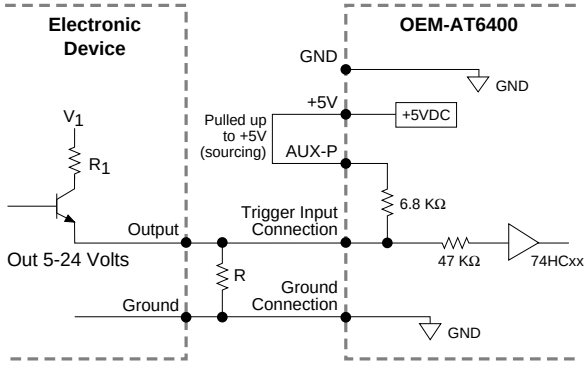
Connection to a Sinking Output Device



Connection to a Sourcing Output Device



Connection to a Combination of Sinking & Sourcing Outputs



Typical value for R = 450Ω (assuming R_1 = 0)

Note: The value of R may vary depending on the value of R_1 and V_1.

If you will be connecting to a combination of sourcing and sinking outputs, connect **AUX-P** to **+5V** to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the OEM-AT6400's trigger input terminal and ground (see illustration). The resistor provides a path for current to flow from the device when the output is active.

PROGRAMMING TIP

Connecting to a sinking output? Set the trigger input's active level to low with the `INLVL` command (`0` = active low, *default setting*).

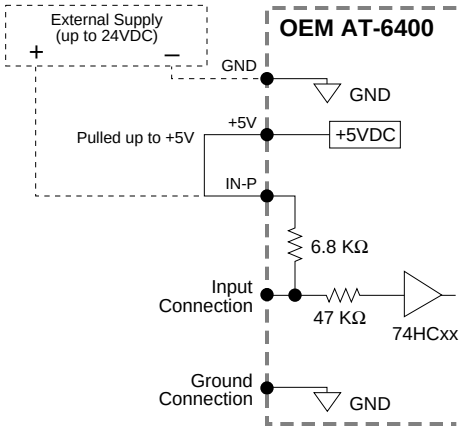
Connecting to a sourcing output? Set the trigger input's active level to high with the `INLVL` command (`1` = active high).

Thus, when the output is active, the `TIN` status command will report a "`1`" (indicates that the input is active), regardless of the type of output that is connected.

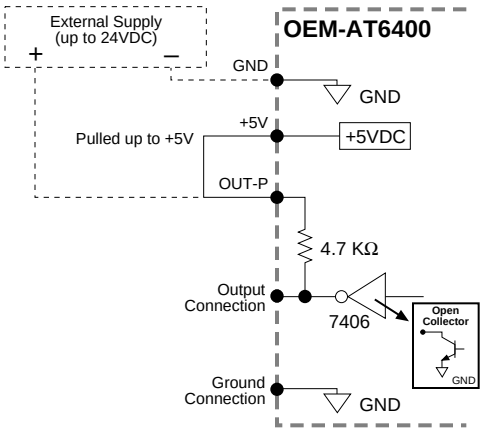
For details on setting the active level and checking the input status refer to the `INLVL` and `TIN` command descriptions in the *6000 Series Software Reference Guide*.

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INPUT PIN OUTS & SPECIFICATIONS

Pin #	Function	Internal Schematic	Specifications
36	+5 VDC		HCMOS-compatible voltage levels (low ≤ 1.00V, high ≥ 3.25V).
38	IN-P Input Pullup		Voltage range = 0-24V.
49	Input #1 (LSB)		Sourcing Current: Connect **IN-P** to **+5V** or to your own power supply of up to 24VDC.
51	Input #2		Sinking Current: Connect **IN-P** to **GND**.
53	Input #3		STATUS: Check with the `TIN` status command.
55	Input #4		Active level: Default is active low, but can be changed to active high with the `INLVL` command.
57	Input #5		
59	Input #6 (MSB)		

OUTPUT PIN OUTS & SPECIFICATIONS

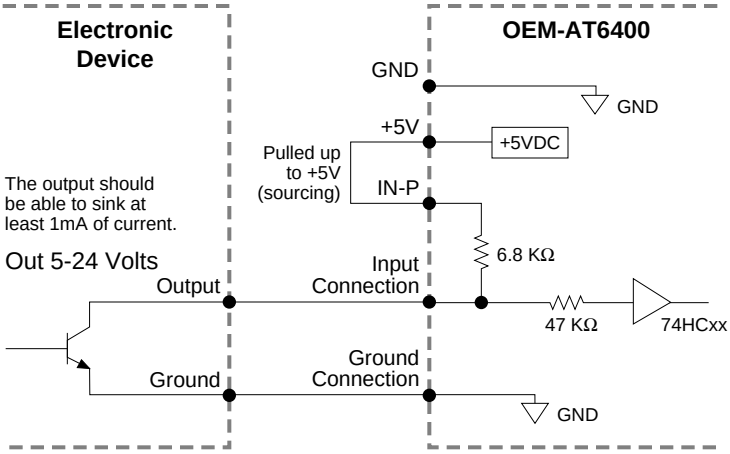
Pin #	Function	Internal Schematic	Specifications
40	+5 VDC		Open collector output.
42	OUT-P Output Pullup		Pull-up connection for outputs. Connect **OUT-P** to **+5V**, or to an external supply of up to 24V.
44	Output #1 (LSB)		Max. voltage in the OFF state (not sinking current) = 24V, max. current in the ON state (sinking) = 30mA.
46	Output #2		STATUS: Check with the `TOUT` status command.
48	Output #3		Active level: Default is active low, but can be changed to active high with the `OUTLVL` command.
50	Output #4 (MSB)		

NOTE: LSB = least significant bit; MSB = most significant bit

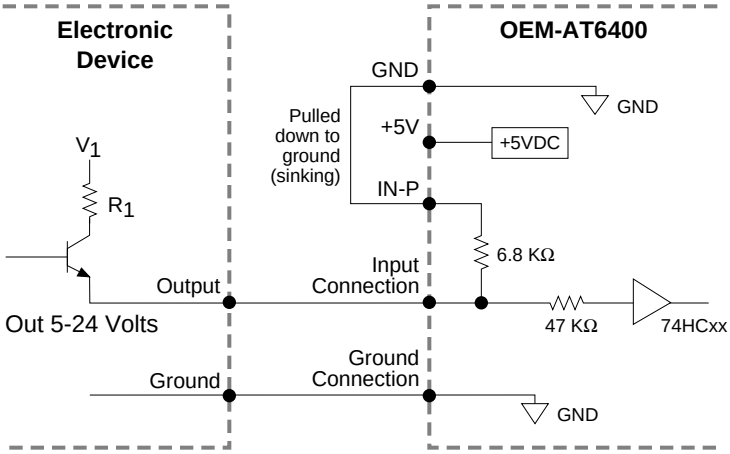
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INPUT CONNECTIONS – *Connecting to electronic devices such as PLCs*

