

# Altivar® 31

Adjustable Speed Drive Controllers

Variadores de velocidad ajustable

Variateurs de vitesse



Installation Manual  
Guía de instalación  
Guide d'installation

Retain for future use.  
Conservar para uso futuro.  
À conserver pour usage ultérieur.



a brand of  
**Schneider**  
Electric



**Telemecanique**



**Altivar® 31 Adjustable Speed Drive Controllers**  
**Installation Manual**

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ENGLISH

**Variadores de velocidad Ajustable Altivar® 31**  
**Guía de instalación**

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ESPAÑOL

**Variateurs de vitesse Altivar® 31**  
**Guide d'installation**

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FRANÇAIS

ENGLISH

ESPAÑOL

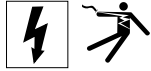
FRANÇAIS

## TABLE OF CONTENTS

Before You Begin .....	7
Introduction .....	8
Catalog Numbers .....	8
Receiving and Preliminary Inspection .....	8
Storing and Shipping .....	8
Precautions .....	9
Technical Specifications .....	10
Ratings .....	12
Dimensions and Weights .....	15
Mounting .....	16
Clearances .....	16
Removing the Protective Cover .....	16
Mounting Methods .....	17
Derating Curves .....	17
Minimum Air Flow Rates .....	18
Electromagnetic Compatibility .....	19
Mounting in a Type 12 or IP54 Metal Enclosure .....	20
Calculating Enclosure Size .....	20
Ventilation .....	21
Bus Voltage Measurement Procedure .....	22
General Wiring Practices .....	22
Branch Circuit Connections .....	23
Output Wiring .....	24
Grounding .....	25
Wiring .....	26
Access to Terminals .....	26
Power Terminals .....	26
Arrangement of the Power Terminals .....	28
Control Terminals .....	29
Wiring Diagram for Factory Settings .....	31
Logic Input Switch .....	32
Recommended Circuit Diagrams:	
Positive (Source) Logic .....	33
Recommended Circuit Diagrams: Negative (Sink) Logic .....	34
Operation on an Impedance Grounded System .....	35
Recommended Fuses .....	36
Available Torque .....	37
Drive Controller Ventilation .....	38
Motor Thermal Protection .....	38
Electromagnetic Compatibility .....	39
Installation Recommendations for Meeting EN 55011 Class A .....	39
Index .....	41

## HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **⚠ DANGER**

**DANGER** indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

### **⚠ WARNING**

**WARNING** indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

### **⚠ CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

### **CAUTION**

**CAUTION**, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

## PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

## DRIVES PRODUCT SUPPORT

The Product Support Group is staffed from 8:00 am until 6:00 pm Eastern time to assist with product selection, start-up, and diagnosis of product or application problems. Emergency phone support is available 24 hours a day, 365 days a year.

Toll free	888-Square D (888-778-2733)
Telephone	919-266-8600
E-mail	drive.products.support@us.schneider-electric.com
Fax	919-217-6508

## BEFORE YOU BEGIN

Read and follow these precautions before beginning any procedure with this drive controller.

### **⚠ DANGER**

#### **HAZARDOUS VOLTAGE**

- Read and understand this manual before installing or operating the Altivar 31 drive controller. Installation, adjustment, repair, and maintenance must be performed by qualified personnel.
- For more information on Altivar 31 drive controllers, see the *Altivar 31 Start-Up Guide*, VVDED303043US, and the *Altivar 31 Programming Manual*, VVDED303042US. Both manuals are shipped on a CD with the drive controller. They are also available from [www.us.SquareD.com](http://www.us.SquareD.com) or from your Schneider Electric representative.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. **DO NOT TOUCH.** Use only electrically insulated tools.
- **DO NOT** touch unshielded components or terminal strip screw connections with voltage present.
- **DO NOT** short across terminals PA and PC or across the DC bus capacitors.
- Install and close all covers before applying power or starting and stopping the drive controller.
- Before servicing the drive controller:
  - Disconnect all power.
  - Place a “DO NOT TURN ON” label on the drive controller disconnect.
  - Lock the disconnect in the open position.
- Disconnect all power including external control power that may be present before servicing the drive controller. **WAIT 3 MINUTES** for the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure on page 22 to verify that the DC voltage is less than 45 Vdc. The drive controller LEDs are not accurate indicators of the absence of DC bus voltage.

**Electric shock will result in death or serious injury.**

## INTRODUCTION

The Altivar 31 (ATV31) family of adjustable frequency AC drive controllers is used for controlling three-phase asynchronous motors. The controllers range from:

- 0.25 to 3 hp (0.18 to 2.2 kW), 208/230/240 V, single-phase input
- 0.25 to 20 hp (0.18 to 15 kW), 208/230/240 V, three-phase input
- 0.5 to 20 hp (0.37 to 15 kW), 400/460/480 V, three-phase input
- 1 to 20 hp (0.75 to 15 kW), 525/575/600 V, three-phase input

This manual contains installation instructions for ATV31 drive controllers. The following documentation is also provided with the controller:

- *Altivar 31 Start-Up Guide*, VVDED303043US
- *Altivar 31 Programming Manual*, VVDED303042US (on CD only)

## CATALOG NUMBERS

Refer to Table 1 for a guide to interpreting ATV31 drive controller catalog numbers. ATV31HU15M2A is used as an example catalog number.

**Table 1: ATV31 Catalog Numbers**

Drive Controller Family:	Type:	Rating:	Voltage Range:	Variation:
ATV31	H	U15	M2	A
	H: Heatsink product C: Enclosed product K: Kit product	O: 0 to 0.99 kW U: 1 to 9.99 kW D: 10 to 99.99 kW	M2: 200 V / 240 V, 1 phase M3X: 200 V / 240 V, 3 phase without filter N4: 380 V / 500 V, 3 phase S6X: 525 V / 600 V, 3 phase without filter	A: with local control panel

## RECEIVING AND PRELIMINARY INSPECTION

Before installing the ATV31 drive controller, read this manual and follow all precautions.

- Before removing the drive controller from its packaging, verify that the carton was not damaged in shipping. Carton damage usually indicates improper handling and the potential for device damage. If any damage is found, notify the carrier and your Schneider Electric representative.
- After removing the drive controller from its packaging, visually inspect the exterior for shipping damage. If any is found, notify the carrier and your sales representative. Do not install a damaged device.
- Verify that the drive controller nameplate and label conform to the packing slip and corresponding purchase order.

### **⚠ CAUTION**

#### **DAMAGED EQUIPMENT**

Do not operate or install any drive controller that appears damaged.

**Failure to follow this instruction can result in injury or equipment damage.**

## STORING AND SHIPPING

If the drive controller is not being immediately installed, store it in a clean, dry area with an ambient temperature between -25 and +70 °C (-13 to +158 °F). If the drive controller must be shipped to another location, use the original shipping carton and packing material to protect it.



## PRECAUTIONS

Before powering up and configuring the drive controller, read and observe the following precautions.

### **▲ DANGER**

#### **UNINTENDED EQUIPMENT OPERATION**

- Before powering up and configuring the drive controller, ensure that the logic inputs are switched off (state 0) to prevent unintended starting.
- An input assigned to the run command may cause the motor to start immediately on exiting the configuration menus.

**Failure to follow these instructions will result in death or serious injury.**

### **CAUTION**

#### **INCOMPATIBLE LINE VOLTAGE**

- Before powering up and configuring the drive controller, ensure that the line voltage is compatible with the supply voltage range shown on the drive controller nameplate.
- The drive controller may be damaged if the line voltage is not compatible.

**Failure to follow this instruction can result in equipment damage.**

## TECHNICAL SPECIFICATIONS

**Table 2: Environment**

Degree of Protection	<ul style="list-style-type: none"> <li>IP20 without protective vent cover, NEMA 1, UL open type.</li> <li>IP21 on wiring terminals</li> <li>IP31 and IP41 all other areas</li> <li>UL Type 1 without removal of the protective vent cover from the top of the controller and with the addition of the Conduit Entry Kit (see page 16).</li> </ul>
Resistance to vibrations	Conforming to IEC/EN 60068-2-6: 1.5 mm peak to peak from 3 to 13 Hz, 1 gn from 13 to 150 Hz
Resistance to shocks	15 gn for 11 ms conforming to IEC/EN 60068-2-27
Pollution degree	Pollution degree 2 according to UL 840. Protect the drive controller against dust, corrosive gas, and falling liquid.
Maximum relative humidity	96% maximum, non-condensing and without dripping (provide heating system if there is condensation) Conforms to IEC 60068-2-3
Maximum ambient temperature	Storage: -13 to +158 °F (-25 to +70 °C) Operation: +14 to +122 °F (-10 to +50 °C) without vent cover removed and without derating +14 to +140 °F (-10 to +60 °C) with vent cover removed and with derating. Refer to derating curves on page 17.
Altitude	Up to 3,300 ft (1,000 m) without derating; derate by 1% for each additional 330 ft (100 m)

**Table 3: Electrical Characteristics**

Input voltage	ATV31••••M2 (1 phase): 200 V -15% to 240 V +10% ATV31••••M3X (3 phase): 200 V -15% to 240 V +10% ATV31••••N4 (3 phase): 380 V -15% to 460 V +15% ATV31••••S6X (3 phase): 525 V -15% to 575 V +15%
Input frequency	50/60 Hz ±5%
Input phases	ATV31••••M2: 1 ATV31••••M3X: 3 ATV31••••N4: 3 ATV31••••S6X: 3
Output voltage	Maximum voltage equal to input voltage
Output frequency	0 to 500 Hz
Output phases	3
Max. transient current	Up to 150% of nominal drive controller current for 60 seconds (see Tables 4–7 on pages 12–13)
Braking torque	With braking resistor: 100% of nominal motor torque continuously and up to 150% for 60 s. Without braking resistor: Drive controllers ≥ ATV31•U22••: 30% of nominal motor torque Drive controllers ≤ ATV31•U15••: 50% of nominal motor torque Drive controllers ≤ ATV31•075••: 100% of nominal motor torque Drive controllers ≤ ATV31•018M2: 150% of nominal motor torque
Frequency resolution	Display: 0.1 Hz Analog inputs: 0.1 Hz to 100 Hz maximum [(high speed - low speed)/1024]
Switching frequency	Adjustable from 2.0 kHz to 16 kHz. Randomly modulated by default, but this can be disabled.
Drive controller protection	Galvanic isolation between power and control (power supplies, inputs, outputs) Protection against short circuits: <ul style="list-style-type: none"> <li>within internal power supplies</li> <li>between output phases</li> <li>between output phases and ground</li> </ul> Protection against input phase loss Thermal protection against overheating and overcurrents Undervoltage and overvoltage faults Overbraking fault
Motor protection	Thermal protection integrated in the drive controller by $I^2t$ calculation Protection against motor phase loss

