Chapter 1: Getting Started

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User Manual Overview

Overview of this Publication

This user manual describes the installation, configuration, accessories, and methods of operation of the *IronHorse* ACG Series Variable Frequency AC Drives.

Who Should Read This Manual

This manual contains important information for those who will install, maintain, and/or operate any of the *IronHorse* ACG Series AC Drives.

Supplemental Publications

The National Electrical Manufacturers Association (NEMA) publishes many different documents that discuss standards for industrial control equipment. Global Engineering Documents handles the sale of NEMA documents. For more information, you can contact Global Engineering Documents at:

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Special Symbols

NOTE: When you see the "notepad" icon in the left-hand margin, the paragraph to its immediate right will be a special note.

WARNING: When you see the "exclamation mark" icon in the left-hand margin, the paragraph to its immediate right will be a warning. This information could prevent injury, loss of property, or even death (in extreme cases).

Purpose of AC Drives

AC drives are generally known by many different names: Adjustable Frequency Drives (AFD), Variable Frequency Drives (VFD), and Inverters. Drives are used primarily to vary the speed of three phase AC induction motors, and they also provide non-emergency start and stop control, acceleration and deceleration, and overload protection. By gradually accelerating the motor, drives can reduce the amount of motor startup inrush current.

AC drives function by converting incoming AC power to DC, which is then synthesized back into three phase output power. The voltage and frequency of this synthesized output power is directly varied by the drive, where the frequency determines the speed of the three phase AC induction motor.

Selecting the Proper Drive Rating

Determine Motor Full-Load Amperage (FLA)

Motor FLA is located on the nameplate of the motor.
NOTE: FLA of motors that have been rewound may be higher than stated.

Determine Motor Overload Requirements

Many applications experience temporary overload conditions due to starting requirements or impact loading. Most AC drives are designed to operate at 150% overload for 60 seconds. If the application requires an overload greater than 150% or longer than 60 seconds, the AC drive must be oversized.

NOTE: Applications that require replacement of existing motor starters with AC drives may require up to 600% overload.

Determine Application Type; Heavy load (HD) or Normal load (ND)

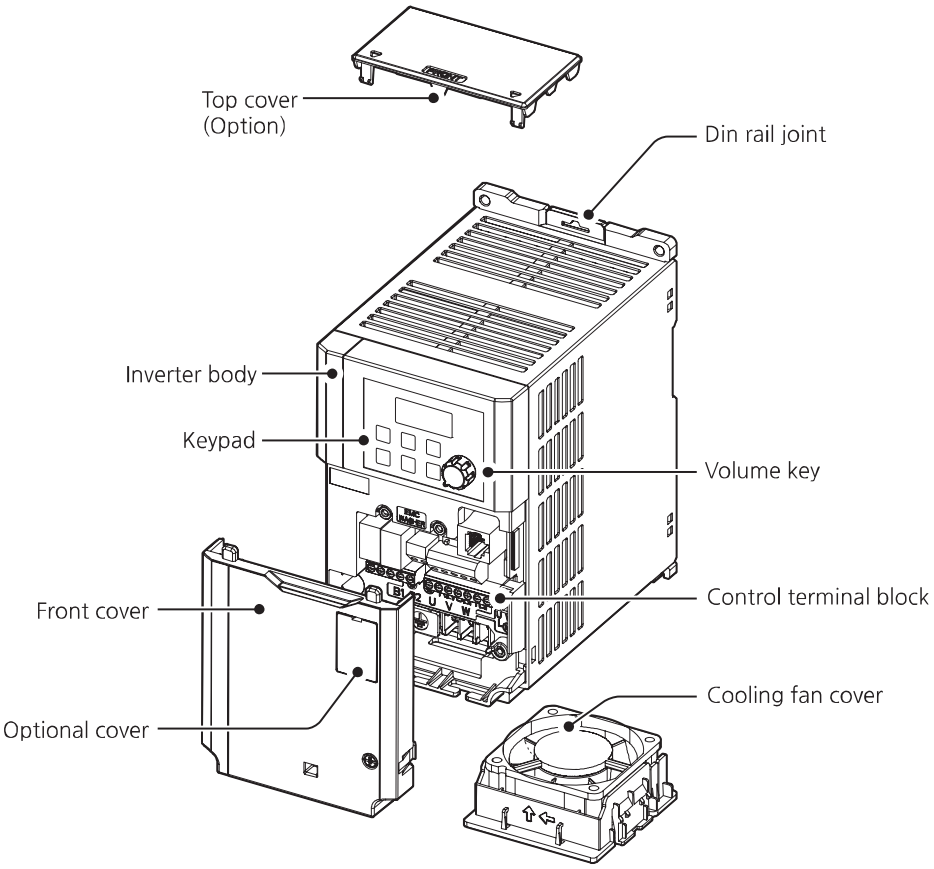
The load (also called torque) requirement has a direct effect on which drive to select. Normal load (ND) (also called Variable Torque (VT)) applications are generally easier to start; typically fans and pumps. Most other applications outside fans and pumps fall into the Heavy load (HD) (also called Constant Torque (CT)) category (machine control, conveyors, etc.). If you are unsure of the application, assume Heavy load (HD). This will provide the most robust performance from the drive.