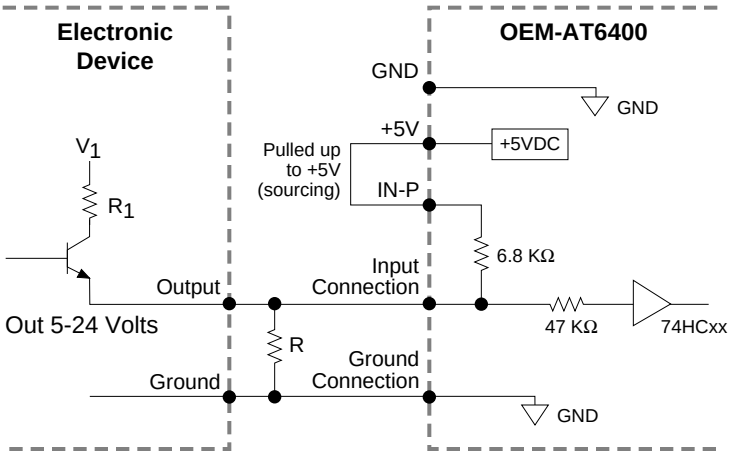
Connection to a Sinking Output Device



Connection to a Sourcing Output Device



Connection to a Combination of Sinking & Sourcing Outputs



Typical value for R = 450Ω (assuming R_1 = 0)
Note: The value of R may vary depending on the value of R_1 and V_1.

PROGRAMMING TIP

Connecting to a sinking output? Set the input's active level to low with the `INLVL` command (Ø = active low).

Connecting to a sourcing output? Set the input's active level to high with the `INLVL` command (1 = active high).

Thus, when the output is active, the `TIN` status command will report a "1" (indicates that the input is active), regardless of the type of output that is connected.

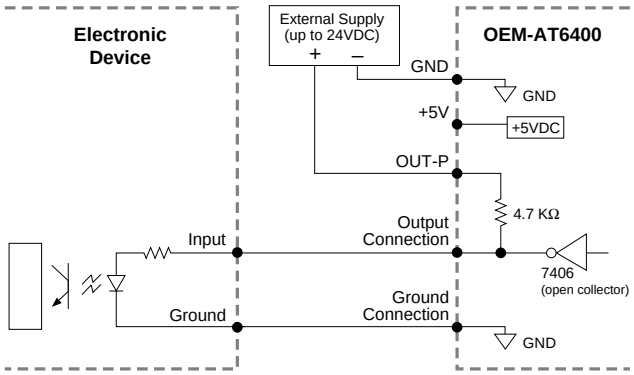
Details on setting the active level and checking the input status are provided in the *6000 Series Programmer's Guide*. Refer also to the `INLVL` and `TIN` command descriptions in the *6000 Series Software Reference Guide*.

If you will be connecting to a combination of sourcing and sinking outputs, connect **IN-P** to **+5V** to accommodate sinking output devices. Then for each individual input connected to a sourcing output, wire an external resistor between the OEM-AT6400's programmable input terminal and ground (see illustration). The resistor provides a path for current to flow from the device when the output is active.

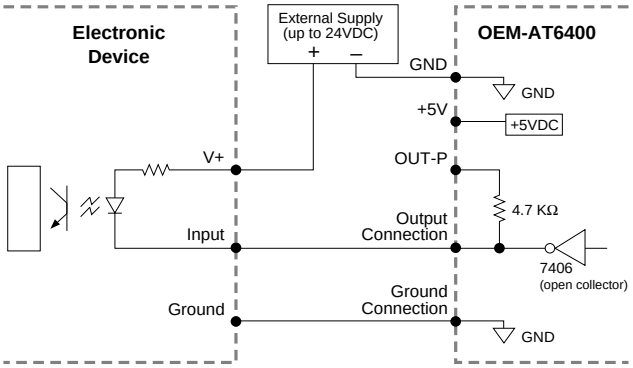
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OUTPUT CONNECTIONS – *for electronic devices such as PLCs*

Connection to a Sinking Input (active high)

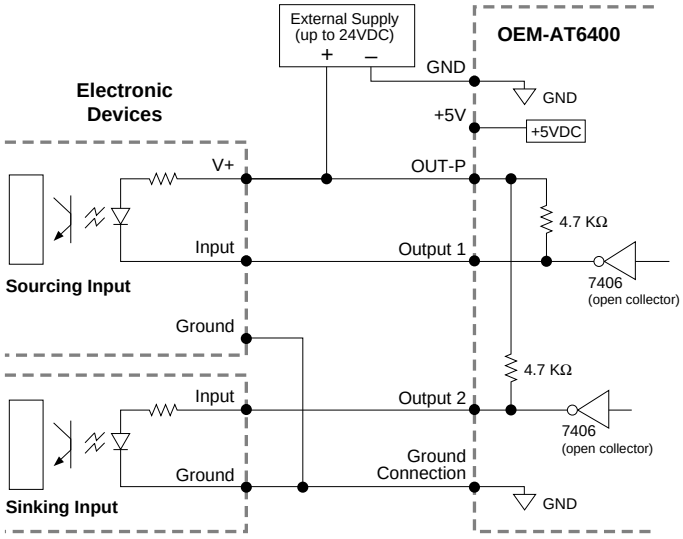


Connection to a Sourcing Input (active low)



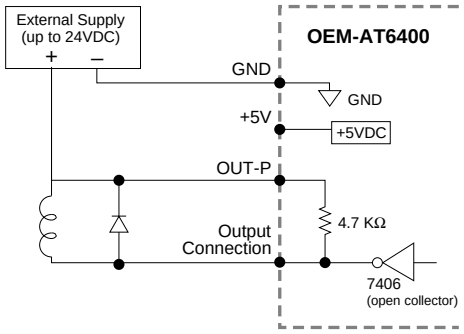
NOTE: It is not necessary to use the OUT-P pin for a sourcing input.

Connection to a Combination of Sinking & Sourcing Inputs



Combinations of sourcing and sinking inputs can be accommodated at the same voltage level. Be aware of the input impedance of the sourcing input module, and make sure that there is enough current flowing through the input module while in parallel with the OUT-P pull-up resistor.