**Table 3: Electrical Characteristics (continued)**

Dielectric strength	<p>Between ground and power terminals:</p> <ul style="list-style-type: none"> <li>• ATV31****M2 and M3X: 2040 Vdc</li> <li>• ATV31****N4: 2410 Vdc</li> <li>• ATV31****S6X: 2550 Vdc</li> </ul> <p>Between control and power terminals:</p> <ul style="list-style-type: none"> <li>• ATV31****M2 and M3X: 2880 Vac</li> <li>• ATV31****N4: 3400 Vac</li> <li>• ATV31****S6X: 3600 Vac</li> </ul>
Resistance to ground	>500 MΩ (electrical isolation) 500 Vdc for 1 minute
Communication	<p>Modbus and CANopen are integrated into the drive controller and available via an RJ45 connector.</p> <p><b>Modbus</b> RS-485 multidrop serial link characteristics:</p> <ul style="list-style-type: none"> <li>• Modbus in RTU mode</li> <li>• Services supported: decimal function codes 03, 06, 16, 23, and 43</li> <li>• Broadcasting</li> <li>• Number of addresses: drive address can be configured via the integrated terminal from 1 to 247</li> <li>• Maximum number of ATV31 drive controllers: 31 (two 470 Ω master pull-down resistors)</li> <li>• Transmission speed: 4800, 9600, or 19200 bps</li> </ul> <p>The following devices can be connected to the RS-485 link:</p> <ul style="list-style-type: none"> <li>• Remote keypad display</li> <li>• PowerSuite software workstation</li> <li>• PLC</li> <li>• Microprocessor card</li> <li>• PC</li> </ul> <p><b>CANopen</b> To connect the ATV31 drive controller to a CANopen network, use the VW3CANTAP2 adapter. The following services are supported:</p> <ul style="list-style-type: none"> <li>• Implicit exchange of Process Data Object (PDO): <ul style="list-style-type: none"> <li>- 2 PDOs depending DSP 402 velocity mode.</li> <li>- 2 configurable PDOs (data and transmission type).</li> <li>- PDOs can be exchanged between slave devices.</li> </ul> </li> <li>• Explicit exchange of Service Data Object (SDO): <ul style="list-style-type: none"> <li>- 1 receive SDO and 1 transmit SDO</li> </ul> </li> <li>• Boot-up messages, emergency messages, node guarding, and producer and consumer heartbeat.</li> <li>• Number of addresses: drive controller address can be configured via the integrated terminal from 1 to 127.</li> <li>• Maximum number of drive controllers: 127</li> <li>• Transmission speed: 10, 20, 50, 125, 250, 500 kbps or 1 Mbps</li> </ul>
Codes and standards	<p>UL Listed per UL 508C as incorporating electronic overload protection: UL File E164874 CCN NMMS.</p> <p>CSA Certified to CSA C22.2 No. 14: CSA File LR96921 Class 3211 06.</p> <p>CE Marked in accordance with the European low voltage (73/23/EEC and 93/68/EEC) and EMC (89/336/EEC) directives.</p> <p>Conforms to applicable NEMA ICS, IEC, NOM, C-TICK, and ISO 9001 standards.</p>
Electromagnetic compatibility	<p>Altivar 31 drive controllers meet IEC and EN requirements, the strictest international standards for electrical industrial control devices. They conform to EN 50178 governing electromagnetic compatibility and conducted and radiated emissions.</p> <ul style="list-style-type: none"> <li>• IEC/EN 61000-4-2 level 3</li> <li>• IEC/EN 61000-4-3 level 3</li> <li>• IEC/EN 61000-4-4 level 4</li> <li>• IEC/EN 61000-4-5 level 3 (power access)</li> <li>• IEC/EN 61800-3, environments 1 and 2</li> </ul>
Conducted and radiated emissions for drive controllers (Consult the ATV31 Catalog for optional EMC filters)	<p><b>All ratings:</b></p> <ul style="list-style-type: none"> <li>• IEC/EN 61800-3, environments 2 (industrial network) and 1 (public utility network) in limited distribution.</li> </ul> <p><b>ATV31H018M2 to CU40N4:</b></p> <ul style="list-style-type: none"> <li>• EN 55011, Class A, Group 1; EN 61800-3 Category C2 with additional EMC filter;</li> <li>• EN 55022, Class B, Group 1; EN 61800</li> </ul> <p><b>ATV31HU22M2 to HD15N4:</b></p> <ul style="list-style-type: none"> <li>• EN 55011, Class A, Group 2; EN 61800-3 Category C3 with additional EMC filter</li> <li>• EN 55022, Class A, Group 1; EN 61800-3 Category C2</li> <li>• EN 55022, Class B, Group 1; EN 61800-3 Category C1</li> </ul> <p><b>ATV31H018M3X to HD15M3X:</b> With additional EMC filter:</p> <ul style="list-style-type: none"> <li>• EN 55011, Class A, Group 1; EN 61800-3 Category C2</li> <li>• EN 55022, Class B, Group 1; EN 61800-3 Category C1</li> </ul>

## RATINGS

**Table 4: 208 V -15% / 240 V +10% at 50/60 Hz, Single-Phase Input, Three-Phase Output**

Altivar 31  Catalog no. <sup>1</sup>	Motor  Power indicated on nameplate <sup>2</sup>		Line supply (input)				Drive controller (output)		
			Max. line current <sup>3</sup>		Short-circuit current rating	Max. inrush current <sup>4</sup>	Nominal rated output current I <sub>n</sub> <sup>2</sup>	Transient output current <sup>2,5</sup>	Total dissipated power at rated load
	at 208 V	at 240 V	kA	A					
	kW	hp	A	A	kA	A	A	W	
ATV31H018M2	0.18	0.25	3.0	2.5	1	10	1.5	2.3	24
ATV31H037M2	0.37	0.5	5.3	4.4	1	10	3.3	5.0	41
ATV31H055M2	0.55	0.75	6.8	5.8	1	10	3.7	5.6	46
ATV31H075M2	0.75	1	8.9	7.5	1	10	4.8, 4.6, 4.2 <sup>6</sup>	7.2	60
ATV31HU11M2	1.1	1.5	12.1	10.2	1	19	6.9	10.4	74
ATV31HU15M2	1.5	2	15.8	13.3	1	19	8.0	12.0	90
ATV31HU22M2	2.2	3	21.9	18.4	1	19	11.0	16.5	123

**Table 5: 208 V -15% / 240 V +10% at 50/60 Hz, Three-Phase Input, Three-Phase Output**

Altivar 31  Catalog no. <sup>1</sup>	Motor  Power indicated on nameplate <sup>2</sup>		Line supply (input)				Drive controller (output)		
			Max. line current <sup>3</sup>		Short-circuit current rating	Max. inrush current <sup>4</sup>	Nominal rated output current I <sub>n</sub> <sup>2</sup>	Transient output current <sup>2,5</sup>	Total dissipated power at rated load
	at 208 V	at 240 V	kA	A					
	kW	hp	A	A	kA	A	A	W	
ATV31H018M3X	0.18	0.25	2.1	1.9	5	10	1.5	2.3	23
ATV31H037M3X	0.37	0.5	3.8	3.3	5	10	3.3	5.0	38
ATV31H055M3X	0.55	0.75	4.9	4.2	5	10	3.7	5.6	43
ATV31H075M3X	0.75	1	6.4	5.6	5	10	4.8	7.2	55
ATV31HU11M3X	1.1	1.5	8.5	7.4	5	10	6.9	10.4	71
ATV31HU15M3X	1.5	2	11.1	9.6	5	10	8.0	12.0	86
ATV31HU22M3X	2.2	3	14.9	13.0	5	10	11.0	16.5	114
ATV31HU30M3X	3	3	19.1	16.6	5	19	13.7	20.6	146
ATV31HU40M3X	4	5	24.2	21.1	5	19	17.5	26.3	180
ATV31HU55M3X	5.5	7.5	36.8	32.0	22	23	27.5	41.3	292
ATV31HU75M3X	7.5	10	46.8	40.9	22	23	33.0	49.5	388
ATV31HD11M3X	11	15	63.5	55.6	22	93	54.0	81.0	477
ATV31HD15M3X	15	20	82.1	71.9	22	93	66.0	99.0	628

<sup>1</sup> Catalog number for a drive controller without a reference potentiometer and RUN/STOP buttons. For a drive controller with a reference potentiometer and RUN/STOP buttons, add an "A" at the end of the catalog number. For example, ATV31H018M2A.

<sup>2</sup> These power ratings and currents are for a maximum ambient temperature of 50 °C (122 °F) and a switching frequency of 4 kHz in continuous operation. The switching frequency is adjustable from 2 to 16 kHz. Above 4 kHz, the drive controller will reduce the switching frequency in the event of excessive temperature rise. The temperature rise is controlled by a PTC probe in the power module. Derate the nominal current if continuous operation above 4 kHz is required. Derating curves are shown on page 17 as a function of switching frequency, ambient temperature, and mounting conditions.

<sup>3</sup> Current on a line supply with the indicated short-circuit current rating.

<sup>4</sup> Peak current on power-up, for the maximum voltage (240 V +10%).

<sup>5</sup> For 60 seconds.

<sup>6</sup> 4.8 A at 200 V, 4.6 A at 208 V, 4.2 A at 240 V.

**Table 6: 400 V -15% / 460 V +15% at 50/60 Hz, Three-Phase Input, Three-Phase Output**

Altivar 31  Catalog no. <sup>2</sup>	Motor		Line supply (input)				Drive controller (output)		
	Power indicated on nameplate <sup>3</sup>		Max. line current <sup>4</sup>		Short-circuit current rating	Max. inrush current <sup>5</sup>	Nominal rated output current I <sub>n</sub> <sup>3</sup>	Max. transient current <sup>3,6</sup>	Total dissipated power at rated load
			at 400 V	at 460 V					
	kW	hp	A	A	kA	A	A	A	W
ATV31H037N4	0.37	0.5	2.2	1.7	5	10	1.5	2.3	32
ATV31H055N4	0.55	0.75	2.8	2.2	5	10	1.9	2.9	37
ATV31H075N4	0.75	1	3.6	2.7	5	10	2.3	3.5	41
ATV31HU11N4	1.1	1.5	4.9	3.7	5	10	3.0	4.5	48
ATV31HU15N4	1.5	2	6.4	4.8	5	10	4.1	6.2	61
ATV31HU22N4	2.2	3	8.9	6.7	5	10	5.5	8.3	79
ATV31HU30N4	3	3	10.9	8.3	5	10	7.1	10.7	125
ATV31HU40N4	4	5	13.9	10.6	5	10	9.5	14.3	150
ATV31HU55N4	5.5	7.5	21.9	16.5	22	30	14.3	21.5	232
ATV31HU75N4	7.5	10	27.7	21.0	22	30	17.0	25.5	269
ATV31HD11N4	11	15	37.2	28.4	22	97	27.7	41.6	397
ATV31HD15N4	15	20	48.2	36.8	22	97	33.0	49.5	492

**Table 7: 525 V -15% / 575 V +15% at 50/60 Hz, Three-Phase Input, Three-Phase Output<sup>1</sup>**

Altivar 31  Catalog no. <sup>2</sup>	Motor		Line supply (input)				Drive controller (output)		
	Power indicated on nameplate <sup>3</sup>		Max. line current <sup>4</sup>		Short-circuit current rating	Max. inrush current <sup>5</sup>	Nominal rated output current I <sub>n</sub> <sup>3</sup>	Max. transient current <sup>3,6</sup>	Total dissipated power at rated load
			at 525 V	at 600 V					
	kW	hp	A	A	kA	A	A	A	W
ATV31H075S6X	0.75	1	2.8	2.4	5	12	1.7	2.6	36
ATV31HU15S6X	1.5	2	4.8	4.2	5	12	2.7	4.1	48
ATV31HU22S6X	2.2	3	6.4	5.6	5	12	3.9	5.9	62
ATV31HU40S6X	4	5	10.7	9.3	5	12	6.1	9.2	94
ATV31HU55S6X	5.5	7.5	16.2	14.1	22	36	9.0	13.5	133
ATV31HU75S6X	7.5	10	21.3	18.5	22	36	11.0	16.5	165
ATV31HD11S6X	11	15	27.8	24.4	22	117	17.0	25.5	257
ATV31HD15S6X	15	20	36.4	31.8	22	117	22.0	33.0	335

<sup>1</sup> A 3% line reactor is required for all 575 V drive controller installations.