ACG drives are specified by Heavy load (HD) rating. Normal load (ND) ratings are also listed on the nameplate and specification tables.

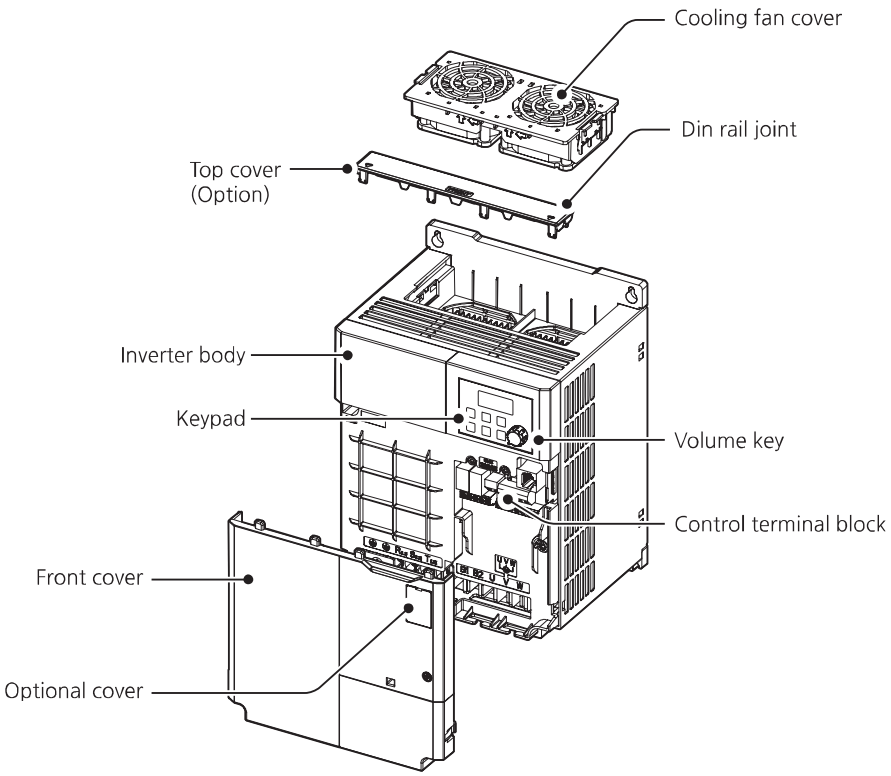
Parts Locater

The illustrations below show part names and locations. Details may vary between product groups.

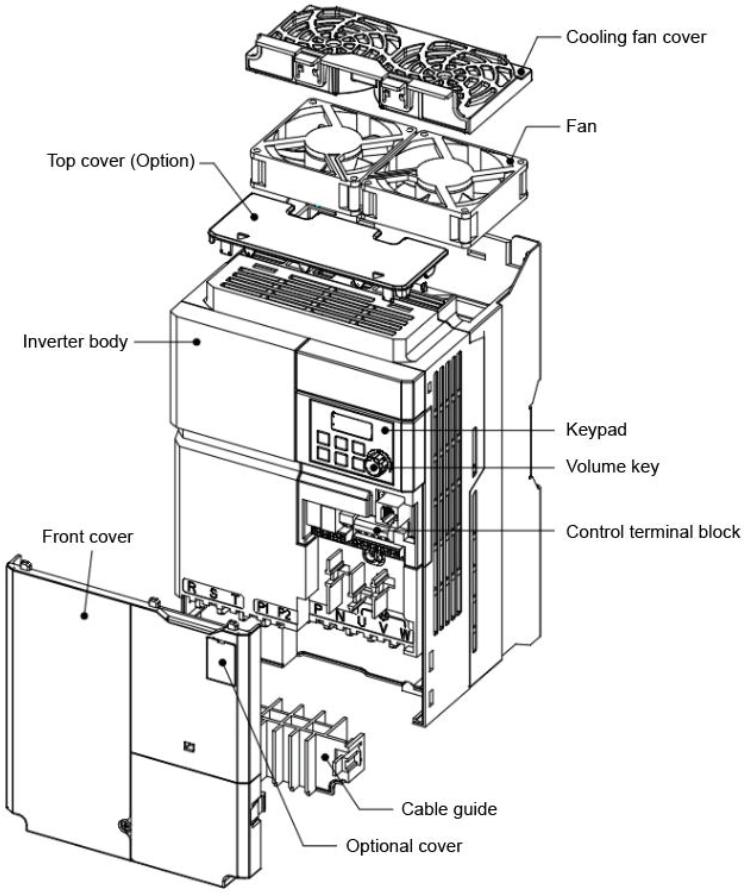
0.5–5 hp Drives:



7–10 hp Drives:



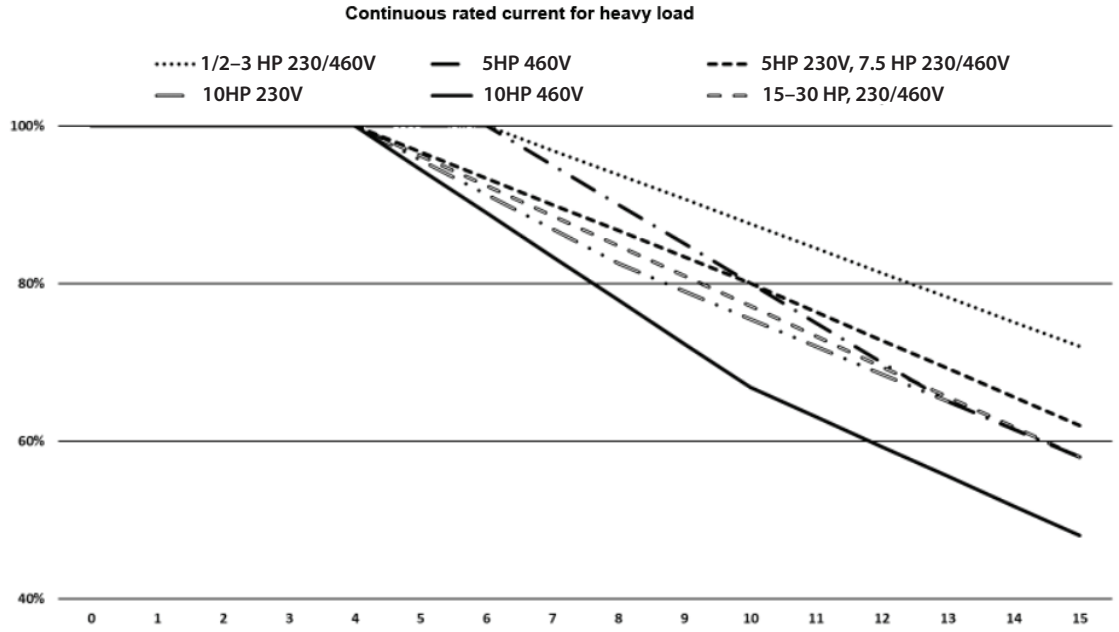
15–30 hp Drives:



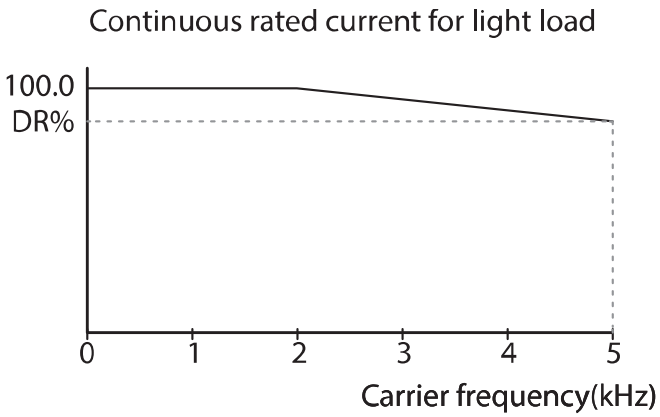
Continuous Rated Current Derating

Derating by Carrier Frequency

The continuous rated current of the drive is limited based on the carrier frequency. Refer to the following graph.



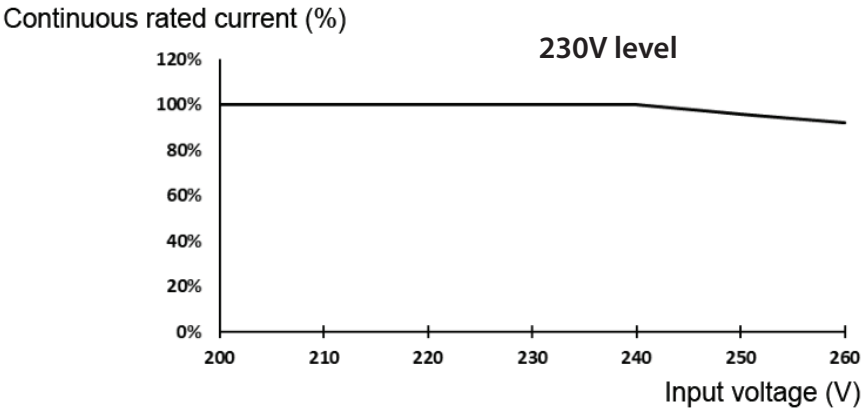
Derating by Carrier Frequency										
Carrier Frequency (kHz)	***Constant Rated Current (%)***									
	0.5–3.0 hp		***5.0 hp***		***7.5 hp***		***10 hp***		***15–30 hp***	
	230V	***460V***	***230V***	***460V***	***230V***	***460V***	***230V***	***460V***	***230V***	***460V***
1–4	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6	100%	100%	93%	100%	93%	93%	91%	89%	92%	92%
9	91%	91%	83%	85%	83%	83%	79%	72%	81%	81%
12	81%	81%	73%	70%	73%	73%	69%	59%	69%	69%
15	72%	72%	62%	58%	62%	62%	58%	48%	58%	58%

