



# AutomationDirect AC Motors Selection Overview

## EPAcT, High, 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 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

For full text, visit [www.energy.senate.gov](http://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.

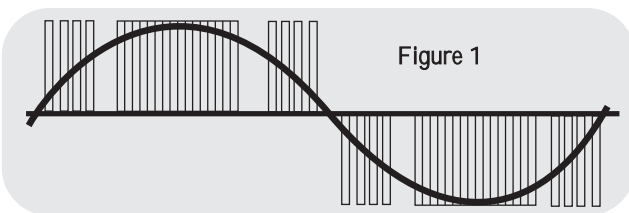
NOTE: Marathon inverter-duty motors have limitations as well. Please see the Marathon section for more details.

**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):

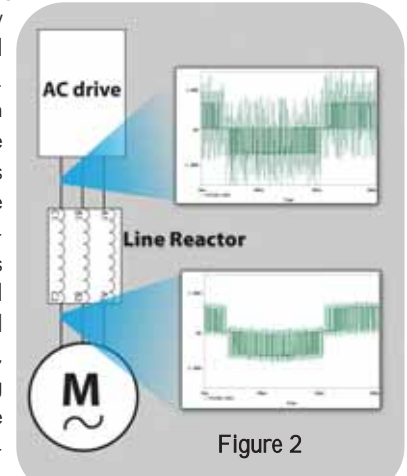
Drives were introduced to allow the speed of these motors to be changed while running and to lessen the inrush current when the drive first starts up. To do this, the drive takes the incoming 60Hz AC power and rectifies it to a DC voltage (every drive has a DC bus that is around 1.414 (sqrt of 2) \*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



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].

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)	1800/5 = 360RPM
	10:1 (PE motors)	1800/5 = 180RPM
Constant Torque Applications (conveyors, extruders, etc.)	2:1 (EPAct motors)	1800/2 = 900RPM
	4:1 (PE motors)	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'	250'

\* Up to 6kHz carrier frequency

# IronHorse® General Purpose AC Motors

## Using IronHorse General Purpose Motors with AC Drives



### 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 – Three-phase Motors

(Single-phase motors are shown on page 15-15)