Connection to an Inductive Load (active low)



Use an external diode when driving inductive loads. Connect the diode in parallel to the inductive load, attaching the anode to the OEM-AT6400 output and the cathode to the supply voltage of the inductive load.

PROGRAMMING TIP

Connecting to an active-high sinking input? Set the output's active level to high with the OUTLVL command (1 = active high).

Connecting to an active-low sourcing input? Set the output's active level to low with the OUTLVL command (Ø = active low).

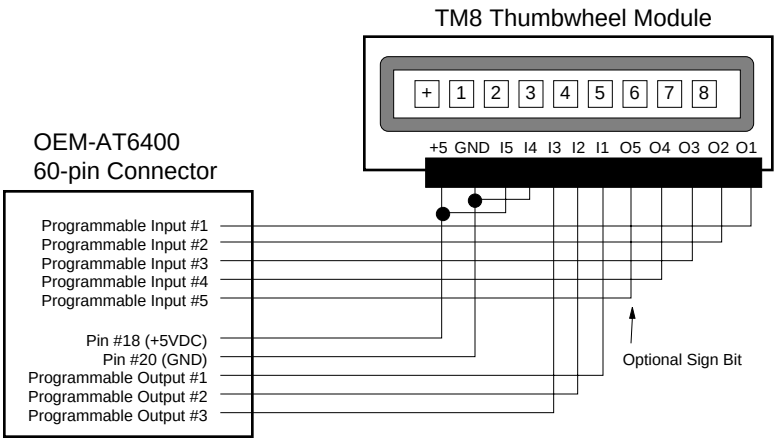
Thus, when the OEM-AT6400's output is activated, current will flow through the attached input and the TOUT status command will report a "1" (indicates that the output is active), regardless of the type of input that is connected.

Details on setting the active level and checking the output status are provided in the *6000 Series Programmer's Guide*. Refer also to the OUTLVL and TOUT command descriptions in the *6000 Series Software Reference Guide*.

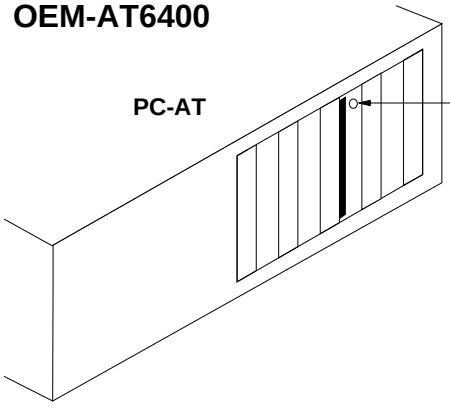
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THUMBWHEEL CONNECTIONS – *for entering BCD data*

Connection to the Compumotor TM8 Module



STATUS LED



After applying power, the LED will be off. After downloading the operating system, the status LED will turn green indicating the system is ready for operation. If the LED does not turn green after downloading the operating system, an error has occurred. The download program (AT6400) issues an error message if it cannot find the card or if the download operation is not successful (refer also to the Downloading Error Table provided in Chapter 2).

Board Monitor Alarm (BMA): Detects un-recoverable faults in hardware and software. When the BMA detects a fault, the LED turns off. The BMA can be reset by cycling power to the PC-AT, or by re-downloading the operating system.

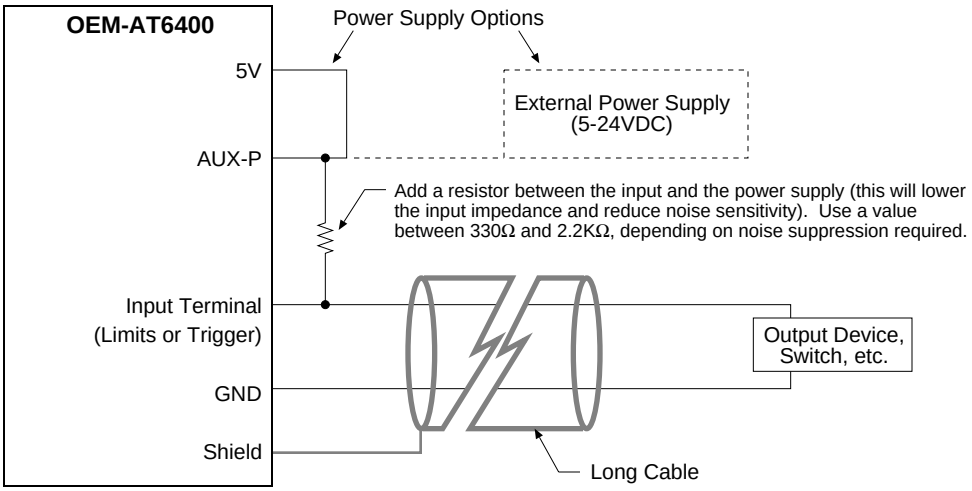
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Bear in mind that the length of the cables is directly related to noise sensitivity; lengthening cables increases noise sensitivity. The maximum length of cables is ultimately determined by the environment in which the equipment will be used. (The optional VM60 screw terminal includes a 5 foot long ribbon cable.)

The input and output lines on the OEM-AT6400 are **not** optically isolated. The state of the ground plane in most PCs can leave the OEM-AT6400 susceptible to ground-loop noise. Follow the precautions below to minimize noise problems.

- Use a minimum wire size of 22 AWG.
- Use twisted pair shielded cables and connect the shield to a **SHLD** pin (pins 58 and 60) on the 60-pin connector. Leave the other end of the shield disconnected.
- Do not route I/O signals in the same conduit or wiring trays as high-voltage AC wiring or motor wiring.
- Provide some form of isolation for the I/O, preferably optical isolation, to reduce the effects of noise in your system.

Reducing noise on limit and trigger inputs. If you are experiencing noise problems, try adding resistors to reduce noise sensitivity (see illustration below).



See Appendix A for additional information about reducing electrical noise.

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Installation Test *(DOS Support Software)*

The DOS Support Software diskette (supplied in the ship kit) contains a utility program to help verify proper system installation. The program is called `TEST.EXE`. To verify system installation, follow the steps below.

> ⚠ **WARNING** ⚠
>
> The test program allows you to control I/O and produce motion. Make sure that exercising the I/O will not adversely affect other components in your system. If you have coupled the load to the motor, make sure that the load can move without causing injury to equipment or personnel.

