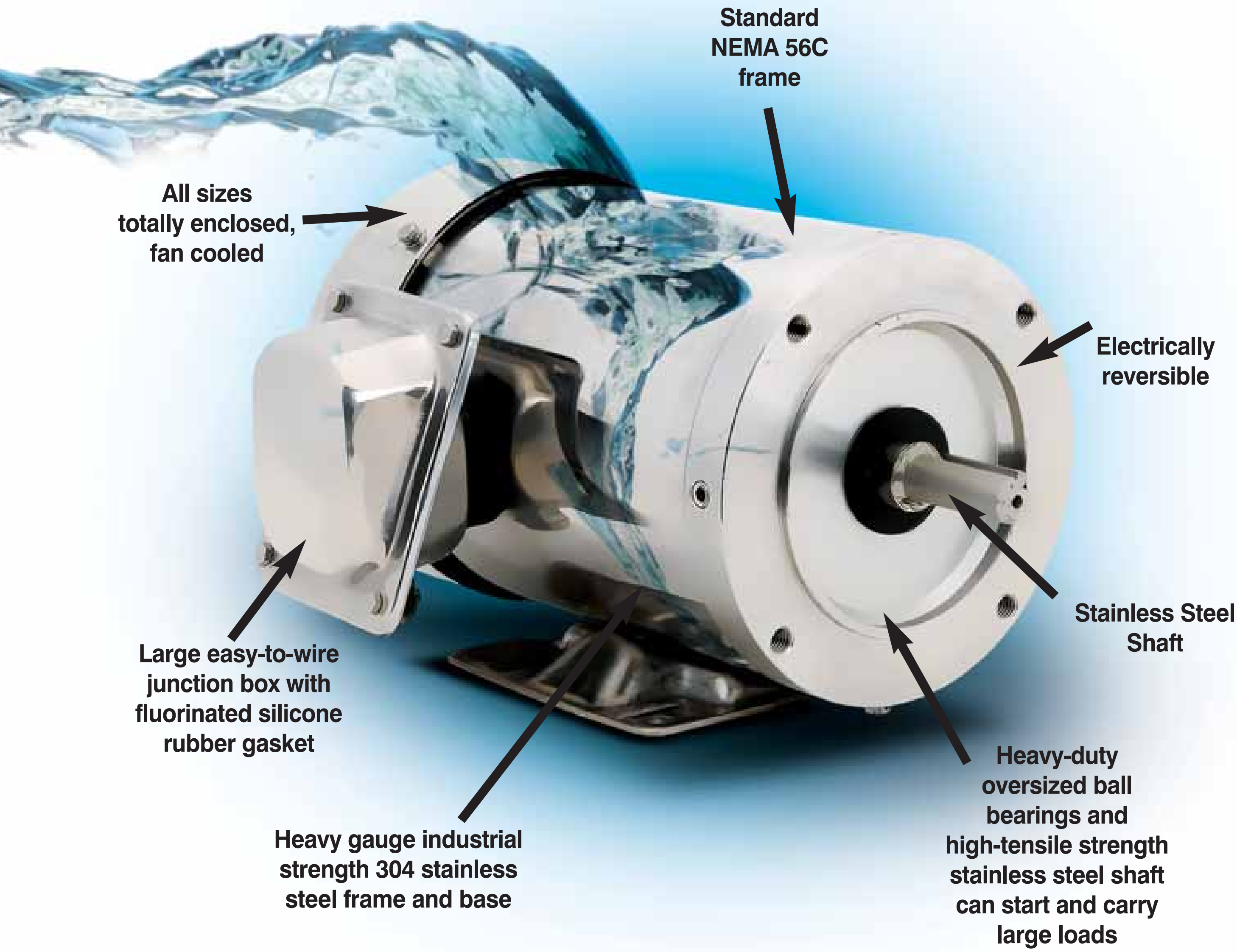
IronHorse is ready for washdowns and harsh environments!