3-Phase Characteristic	IronHorse® 56C Frame 3-Phase	IronHorse® T & TC Frames EPAct & PE	Marathon microMAX™	Marathon Black Max®	Marathon Blue Max®	Marathon NEMA Premium® XRI®	Marathon Blue Chip XRI®
<b>Electrical Characteristics</b>							
<b>Horsepower range</b>	1/3 - 2	PE: 1-200(T); 1-100(TC) EPAct: 1-300(T); 1-100(TC)	1/4 - 10	1/4 - 30	40 - 100	1 - 10	15 - 100
<b>Base speed (# Poles)</b>	1800 (4), 3600 (2)	1200(6), 1800 (4), 3600(2)	1800 (4)	1800 (4) and 1200 (6)	1800 (4)	1200(6),1800(4),3600(2)	1800 (4)
<b>Standard Voltage</b>	208-230/460	208-230/460 (250 & 300 hp 460V only)	230/460 (1/4 hp is 230V only)	230/460 and 575	230/460	208-230/460	230/460 and 575
<b>Insulation Class</b>	F	F	H	F	H	F	F
<b>Insulation System</b>	dip & bake	EPAct: double dip & bake PE: VPI	CR <sup>200</sup> magnet wire	MAX GUARD®		CR <sup>200</sup> magnet wire	
<b>Service Factor</b>	1.15 (line) 1.0 (drive)	1.15 (line) 1.0 (drive)	1.0	1.0	1.0	1.15 (line) 1.0 (drive)	1.15
<b>Phase/Base Frequency</b>	3/60						
<b>Design Code (NEMA)</b>	B	A: 10-50 hp 4&6-pole EPAct B: all other EPAct; all PE	A and B for 1/4 - 2 hp	A	A	B	B
<b>Duty Cycle</b>	Continuous						
<b>Thermal protection</b>	None			Class F thermostats		None	
<b>Mechanical Characteristics</b>							
<b>Frame size (mounting)</b>	56C	143T/TC - 405TC/449T	56C - 215TC	56C - 286TC	324T(C)-405T(C)	56C - 215TC	254T - 405T
<b>Enclosure</b>	TEFC	TEFC	TENV and TEFC	TENV	TEFC and TEBC	TEFC	TEFC
<b>Frame material</b>	Rolled Steel frame; Aluminum end bell	Cast Iron	Rolled Steel	Rolled Steel w Al face; Cast Iron	Cast Iron	Rolled Steel	Cast Iron
<b>End bracket material</b>	Aluminum	Cast Iron	Aluminum	Aluminum, Cast Iron	Cast Iron	Aluminum	Cast Iron
<b>Conduit box material</b>	Steel	Cast Iron	Steel	Steel	Cast Iron	Steel	Steel (<326T) Cast Iron (>364T)
<b>Fan guard material</b>	Steel	Steel	Polypropylene	None (all ratings TENV)	Cast Iron	Plastic	Polyprop. (<286T) Cast Iron (>324T)
<b>Fan material</b>	Plastic	Plastic (143T/TC - 445/7T) Aluminum (449T)	Polypropylene	None (all ratings TENV)	Polypropylene	Plastic	Polypropylene
<b>Lead termination</b>	Conduit box	Conduit box	Conduit box except Terminal block - 1/4 hp	Conduit box	Conduit box	Conduit box	Conduit box
<b>Standard mounting</b>	C-Face with Removable Rigid Base	Rigid Base (C-Flange kit available EPAct) C-Face with Rigid Base (1-100 hp)	C-Face with Rigid Base & C-Face Round Body	C-Face with Rigid Base	C-Face with Rigid Base	C-Face with Rigid Base	Rigid Base
<b>Drive end shaft slinger</b>	Yes	Yes	No	No	Yes	Yes	Yes
<b>Paint</b>	Black	EPAct: Epoxy primer / Synthetic alkyd enamel PE: Polyurethane enamel	Black powder-coat	Black enamel	Blue enamel	Blue enamel	epoxy paint
<b>Bearings</b>	Ball	1-75 hp: Ball 100-300 hp: Roller	Ball (C3 fit)	Ball (C3 fit)	Ball (C3 fit)	Ball	Ball (C3 fit)
<b>Grease</b>	Exxon Polyrex EM						
<b>Standard conduit box assembly position</b>	F1	F1 some sizes reversible to F2	F3	F1, reversible to F2	F1, reversible to F2	F3	F1
<b>Performance Characteristics</b>							
<b>Constant Torque speed range</b>	2:1	2:1 (EPAct) 4:1 (Premium Efficiency)	20:1 (TEFC) 1000:1 (TENV)	1000:1 (TENV)	2000:1 (all enclosures)	10:1	20:1
<b>Variable Torque speed range</b>	5:1	5:1 (EPAct) 10:1 (Premium Efficiency)	-	-	-	10:1	-
<b>Constant Horsepower speed range</b>	1.5:1	1.5:1	2:1	2:1 (90-120Hz intermit- tent @50% duty cycle)	2:1	2:1	2:1
<b>Temperature rise</b>	B	B	B	F	F (TEFC) and B (TEBC)	F	B
<b>Encoder provisions</b>	No	No	No	Yes	Yes	No	No
<b>Other Characteristics</b>							
<b>Agency listings</b>	cCSA <sub>US</sub>	CE, cCSA <sub>US</sub> , EPAct	UL Recognized and CSA Certified				
<b>Warranty*</b>	2 years			3 years (through Marathon Electric)			
<p><b>*See Terms and Conditions for motor warranty explanation.</b></p> <p>1) For warranty on IronHorse motors below 50 hp, warranty service can be arranged through AutomationDirect.</p> <p>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 &amp; Conditions.</p> <p>3) Marathon warranty service can be arranged through Marathon Electric service centers. See list of service centers on our web site at <a href="http://www.automationdirect.com">www.automationdirect.com</a>.</p>							