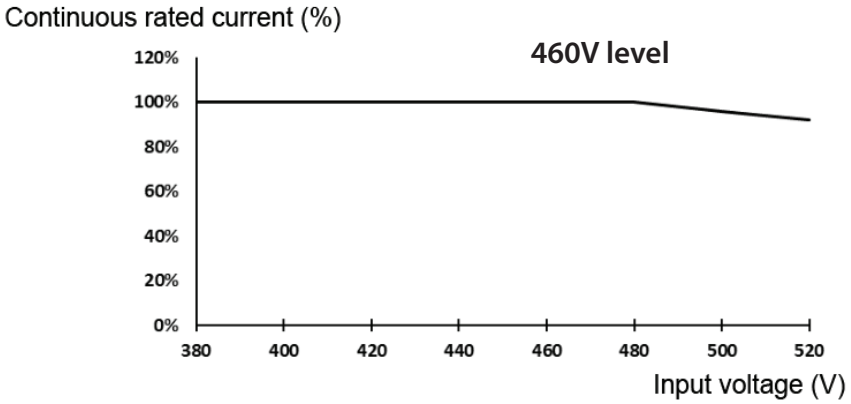


Capacity (hp)	*230V DR (%)*	*460V DR (%)*
0.5	88	74
1.0	88	86
2.0	88	84
3.0	94	85
5.0	96	93
7.5	85	81
10	85	77
15–30	80	80

Derating by Input Voltage

The continuous rated current of the drive is limited based on the input voltage. Refer to the following graphs.

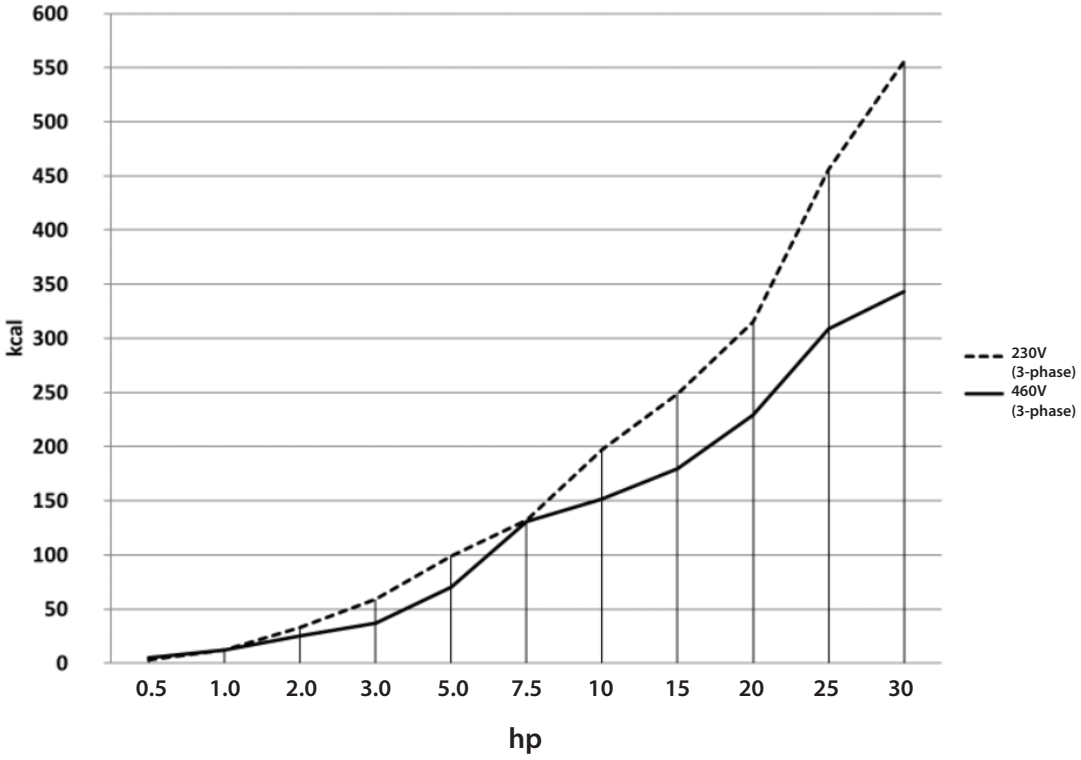




Voltage Class	Input Voltage (V)	Derating
230V	200	100%
	210	100%
	220	100%
	230	100%
	240	100%
	250	96%
	260	92%
	264	91%
460V	380	100%
	400	100%
	420	100%
	440	100%
	460	100%
	480	100%
	490	98%
	500	96%
	510	94%
	520	92%
	528	91%