IRONHORSE
AUTOMATIONDIRECT

IP56 environmental rating

MTSS Stainless Steel 56C Frame Motors 0.33 to 2 hp



Three-phase - 208-230/460 Volt, 56C Frame - TEFC Enclosure, 1800 & 3600 RPM

- 0.33 to 2 hp
- Electrically reversible
- Round body motors (no base) also available
- Heavy gauge stainless steel shaft, frame and base
- Available with or without mounting feet
- Includes pre-installed IP66 cord grip

IronHorse® MTSS Stainless Steel Three Phase General Purpose AC Motors

56C Frame Stainless Steel TEFC Motors – Three Phase – 0.33 to 2 hp

MTSS-xxx-3BDxxR
3-Phase Stainless Steel 56C Frame without Feet

MTSS-xxx-3BDxx
3-Phase Stainless Steel 56C Frame with Feet

MTAS-CG-M22
Spare/Replacement Nickel-plated Brass Cable Gland

Features

- Totally Enclosed Fan Cooled (TEFC) enclosure
- NEMA 56C flange mount
- 304 stainless steel shell frame
- Stainless steel shaft
- Large easy-to-wire junction box with fluorinated silicone rubber gasket
- Nickel-plated brass cable gland included
- IP56 environmental rating
- Available with or without mounting feet
- Heavy-duty permanently-sealed oversized ball bearings
- Nameplate information with wiring diagram etched into frame
- Electrically reversible
- NEMA design B
- Class F winding insulation
- Service Factor: 1.15 across-the-line (1.0 with AC drive)
- One year warranty
- $_c$CSA$_{us}$ certified

Accessories & Spare Parts Available

- Nickel-plated brass cable gland (spare/replacement)

Applications

- Conveyors
- Fans
- Gear reducers
- Pumps
- Inverter capable
- Washdown environments

IronHorse® MTSS Stainless Steel Three Phase General Purpose AC Motors

56C Frame Stainless Steel TEFC Motors – Three Phase – 0.33 to 2 hp

Motor Specifications – 3-phase 56C Frame Stainless Steel Motors – 1800 & 3600 RPM										
Part Number	**Price**	**HP**	**Base RPM**	**Phase**	**Voltage**	**Housing**	**NEMA Frame**	**Service Factor**	**F.L. Amps @ 208-230V/460V**	**Approx Weight (lb)**
MTSS-P33-3BD18R	<--->	1/3	1800	3	208-230/460	TEFC stainless steel frame with round body F1 conduit box location	56C flange mount	1.15	1.5-1.4 / 0.7	27
MTSS-P50-3BD18R	<--->	1/2							1.55-1.5 / 0.75	27
MTSS-P75-3BD18R	<--->	3/4							2.6-2.4 / 1.2	29
MTSS-001-3BD18R	<--->	1							3.5-3.2 / 1.6	34
MTSS-1P5-3BD18R	<--->	1-1/2							4.6-4.2 / 2.1	36
MTSS-002-3BD18R	<--->	2							6.6-6.0 / 3.0	43
MTSS-P33-3BD18	<--->	1/3	1800			TEFC stainless steel frame with rigid base F1 conduit box location			1.5-1.4 / 0.7	28
MTSS-P50-3BD18	<--->	1/2	1800						1.55-1.5 / 0.75	28
MTSS-P50-3BD36	<--->		3600						1.99-1.8 / 0.9	29
MTSS-P75-3BD18	<--->	3/4	1800						2.6-2.4 / 1.2	30
MTSS-P75-3BD36	<--->		3600						2.4-2.3 / 1.15	31
MTSS-001-3BD18	<--->	1	1800						3.5-3.2 / 1.6	35
MTSS-001-3BD36	<--->		3600						3.3-3.0 / 1.5	31
MTSS-1P5-3BD18	<--->	1-1/2	1800						4.6-4.2 / 2.1	36
MTSS-1P5-3BD36	<--->		3600						4.2-4.0 / 2.0	36
MTSS-002-3BD18	<--->	2	1800						6.6-6.0 / 3.0	44
MTSS-002-3BD36	<--->		3600						5.0-4.8 / 2.4	43

Note: Please review the AutomationDirect Terms & Conditions for warranty and service on this product.