1. Apply power to the computer system and the motor drives.
2. Install the DOS support software by placing the DOS Support Software Diskette in drive A and typing `a:\install`.
3. When prompted, identify the destination drive and directory. The default directory is AT6400.
4. Change to the directory in which you installed the DOS Support Software. If you installed the support software in the default directory, type `cd \AT6400`.
5. Initiate the test program by typing `TEST`.
6. The program prompts you to identify the AUX board version you are using. The OEM-AT6400 does not use an AUX board, but Type "1" to select AUX1 and press ENTER.
7. The program prompts you for the base port address of the OEM-AT6400 PC card. If you have not changed the default DIP switch setting (default is 768 decimal), just press ENTER. If you changed the DIP switch (see page 4), type in the new address and press ENTER.
   The program displays this menu:

```
     Parker Compumotor's Motion and I/O Test Program

1.  Limits
2.  Pulse Cutoff (P-CUT)  [Not applicable for OEM-AT6400]
3.  Programmable Inputs
4.  Joystick Inputs  [Not applicable for OEM-AT6400]
5.  Programmable Outputs
6.  Encoders  [Not applicable for OEM-AT6400]
7.  Motion
8.  Terminal Emulation
9.  Exit
```

8. Step through menu items 1, 3, 5, and 7, following the test procedures within each selection. To execute each menu item, type in the number of the desired selection (or use an arrow key to position the cursor on the selection) and press ENTER.
   NOTE: The P-CUT, Joystick, and Encoder features are not available on the OEM-AT6400, so menu items 2, 4, and 6 are not applicable. Also, note that on menu items 3 and 5 that the OEM-AT6400 only has 6 programmable inputs, 4 trigger inputs, and 4 programmable outputs.
9. Select menu item #8 (`Terminal Emulation`). The program prompts you for the OEM-AT6400 address–repeat step 7 above. Terminal Emulation places the computer in direct communication with the OEM-AT6400 card. While in this mode, you can send 6000 Series commands directly to the OEM-AT6400.

   As an example, type `TSTAT`. The computer then displays a screen full of OEM-AT6400 status information. Press Esc to return to the main menu.
10. Type `9` and press ENTER to exit the test program.

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What's Next?

By now, you should have completed this chapter's configuration, mounting, connection, and test instructions. You should be ready to begin developing your motion control program based on the 6000 Series programming language.

Assuming you have already determined your system's motion control requirements and identified the OEM-AT6400 software features that you will use in your application, refer to your *6000 Series Programmer's Guide* to learn how to implement these features. Be sure to keep the *6000 Software Reference Guide* at hand as a reference for the 6000 Series command descriptions.

Motion Architect

To assist you in your programming effort, we recommend using Motion Architect®, an intuitive Microsoft® Windows™ based programming tool. Motion Architect is available as part of the ship kit for the OEM-AT6400 (p/n OEM-AT6400 shipkit). Motion Architect provides these features (refer to the *Motion Architect User Guide* for detailed information):

- **System configurator and code generator**: Automatically generate controller code for basic system set-up parameters (I/O definitions, drive configuration operations, etc.).
- **Program editor**: Create blocks or lines of 6000 controller code, or copy portions of code from previous files. You can save program editor files for later use in BASIC, C, etc., or in the terminal emulator or test panel.
- **Terminal emulator**: Communicating directly with the 6000 controller, the terminal emulator allows you to type in and execute controller code, transfer code files to and from the 6000 product. You can also use this module to transfer (download) the soft operating system.
- **Test panel and program tester**: You can create your own test panel to run your programs and check the activity of I/O, motion, system status, etc. This can be invaluable during start-ups and when fine tuning machine performance.
- **On-line context-sensitive help and technical references**: These on-line resources provide help information about Motion Architect, as well as interactive access to the contents of the *6000 Series Software Reference Guide*.
- **Dynamic Link Library**: A DLL device driver is provided for bus-based controller customers who wish to create a Windows-based application to interface with the controller.

Other Software Tools Available
(Contact your local Automation Technology Center (ATC) or distributor)

- **CompuCAM™**. A CAD-to-Motion (CAM) program that allows you to easily translate DXF, HP-GL, and G-Code files into 6000 Series Language motion programs.
- **DDE6000™**. Facilitates data exchange between the OEM-AT6400 and Windows™ applications that support the dynamic data exchange (DDE) protocol. NetDDE™ compatible.
- **Motion Toolbox™**. A library of LabVIEW® virtual instruments (VIs) for programming and monitoring the OEM-AT6400.

Technical Support

Troubleshooting instructions are provided in chapter 2 of this manual (for hardware-related problems) and in the *6000 Series Programmer's Guide* (for software-related problems). If you cannot find the answer in this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance.

If you need to talk to our in-house application engineers, please contact us at the phone/FAX/BBS numbers listed on the inside cover of this manual. (The phone numbers are also provided when you issue the HELP command to the OEM-AT6400.) **NOTE**: The BBS contains the latest software upgrade opportunities and late-breaking product documentation.

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CHAPTER TWO

2 Troubleshooting

IN THIS CHAPTER

• Troubleshooting basics:
  - Reducing electrical noise
  - Diagnostic LED
  - Test program
  - Motion Architect Test Panel
  - Technical support
• Solutions to common problems
• Corrective actions in response to operating system download errors
• Product repair procedure

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Troubleshooting Basics

When your system does not function properly (or as you expect it to operate), the first thing that you must do is identify and isolate the problem. When you have accomplished this, you can effectively begin to resolve the problem.

The first step is to isolate each system component and ensure that each component functions properly when it is run independently. You may have to dismantle your system and put it back together piece by piece to detect the problem. If you have additional units available, you may want to exchange them with existing components in your system to help identify the source of the problem.

Determine if the problem is mechanical, electrical, or software-related. Can you repeat or re-create the problem? Random events may appear to be related, but they are not necessarily contributing factors to your problem. You may be experiencing more than one problem. You must isolate and solve one problem at a time.

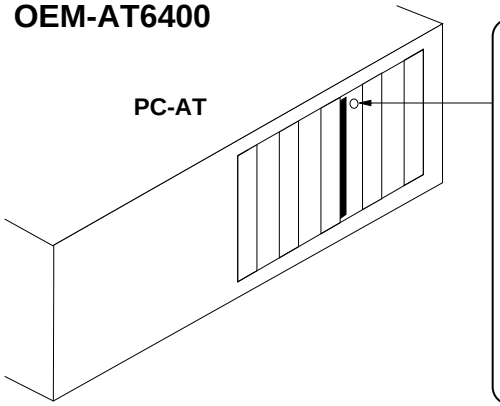
Log (document) all testing and problem isolation procedures. Also, if you are having difficulty isolating a problem, be sure to document all occurrences of the problem along with as much specific information as possible. You may need to review and consult these notes later. This will also prevent you from duplicating your testing efforts.