Heat Emission

The following graph shows the drive's heat emission characteristics (by product capacity). Heat emission data is based on operations with default carrier frequency settings, under normal operating conditions. For detailed information on carrier frequency see "Operational Noise Settings (carrier frequency settings)" on page 4–118.



IronHorse ACG Series AC Drive Environmental Information

Storage and Transportation

AC drives should be kept in the shipping cartons or crates until they are installed to maintain the warranty coverage. Should they not be installed within three months of delivery, please store them as described below.

- *Store in a clean and dry location free from direct sunlight and corrosive fumes.*
- *Store within environmental conditions shown below in the "Environmental Conditions" table.*
- *DO NOT store in an area with rapid changes in temperature, to avoid condensation and frost.*
- *DO NOT place directly on the ground.*
- *Do not transport the drive by lifting with the drive's covers or plastic surfaces. The drive may tip over if covers break, causing injuries or damage to the product. Always support the drive using the metal frames during transport.*
- *Hi-capacity drives are very heavy and bulky. Use an appropriate transport method that is suitable for the weight.*

If the drive is stored or is otherwise unused for more than a year, the drive's internal DC link capacitors should be recharged before use. Otherwise, the capacitors may be damaged when the drive starts to operate. We recommend recharging the capacitors of any unused drive at least once per year.

Environmental Conditions

Environmental Conditions for IronHorse ACG Series AC Drives	
Installation Location	Mount the drive on a wall or inside a panel. Not suitable for use in direct sunlight.
Cooling	Forced fan cooling structure
Operating Ambient Temperature*	Heavy load (HD): -10 to 50°C (14 to 122°F) Normal load (ND): -10 to 40°C (14 to 104°F)
Storage Temperature	-20° to 65°C (-4 to 149°F)
Relative Humidity	Less than 95% (to avoid condensation)
Air Pressure	70 to 106 kPa
Pollution Level	Pollution level 3 environment: Prevent contact with corrosive gases, flammable gases, oil stains, dust, and other pollutants.
Altitude	No higher than 3280ft (1,000m). From 1000 to 4000m, the rated input voltage and rated output current of the drive must be derated by 1% for every 100m.
Vibration	Less than 9.8 m/sec^2 (1G)
Installation Orientation	Max allowed offset angle = 0 degrees. (Vertical orientation only). Do not install the drive on the floor or mount it sideways against a wall. The drive MUST be installed vertically, on a wall or inside a panel, with its rear flat on the mounting surface.
** The ambient temperature is the temperature measured at a point 2" (5 cm) from the surface of the drive.*	

IronHorse ACG Series AC Drive Specifications

230V Class – (Model Specifications)

ACG 230V Class Specifications; Frame Sizes A–C								
Model Name: ACG-xxxx				20P5	21P0	22P0	23P0	25P0
Frame Size				A	A	B	B	C
Applied Motor	Heavy load (HD)		hp	0.5	1.0	2.0	3.0	5.0
			kW	0.4	0.75	1.5	2.2	4.0
	Normal load (ND)		hp	1.0	2.0	3.0	5.0	7.5
			kW	0.75	1.5	2.2	4.0	5.5
Output Rating	Rated Capacity	HD	kVA	1.0	1.9	3.0	4.2	6.5
		ND	kVA	1.2	2.3	3.7	4.6	6.9
	Rated Current–3ph input	HD	A	2.5	5.0	8.0	11.0	17.0
		ND	A	3.1	6.0	9.6	12.0	18.0
	Rated Current –1ph input (60Hz)	HD	A	1.5	2.8	4.6	6.1	9.3
		ND	A	2.0	3.6	5.9	6.7	9.8
	Rated Current –1ph input (50Hz)	HD	A	1.5	2.7	4.5	5.9	9.1
		ND	A	1.9	3.5	5.7	6.5	9.5
	Output Frequency		Hz	0-400 Hz (IM Sensorless: 0-120 Hz)				
	Output Voltage		V	3-phase 200-240 VAC				
Input Rating	Input Voltage–3ph input		V	3-phase 200-240 VAC (-15% to +10%)				
	Input Voltage–1ph input		V	1-phase 240 VAC (-5% to +10%)				
	Input Frequency–3ph input		Hz	50-60 Hz (±5%)				
	Input Frequency–1ph input		Hz	60Hz (±5%)				
	Rated Current –1 or 3ph input	HD	A	2.2	4.9	8.4	11.8	18.5
		ND	A	3.0	6.3	10.3	13.1	19.4
IE2 Efficiency - Relative Power Loss (%)				1.5	1.4	1.6	1.7	2.0
Weight (lb [kg])				2.29 [1.04]	2.34 [1.06]	3.0 [1.36]	3.09 [1.4]	4.17 [1.89]
Cooling Method				Forced Fan–Internal				