Motor Accessory (Optional) – 3-phase 56C Frame Stainless Steel Motors – 1800 & 3600 RPM			
Part Number	**Price**	**Description**	**Approx Weight (lb)**
MTAS-CG-M22	<--->	Cable gland; M22 x 1.5 mm thread; (1) silicone rubber gasket accommodates a cable diameter range of 0.393 to 0.512 in (10 to 13 mm); IP66 protection level; nickel-plated brass housing. This is a SPARE part for IronHorse MTSS motors - one cable gland is pre-installed on each MTSS motor.	0.2

Performance Data – 3-phase 56C Frame Stainless Steel Motors (460V data except as indicated) – 1800 & 3600 RPM																
Part Number	**HP**	**NEMA Design**	**FL RPM**	**Minimum Speed (rpm)**		**Current @ 460V (Amps)**		**Torque (lb·ft)**			**Maximum Speed (rpm)**		**FL Efficiency (%)**	**FL Power Factor**	**Rotor Inertia (lb·ft²)**
				CT (2:1)	**VT (5:1)**	**No Load**	**Locked Rotor**	**Full Load**	**Locked Rotor**	**Break -down**	**CHP***	**Safe**			
MTSS-P33-3BD18(R)	1/3	B	1725	900	360	0.29	4.2	1.0	2.9	3.9	2250	4500	82.5	0.71	2.88
MTSS-P50-3BD18(R)	1/2		1725	900	360	0.30	4.6	1.5	3.8	5.2	2250		82.5	0.76	3.75
MTSS-P50-3BD36			3460	1800	720	0.36	6.0	0.7	1.9	2.5	4500		77.0	0.88	1.93
MTSS-P75-3BD18(R)	3/4		1725	900	360	0.44	7.3	2.2	5.0	7.0	2250		82.5	0.78	4.99
MTSS-P75-3BD36			3470	1800	720	0.43	7.6	1.1	2.7	3.3	4500		73.0	0.84	2.65
MTSS-001-3BD18(R)	1		1740	900	360	0.61	10.0	3.0	7.2	9.9	2250		84.0	0.78	7.20
MTSS-001-3BD36			3470	1800	720	0.58	10.0	1.5	4.6	5.5	4500		80.0	0.72	4.60
MTSS-1P5-3BD18(R)	1-1/2		1740	900	360	0.70	13.8	4.4	10.3	14.5	2250		84.0	0.83	10.34
MTSS-1P5-3BD36			3480	1800	720	0.70	15.0	2.3	6.6	9.0	4500		84.0	0.74	6.56
MTSS-002-3BD18(R)	2		1740	900	360	1.08	21.0	5.9	13.9	18.9	2250		84.0	0.83	13.87
MTSS-002-3BD36			3480	1800	720	0.85	18.0	2.9	8.6	11.3	4500		80.0	0.72	8.58

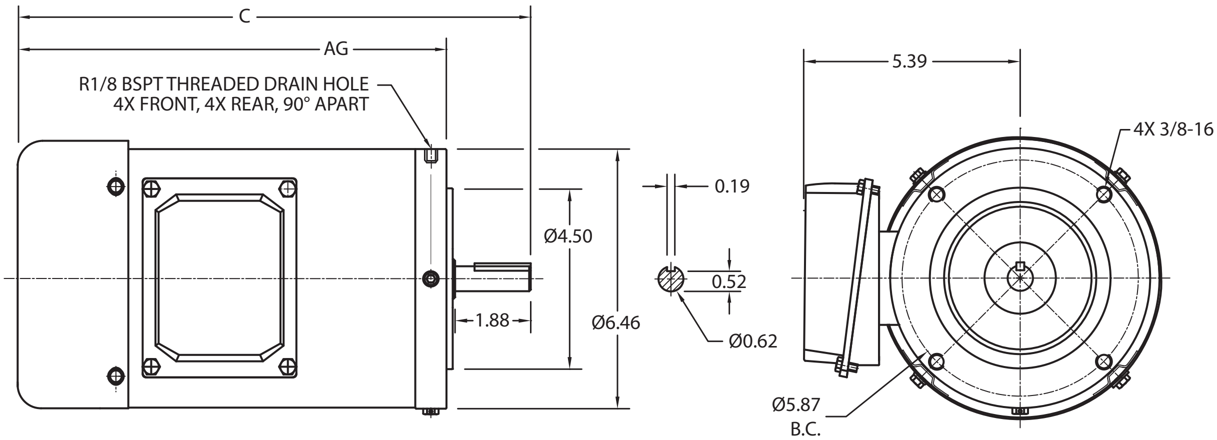
** Maximum Coupled HP speed is for direct-coupled loads.*