# IronHorse® General Purpose AC Motors

## Model Overview – MTC & MTCP



**Single-Phase  
Rolled Steel 56C-Frame**



**EPACT Three-Phase  
Cast Iron T-Frame**



**EPACT Three-Phase  
Cast Iron TC-Frame**



**Three-Phase  
Rolled Steel 56C-Frame**



**Premium Efficiency Three-Phase  
Cast Iron T-Frame**



**Premium Efficiency Three-Phase  
Cast Iron TC-Frame**

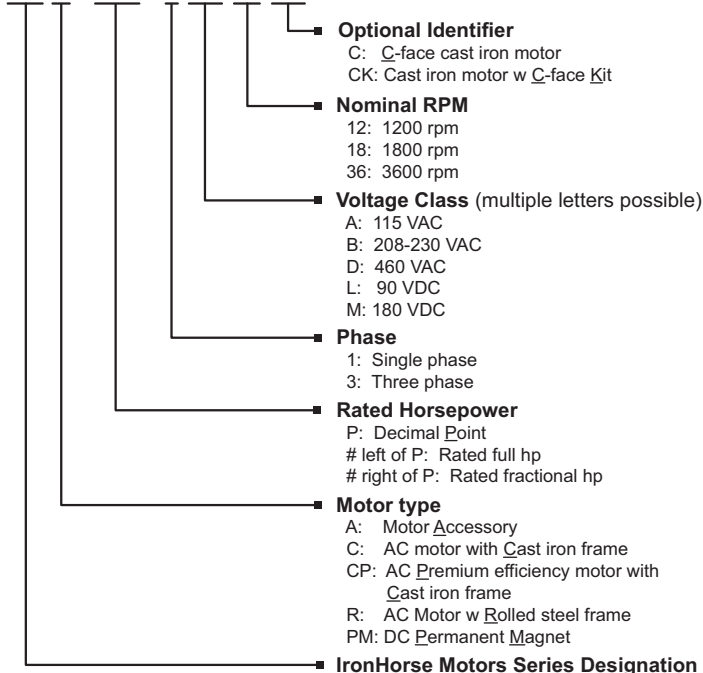
IronHorse motors are manufactured by a leading motor supplier with over 20 years experience delivering high-quality motors to the demanding U.S. market. Our supplier produces motors in an ISO9001 facility which tests the motors during production and after final assembly. This is how we can stand behind our IronHorse motors with a **two-year warranty**.

The IronHorse line of motors includes:

- TEFC 56C-frame single-phase AC motors with rolled steel frames; flange mount and removable mounting bases; 0.33–1.5 hp
- TEFC 56C-frame three-phase AC motors with rolled steel frames; flange mount and removable mounting bases; 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; 1–300 hp
- TEFC TC-frame three-phase C-face Premium Efficiency and EPACT 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 EPACT motors
- STABLE motor slide bases for adjustable mounting of NEMA motors from 56 - 449T

### IronHorse Part Number Explanation

MT C - 7P5 - 3 BD 18 CK



**NOTE THAT SOME POSSIBLE PART NUMBER COMBINATIONS MAY NOT EXIST AS ACTUAL PARTS. PLEASE CHECK ACTUAL AVAILABLE PART NUMBERS BEFORE ORDERING.**

# IronHorse® Permanent Magnet DC Motors (SCR Rated) Model Overview

IronHorse motors are manufactured by a leading motor supplier with over 20 years experience delivering high-quality motors to the demanding U.S. market. Our supplier produces motors in an ISO9001 facility which tests the motors during production and after final assembly. This is how we can stand behind our IronHorse motors with a **two-year warranty**.

IronHorse DC motors are designed for use on unfiltered SCR (Thyristor) type rectified AC input. They may also be used with PWM (pulse width modulated) type DC adjustable speed drives.

The IronHorse line of DC motors features:

- TENV or TEFC 56C-frame DC motors with rolled steel frames, flange mount and removable mounting bases; 0.33 - 2hp
- Replacement brush sets
- STABLE motor slide bases for adjustable mounting of NEMA motors from 56 - 449T
- Input power of 115 or 230 volts rectified AC can be used with an appropriate SCR drive
- Linear speed/torque characteristics over entire speed range
- High starting torque for heavy load applications
- Capable of dynamic braking for faster stops
- Reversible rotation
- Simple two-lead connection