<sup>2</sup> Catalog number for a drive controller without a reference potentiometer and RUN/STOP buttons. For a drive with a control potentiometer and RUN/STOP buttons, add an "A" at the end of the catalog number. For example, ATV31H037N4A.

<sup>3</sup> These power ratings and currents are for a maximum ambient temperature of 50 °C (122 °F) and a switching frequency of 4 kHz in continuous operation. The switching frequency is adjustable from 2 to 16 kHz. Above 4 kHz, the drive controller will reduce the switching frequency in the event of excessive temperature rise. The temperature rise is controlled by a PTC probe in the power module. Derate the nominal current if continuous operation above 4 kHz is required. Derating curves are shown on page 17 as a function of switching frequency, ambient temperature, and mounting conditions.

<sup>4</sup> Current on a line supply with the indicated short-circuit current rating.

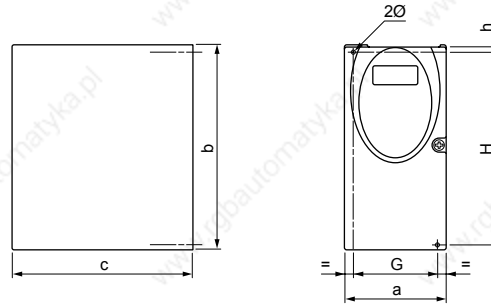
<sup>5</sup> Peak current on power-up, for the maximum voltage (460 Vac / 575 Vac +15%).

<sup>6</sup> For 60 seconds.

**Table 8: Minimum Dynamic Braking Resistance Values**

Drive Controller Catalog No.	PA to PB Min. Resistance Value
	Ω
ATV31H/C/K018M2, ATV31H/C/K037M2	40
ATV31H/C/K055M2, ATV31H/C/K075M2	
ATV31H/C/KU11M2, ATV31H/C/KU15M2	27
ATV31H018M3X, ATV31H037M3X	40
ATV31H055M3X, ATV31H075M3X	
ATV31HU11M3X, ATV31HU15M3X	27
ATV31H/C/K037N4, ATV31H/C/K055N4	80
ATV31H/C/K075N4	
AATV31H/C/KU11N4, ATV31H/C/KU15N4	54
ATV31H/C/KU22N4	
ATV31H/C/KU22M2	25
ATV31HU22M3X	
ATV31HU30M3X	16
ATV31H/C/KU30N4	55
ATV31H/C/KU40N4	36
ATV31HU22M3X	25
ATV31HU30M3X	16
ATV31H/C/KU30N4	55
ATV31H/C/KU40N4	36
ATV31H/KU55N4	29
ATV31H/KU75N4	19
ATV31HU55S6X	34
ATV31HU75S6X	23
ATV31HU40M3X	16
ATV31H/KD11N4, ATV31H/KD15N4	20
ATV31HD11S6X, ATV31HD15S6X	24
ATV31HU55M3X, ATV31HU75M3X	8
ATV31HD11M3X, ATV31HD15M3X	5

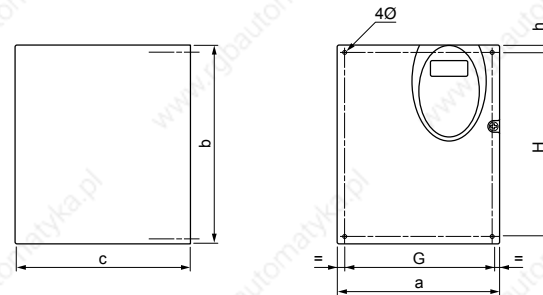
**DIMENSIONS AND WEIGHTS**



ATV31 Size 1 to 6 Dimensions.eps

**Table 9: Frame Sizes 1–6**

ATV31..... <sup>1</sup>	Frame Size	a mm (in.)	b mm (in.)	c <sup>2</sup> mm (in.)	G <sup>3</sup> mm (in.)	h mm (in.)	H <sup>3</sup> mm (in.)	Ø mm (in.)	Weight kg (lb.)
H018M3X, H037M3X	1	72 (2.83)	145 (5.71)	120 (4.72)	60 (2.36)	5 (0.20)	121.5 (4.78)	5 (0.20)	0.9 (1.99)
H055M3X, H075M3X	2	72 (2.83)	145 (5.71)	130 (5.12)	60 (2.36)	5 (0.20)	121.5 (4.78)	5 (0.20)	0.9 (1.99)
H018M2, H037M2	3	72 (2.83)	145 (5.71)	130 (5.12)	60 (2.36)	5 (0.20)	121.5 (4.78)	5 (0.20)	1.05 (2.32)
H055M2, H075M2	4	72 (2.83)	145 (5.71)	140 (5.51)	60 (2.36)	5 (0.20)	121.5 (4.78)	5 (0.20)	1.05 (2.32)
HU11M3X, HU15M3X	5	105 (4.13)	143 (5.63)	130 (5.12)	93 (3.66)	5 (0.20)	121.5 (4.78)	5 (0.20)	1.25 (2.76)
HU11M2, HU15M2, HU22M3X, H037N4, H055N4, H075N4, HU11N4, HU15N4, H075S6X, HU15S6X	6	105 (4.13)	143 (5.63)	150 (5.91)	93 (3.66)	5 (0.20)	121.5 (4.78)	2 x 5 (0.20)	1.35 (2.92)



ATV31 Size 7 to 8 Dimensions.eps

**Table 10: Frame Sizes 7–9**

ATV31..... <sup>1</sup>	Frame Size	a mm (in.)	b mm (in.)	c <sup>2</sup> mm (in.)	G <sup>3</sup> mm (in.)	h mm (in.)	H <sup>3</sup> mm (in.)	Ø mm (in.)	Weight kg (lb.)
HU22M2, HU30M3X, HU40M3X, HU22N4, HU30N4, HU40N4, HU22S6X, HU40S6X	7	140 (5.51)	184 (7.24)	150 (5.91)	126 (4.96)	6.5 (0.26)	157 (6.18)	5 (0.20)	2.35 (5.19)
HU55M3X, HU75M3X, HU55N4, HU75N4, HU55S6X, HU75S6X	8	180 (7.09)	232 (9.13)	170 (6.69)	160 (6.30)	5 (0.20)	210 (8.27)	5 (0.20)	4.70 (10.39)
HD11M3X, HD15M3X, HD11N4, HD15N4, HD11S6X, HD15S6X	9	245 (9.65)	330 (13.0)	190 (7.48)	225 (8.86)	7 (1.93)	295 (11.61)	6 (0.24)	9.0 (19.89)

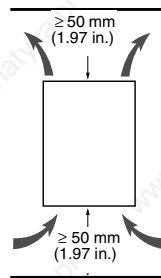
<sup>1</sup> The symbol “\*” in a catalog number indicates the part of the number that varies with drive controller size or rating.

<sup>2</sup> For controllers with a potentiometer and Run/Stop buttons, add 8 mm (0.31 in.) for the potentiometer.

<sup>3</sup> The values for this dimension are ±1 mm (0.04 in.).

## MOUNTING

### Clearances



Install the drive controller vertically,  $\pm 10^\circ$ .

Do not place the drive controller close to heating sources.

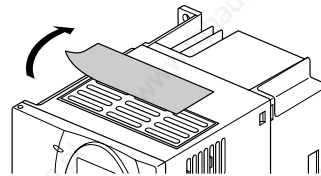
Leave sufficient free space around the drive controller to ensure that air can circulate from the bottom to the top of the unit.

Leave a minimum of 10 mm (0.4 in.) of free space in front of the drive controller.

ATV31 Clearances.eps

### Removing the Protective Cover

When IP20 protection is adequate, remove the protective cover on top of the drive controller as shown in the figure below. Consult "Mounting Methods" on page 17 to determine the type of mounting appropriate for your application before removing the protective cover from the drive controller. For UL Type 1 protection, the protective cover must remain installed on the top of the controller and a conduit entry kit must be installed.



Example: ATV31HU11M3X

ATV31 Protective Covers.eps

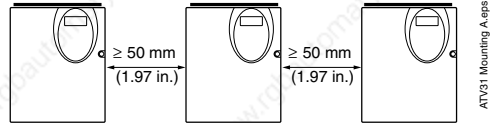


### Mounting Methods

Refer to the derating curves below to determine which mounting method best fits the application.

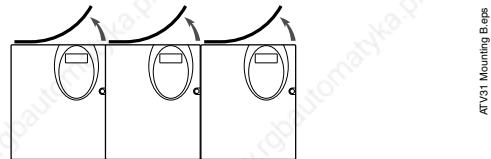
#### Type A Mounting

Free space  $\geq 50$  mm (1.97 in.) on each side, with the protective cover in place.



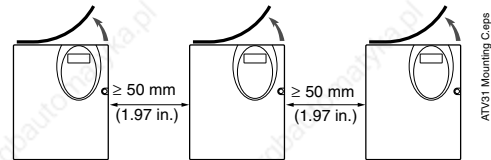
#### Type B Mounting

Drive controllers mounted side-by-side, with the protective cover removed (degree of protection becomes IP20).



#### Type C Mounting

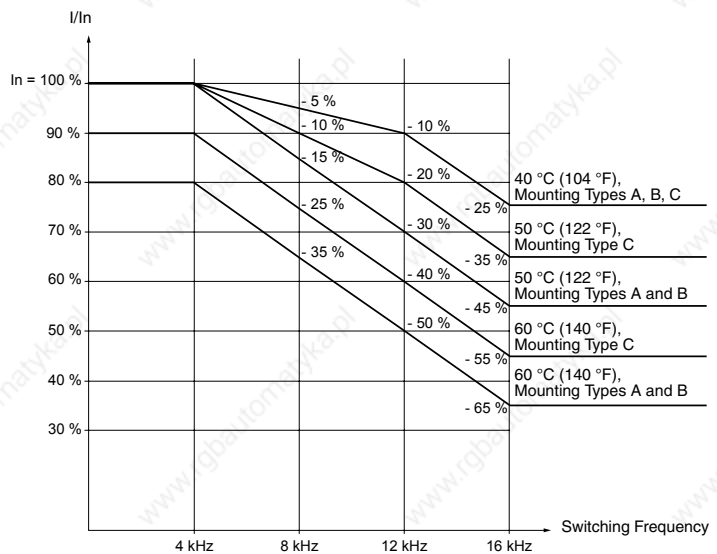
Free space  $\geq 50$  mm (1.97 in.) on each side, with the protective cover removed (degree of protection becomes IP20).



### Derating Curves

The following figure contains derating curves for the drive current ( $I_n$ ) as a function of temperature, switching frequency, and type of mounting. For intermediate temperatures, such as 55 °C (131 °F), interpolate between two curves.

ATV31 drive controllers can be used at altitudes up to 3,300 ft. (1,000 m) without derating. Derate by 1% for each additional 330 ft. (100 m.).



## Minimum Air Flow Rates

If you are installing the drive controller in an enclosure, provide an air flow at least equal to the value listed in Table 11 for your drive controller.