IronHorse® MTSS Stainless Steel Three Phase General Purpose AC Motors

56C Frame Stainless Steel TEFC Motors – Three-Phase – Dimensions

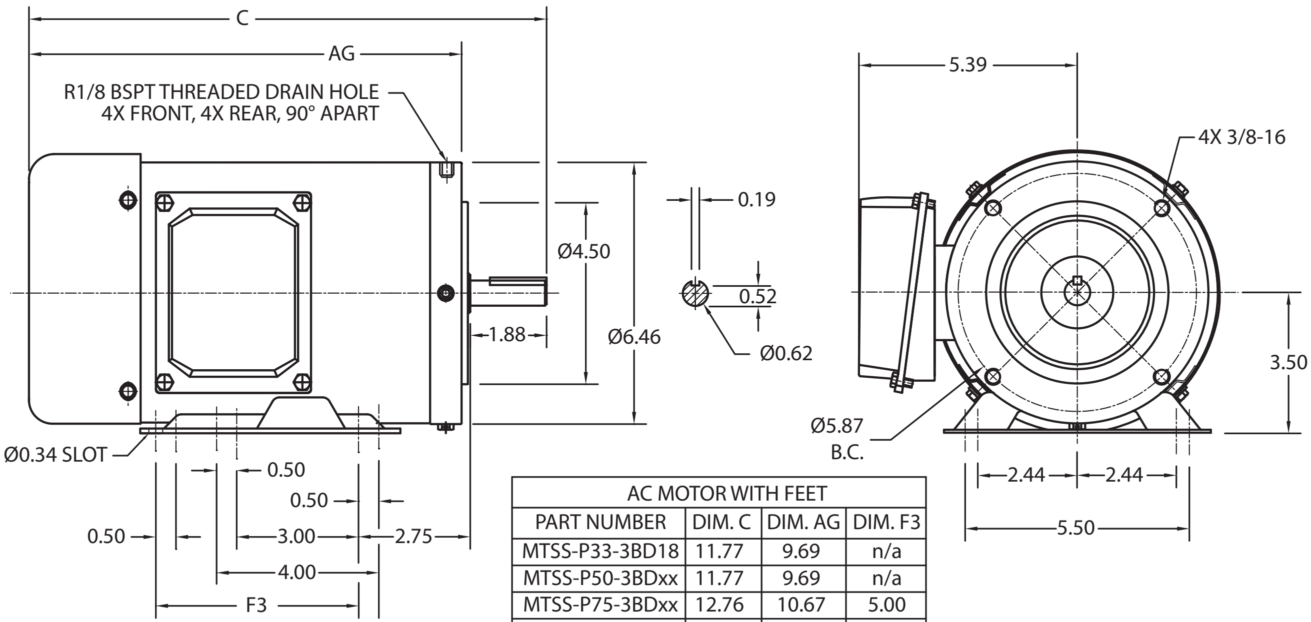
Dimensions = inches

MTSS-xxx-xxxxxR 3-Phase Stainless Steel 56C Frame Round-body Motors



AC MOTOR WITHOUT FEET		
PART NUMBER	DIM. C	DIM. AG
MTSS-P33-3BD18R	11.59	9.50
MTSS-P50-3BD18R	11.59	9.50
MTSS-P75-3BD18R	12.76	10.67
MTSS-001-3BD18R	12.76	10.67
MTSS-1P5-3BD18R	12.76	10.67
MTSS-002-3BD18R	12.76	10.48

MTSS-xxx-xxxxx 3-Phase Stainless Steel 56C Frame Rigid-base Motors



AC MOTOR WITH FEET			
PART NUMBER	DIM. C	DIM. AG	DIM. F3
MTSS-P33-3BD18	11.77	9.69	n/a
MTSS-P50-3BDxx	11.77	9.69	n/a
MTSS-P75-3BDxx	12.76	10.67	5.00
MTSS-001-3BDxx	12.76	10.67	5.00
MTSS-1P5-3BDxx	12.76	10.67	5.00
MTSS-002-3BDxx	13.50	11.42	5.00

AutomationDirect AC Motors Selection Overview

EPAct, High and Premium Efficiency What does it all mean?