Once you isolate the problem, refer to the problem solutions contained in this chapter. If the problem persists, contact your local technical support resource (see *Technical Support* below).

Reducing Electrical Noise

Refer to the guidelines on page 14 and in Appendix A. General information on reducing electrical noise can be found in the Engineering Reference section of the Parker Compumotor/Digiplan *Positioning Control Systems and Drives Catalog*.

Diagnostic LED



After applying power, the LED will be off. After downloading the operating system, the status LED will turn green indicating the system is ready for operation. If the LED does not turn green after downloading the operating system, an error has occurred. The download program (`AT6400`) issues an error message if it cannot find the card or if the download operation is not successful (refer also to the Downloading Error Table provided later in this chapter).

Board Monitor Alarm (BMA): Detects un-recoverable faults in hardware and software. When the BMA detects a fault, the LED turns off. The BMA can be reset by cycling power to the PC-AT, or by re-downloading the operating system.

Test Program

A test program is available to test the functionality of many system components. Refer to page 15 for step-by-step test procedures.

CAUTION

The TEST program will re-download the OEM-AT6400 operating system, erasing all programs stored in the OEM-AT6400. Therefore, prior to launching the TEST program, you should save a copy of your application program to a disk.

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Motion Architect's Panel Module

As an alternative to the test program noted above, you can use the Panel Module in Motion Architect. The Panel Module allows you to set up displays for the purpose of testing various system I/O and operating parameters. For more information, refer to the *Motion Architect User Guide*.

Technical Support

If you cannot solve your system problems using this documentation, contact your local Automation Technology Center (ATC) or distributor for assistance. If you need to talk to our in-house application engineers, please contact us at the phone/FAX/BBS numbers listed on the inside cover of this manual. (The phone numbers are also provided when you issue the HELP command to the OEM-AT6400.) **NOTE**: The BBS contains the latest software upgrade opportunities and late-breaking product documentation.

Common Problems & Solutions

NOTE

Some software-related causes are provided because it can sometimes be difficult to identify a problem as either hardware or software related.

Problem	Cause	Solution
Communication errors.	1. Communication program looking for card at wrong address. 2. Address conflict. 3. OEM-AT6400 card not properly seated.	1. Select correct address for communication program. 2. See *Address Selection* section below. 3. Seat board properly in slot. Apply pressure directly over area with gold card edge fingers.
Computer will not boot with OEM-AT6400 installed.	1. Interrupt conflict. 2. See problem: *Communication Errors.*	1.a. Turn interrupt DIP switches OFF. 1.b. See *Interrupt Selection* section below.
Direction is reversed.	1. Direction connections on OEM-AT6400 card reversed. 2. Phase of step motor reversed.	1. Switch DIR+ with DIR- connection to drive. 2. Switch PHA+ with PHA- connection from drive to motor.
Distance is incorrect as programmed.	1. Incorrect resolution setting. 2. Pulse width too narrow.	1. Set the resolution on the drive (usually set with DIP switches) to match the OEM-AT6400's DRES command setting (default DRES setting is 25,000 steps/rev). 2. Set pulse width to drive specifications using the PULSE command.
Erratic operation.	1. Electrical Noise. 2. Improper shielding. 3. Improper wiring.	1. Reduce electrical noise or move OEM-AT6400 away from noise source. 2. Refer to the Electrical Noise portion of the Technical Reference section in the Compumotor/Digiplan catalog. 3. Check wiring for opens, shorts, & mis-wired connections.

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Common Problems and Solutions *(continued)*

Problem	Cause	Solution
LED: LED on OEM-AT6400 PC card is off.	1. No power. 2. Operating system not downloaded.	1. Check PC-AT power and check proper card installation in bus slot. 2. Download operating system.
LED: LED on OEM-AT6400 PC card is red.	1. Internal Board Monitor Alarm (BMA) has detected a non-recoverable fault.	1.a. Recycle power to the OEM-AT6400. 1.b. Ensure +5V is not shorted to GND on the I/O connections.
Motion does not occur.	1. STATUS LED on OEM-AT6400 PC card off or red. 2. End-of-travel limits are active. 3. Step pulse too narrow for drive to recognize. 4. Improper wiring. 5. Load is jammed. 6. No torque from motor.	1. See LED troubleshooting as noted above. 2a. Move load off of limits or disable limits with the `LHØ,Ø,Ø,Ø` command. 2b. Set `LSCW` to a value less than `LSCCW`. 3. Set pulse width to drive specifications using the `PULSE` command. 4. Check step , direction, & limit connections. 5. Remove power and clear jam. 6. See problem: *Torque, loss of.*
Mouse stops working or serial ports affected (after OEM-AT6400 is installed).	1. Interrupt conflict. 2. Address conflict.	1. See *Interrupt Selection* section below. 2. See *Address Selection* section below.
Operating system will not download, or download stops part way through.	1. Address conflict. 2. Download error.	1. See *Address Selection* section below. 2. See *Downloading Errors* table below.
Programmable inputs not working.	1. IN-P (input pull-up) on OEM-AT6400 card not connected to a power supply. 2. If external power supply is used, the grounds must be connected together. 3. Improper wiring.	1a. When inputs will be pulled down to 0V by an external device, connect IN-P to +5V supply on the OEM-AT6400 card or other positive supply. 1b. When inputs will be pulled to 5V or higher by an external device, connect IN-P to 0V. 2. Connect external power supply's ground to OEM-AT6400's ground (GND). 3. Check wiring for opens, shorts, and mis-wired connections.
Programmable outputs not working.	1. Output connected such that it must source current (pull to positive voltage). 2. OUT-P (output-pull-up) on OEM-AT6400 card not connected to a voltage source. 3. If external power supply is used, the grounds must be connected together. 4. Improper wiring.	1. Outputs are open-collector and can only sink current -- change wiring. 2. Connect OUT-P to the +5V supply on the OEM-AT6400 card or to an external supply of up to 24V. 3. Connect the external power supply's ground to the OEM-AT6400's ground (GND). 4. Check wiring for opens, shorts, and mis-wired connections.
Torque, loss of.	1. Improper wiring. 2. No power to drive. 3. Drive failed. 4. Drive faulted. 5. Drive shutdown.	1. Check wiring to drive enable input on drive as well as other system wiring. 2. Check power to drive. 3. Check drive status. 4. Check drive status. 5. Enable drive with the `DRIVE1111` command.
Trigger inputs not working.	1. If external power supply is used, the grounds must be connected together. 2. Improper wiring. 3. Make sure INFEN 1 and INFNC-25 are set appropriately.	1. Connect external power supply's ground to OEM-AT6400's ground (GND). 2.a. Check wiring for opens, shorts, and mis-wired connections. 2.b. When inputs will be pulled down to 0V by an external device, connect AUX-P to +5V supplied or other positive supply. 2.c. When inputs will be pulled to 5V or higher by an external device, connect AUX-P to 0V.
Velocity & acceleration is incorrect as programmed.	See *Distance* problem noted above.	