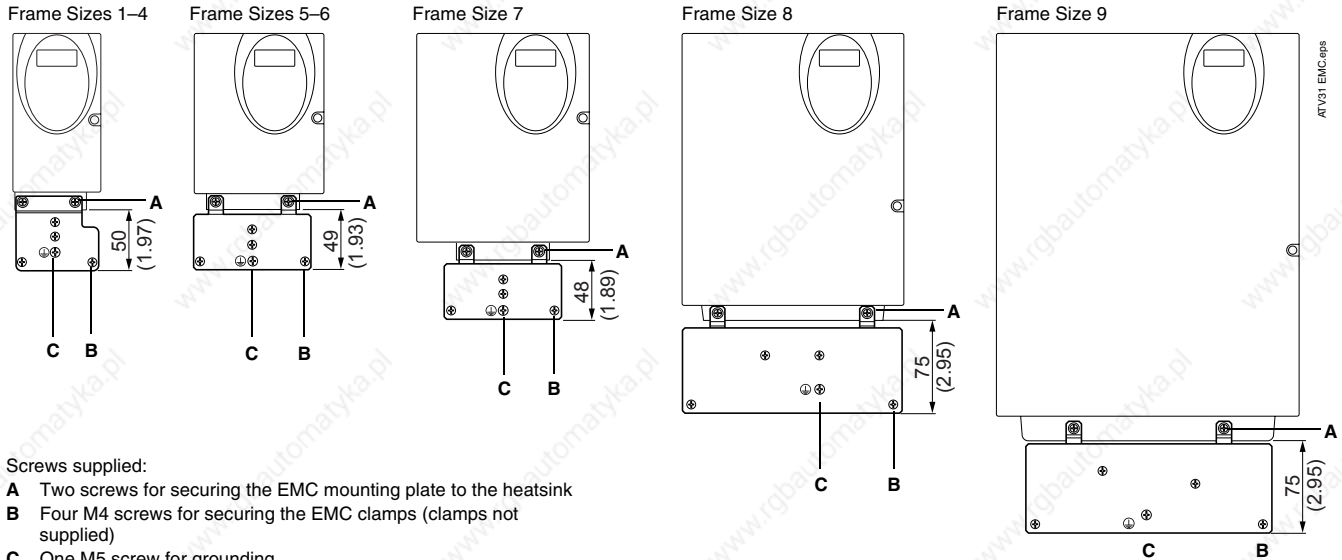
**Table 11: Minimum Air Flow Rates**

ATV31***** <sup>1</sup>	Flow Rate	
	m <sup>3</sup> /hour	Cubic Feet per Minute (CFM)
H018M2, H037M2, H055M2, H018M3X, H037M3X, H055M3X, H037N4, H055N4, H075N4, HU11N4 H075S6X, HU15S6X	18	10.6
H075M2, HU11M2, HU15M2 H075M3X, HU11M3X, HU15M3X HU15N4, HU22N4 HU22S6X, HU40S6X	33	19.4
HU22M2, HU22M3X, HU30M3X, HU40M3X HU30N4, HU40N4 HU55S6X, HU75S6X	93	54.8
HU55M3X HU55N4, HU75N4 HD11S6X	102	60.1
HU75M3X, HD11M3X, HD11N4, HD15N4 HD15S6X	168	99.0
HD15M3X	216	127.2

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

### Electromagnetic Compatibility

An EMC mounting plate is supplied with the drive controller for grounding the shields of the power cables when it is necessary for the installation to meet EN 55011 Class A requirements. Secure the mounting plate to the holes in the ATV31 drive controller's heatsink using the two screws (A) supplied as shown in the figure below. Refer to page 39 for instructions on grounding the cable shields on the EMC plate.



Screws supplied:

- A Two screws for securing the EMC mounting plate to the heatsink
- B Four M4 screws for securing the EMC clamps (clamps not supplied)
- C One M5 screw for grounding

ATV31***** <sup>1</sup>	Frame Size
H018M3X, H037M3X	1
H055M3X, H075M3X	2
H018M2, H037M2	3
H055M2, H075M2	4
HU11M3X, HU15M3X	5
HU11M2, HU15M2, HU22M3X, H037N4, H055N4, H075N4, HU11N4, HU15N4, H075S6X, HU15S6X	6

ATV31***** <sup>1</sup>	Frame Size
HU22M2, HU30M3X, HU40M3X, HU22N4, HU30N4, HU40N4, HU22S6X, HU40S6X	7
HU55M3X, HU75M3X, HU55N4, HU75N4, HU55S6X, HU75S6X	8
HD11M3X, HD15M3X, HD11N4, HD15N4, HD11S6X, HD15S6X	9

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

## MOUNTING IN A TYPE 12 OR IP54 METAL ENCLOSURE

### Calculating Enclosure Size

The equation for calculating  $R_{th}$  (°C/W), the maximum allowable thermal resistance of the enclosure, is as follows:

$$R_{th} = \frac{T_i - T_o}{P}$$

$T_i$  = Max. internal ambient temp. (°C) around the controller  
 $T_o$  = Max. external ambient temp. (°C) around enclosure  
 $P$  = Total power dissipated in enclosure (W)

For the power dissipated by the drive controllers at rated load, see Tables 4–7 on pages 12–13.

The useful heat exchange surface area,  $S$  (in<sup>2</sup>), of a wall-mounted enclosure generally consists of the sides, top, and front. The minimum surface area required for a drive controller enclosure is calculated as follows:

*NOTE: Contact the enclosure manufacturer for K factors.*

$$S = \frac{K}{R_{th}}$$

$K$  = Thermal resistance per square inch of the enclosure  
 $R_{th}$  = Thermal resistance of the enclosure (calculated previously)

Consider the following points when sizing the enclosure:

- Use only metal enclosures, since they have good thermal conduction.
- Do not install enclosures where external heat sources (such as direct sunlight) can add to the enclosure heat load. This procedure does not consider radiant or convected heat load from external sources.
- If additional devices are present inside the enclosure, consider the heat load of those devices in the calculation.
- The actual useful area for convection cooling of the enclosure will vary depending upon the method of mounting. The mounting method must allow for free air movement over all surfaces considered for convection cooling.

The following sample illustrates calculation of the enclosure size for an ATV31HU40N4 (5 hp) drive controller mounted in a Type 12 or IP54 enclosure.

- Maximum external temperature:  $T_o = 25$  °C
- Power dissipated inside the enclosure:  $P = 150$  W
- Maximum internal temperature:  $T_i = 40$  °C
- Thermal resistance per square inch of the enclosure:  $K = 186$

Calculate the maximum allowable thermal resistance,  $R_{th}$ :

$$R_{th} = \frac{40\text{ °C} - 25\text{ °C}}{150\text{ W}} = 0.115\text{ °C/W}$$

Calculate the minimum useful heat exchange surface area,  $S$ :

$$S = \frac{186}{0.115} = 1624.4\text{ in}^2$$

Useful heat exchange surface area (S) of the proposed wall-mounted enclosure:

- Height: 28 in (711 mm)
- Width: 24 in (610 mm)
- Depth: 12 in (305 mm)

$$S = (24 \times 28) + (24 \times 12) + 2(28 \times 12) = 1632 \text{ in}^2$$

Diagram illustrating the calculation of the useful heat exchange surface area (S) of the proposed wall-mounted enclosure. The enclosure is a rectangular prism with dimensions: Height = 28 in (711 mm), Width = 24 in (610 mm), and Depth = 12 in (305 mm). The calculation includes the front area, top area, and two side areas.

If the selected enclosure does not provide the required surface area or does not meet application needs, consider the following:

- Use a larger enclosure.
- Add a passive heat exchanger to the enclosure.
- Add an air conditioning unit to the enclosure.

## Ventilation

When mounting the drive controller inside a Type 12 or IP54 enclosure, follow these ventilation precautions:

- Observe the minimum clearance distances shown on page 16.
- Follow the installation precautions on page 9.
- If necessary, install a stirring fan to circulate the air inside the enclosure, to prevent hot spots in the drive controller, and to distribute the heat uniformly to surfaces used for convection cooling.

## ⚠ CAUTION

### CONDENSATION

Where condensation is possible, keep the drive controller powered up when the motor is not running, or install thermostatically controlled strip heaters.

**Failure to follow this instruction can result in injury or equipment damage.**

## BUS VOLTAGE MEASUREMENT PROCEDURE

### **⚠ DANGER**

#### **HAZARDOUS VOLTAGE**

Read and understand the precautions on page 7 before performing this procedure.

**Failure to follow this instruction will result in death or serious injury.**

The bus voltage can exceed 1000 Vdc. Use appropriately rated measuring equipment when performing this procedure. To measure the bus capacitor voltage:

1. Disconnect all power from the drive controller.
2. Wait 3 minutes to allow the DC bus to discharge.
3. Measure the DC bus voltage between the PA (+) and PC (–) terminals to verify that the DC voltage is less than 45 Vdc. Refer to page 28 for the location of the power terminals. **It may take up to 15 minutes for the DC bus voltage to discharge.**
4. If the bus capacitors do not fully discharge, contact your local Schneider Electric representative—do not service or operate the drive controller.

## GENERAL WIRING PRACTICES

Good wiring practice requires the separation of control circuit wiring from all power (line) wiring. In addition, power wiring to the motor must have the maximum possible separation from all other power wiring, whether from the same drive controller or other drive controllers; **do not run in the same conduit**. This separation reduces the possibility of coupling electrical transients from power circuits into control circuits or from motor power wiring into other power circuits.

### **⚠ CAUTION**

#### **IMPROPER WIRING PRACTICES**

- Follow the wiring practices described in this document in addition to those already required by the National Electrical Code and local electrical codes.
- The drive controller will be damaged if input line voltage is applied to the output terminals (U, V, W).
- Check the power connections before energizing the drive controller.
- If replacing another drive controller, verify that all wiring connections to the ATV31 drive controller comply with all wiring instructions in this manual.

**Failure to follow this instruction can result in injury or equipment damage.**

Follow the practices below when wiring ATV31 drive controllers:

- Verify that the voltage and frequency of the input supply line and the voltage, frequency, and current of the motor match the rating on the drive controller nameplate.
- Use metallic conduit for all drive controller wiring. Do not run control and power wiring in the same conduit.
- Separate the metallic conduits carrying power wiring from those carrying control wiring by at least 76 mm (3 in.).

- Separate the non-metallic conduits or cable trays used to carry power wiring from the metallic conduit carrying control wiring by at least 305 mm (12 in.).
- Whenever power and control wiring cross, the metallic conduits and non-metallic conduits or trays must cross at right angles.
- Equip all inductive circuits near the drive controller (such as relays, contactors, and solenoid valves) with noise suppressors, or connect them to a separate circuit.

### Branch Circuit Connections

Refer to NEC Article 430 for sizing of branch circuit conductors. Ensure that all branch circuit components and equipment (such as transformers, feeder cables, disconnect devices, and protective devices) are rated for the input current of the ATV31 drive controller, or for the rated output current, whichever value is larger. The input current of the controller depends on the impedance of the power distribution system and the available short-circuit current at the drive input terminals.

Tables 4–7 on pages 12–13 provide input current information to optimally size branch circuit conductors. Do not exceed the short-circuit rating shown in the tables. The short-circuit rating is the available short-circuit current capability on the line side of the fuses or circuit breakers. A line reactor can be used to add impedance and reduce the available short-circuit current capability to the level allowed by the drive controller.

*NOTE: Ensure that the branch circuit feeder protection rating is not less than the rated output current of the drive controller.*

## CAUTION

### NUISANCE TRIPPING

A 3% line reactor is required in all 575 V drive installations.