EPAct (1992)

In 1992, the U.S. Congress passed legislation requiring that general purpose Design A & B motors meet minimum efficiency requirements, and this legislation was called the Energy Policy Act of 1992. Previously, there had been no U.S. standards set forth for motor energy efficiency. Since 1997 (when EPAct '92 was first enforced), two-, four-, and six-pole general purpose Design A & B motors had to meet EPAct guidelines. Since then, most general purpose motors manufactured and/or sold in the U.S. have met these requirements.

Premium Efficiency (EISA 2007)

In December 2010, a new level of energy efficiency mandate went into effect. The Energy Independence and Security Act of 2007 mandated that all AC industrial motors as described below must meet Premium Efficiency standards. The NEMA trade group was instrumental in getting this legislation passed, so many people refer to the high efficiency motors by their nickname – NEMA Premium®. All applicable motors manufactured or imported into the U.S. after December 2010 must meet the Premium Efficiency guidelines.

Motors Covered Under EISA 2007 (Premium Efficiency Mandate)
Included – must meet the new Premium Efficiency standards – Industrial AC electric squirrel-cage general-purpose motors as follows:
Single speed; Polyphase; 1–200 hp with 3-digit frame sizes; 2, 4, & 6 pole (3600, 1800, & 1200 rpm); NEMA design A & B (including IEC equivalent); Continuous rated
Not Included in Premium Efficiency standards, but must now meet EPAct standards:
JM; JP; Round body (footless); 201–500 hp; Fire pump; U-frame; Design C; 8-pole
Certain motors (Inverter/Vector Duty, NEMA design D, etc.) are not covered by EISA 2007. For full text, visit www.energy.senate.gov and click "ENERGY INDEPENDENCE & SECURITY ACT OF 2007".

Nominal Full-Load Efficiency Standards Comparisons (%)

Enclosed Electric Motors, Random Wound, 60 Hz, 600V or Less

Motor HP	1200 rpm [6-pole]		1800 rpm [4-pole]		3600 rpm [2-pole]	
	EPAct	Premium Efficiency	EPAct	Premium Efficiency	EPAct	Premium Efficiency
1	80.0	82.5	82.5	85.5	75.5	77.0
1.5	85.5	87.5	84.0	86.5	82.5	84.0
2	86.5	88.5	84.0	86.5	84.0	85.5
3	87.5	89.5	87.5	89.5	85.5	86.5
5	87.5	89.5	87.5	89.5	87.5	88.5
7.5	89.5	91.0	89.5	91.7	88.5	89.5
10	89.5	91.0	89.5	91.7	89.5	90.2
15	90.2	91.7	91.0	92.4	90.2	91.0
20	90.2	91.7	91.0	93.0	90.2	91.0
25	91.7	93.0	92.4	93.6	91.0	91.7
30	91.7	93.0	92.4	93.6	91.0	91.7
40	93.0	94.1	93.0	94.1	91.7	92.4
50	93.0	94.1	93.0	94.5	92.4	93.0
60	93.6	94.5	93.6	95.0	93.0	93.6
75	93.6	94.5	94.1	95.4	93.0	93.6
100	94.1	95.0	94.5	95.4	93.6	94.1
125	94.1	95.0	94.5	95.4	94.5	95.0
150	95.0	95.8	95.0	95.8	94.5	95.0
200	95.0	95.8	95.0	96.2	95.0	95.4

AutomationDirect AC Motors Selection Overview

General purpose or inverter-duty motor?

How to choose a general purpose motor vs. an inverter-duty motor

General purpose motors have been around for many years. They are the workhorse of almost every industry. An inverter-duty motor is a much newer concept that was necessary as general purpose motors began to be driven by VFDs (inverters or AC drives). An inverter duty motor can withstand the higher voltage spikes produced by all VFDs (amplified at longer cable lengths) and can run at very slow speeds without overheating. This performance comes at a cost: inverter-duty motors can be much more expensive than general purpose motors. Guidelines for choosing an IronHorse general purpose motor vs. an inverter-duty motor are given below. If your application falls within the guidelines below, there is no need to apply an inverter-duty motor.

NOTE: Marathon inverter-duty motors have limitations as well. Please see the Marathon section for more details.