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Interrupt & Address Selection

CAUTION

Refer to your PC-AT's documentation to avoid interrupt and address conflicts, and the resulting possibility of system damage.

If you are using Motion Architect and you change these settings, be sure to configure the same address and interrupt settings in Motion Architect's Terminal or Panel modules.

Interrupts

The OEM-AT6400 is factory configured with no interrupts selected. The OEM-AT6400 does not need them to function properly. If you want to use interrupts, select an interrupt in your system that is not already used (refer to instructions on page 4).

Interrupts that are unassigned on the AT bus are IRQ10, 11,12, and 15. If serial port COM1 is not used, IRQ4 may be available. If serial port COM2 is not used, IRQ3 may be available. IRQ5 and 7 are defined for parallel printer ports and one or both of these may be available if your system has one or no parallel printer ports.

Address

The OEM-AT6400 is factory-set to address 300H. If another card in your system uses address 300H (default setting), select a different address (refer to instructions on page 4).

If you are unsure which addresses are used, the following address are likely to be available: 308H, 310H, 318H, 380H, 388H, 3A0H, or 3A8H.

Downloading Errors *(downloading the operating system)*

Error	Description	Reason/Corrective Action
1	Operating System File Not Found	The operating system specified, or the default operating system (if unspecified) could not be found by the `AT6400.EXE` loader program. Put the `AT6400.OPS` file in the same directory as the `AT6400.EXE` file.
2	Invalid Operating System File	The operating system specified, or the default operating system (if unspecified) is not a valid operating system or is corrupted. Re-install the operating system from the original disk.
3	Unexpected EOF	An EOF character was received during the download. Re-install the operating system from the original disk.
4	Invalid Port Address	The port address specified while downloading is invalid. Use another address setting ($768 \leq$ port ≤ 1024 in increments of 8).
5	Unknown Option	An unknown option was specified on the `AT6400.EXE` command line.
6	Base Port Address Greater than 1024	The base port address is too high. Specify an address between 768 and 1024 decimal with the `/PORT=` parameter.
7	Base Port Address Less than 255	The base port address is too low. Specify an address between 768 and 1024 decimal with the `/PORT=` parameter.
8	Base Port Address Not a Multiple of 8	The base port address is not a multiple of 8. Specify a valid address with the `/PORT=` parameter.
9	Modified Download Requested	A partial download was requested on the command line.
10	Card Controller Error	The card controller did not respond as expected. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.
11	Card Not found	The card did not respond as expected. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.
12	Reading Card Rev	The card appeared to be working as expected until the revision was requested. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.
13	Waiting for Data Ready	The card did not respond when expected. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.
14	Purging Data Out Buffer	The card output buffer could not be emptied. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.
15	Waiting for Data Input Buffer Empty	The card did not respond to the data sent to it. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address.

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Downloading Errors *(continued)*

Error	Description	Reason/Corrective Action
16	Time-out Waiting for Processor Startup	The card did not respond as expected. The green LED on the back of the PC-card should be on for this error to occur. Verify that you are downloading to the correct address. Make sure there are no other peripheral cards (network adapters, bus mouse, etc.) at the same address. Try changing the card address. Use a fresh copy of the operating system from the disk that was shipped with the card. If the green LED on the back of the card flashes briefly during download of the operating system, the card may need repair.
17	CRC Error	The CRC value calculated during download is not the same as stored with the operating system. Either the file is corrupted on disk, or was corrupted during download. Try a fresh copy of the operating system. If your computer has a Turbo switch, switch it to low speed because some computers violate ISA bus timing specifications at high speed.
18	Operating System Rev not Compatible with Loader Rev	The operating system being downloaded is not compatible with the `AT6400.EXE` file (downloader) being used. Use the same downloader on the diskette with the operating system.
19	Incompatible Card ROM rev	The card ROMS and the `AT6400.EXE` file (downloader) are incompatible. If you are using a new downloader, obtain a new set of ROMS from the factory.
20	Card Read Error (bad compare)	The downloader is unable to communicate reliably with the card. Try switching to 8-bit mode on the card, switching out of Turbo mode on your PC, or a different address.
21	Card Read Error (outbuf)	The downloader is unable to empty the output buffer. There may be an address conflict with another board. Try a different address.
22	Card ROMS - Command Line Parameter Passing Not Supported	The card ROMS are an old revision that do not support command line arguments. Obtain a ROM update from the factory.
23	Card ROMS - Unsupported Option Requested	The card ROMS do not support the option specified on the command line. Obtain a ROM update from the factory.
24	NULL Error	

Product Repair Procedure

Step 1 Obtain the serial number and the model number (OEM-AT6400) of the defective unit, and secure a purchase order number to cover repair costs in the event the unit is determined by the manufacturers to be out of warranty.

Step 2 Before you return the unit, have someone from your organization with a technical understanding of the OEM-AT6400 system and its application include answers to the following questions:

- What is the extent of the failure/reason for return?
- How long did it operate?
- Did any other items fail at the same time?
- What was happening when the unit failed (e.g., installing the unit, cycling power, etc.)?
- How was the product configured (in detail)?
- What, if any, cables were modified and how?
- With what equipment is the unit interfaced?
- What was the application?
- What was the system environment (temperature, enclosure, spacing, contaminants, etc.)?
- What upgrades, if any, are required (hardware, software, user guide)?

Step 3 In North America, call Parker Compumotor for a Return Material Authorization (RMA) number. Returned products cannot be accepted without an RMA number. The phone number for Parker Compumotor Applications Department is (800) 358-9070 or (707) 584-7558.

Ship the unit to: Parker Hannifin Corporation, Compumotor Division
5500 Business Park Drive, Suite D
Rohnert Park, CA 94928
Attn: RMA # xxxxxxx

Step 4 In the UK, call Parker Digiplan for a GRA (Goods Returned Authorization) number. Returned products cannot be accepted without a GRA number. The phone number for Parker Digiplan Repair Department is 0202-690911. The phone number for Parker Digiplan Service/Applications Department is 0202-699000.