- *The standard motor capacity is based on a standard 4-pole motor.*
- *The standard used for 230V drives is based on a 220V supply voltage.*
- *The rated output current is limited based on the carrier frequency set at Cn.04.*
- *The output voltage becomes 20~40% lower during no-load operations to protect the drive from the impact of the motor closing and opening (0.5~5HP models only).*
- *For Single Phase Power input, an input line reactor is required. See "Appendix A: Accessories" for the specific line reactor compatible with each drive model.*

230V Class – (Model Specifications)

ACG 230V Class Specifications; Frame Sizes D–E							
Model Name: ACG-xxxx				27P5	2010	2015	2020
Frame Size				D	D	E	E
Applied Motor	***Heavy load (HD)***		***hp***	7.5	10	15	20
			kW	5.5	7.5	11	15
	Normal load (ND)		***hp***	10	15	20	25
			kW	7.5	11	15	18.5
Output Rating	***Rated Capacity***	***HD***	***kVA***	9.1	12.2	17.9	22.9
		ND	***kVA***	11.4	15.2	21.3	26.7
	Rated Current–3ph input	***HD***	***A***	24.0	32.0	47	60
		ND	***A***	30.0	40.0	56	70
	Rated Current –1ph input (60Hz)	***HD***	***A***	12.8	17.4	26.8	34
		ND	***A***	16.3	22.0	31	38
	Rated Current –1ph input (50Hz)	***HD***	***A***	12.4	16.9	26	33.1
		ND	***A***	15.8	21.3	30	36.9
	Output Frequency		***Hz***	0-400 Hz (IM Sensorless: 0-120 Hz)			
	Output Voltage		***V***	3-phase 200-240 VAC			
Input Rating	***Input Voltage–3ph input***		***V***	3-phase 200-240 VAC (-15% to +10%)			
	Input Voltage–1ph input		***V***	1-phase 240 VAC (-5% to +10%)			
	Input Frequency–3ph input		***Hz***	50-60 Hz (±5%)			
	Input Frequency–1ph input		***Hz***	60Hz (±5%)			
	Rated Current –1 or 3ph input	***HD***	***A***	25.8	34.9	53.2	68.4
		ND	***A***	32.7	44.2	63.8	79.8
IE2 Efficiency - Relative Power Loss (%)				1.9	1.9	1.4	1.4
Weight (lb [kg])				6.79 [3.08]	7.08 [3.21]	10.7 [4.84]	16.8 [7.6]
Cooling Method				Forced Fan–Internal			

- *The standard motor capacity is based on a standard 4-pole motor.*
- *The standard used for 230V drives is based on a 220V supply voltage.*
- *The rated output current is limited based on the carrier frequency set at Cn.04.*
- *The output voltage becomes 20~40% lower during no-load operations to protect the drive from the impact of the motor closing and opening (0.5~5HP models only).*
- *For Single Phase Power input, an input line reactor is required. See "Appendix A: Accessories" for the specific line reactor compatible with each drive model.*
- *DC Link terminals (P1/P2) are only available on 15hp and larger models.*

460V Class – (Model Specifications)

ACG 460V Class Specifications; Frame Sizes A–C									
Model Name: ACG-xxxx				**40P5**	**41P0**	**42P0**	**43P0**	**45P0**
Frame Size				A	A	B	B	C
Applied Motor	***Heavy load (HD)***		***hp***	0.5	1.0	2.0	3.0	5.0
			kW	0.4	0.75	1.5	2.2	4.0
	Normal load (ND)		***hp***	1.0	2.0	3.0	5.0	7.5
			kW	0.75	1.5	2.2	4.0	5.5
Output Rating	***Rated Capacity***	***HD***	***kVA***	1.0	1.9	3.0	4.2	6.9
		ND	***kVA***	1.5	2.4	3.9	5.3	7.6
	Rated Current–3ph input	***HD***	***A***	1.3	2.5	4.0	5.5	9.0
		ND	***A***	2.0	3.1	5.1	6.9	10.0
	Rated Current –1ph input (60Hz)	***HD***	***A***	0.7	1.4	2.1	2.8	4.9
		ND	***A***	1.3	1.9	2.8	3.6	5.4
	Rated Current –1ph input (50Hz)	***HD***	***A***	0.7	1.4	2.0	2.7	4.8
		ND	***A***	1.3	1.8	2.7	3.5	5.2
	Output Frequency		***Hz***	0-400 Hz (IM Sensorless: 0-120 Hz)				
	Output Voltage		***V***	3-phase 380-480 VAC				
Input Rating	***Input Voltage–3ph input***		***V***	380-480 VAC (-15% to +10%)				
	Input Voltage–1ph input		***V***	480 VAC (-5% to +10%)				
	Input Frequency–3ph input		***Hz***	50-60 Hz (±5%)				
	Input Frequency–1ph input		***Hz***	60Hz (±5%)				
	Rated Current –1 or 3ph input	***HD***	***A***	1.1	2.4	4.2	5.9	9.8
		ND	***A***	2.0	3.3	5.5	7.5	10.8
IE2 Efficiency - Relative Power Loss (%)				1.6	1.3	1.3	1.3	1.4
Weight (lb [kg])				2.25 [1.02]	2.34 [1.06]	3.09 [1.4]	3.13 [1.42]	4.23 [1.92]
Cooling Method				Forced Fan–Internal				