Background: For many years, AC motors were driven by across-the-line contactors and starters. The electricity sent to the motor was a very clean sine wave at 60Hz. Noise and voltage peaks were relatively small. However, there were drawbacks: they only ran electrically at one speed (speed reduction was usually handled by gearboxes or some other, usually inefficient, mechanical means) and they had an inrush of electrical current (when the motor was first turned on) that was usually 5 to 6 times the normal current that the motor would consume. The speed reduction apparatus was expensive and bulky, and the inrush would wreak havoc with power systems and loading (imagine an air conditioning system in an old house - when the compressor would kick on, the lights would dim; now imagine the same circumstances with a motor the size of a small car).

Note: The following discussion applies only to 3-phase motors.

Enter the VFDs (variable frequency drives): Drives were introduced to allow the speed of these motors to be changed while running and to lessen the inrush current when the drive first starts up. To do this, the drive takes the incoming 60Hz AC power and rectifies it to a DC voltage (every drive has a DC bus that is around 1.414 (sqrt of 2) * incoming AC Line Voltage).

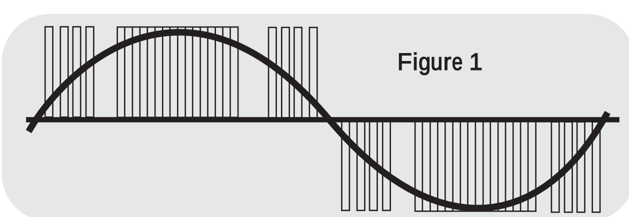


Figure 1

This DC voltage is then "chopped" by power transistors at very high frequencies to simulate a sine wave that is sent to the motor [see Figure 1]. By converting the incoming power to DC and then reconverting it to AC, the drive can vary its output voltage and output frequency, thus varying the speed of a motor. Everything sounds great, right? We get to control the frequency and voltage going out to the motor, thus controlling its speed.

Some things to watch out for: A VFD-driven general purpose motor can overheat if it is run too slowly. *(Motors can get hot if they're run slower than their rated speed.)* Since most general purpose motors cool themselves with shaft-mounted fans, if the motor overheats, bearing and insulation life will be reduced. Therefore there are minimum speed requirements for all motors.

The voltage "chopping" that occurs in the drive actually sends high-voltage spikes (at the DC bus level) down the wire to the motor. If the system contains long cabling, there are actually instances where a reflected wave occurs at the motor. The reflected wave can effectively double the voltage on the wire. This can lead to premature failure of the motor insulation. Long cable lengths between the motor and drive increase the harmful effects of the reflected wave, as do high chopping frequencies (listed in drive manuals as carrier frequencies). Line reactors, 1:1 transformers placed at the output of the drive, can help reduce the voltage spikes going from the drive to the motor. Line reactors are used in many instances when the motor is located far from the drive [see Figure 2].

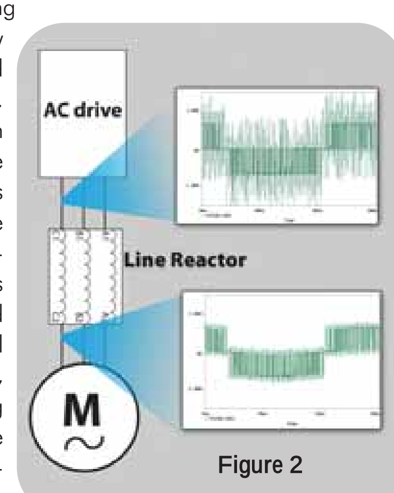


Figure 2

In summary, general purpose motors can be run with drives in many applications; however inverter-duty motors are designed to handle much lower speeds without overheating and they are capable of withstanding higher voltage spikes without their insulation failing. With the increased performance comes an increase in cost. This additional cost can be worth it if you need greater performance.

The considerations for applying IronHorse motors are given below.

Heat considerations

	IronHorse speed ratio	For an 1800 RPM motor, minimum IronHorse speed is:
Variable Torque applications (fans, centrifugal pumps, etc.)	5:1 (EPAct motors) 10:1 (PE motors)	1800/5 = 360RPM 1800/5 = 180RPM
Constant Torque Applications (conveyors, extruders, etc.)	2:1 (EPAct motors) 4:1 (PE motors)	1800/2 = 900RPM 1800/4 = 450RPM

Voltage Spike considerations

	Max cable distance from drive to IronHorse motor	Max cable distance with a 3% line reactor between drive and IronHorse motor
For use with 230V and 460V VFDs*	125 ft	250 ft

** Up to 6kHz carrier frequency*

IronHorse® General Purpose AC Motors

Using IronHorse General Purpose Motors with AC Drives

Drive *Reactor* *Motor*

AC drive motor control vs. across-the-line motor control

General purpose AC induction motors are typically controlled by across-the-line starters, i.e. contactors, manual motor starters, etc. However, three-phase general purpose motors can also be controlled by AC drives under certain conditions. (Single-phase AC motors cannot be controlled by typical three-phase AC drives.)