Ship the unit to: Parker Digiplan Ltd.,
21, Balena Close,
Poole, Dorset,
England. BH17 7DX

Step 5 Elsewhere: Contact the distributor who supplied the OEM-AT6400.

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Appendix A: Reducing Electrical Noise

Noise-related difficulties can range in severity from minor positioning errors to damaged equipment from runaway motors crashing blindly through limit switches. In microprocessor-controlled equipment such as the OEM-AT6400, the processor constantly retrieves instructions from the PC-AT and from on-board memory in a controlled sequence. If an electrical disturbance occurs, it may cause the processor to misinterpret an instruction or access the wrong data. This can be catastrophic to the program and force you to reset the processor.

Sources of Noise

Being invisible, electrical noise can be very mysterious, but it invariably comes from the following sources:

- Power line noise
- Externally conducted noise
- Transmitted noise
- Ground loops

The following electrical devices are notorious for generating unwanted electrical noise conditions:

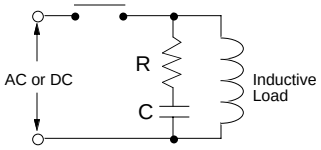
- Coil-driven devices: conducted and power line noise
- SCR-fired heaters: transmitted and power line noise
- Motors & motor drives: transmitted and power line noise
- Welders (electric): transmitted and power line noise

Power Line Noise

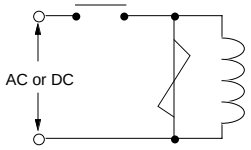
Power line noise is usually easy to resolve due to the wide availability of line filtering equipment for the industry. Only the most severe situations call for an isolation transformer. Line filtering equipment is required when other devices connected to the local power line are switching large amounts of current, especially if the switching occurs at a high frequency.

Any device having coils is likely to disrupt the power line when it is switched off. Surge suppressors, such as metal oxide varistors (MOVs) are capable of limiting this type of electrical noise. A series resistor/capacitor (RC) network across the coil is also effective (resistance: 500 to 1,000 Ω; capacitance: 0.1 to 0.2 μF). Coil-driven devices (inductive loads) include relays, solenoids, contractors, clutches, brakes, and motor starters.

Typical RC Network



MOV

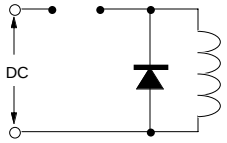


Externally Conducted Noise

Externally-conducted noise is similar to power line noise, but the disturbances are created on signal and ground wires that are connected to the OEM-AT6400. This kind of noise can get into logic circuit ground or into the processor power supply and scramble the program. The problem here is that control equipment often shares a common DC ground wire that may be connected to several devices, such as a DC power supply, programmable controller, remote switches, etc. When a noisy device like a relay or solenoid is attached to the DC ground, it may cause disturbances within the OEM-AT6400.

To solve a noise problem caused by DC mechanical relays and solenoids, you can connect a diode backwards across the coil to clamp the induced voltage *kick* that the coil will produce. The diode should be rated at 4 times the coil voltage and 10 times the coil current. Using solid state relays is another way to eliminate this problem.

Diode



To eliminate ground loops, multiple devices on the same circuit should be grounded together at a single point.

Furthermore, power supplies and programmable controllers often have DC common tied to Earth (AC power ground). As a rule, it is preferable to have the OEM-AT6400 signal ground or DC common floating with respect to Earth. This prevents noisy equipment which is grounded to Earth from sending noise into the OEM-AT6400. When floating the signal ground is not possible, you should make the Earth ground connection at only one point.

In many cases, optical isolation may be required to completely eliminate electrical contact between the OEM-AT6400 and a noisy environment. Solid state relays provide this type of isolation.

Transmitted Noise

Transmitted noise is picked up by external connections to the OEM-AT6400, and in severe cases can attack the OEM-AT6400 when there are no external connections. The sheet metal enclosure of your computer will typically shield the electronics from this, but openings in the enclosure for connections and front panel controls may *leak*.

When high current contacts open, they draw an arc, producing a burst of broad spectrum radio frequency noise that can be picked up on a limit switch or other wiring. High-current and high-voltage wires have an electrical field around them and may induce noise on

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signal wiring, especially when they are tied in the same wiring bundle or conduit.

When this kind of problem occurs, you should consider shielding signal cables or isolating the signals. A proper shield surrounds the signal wires to intercept electrical fields, but this shield must be tied to Earth to drain the induced voltages. At the very least, wires should be run in twisted pairs to limit straight line antenna effects.

Even the worst noise problems in environments near 600 amp welders and 25kW transmitters have been solved using enclosures, conduit, optical isolation, and single-point ground techniques.

Ground Loops

Ground Loops are the most mysterious noise problems. Symptoms like garbled transmissions and intermittent operation are typical.

The problem occurs in systems where multiple Earth ground connections exist, particularly when these connections are far apart.

The way to test for and ultimately eliminate a ground loop is to lift or *cheat* Earth ground connections in the system until the symptoms disappear.

Defeating Noise

The best time to handle electrical noise problems is before they occur. When a motion system is in the design process, the designer should consider the following set of guidelines for system wiring (in order of importance):

① Put surge suppression components on all electrical coils: Resistor/capacitor filters, MOVs, Zener and clamping diodes.

② Shield all remote connections, use twisted pairs. Shields should be tied to Earth at one end.

③ Put all microelectronic components in an enclosure. Keep noisy devices outside. Watch internal temperature.

④ Ground signal common wiring at one point. Float this ground from Earth if possible.

⑤ Tie all mechanical grounds to Earth at one point. Run chassis and motor grounds to the frame, and the frame to Earth.

⑥ Isolate remote signals. Solid state relays or opto isolators are recommended.

⑦ Filter the power line. Use common RF filters, and use an isolation transformer for worst case.

A noise problem must be identified before it can be solved. The obvious way to approach a problem situation is to eliminate potential noise sources until the symptoms disappear, as in the case of ground loops. When this is not practical, use the above guidelines to make the installation as robust as possible.

References

Information about the equipment referred to may be obtained by calling the numbers listed below.