**Failure to follow this instruction can result in equipment damage.**

When more than two drive controllers are installed in parallel on a common power line voltage, regardless of voltage rating, an individual line reactor per drive controller is recommended. This provides filtering between controllers and reduces harmonic distortion when the system is partially loaded.

If starting the drive controller from line power, limit operations of the line contactor to less than once per minute to avoid premature failure of the filter capacitors and precharge resistor. Use the logic inputs to command the drive controller.

## ⚠ WARNING

### INADEQUATE OVERCURRENT PROTECTION

- Overcurrent protective devices must be properly coordinated.
- The National Electrical Code requires branch circuit protection. Use the fuses recommended in Tables 15–17 on pages 36–37 to achieve published short-circuit current ratings.
- Do not connect the drive controller to a power feeder whose short-circuit capacity exceeds the drive controller short-circuit current rating listed on the drive controller nameplate or Tables 4–7 on pages 12–13.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## Output Wiring

The drive controller is sensitive to the amount of capacitance (either phase-to-phase or phase-to-ground) present on the output power conductors. Excessive capacitance can cause an overcurrent trip. Follow these guidelines when selecting output cable:

- **Cable type:** The cable selected must have a low capacitance phase-to-phase and phase-to-ground. Do not use mineral-impregnated cable because it has a very high capacitance. Immersion of cables in water increases capacitance.
- **Cable length:** The longer the cable, the greater the capacitance. Cable lengths greater than 30.5 m (100 ft.) can affect controller and motor performance.
- A load filter is recommended on all 575 V applications, especially when the motor leads exceed 12 m (40 ft.).
- When the output cable is in close proximity to other output cables, the drive controller may fault under some conditions because of high frequency switching and increased capacitance.
- **Do not use lightning arrestors and/or power factor correction capacitors on the output of the drive controller.**

Provide at least 500 mm (20 in.) of cable at the drive controller output (U, V, W) to ensure a minimum inductance to protect the drive controller output from short circuits.

### **▲ CAUTION**

#### **INSUFFICIENT OUTPUT INDUCTANCE**

For proper drive controller short circuit protection, certain values of inductance may be required in the output power wiring. Inductance can be supplied by the power wiring or auxiliary inductors.

**Failure to follow this instruction can result in injury or equipment damage.**



## GROUNDING

Ground the drive controller according to the National Electrical Code and all local codes to ensure safe, dependable operation. To ground the drive controller:

- Connect a copper wire from the equipment ground lug or terminal to the power system ground conductor. Size the wire according to the drive controller rating and national and local codes.
- Verify that resistance to ground is one ohm or less. Improper grounding causes intermittent and unreliable operation.

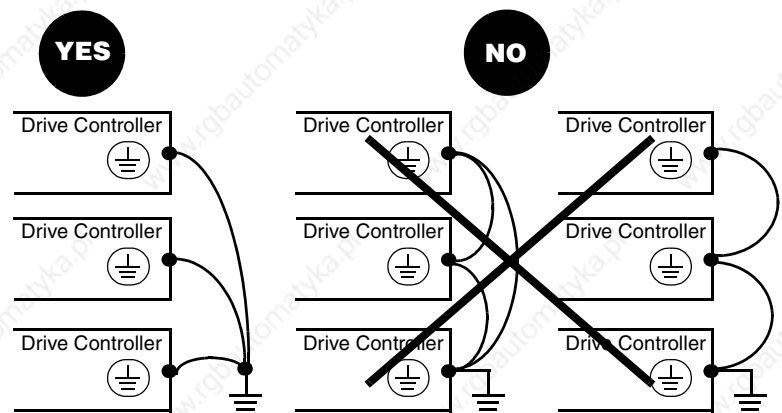
### **⚠ DANGER**

#### **HAZARDOUS VOLTAGE**

Ground equipment using the provided ground connecting point as shown in the figure below. The drive controller panel must be properly grounded before power is applied.

**Electric shock will result in death or serious injury.**

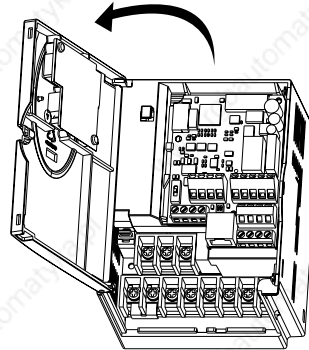
Ground multiple drive controllers as shown in the figure below. Do not loop the ground cables or connect them in series.



## WIRING

### Access to Terminals

To access the terminals, open the cover as shown in the figure below.



Example ATV31HU11M2

ATV31 Terminals.eps

### Power Terminals

Connect the power terminals before connecting the control terminals.

**Table 12: Power Terminal Characteristics**

ATV31..... <sup>1</sup>	Maximum Conductor Size		Tightening Torque	
	mm <sup>2</sup>	AWG	N•m	lb-in
H018M2, H037M2, H055M2, H075M2, H018M3X, H037M3X, H055M3X, H075M3X, HU11M3X, HU15M3X	2.5	14	0.8	7.08
HU11M2, HU15M2, HU22M2, HU22M3X, HU30M3X, HU40M3X, H037N4, H055N4, H075N4, HU11N4, HU15N4, HU22N4, HU30N4, HU40N4 H075S6X, HU15S6X, HU22S6X, HU40S6X	5	10	1.2	10.62
HU55M3X, HU75M3X, HU55N4, HU75N4, HU55S6X, HU75S6X	16	6	2.2	19.47
HD11M3X, HD15M3X, HD11N4, HD15N4, HD11S6X, HD15S6X	25	3	4	35.40

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

**Table 13: Power Terminal Functions**

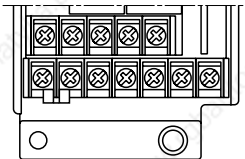
Terminal	Function	On ATV31 Drive Controllers:
⏏	Ground terminal	All ratings
R/L1 S/L2	Power supply	ATV31••••M2 <sup>1</sup>
R/L1 S/L2 T/L3		ATV31••••M3X <sup>1</sup>
		ATV31••••N4 <sup>1</sup> ATV31••••S6X <sup>1</sup>
PO	DC bus + polarity	All ratings
PA/+	Output to braking resistor (+ polarity)	All ratings
PB	Output to braking resistor	All ratings
PC/-	DC bus - polarity	All ratings
U/T1 V/T2 W/T3	Outputs to the motor	All ratings

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

*NOTE: Never remove the jumper between PO and PA/+.*

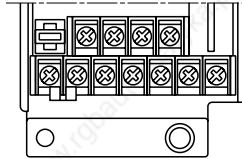
### Arrangement of the Power Terminals

ATV31H018M3X, H037M3X, H055M3X, H075M3X



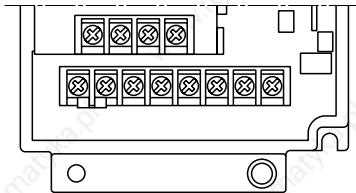
⊕	⊕	R/L1	S/L2	T/L3			
P0	PA+	PB	PC-	U/T1	V/T2	W/T3	

ATV31H018M2, H037M2, H055M2, H075M2



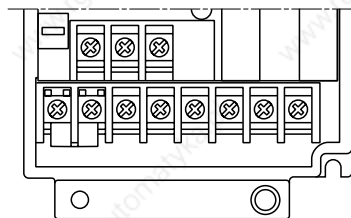
⊕	⊕	R/L1	S/L2				
P0	PA+	PB	PC-	U/T1	V/T2	W/T3	

ATV31HU11M3X, HU15M3X, HU22M3X, HU30M3X, HU40M3X, H037N4,  
H055N4, H075N4, HU11N4, HU15N4, HU22N4, HU30N4, HU40N4,  
H075S6X, HU15S6X, HU22S6X, HU40S6X



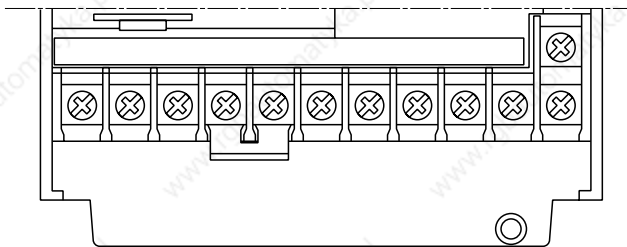
⊕	R/L1	S/L2	T/L3				
P0	PA+	PB	PC-	U/T1	V/T2	W/T3	⊕

ATV31HU11M2, HU15M2, HU22M2



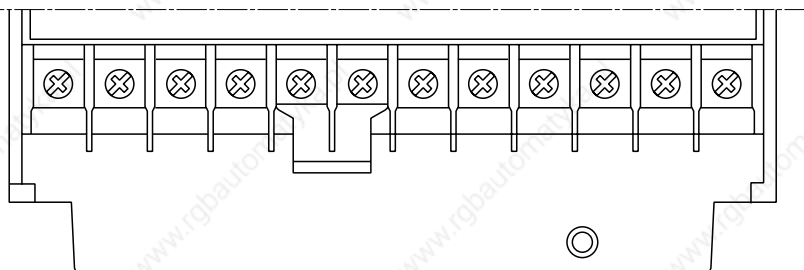
⊕	R/L1	S/L2					
P0	PA+	PB	PC-	U/T1	V/T2	W/T3	⊕

ATV31HU55M3X, HU75M3X, HU55N4, HU75N4, HU55S6X, HU75S6X



R/L1	S/L2	T/L3	P0	PA+	PB	PC-	U/T1	V/T2	W/T3	⊕
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ATV31HD11M3X, HD15M3X, HD11N4, HD15N4, HD11S6X, HD15S6X

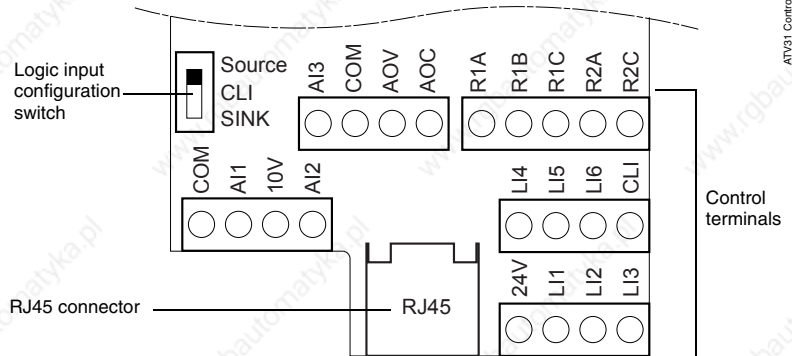


⊕	R/L1	S/L2	T/L3	P0	PA+	PB	PC-	U/T1	V/T2	W/T3	⊕
---	------	------	------	----	-----	----	-----	------	------	------	---

ATV31 Power Terminals.eps

Control Terminals

Connect the control terminals after connecting the power terminals.



Maximum conductor size is 2.5 mm<sup>2</sup> (14 AWG)  
Maximum tightening torque is 0.6 N•m (5.31 lb-in).