Across-the-line control applies full voltage to the motor at startup, and has several disadvantages.

- High inrush current - startup inrush current is typically 5-6 times the normal motor full load current, and can significantly increase utility bills.
- Inability to change speeds - the motor runs only at its rated speed.
- Inefficiency in some applications - fan and pump applications require ON/OFF control or valves/dampers to control flow.
- Contact maintenance - arcing caused by high inrush and breaking currents significantly reduce the motor starter's life span.

Many applications can use AC drive control for three-phase AC induction motors, which has several advantages:

- Lower inrush current at motor startup
- Ability to change motor speed
- Greater efficiency in some applications. - fan and pump applications can use the AC drive to provide both motor control and flow control. The drive can control the flow by varying the motor speed, and therefore eliminate the need for inefficient valves/dampers.
- Solid state power delivery; minimal maintenance.

NOTE: AC drive (VFD) control is applicable only for three-phase AC motors (three-phase AC drives cannot be used to control single-phase motors)

General purpose AC induction motors are not designed specifically for use with AC drives, so there are three major considerations for AC drive control of three-phase general purpose motors:

1. Heat considerations for AC drive control

Fan-cooled motors are designed to provide sufficient insulation cooling when the motors run at rated speed. The cooling ability of fans is reduced when motors run at lower speeds, and the insulation in general purpose motors is not designed for this condition. Therefore, there are limitations on how slowly general purpose motors can be continuously run without prematurely causing motor insulation failure.

- **Constant Torque (CT) Applications**
  PE motors: 4:1 (1/4 rated speed)
  EPAct motors: 2:1 (1/2 rated speed)
  The CT minimum continuous speed for an IronHorse general purpose motor is either one quarter or one half of its rated speed, as shown in the motor Performance Data tables. (Constant torque loads require the same amount of torque from the motor regardless of speed; e.g., conveyors, cranes, machine tools.)
- **Variable Torque (VT) Applications**
  PE motors: 10:1 (1/10 rated speed)
  EPAct motors: 5:1 (1/5 rated speed)
  The VT minimum continuous speed for an IronHorse general purpose motor is either one tenth or one fifth of its rated speed, as shown in the motor Performance Data tables. (Variable torque loads require less torque at lower speeds, resulting in less heat generated by the motor; e.g., fans, centrifugal pumps.)

If your application requires motors to run at speeds below those described above, use our Marathon inverter duty motors. Inverter duty motors can run fully loaded at very low speeds without being damaged by overheating.

2. Voltage spike considerations for AC drive control

All AC drives cause large voltage spikes between the drive and the motor, and long cable distances increase these spikes even more. Therefore, there are maximum cable lengths that can be run between the drive and the motor. Line (load) reactors can be installed near the drive output to reduce the voltage spikes.

- 230V and 460V **Without Reactor – 125 ft maximum cable length** between drive and motor
- 230V and 460V **With Reactor – 250 ft maximum cable length** between drive and motor

If your application requires cable lengths longer than those described above, please use our Marathon inverter-duty motors.

3. Carrier frequency limitation for AC drive control

The AC Drive carrier frequency should be set to 6kHz or less.