- Corcom line filters, (214) 386-5515
- Opto-22 optically isolated relays, (408) 496-6611
- Crydom optically isolated relays, (415) 463-2250
- Potter Brumfield optically isolated relays, (812) 386-1000
- Teal power line isolation filters, (800) 888-8325

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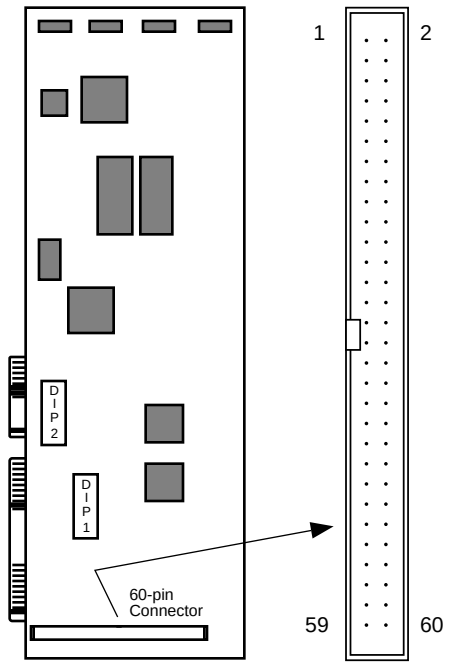
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OEM-AT6400 Controller

Parker Automation

Connections

see also pages 6-14



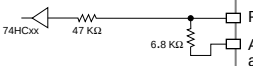
PIN OUTS FOR 60-PIN CONNECTOR

Pin	Function	Pin	Function
1	Step 1 +	2	Step 1 –
3	Direction 1 +	4	Direction 1 –
5	Step 2 +	6	Step 2 –
7	Direction 2 +	8	Direction 2 –
9	Step 3 +	10	Step 3 –
11	Direction 3 +	12	Direction 3 –
13	Step 4 +	14	Step 4 –
15	Direction 4 +	16	Direction 4 –
17	POS 1	18	+5V
19	NEG 1	20	GND
21	HOM 1	22	GND
23	POS 2	24	GND
25	NEG 2	26	GND
27	HOM 2	28	GND
29	POS 3	30	GND
31	NEG 3	32	+5V
33	HOM 3	34	AUX-P
35	POS 4	36	+5V
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47	TRIG-D	48	OUT 3
49	IN 1	50	OUT 4
51	IN 2	52	GND
53	IN 3	54	GND
55	IN 4	56	GND
57	IN 5	58	SHLD
59	IN 6	60	SHLD

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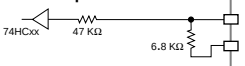


POS, NEG, HOM, or TRG-x

AUX-P (connect to +5V on the 60-pin connector, or to an external supply of up to 24VDC)

Specs: HCMOS-compatible*; voltage range = 0-24VDC.

Programmable Inputs

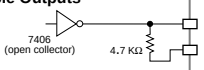


General-purpose Programmable Input

IN-P (Connect to +5V on the 60-pin connector, or to an external supply of up to 24VDC. To sink current, connect to a GND pin.)

Specs: HCMOS-compatible*; voltage range = 0-24VDC.

Programmable Outputs

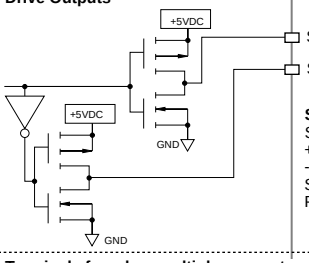


General-purpose Programmable Output

OUT-P (connect to the +5V on the 60-pin connector, or to an external supply of up to 24VDC)

Specs: Open collector output.
Max. voltage in OFF state (not sinking current) = 24V,
max. current in ON state (sinking) = 30mA.

Drive Outputs

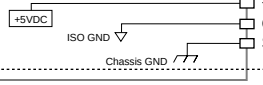


Step+ or Direction+ (pins 1, 3, 5, 7, 9, 11, 13, or 15)

Step– or Direction– (pins 2, 4, 6, 8, 10, 12, 14, or 16)

Specs: Differential line driver output.
Signal high ≥ 3.25VDC @ +30mA; signal low ≤ 1.0VDC @ -30mA.
+output for each differential driver is active high;
-output for each driver is active low.
Step pulse width is 0.3 µs to 20 µs (depends on the value of the PULSE command—default is 0.3 µs).

Terminals found on multiple connectors



+5V
GND
SHLD

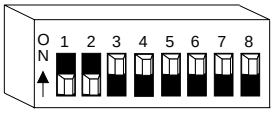
5V Load Limit (for all I/O connections): typically 1.0 A, depends on power supply of PC.

** HCMOS-compatible levels: Low ≤ 1.00V, High ≥ 3.25V.*

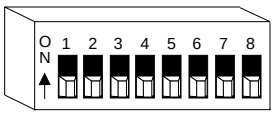
DIP Switch Factory Default Settings

DIP Switch 1 is used to set the Address and Transfer Mode.
DIP Switch 2 is used to set Interrupts.

DIP Switch 1

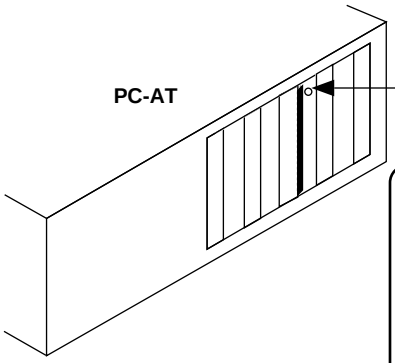


DIP Switch 2



Troubleshooting

see also pages 18 -22



After applying power, the LED will be off. After downloading the operating system, the status LED will turn green indicating the system is ready for operation. If the LED does not turn green after downloading the operating system, an error has occurred. The download program (AT6400) issues an error message if it cannot find the card or if the download operation is not successful (refer also to the Downloading Error Table provided Chapter 2).

Board Monitor Alarm (BMA): Detects un-recoverable faults in hardware and software. When the BMA detects a fault, the LED turns off. The BMA can be reset by cycling power to the PC-AT, or by re-downloading the operating system.

- LED – see illustration (above).
- Status information (see command descriptions in *6000 Series Software Reference Guide*):
  Axis status (general problem conditions)...TAS command
  Limit switches.....TLIM command
  Programmable and trigger inputs.....TIN command
  Programmable outputs.....TOUT command
- Programmable input functions (INFNC command) will not be operable until you enable input functions with the INFEN1 command.
- To help prevent electrical noise, shield all connections at one end only.
- Error messages while programming or executing programs – see the *6000 Series Programmer's Guide*.
- Download errors – see page 21.
- Address, transfer mode, and interrupt DIP switch settings – see page 4.
- Technical support – see phone numbers on inside of front cover.

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