- *The standard motor capacity is based on a standard 4-pole motor.*
- *The standard used for 460V drives is based on a 440V supply voltage.*
- *The rated output current is limited based on the carrier frequency set at Cn.04.*
- *The output voltage becomes 20~40% lower during no-load operations to protect the drive from the impact of the motor closing and opening (0.5~5HP models only).*
- *For Single Phase Power input, an input line reactor is required. See "Appendix A: Accessories" for the specific line reactor compatible with each drive model.*

460V Class – (Model Specifications)

ACG 460V Class Specifications; Frame Sizes D–F									
Model Name: ACG-xxxx				47P5	4010	4015	4020	4025	4030
Frame Size				D	D	E	E	F	F
Applied Motor	Heavy load (HD)		hp	7.5	10	15	20	25	30
			kW	5.5	7.5	11	15	18.5	22
	Normal load (ND)		hp	10	15	20	25	30	40
			kW	7.5	11	15	18.5	22	30
Output Rating	Rated Capacity	HD	kVA	9.1	12.2	18.3	23.6	29.7	34.3
		ND	kVA	12.2	17.5	23.6	29.0	34.3	46.5
	Rated Current–3ph input	HD	A	12.0	16.0	24	31	39	45
		ND	A	16.0	23.0	31	38	45	61
	Rated Current –1ph input (60Hz)	HD	A	6.4	8.7	15	18	23	27
		ND	A	8.7	12.6	18	23	27	35
	Rated Current –1ph input (50Hz)	HD	A	6.2	8.5	14.6	17.4	22.3	26.2
		ND	A	8.4	12.2	17.4	22.2	26.1	33.8
	Output Frequency		Hz	0-400 Hz (IM Sensorless: 0-120 Hz)					
	Output Voltage		V	3-phase 380-480 VAC					
Input Rating	Input Voltage–3ph input		V	380-480 VAC (-15% to +10%)					
	Input Voltage–1ph input		V	480 VAC (-5% to +10%)					
	Input Frequency–3ph input		Hz	50-60 Hz (±5%)					
	Input Frequency–1ph input		Hz	60Hz (±5%)					
	Rated Current –1 or 3ph input	HD	A	12.9	17.5	27.2	35.3	44.5	51.9
		ND	A	17.5	25.4	35.3	43.3	51.9	70.8
IE2 Efficiency - Relative Power Loss (%)				1.3	1.4	0.9	1.0	0.9	0.9
Weight (lb [kg])				6.79 [3.08]	6.88 [3.12]	10.8 [4.89]	10.8 [4.91]	16.8 [7.63]	16.9 [7.65]
Cooling Method				Forced Fan–Internal					

- *The standard motor capacity is based on a standard 4-pole motor.*
- *The standard used for 460V drives is based on a 440V supply voltage.*
- *The rated output current is limited based on the carrier frequency set at Cn.04.*
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- *For Single Phase Power input, an input line reactor is required. See "Appendix A: Accessories" for the specific line reactor compatible with each drive model.*
- *DC Link terminals (P1/P2) are only available on 15hp and larger models.*