Table 14: Control Terminal Characteristics

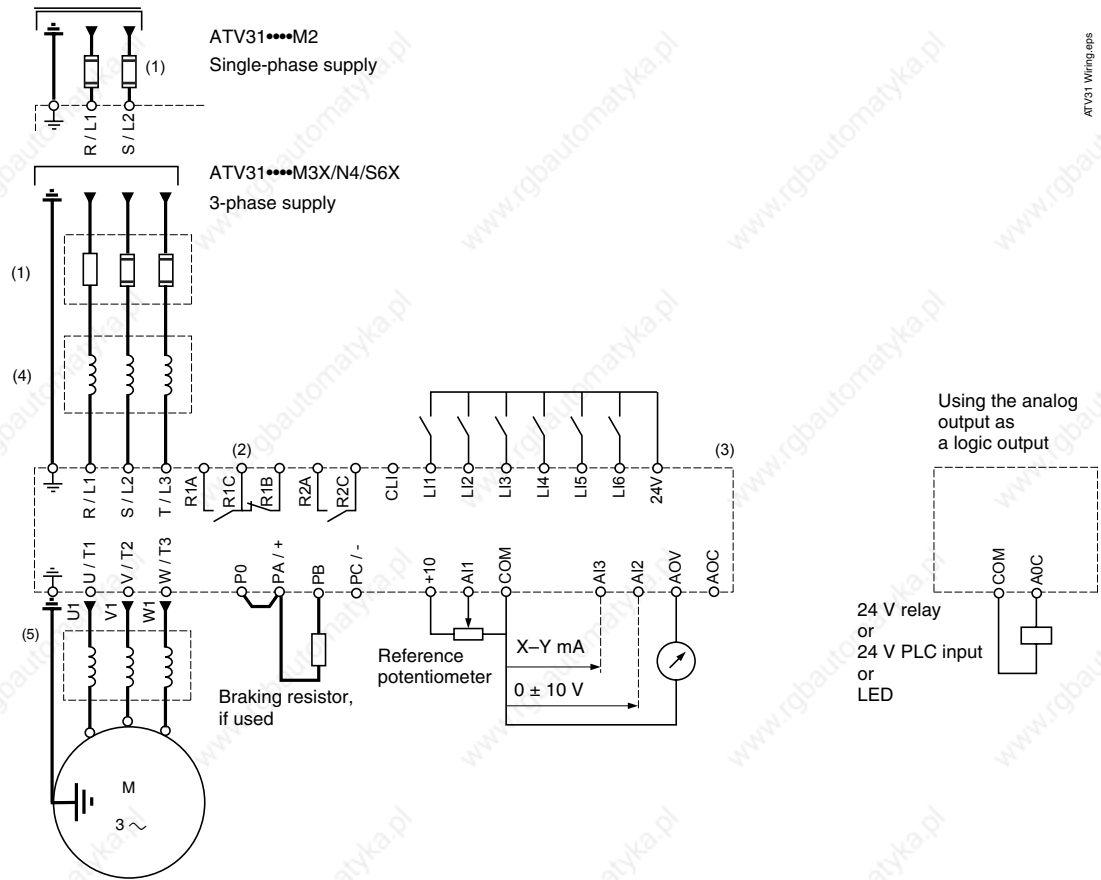
Terminal	Function	Electrical characteristics
R1A R1B R1C	R1A is a N.O. contact. R1B is a N.C. contact. R1C is the common.  R1 is a programmable relay, factory set as a fault relay. As a fault relay, R1A is closed and R1B is open when the controller is powered with no fault.	<ul style="list-style-type: none"> <li>Min. switching capacity: 10 mA for 5 Vdc</li> <li>Max. switching capacity on a resistive load (power factor = 1 and L/R time constant = 0 ms): 5 A for 250 Vac and 30 Vdc</li> <li>Max. switching capacity on an inductive load (power factor = 0.4 and L/R time constant = 7 ms): 1.5 A for 250 Vac and 30 Vdc</li> <li>Sampling time: 8 ms</li> <li>Service life: 100,000 operations at max. switching power; 1,000,000 operations at min. switching power</li> </ul>
R2A R2C	N.O. contact of programmable relay R2	
COM	Analog I/O common	0 V
AI1	Analog voltage input	Analog input 0 to +10 V (max. safe voltage is 30 V) <ul style="list-style-type: none"> <li>Impedance: 30 kΩ</li> <li>Resolution: 0.01 V, 10-bit converter</li> <li>Precision: ± 4.3% of max. value</li> <li>Linearity: ± 0.2% of max. value</li> <li>Sampling time: 8 ms</li> <li>Shielded cable length: 100 m max.</li> </ul>
10 V	Power supply for setpoint potentiometer 1 to 10 kΩ	+10 V (+ 8%, - 0%), 10 mA max, protected against short circuits and overloads
AI2	Analog voltage input	Bipolar analog input 0 to ±10 V (max. safe voltage is ±30 V) <b>The + or - polarity of the voltage on AI2 affects the direction of the setpoint and therefore the direction of operation.</b> <ul style="list-style-type: none"> <li>Impedance: 30 kΩ</li> <li>Resolution: 0.01 V, 10-bit + sign converter</li> <li>Precision: ± 4.3% of max. value</li> <li>Linearity: ± 0.2% of max. value</li> <li>Sampling time: 8 ms</li> <li>Shielded cable length: 100 m max.</li> </ul>
AI3	Analog current input	Analog input X to Y mA; X and Y programmable from 0–20 mA <ul style="list-style-type: none"> <li>Impedance: 250 Ω</li> <li>Resolution: 0.02 mA, 10-bit converter</li> <li>Precision: ± 4.3% of max. value</li> <li>Linearity: ± 0.2% of max. value</li> <li>Sampling time: 8 ms</li> </ul>
COM	Analog I/O common	0 V

**Table 14: Control Terminal Characteristics** (continued)

Terminal	Function	Electrical characteristics
AOV or AOC	Analog voltage output AOV or Analog current output AOC or Logic voltage output on AOC Either AOV or AOC can be assigned, but not both.	Analog output 0 to 10 V, min. load impedance 470 Ω or Analog output X to Y mA; X and Y programmable from 0–20 mA, max. load impedance 800 Ω <ul style="list-style-type: none"> <li>Resolution: 8 bits<sup>1</sup></li> <li>Precision: ± 1%<sup>1</sup></li> <li>Linearity: ± 0.2%<sup>1</sup></li> <li>Sampling time: 8 ms</li> </ul> or AOC can be configured as a 24 V logic output with a min. load impedance of 1.2 kΩ
24 V	Logic input power supply	+ 24 V protected against short circuits and overloads, min. 19 V, max. 30 V Max. available current is 100 mA.
L11 L12 L13 L14 L15 L16	Logic inputs	Programmable logic inputs <ul style="list-style-type: none"> <li>+ 24 V power supply (max. 30 V)</li> <li>Impedance: 3.5 kΩ</li> <li>State 0 if the voltage difference between LI- and CLI is &lt; 5 V, State 1 if the voltage difference between LI- and CLI is &gt; 11 V</li> <li>Sampling time: 4 ms</li> </ul>
CLI	Logic input common	See page 31.

<sup>1</sup> Characteristics of the digital/analog converter.

Wiring Diagram for Factory Settings



**NOTE:** The line supply terminals are shown at the top and the motor terminals are shown at the bottom. Connect the power terminals before connecting the control terminals. Install surge suppressors on all inductive circuits located near the drive controller or coupled to the same circuit.

- (1) Refer to the drive controller nameplate or to the tables on pages 36–37 for recommended fuses. Fast acting or time delay Class J fuses can be used.
- (2) Fault relay contacts for remote indication of drive controller status.
- (3) Internal +24 V. If an external source is used (30 V max.), connect the 0 V terminal of the source to the 0 V (COM) terminal, and do not use the +24 V terminal on the drive controller for any purpose.
- (4) Line reactor, if used. All 575 V installations must include a line reactor. See page 23.
- (5) Installation of a load filter is recommended for all 575 V applications. See page 24.

## Logic Input Switch

The logic input switch assigns the logic input common link to 0 V (Source logic), 24 V (Sink logic), or floating.

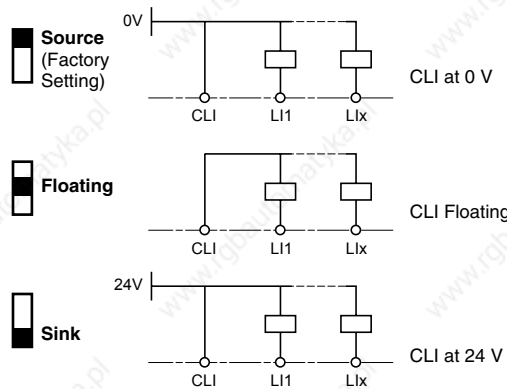
*NOTE: When the logic input is configured for Sink logic, grounding the input signals can result in unintended activation of drive controller functions.*

### **⚠ DANGER**

#### **UNINTENDED EQUIPMENT OPERATION**

- Protect the signal conductors against damage that could result in unintentional conductor grounding.
- Follow NFPA 79 and EN 60204 guidelines for proper control circuit grounding practices.

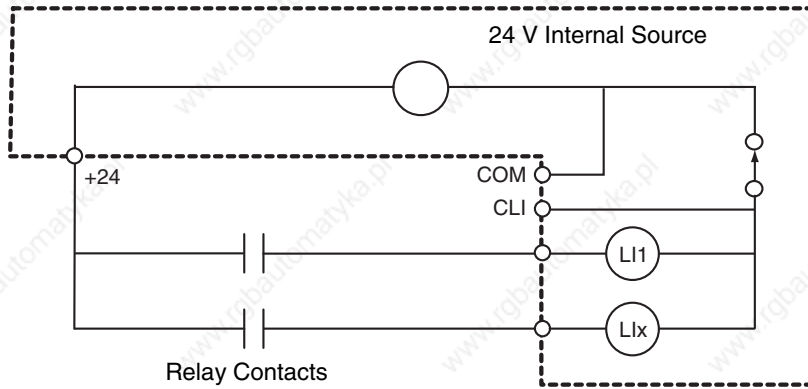
**Failure to follow these instructions can result in death, serious injury, or equipment damage.**





### Recommended Circuit Diagrams: Positive (Source) Logic

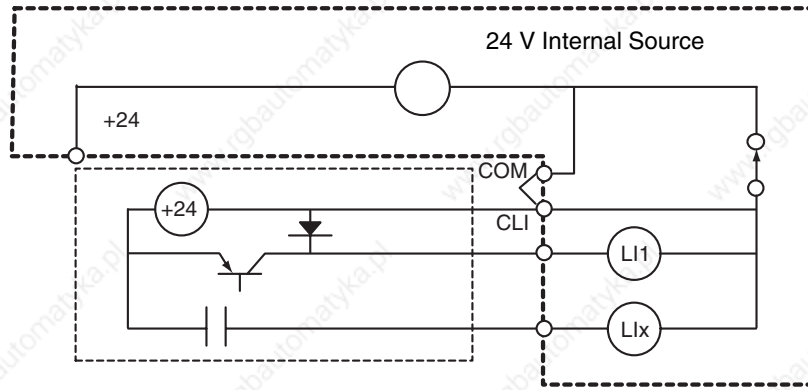
#### Internal 24 V Supply



Logic Input Switch in  
Source Position  
(Factory Setting for  
controllers other than  
ATV31•••A).

*Note: The heavy  
dashed line represents  
the drive controller.*

#### External Supply or PLC



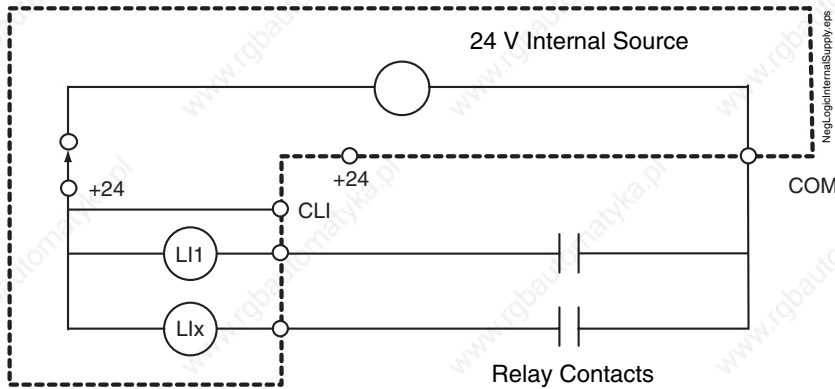
Logic Input Switch in  
Source Position or  
Floating Position with  
a Jumper Installed  
from COM to CLI.