AC Motor Selection – IronHorse®
Three Phase General Purpose Motors

IronHorse® General Purpose Motor Selection				
Characteristics	**1-Phase 56C Frame Rolled Steel**	**3-Phase 56C Frame Rolled Steel**	**3-Phase 56C Frame Stainless Steel**	**3-Phase Cast Iron T & TC Frames**
Electrical Characteristics				
Horsepower range	1/3 – 1-1/2	1/3 – 2		PE: 1–200(T); 1–100(TC) EPAct: 250–300(T)
Base speed (# Poles)	1800 (4)	1800 (4), 3600 (2)		1200(6), 1800 (4), 3600(2)
Standard Voltage	115/208-230	208-230/460		208-230/460 (250 & 300 hp 460V only)
Phase / Base Frequency (Hz)	1 / 60	3 / 60		
Service Factor	1.15	1.15 (line) ; 1.0 (drive)		
Design Code (NEMA)	B			
Insulation Class	F			
Insulation System	dip & bake		double dip & bake	EPAct: double dip & bake PE: VPI
Duty Cycle	continuous			
Thermal protection	none			
Mechanical Characteristics				
Frame size (mounting)	56C			143T/TC - 405TC/449T
Enclosure	TEFC			TEFC
Frame material	rolled steel frame; aluminum end bell		304 stainless steel	cast iron
End bracket material	aluminum		304 stainless steel	cast iron
Conduit box material	steel		304 stainless steel	cast iron
Fan guard material	steel		304 stainless steel	steel
Fan material	plastic		heat-resistant polyethylene	plastic (143T/TC - 445/7T) aluminum (449T)
Lead termination	conduit box			
Standard mounting	C-Face with Removable Rigid Base	C-Face with Removable Rigid Base	C-Face with Rigid Base C-Face with Round Body	Rigid Base (C-Flange kit available EPAct) C-Face with Rigid Base (1-100 hp)
Drive end shaft slinger	yes			
Paint	black		n/a	EPAct: epoxy primer / synthetic alkyd enamel PE: polyurethane enamel
Bearings	ball			1-75 hp: ball 100-300 hp: roller
Grease	Exxon Polyrex EM	Exxon Polyrex EM	Korschun lithium-based	Exxon Polyrex EM
Standard conduit box assembly position	F1			F1 (some sizes reversible to F2)
Performance Characteristics				
Constant Torque speed range	n/a	2:1		2:1 (EPAct) 4:1 (Premium Efficiency)
Variable Torque speed range	n/a	5:1		5:1 (EPAct) 10:1 (Premium Efficiency)
Constant Horsepower speed range	n/a	1.5:1		1.5:1
Temperature rise	B			
Encoder provisions	none			
Other Characteristics				
Agency listings	CE, $_{c}$CSA$_{US}$		$_{c}$CSA$_{US}$	CE, $_{c}$CSA$_{US}$
Warranty*	2 years		1 year	2 years

****See Terms and Conditions for motor warranty explanation.***

1) For warranty on IronHorse motors below 50 hp, warranty service can be arranged through AutomationDirect.
2) For warranty on IronHorse motors 50 hp and above, motors must be inspected by a local EASA motor repair or service center; (see AutomationDirect Terms & Conditions).

IronHorse® General-Purpose AC Motors Model Overview – MTC, MTCP, & MTSS

Single Phase Rolled Steel 56C Frame

Three-Phase Stainless Steel 56C – Round Body

Three-Phase Premium Efficiency Cast Iron T-Frame

Three Phase Rolled Steel 56C Frame

Three-Phase Stainless Steel 56C – Rigid Base

Three-Phase Premium Efficiency Cast Iron TC Frame

IronHorse motors are manufactured by leading motor suppliers with over 20 years experience delivering high-quality motors to the demanding U.S. market. Our suppliers produce motors in ISO9001 facilities, and test the motors during production and after final assembly. This is how we can stand behind our IronHorse motors with a two-year warranty (one year for Stainless Steel).

The IronHorse line of motors includes:

- TEFC 56C frame single-phase AC motors with rolled steel frames; flange mount and removable mounting feet; 0.33–1.5 hp
- TEFC 56C frame three-phase AC motors with rolled steel frames; flange mount and removable mounting feet; 0.33–2 hp
- TEFC 56C frame three-phase AC motors with stainless steel frames; flange mount and round bodies or rigid mounting feet; 0.33–2 hp
- TEFC T-frame three-phase Premium Efficiency AC motors with cast iron frames and mounting feet; 1–200 hp
- TEFC T-frame three-phase EPAct AC motors with cast iron frames and mounting feet; 250–300 hp
- TEFC TC frame three-phase C-face Premium Efficiency AC motors with cast iron frames and mounting feet; 1–100 hp
- Replacement start and run capacitors available for IronHorse single-phase motors
- Accessory C-flange kits available for flange mounting of IronHorse three-phase cast iron T-frame Premium Efficiency motors
- STABLE motor slide bases for adjustable mounting of NEMA motors from 56 - 449T (stainless steel bases not available)