Specifications Applicable to All ACG Series Models

IronHorse ACG Series General Specifications (All Models)				
Control Characteristics	Control Method		V/F control, Slip Compensation, Sensorless Vector	
	Frequency Settings Power Resolution		Digital command: 0.01 Hz Analog command: 0.06 Hz (60Hz standard)	
	Frequency Accuracy		1% of maximum output frequency	
	V/F Pattern		Linear, square reduction, user V/F	
	Overload Capacity		Heavy load (HD) rated current: 150% for 1 minute Normal load (ND) rate current: 120% for 1 minute	
	Torque Boost		Manual torque boost, automatic torque boost	
Operation Characteristics	Operation Type		Select key pad, terminal strip, or communication operation	
	Frequency Setting Signal		Analog type: -10~10 V, 0~10 V, 4~20 mA, or Potentiometer Keypad: Up/Down arrows or integrated dial	
	Main Functions		• PID control • 3-wire operation • Frequency limit • Second motor function • Anti-forward and reverse direction rotation • Commercial transition • Speed search • Power braking • Up-down operation • DC braking • Frequency jump • Slip compensation • Automatic restart • Automatic tuning • Energy buffering • Flux braking • Fire mode	
	Input		Select PNP (Source) or NPN (Sink) mode. Functions can be set according to In.65–In.69 codes and parameter settings.	
		Multi-function Digital Inputs (5) P1-P5	• Forward direction operation • Reset • Emergency Stop • Multi-step speed frequency-high/med/low • DC braking during stop • Frequency increase • 3-wire • Select acc/dec/stop • Reverse run • External trip • Jog operation • Multi-step acc/dec-high/med/low • Second motor selection • Frequency reduction • Fix analog command frequency • Transition from PID to general operation	
		Analog Input (2) VR, V1, I2	Set various drive control parameters to follow the analog input. • Voltage: -10 to 10V, 0–10V • Current: 4–20 mA • Potentiometer: 1–5kΩ	
	Output	Multi-function relay outputs (2) A, B, C	Functions can be set according to parameters OU.31 and OU.33	Less than (N.O., N.C.) 250VAC, 1A Less than 30VDC 1A
		Analog Output (1) AO	0–12 VDC: Select frequency, output current, output voltage, DC terminal voltage and others	
	Communication	Serial (S+, S-)	RS-485 Modbus serial network or software	
		RJ45 Connector	Comunication to software, remote keypad, or communication option card	

IronHorse ACG Series General Specifications (All Models)		
Protection Function Characteristics	***Trip***	• Overcurrent trip • External signal trip • ARM short circuit current trip • Overheat trip • In phase open trip • Ground trip • Motor overheat trip • I/O board link trip • No motor trip • Parameter writing trip • Emergency stop trip • Command loss trip • External memory error • CPU watchdog trip • Motor light load trip • Overvoltage trip • Temperature sensor trip • Drive overheat • Option trip • Out phase open trip • Drive overload trip • Fan trip • Pre-PID operation failure • External break trip • Low voltage trip during operation • Low voltage trip • Analog input error • Motor overload trip • Over-torque trip • Under-torque trip
	Alarm	Command loss trip alarm, overload alarm, light load alarm, drive overload alarm, fan operation alarm, resistance braking rate alarm, number of corrections on rotor tuning error, drive pre-overheat alarm, over-torque alarm, under-torque alarm
	Instantaneous Blackout	• Heavy load less than 15ms (Normal load less than 8ms): must be within the rated input voltage and rated output range • Heavy load more than 15ms (Normal load more than 8ms): auto-restart operation
Accessory	***Communication Card Option***	EtherNet/IP and Modbus TCP (ACG-ET2)
Agency Approvals		UL, CE

Receiving and Inspection

Drive Package Contents

After receiving the ACG Series AC drive, please check the following:

1) Make sure that the package includes the product insert.
2) Carefully follow the unpacking instructions contained in this chapter of this user manual when unpacking your AC drive.
3) Please inspect the unit after unpacking to assure it was not damaged during shipment. Make sure that the part number printed on the package corresponds with the part number indicated on the nameplate.
4) Make sure that the part number indicated on the nameplate corresponds with the part number of your order.
5) Make sure that the voltage for the wiring lies within the range as indicated on the nameplate. Please install the AC drive according to this manual.
6) Before applying the power, please make sure that all the devices, including power, motor, control board, and digital keypad are connected correctly.
7) When wiring the AC drive, please make sure that the wiring of input terminals and output terminals are correct to prevent drive damage.
8) When executing a trial run, please begin with a low speed, and then gradually increase the speed until the desired speed is reached.

In the case of missing inserts, unit damage, or mis-matching nameplates, please contact AutomationDirect technical support.

The ACG series AC drive should be kept in the shipping carton or crate before installation. In order to retain the warranty coverage, the drive should be stored properly when it is not to be used for an extended period of time. Refer to the preceding “Environmental Information” section for proper storage conditions.

Model Number Explanation

ACG - 2 0P5

Applicable Motor Capacity (HD) with 3-Phase Input

0P5: 0.5 hp	010: 10 hp
1P0: 1.0 hp	015: 15 hp
2P0: 2.0 hp	020: 20 hp
3P0: 3.0 hp	025: 25 hp
5P0: 5.0 hp	030: 30 hp
7P5: 7.5 hp	

Input Voltage
2: 230 VAC
4: 460 VAC

Series Name

Nameplate Information