*Note: The heavy  
dashed line represents  
the drive controller.*

PLC with either transistor outputs or  
relay contacts and its own internal  
supply

**Recommended Circuit Diagrams:  
Negative (Sink) Logic**

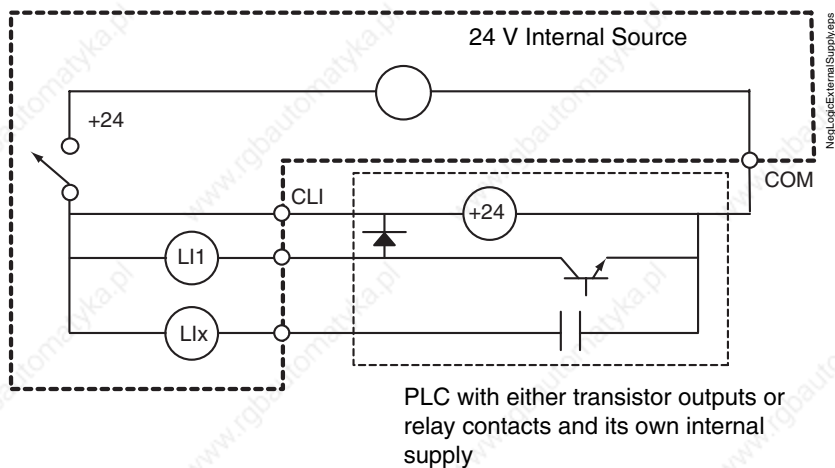
**Internal 24 V Supply**



Logic Input Switch in Sink Position

*Note: The heavy dashed line represents the drive controller.*

**External Supply or PLC**



Logic Input Switch in Floating Position

*Note: The heavy dashed line represents the drive controller.*

PLC with either transistor outputs or relay contacts and its own internal supply

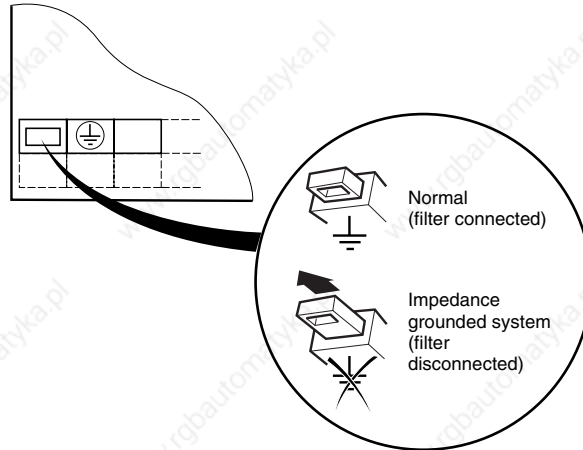
Negative (Sink) Logic is not recommended in cases where COM can become grounded. If COM is grounded, and any of the logic input wires have an insulation fault to ground, that input will be activated, possibly causing an unintended start of the motor. Refer to the precaution on page 32.

### Operation on an Impedance Grounded System

When using the ATV31 drive controller on a system with an isolated or impedance grounded neutral, use a permanent insulation monitor compatible with non-linear loads.

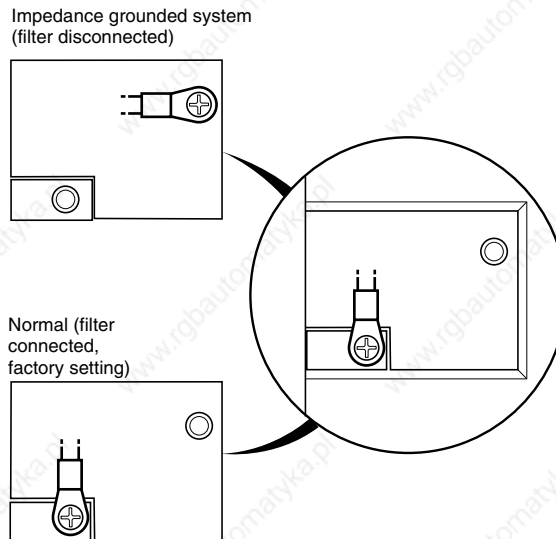
ATV31•••••M2 and N4 drive controllers feature built-in radio frequency interference (RFI) filters with grounded capacitors. When using the drive controller on an impedance grounded system, we recommend that you isolate the RFI filters from ground to prevent reduction of their operating life.

- ATV31H018M2 to U22M2 and ATV31H037N4 to U40N4: Pull out the jumper to the left of the ground terminal as illustrated below to isolate the RFI filters.



ATV31 Jumper.eps

- ATV31HU55N4 to D15N4: Connect the cable to the top left of the power terminals as illustrated below to isolate the filters (ATV31HU55N4 shown).



ATV31 Jumper.eps

RECOMMENDED FUSES

Table 15: Recommended Fuses for 208/230 V Drive Controllers

Motor		Drive Controller ATV31H***** <sup>1</sup>	600 V Fuses	
kW	hp		Class CC	Class J <sup>2</sup>
0.18	0.25	018M2	6 A	6 A
0.37	0.5	037M2	10 A	10 A
0.55	0.75	055M2	10 A	10 A
0.75	1	075M2	15 A	15 A
1.1	1.5	U11M2	20 A	20 A
1.5	2	U15M2	20 A	20 A
2.2	3	U22M2	30 A	30 A
0.18	0.25	018M3X	3 A	3 A
0.37	0.5	037M3X	6 A	6 A
0.55	0.75	055M3X	10 A	10 A
0.75	1	075M3X	10 A	10 A
1.1	1.5	U11M3X	15 A	15 A
1.5	2	U15M3X	15 A	15 A
2.2	3	U22M3X	20 A	20 A
3	3	U30M3X	25 A	25 A
4	5	U40M3X	—	35 A
5.5	7.5	U55M3X	—	50 A
7.5	10	U75M3X	—	60 A
11	15	D11M3X	—	80 A
15	20	D15M3X	—	110 A

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

<sup>2</sup> Fast acting or time delay.

Table 16: Recommended Fuses for 460 V Drive Controllers

Motor		Drive Controller ATV31H***** <sup>1</sup>	600 V Fuses	
kW	hp		Class CC	Class J <sup>2</sup>
0.37	0.5	037N4	3 A	3 A
0.55	0.75	055N4	6 A	6 A
0.75	1	075N4	6 A	6 A
1.1	1.5	U11N4	10 A	10 A
1.5	2	U15N4	10 A	10 A
2.2	3	U22N4	15 A	15 A
3	3	U30N4	15 A	15 A
4	5	U40N4	20 A	20 A
5.5	7.5	U55N4	30 A	30 A
7.5	10	U75N4	—	35 A
11	15	D11N4	—	50 A
15	2.0	D15N4	—	70 A

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

<sup>2</sup> Fast acting or time delay.

**Table 17: Recommended Fuses for 575 V Drive Controllers**

Motor		Drive Controller ATV31H..... <sup>1</sup>	600 V Fuses	
kW	hp		Class CC	Class J <sup>2</sup>
0.75	1	075S6X	6 A	6 A
1.5	2	U15S6X	6 A	6 A
2.2	3	U22S6X	10 A	10 A
4	5	U40S6X	15 A	15 A
5.5	7.5	U55S6X	20 A	20 A
7.5	10	U75S6X	25 A	25 A
11	15	D11S6X	—	35 A
15	20	D15S6X	—	45 A

<sup>1</sup> The symbol "\*" in a catalog number indicates the part of the number that varies with controller size or rating.

<sup>2</sup> Either fast acting or time delay.

## AVAILABLE TORQUE

For continuous duty operation:

- With self-ventilated motors, motor cooling depends on speed.
- When running at speeds less than 50% of the nameplate motor speed, it may be necessary to derate the motor.

For operation in overspeed:

- Since the voltage does not increase with the frequency, reduced induction in the motor and loss of torque occur. Consult the motor manufacturer to ensure that the motor can operate in overspeed.
- For a special motor, the nominal frequency and the maximum frequency are adjustable between 40 and 500 Hz.

## **▲ CAUTION**

### **MACHINERY OVERSPEED**

Some motors and/or loads may not be suited for operation above the nameplate motor speed and frequency. Consult the motor manufacturer before operating the motor above its rated speed.

**Failure to follow this instruction can result in injury or equipment damage.**

## DRIVE CONTROLLER VENTILATION

The fan starts automatically when the drive controller is commanded to run (receives a run command and a speed reference). It stops a few seconds after the drive controller is stopped (when output frequency is less than 0.5 Hz and DC injection braking is completed).

*NOTE: The fan may start without a run command if the drive controller temperature exceeds allowable limits.*

## MOTOR THERMAL PROTECTION

Thermal protection is integrated into the drive controller by continuous calculation of  $I^2t$ , taking motor speed into account. The motor power rating must be between 20% (50% for 575 V drive controllers) and 115% of the drive controller rating.

*NOTE: The motor thermal state memory is reset to zero when the drive controller is switched off.*

### **⚠ CAUTION**

#### **LOSS OF MOTOR OVERLOAD PROTECTION**

- Setting the lth parameter to its maximum value disables the internal motor overload protection function. In this case, external motor overload protection must be provided.
- When using external overload relays connected to the drive controller output, the overload relay must be capable of operation across the expected range of drive controller output frequencies (including direct current).
- When using DC injection braking, the overload relay must be suitable for operation with direct current flowing in the motor. Do not use overload relays equipped with current transformers for sensing the motor current.

**Failure to follow these instructions can result in injury or equipment damage.**

### **⚠ CAUTION**

#### **MOTOR OVERHEATING**

- This drive controller does not provide direct thermal protection for the motor.
- The motor thermal state memory is reset to zero when the drive controller is switched off.
- Use of a thermal sensor in the motor may be required for protection at all speeds and load conditions.
- Consult the motor manufacturer for thermal capability of the motor when operated over the desired speed range.

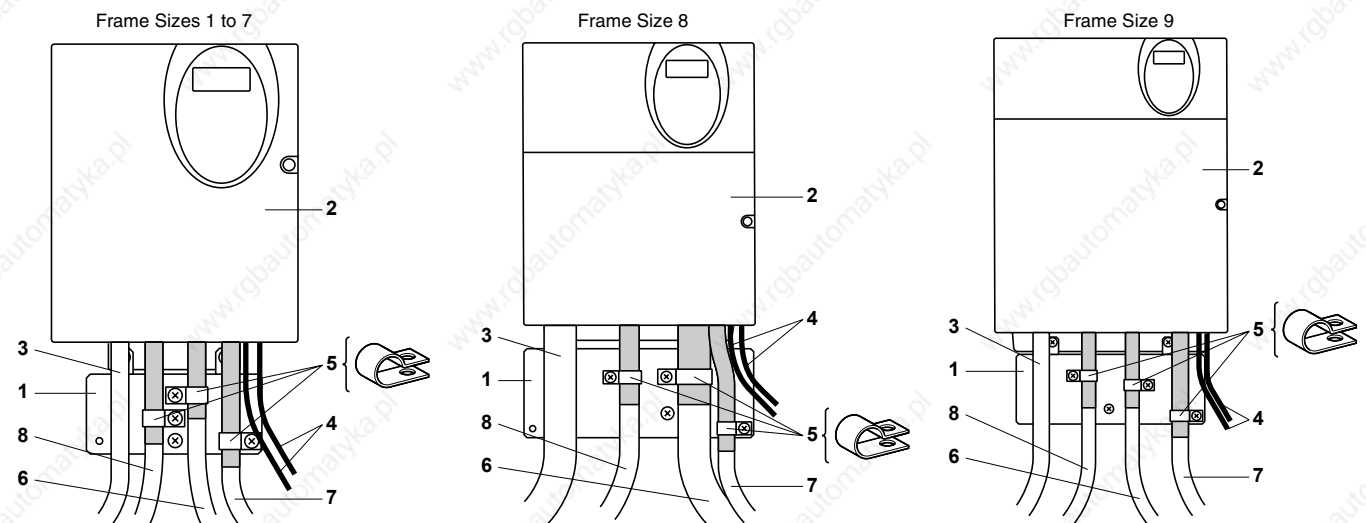
**Failure to follow this instruction can result in injury or equipment damage.**

## ELECTROMAGNETIC COMPATIBILITY

The ATV31 controller is considered to be a component. It is neither a machine nor a piece of equipment ready for use in accordance with the European Community directives (machinery directive or electromagnetic compatibility directive). It is the user's responsibility to ensure that the machine meets those standards.

### Installation Recommendations for Meeting EN 55011 Class A

- Ensure that the grounds of the drive controller, the motor, and the cable shields are at equal potential.
- Use shielded cables with the shields connected to ground at both ends of the motor cable, control cables, and the braking resistor (if used). Conduit can be used for part of the shielding length, provided that there is no break in continuity.
- Ensure maximum separation between the power supply cable (line supply) and the motor cable.



		Frame Size								
		1	2	3	4	5	6	7	8	9
<b>ATV31</b>	H018M3X, H037M3X	H055M3X, H075M3X	H018M2, H037M2	H055M2, H075M2	HU11M3X, HU15M3X	HU11M2, HU15M2 HU22M3X H037N4, H055N4, H075N4, HU11N4, HU15N4 H075S6X, HU15S6X	HU22M2 HU30M3X, HU40M3X HU22N4, HU30N4, HU40N4 HU22S6X, HU40S6X	HU55M3X, HU75M3X HU55N4, HU75N4 HU55S6X, HU75S6X	HD11M3X, HD15M3X HD11N4, HD15N4 HD11S6X, HD15S6X	

1. EMC plate supplied with the drive controller, installed as illustrated on page 19.
2. ATV31 drive controller.
3. Non-shielded power supply wires or cables.
4. Non-shielded wires for the output of the safety relay contacts.
5. The shields for cables 6, 7, and 8 must be securely attached to the EMC plate with stainless steel clamps (item 5). Strip cables 6, 7, and 8 to expose the shields. Apply appropriately-sized clamps around the stripped portion of the cables and fasten them to the EMC plate.
6. Shielded cable for connection to the motor, with shield connected to ground at both ends. This shield must not be interrupted. If intermediate terminal blocks are used, they must be in EMC-shielded metal boxes.

7. Shielded cable for connection to control/command devices. For applications which require a large number of conductors, small cross-sections must be used (20 AWG, 0.5 mm<sup>2</sup>). This shield must not be interrupted. If intermediate terminal blocks are used, they must be in EMC-shielded metal boxes.
8. Shielded cable for connecting the braking resistor, if used. The shield must be connected to ground at both ends. This shield must be unbroken, and if there are intermediate terminals, they must be in EMC-shielded metal boxes.

If using an additional input filter, connect it directly to the line supply with an unshielded cable. Then make connection 3 on the drive controller using the filter output cable.

Although there is a high frequency equipotential ground connection between the drive controller, motor, and cable shielding, you must still connect the PE protective conductors (green-yellow) to the appropriate terminals on each of the devices. You may also need to disconnect the shield at the motor end for very long cable runs to alleviate noise generation.



## A

AI1 29  
AI2 29  
AI3 29  
air flow. See ventilation  
altitude 10, 17  
AOC 30  
AOV 30

## B

braking  
  DC injection and overload relays 38  
  dynamic braking resistance 14  
  resistor 10  
  output to 27  
  torque 10  
branch circuit connections 23  
bus capacitor voltage. See voltage  
bus voltage measurement 22

## C

cable  
  output length 24  
  output type 24  
CANopen 11  
capacitance 24  
capacitors, power factor correction 24  
catalog numbers  
  interpreting drive catalog no. 8  
CE 11  
circuit breakers 23  
clearances  
  mounting 16  
CLI 30  
codes and standards 11  
COM 29  
common  
  analog I/O, COM 29  
  logic input, CLI 30  
communication  
  CANopen 11  
  Modbus 11  
condensation 21  
conductors. See wiring  
conduit  
  for wiring drive 22  
  routing 22  
conduit entry kit 16  
contactors 23  
control terminals. See terminals  
CSA 11  
C-TICK 11  
current  
  drive nominal output 12–13  
  drive transient output 12–13  
  input 23  
  maximum inrush 12–13  
  output 23  
  peak, on power up 12–13  
  short circuit 23  
  transient 10

## D

damage 8

DC bus  
  +polarity 27  
  -polarity 27  
derating 17  
dielectric strength 11  
dimensions 15  
disconnect devices 23  
documentation  
  programming manual 8  
  start-up guide 8  
dynamic braking resistance 14

## E

electrical characteristics 10–11  
electromagnetic compatibility 11, 19  
  EMC filters 11  
  EMC mounting plate 19  
  installation for 39  
  meeting EN 55011 Class A 39  
EMC. See electromagnetic compatibility  
emissions 11  
EN 11  
  EN 55011 11, 39  
enclosure  
  IP54 20  
  mounting the drive in 18, 20–21  
  sizing 20–21  
  Type 12 20  
  ventilation 21  
environment 10

## F

fan  
  in enclosure 21  
  on drive controller 38  
feeder cables 23  
filters  
  EMC 11  
  input 40  
  load 24  
  RFI 35  
floating logic 32  
frequency  
  input 10  
  output 10  
  resolution 10  
  switching 10, 13, 17  
fuses 23  
  recommended 36–37

## G

ground  
  resistance to 11  
  terminal 27  
grounding 25

## H

heat exchanger 21  
hp  
  motor nameplate 12–13  
  range of drive 8  
humidity 10

## I

ICS 11  
IEC 11  
impedance  
  impedance grounded systems 35  
  line 23  
  of analog input 29  
  of analog output 30  
  of logic input 30  
inductance 24  
input  
  analog current, AI3 29  
  analog voltage, AI1 29  
  analog voltage, AI2 29  
  current. See current  
  frequency. See frequency  
  phases. See phases  
  voltage. See voltage  
inputs, logic. See logic inputs  
installation 16–21  
  two or more drives in parallel 23  
insulation monitor 35  
IP20 16  
ISO 11

## K

kW  
  motor nameplate 12–13

## L

L1 27  
L2 27  
L3 27  
LI1 30  
LI2 30  
LI3 30  
LI4 30  
LI5 30  
LI6 30  
lightning arrestors 24  
line  
  contactor 23  
  impedance. See impedance  
  reactor 23  
  voltage. See voltage  
load filter 24  
logic  
  floating 32  
  sink 32, 34  
  source 32–33  
  logic input switch 32  
logic inputs  
  common, CLI 30  
  LI1 30  
  LI2 30  
  LI3 30  
  LI4 30  
  LI5 30  
  LI6 30  
  power supply 30  
  state at power up 9

## M

Modbus 11  
mounting  
    and heating sources 16  
    clearances 16  
    derating curves 17  
    in an enclosure 18, 20–21  
    methods 17  
    NEMA Type 12 (IP54) 21  
    on EMC mounting plate 19

## N

NEMA 11  
noise suppressors 23  
NOM 11

## O

output  
    analog voltage, AOV 30  
    current. See current  
    frequency. See frequency  
    logic voltage, AOC 30  
    phases. See phases  
    terminals 27  
    voltage. See voltage.  
overbraking 10  
overcurrent 10, 23–24  
overheating 10, 38  
overload relays 38  
    with DC injection braking 38  
overspeed 37  
overvoltage 10

## P

PA 27  
PB 27  
PC 27  
phases  
    input 10  
    output 10  
PO 27  
pollution degree 10  
potentiometer 12–13  
    power supply for 29  
power  
    dissipated at rated load 12–13  
    wiring 22  
power supply  
    for logic inputs 30  
    for potentiometer 29  
power terminals. See terminals  
protection  
    against phase loss 10  
    against short circuits 10  
    degree of 10  
    disabling internal motor overload 38  
    drive controller 10  
    external motor overload 38  
    IP20 10, 16  
    IP21 10  
    IP31 10  
    IP41 10  
    motor 10, 38  
    overbraking 10

overcurrent 23  
overvoltage 10  
thermal 10, 38  
UL Type 1 10, 16  
undervoltage 10  
protective vent cover 17  
    removing 16

## R

R1A 29  
R1B 29  
R1C 29  
R2A 29  
R2C 29  
ratings, of drive 12–13  
receiving 8  
relay  
    fault 29  
    programmable 29  
relays 23  
resolution frequency. See frequency  
RFI filters 35  
RJ45 connector 29

## S

shipping  
    damage 8  
    packing the drive 8  
shock 10  
short circuit 10  
    current 23  
    current rating 12–13  
sink logic 32, 34  
solenoid valves 23  
source logic 32–33  
specifications  
    electrical 10–11  
    environment 10  
standards. See codes and standards  
starting  
    from line power 23  
    start-up guide 8  
storing  
    proper storage area 8  
    temperature 8, 10  
supply voltage. See voltage  
switch  
    logic input 32  
switching frequency. See frequency

## T

T1 27  
T2 27  
T3 27  
temperature 17, 20  
    ambient 10  
    operating 10  
    storing 8, 10  
terminals  
    access to 26  
    control 29–30  
    A11 29  
    A12 29  
    A13 29

AOC 30  
AOV 30  
CLI 30  
COM 29  
LI1 30  
LI2 30  
LI3 30  
LI4 30  
LI5 30  
LI6 30  
logic input power supply 30  
power supply for potentiometer 29  
R1A 29  
R1B 29  
R1C 29  
R2A 29  
R2C 29  
power 26–28  
    ground 27  
    L1 27  
    L2 27  
    L3 27  
    PB 27  
    PC 27  
    PO 27  
    T1 27  
    T2 27  
    T3 27

thermal  
    protection 38  
    resistance 20  
    sensor 38

torque  
    available for continuous duty 37  
    available for overspeed 37  
    braking 10  
transformers 23  
transient current. See current  
Type 1. See protection  
Type 12. See enclosure

## U

UL 11  
undervoltage 10

## V

ventilation 18, 21, 38  
    in enclosure 21  
vibration 10  
voltage  
    bus capacitor 22  
    input 10, 12–13  
    line voltage  
        compatibility with supply voltage 9  
    output 10  
    range of drive 8

## W

weights 15

wiring 22–35

branch circuit connections 23

diagram 31

general practices 22

minimum inductance 24

output 24

power 22

routing cable 22

separation of control and power 22

separation of non-metallic and metallic  
23

terminal access 26

wiring diagram

drive 31

sink logic 34

source logic 33