**MTPM-P33-1L18**

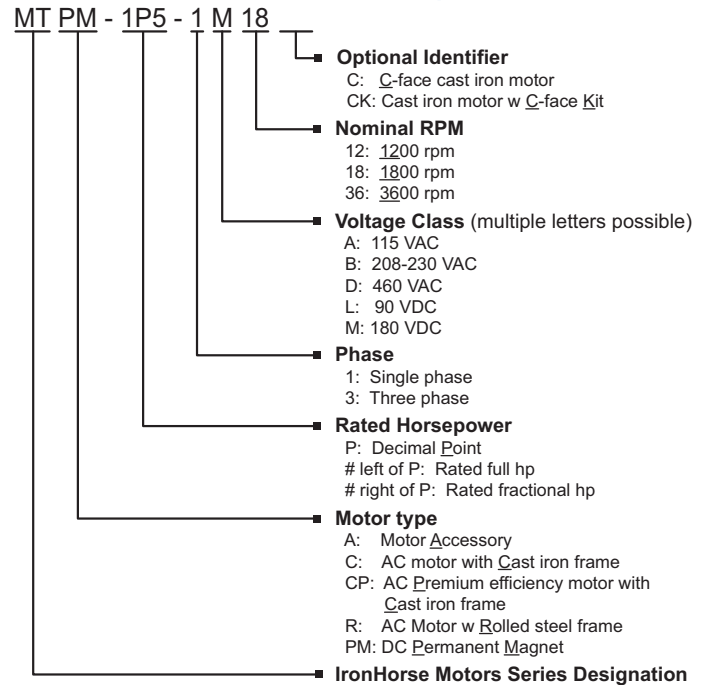


**MTPM-P75-1L18**



**MTPM-1P5-1M18**

## IronHorse Part Number Explanation



**NOTE THAT SOME POSSIBLE PART NUMBER COMBINATIONS MAY NOT EXIST AS ACTUAL PARTS. PLEASE CHECK ACTUAL AVAILABLE PART NUMBERS BEFORE ORDERING.**

## Features

- Available in TENV or TEFC depending on model
- NEMA 56C flange mount
- Rolled steel shell frame / cast aluminum end bell
- Removable base
- Space-saving design
- Large brushes for longer brush life
- Easy access to DC motor brushes (DC motors ship with one set of brushes installed and one set of spare brushes in the box)
- Large easy-to-wire junction box with rubber gasket
- Heavy duty oversized ball bearings
- High tensile strength steel shaft
- Large easy to read nameplate
- Electrically reversible
- Class F winding insulation
- Service Factor: 1.0
- Two year warranty
- cCSA<sub>US</sub> certified, CE

## Applications

- Conveyors
- Turntables
- Where adjustable speed and constant torque are required
- When dynamic braking and reversing capabilities are needed



# IronHorse® DC Motors

## 56C Frame TEFC/TENV Motors – DC – 0.33 to 2 hp



Motor Specifications – DC 56C Frame Motors – 1800 RPM									
Part Number	Price	HP	Base RPM	Armature Voltage	Housing	NEMA Frame	Service Factor	F.L. Amps	Weight (lb)
MTPM-P33-1L18	<--->	1/3	1800	90 VDC	TENV	56C flange mount	1.0	3.5	17.70
MTPM-P50-1L18	<--->	1/2			TENV			5.2	20.74
MTPM-P75-1L18	<--->	3/4			TEFC			7.8	25.30
MTPM-001-1L18	<--->	1			TEFC			10.4	28.36
MTPM-1P5-1L18	<--->	1-1/2			TEFC			15.4	34.97
MTPM-P33-1M18	<--->	1/3		180 VDC	TENV			1.75	17.60
MTPM-P50-1M18	<--->	1/2			TENV			2.6	20.74
MTPM-P75-1M18	<--->	3/4			TEFC			3.9	25.58
MTPM-001-1M18	<--->	1			TEFC			5.2	28.32
MTPM-1P5-1M18	<--->	1-1/2			TEFC			7.7	35.70
MTPM-002-1M18	<--->	2			9.8	61.95			

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

Performance Data – DC 56C Frame Motors – 1800 RPM																												
Part Number	HP	Armature Voltage	Torque (lb-ft)	*Form Factor	Ambient Temp.	Insulation Class	Ball Bearings		Mounting	Wire / Housing	Shaft	Constant Torque Speed Range	Overall Speed Range	Base / Type	Paint Color	Efficiency (%)												
			Full Load				DE Bearing	ODE Bearing																				
MTPM-P33-1L18	1/3	90 VDC	0.97	1.35	40°C (104°F)	F	6203	6203	Top Mounted	Junction Box	Keyed	90-1800 RPM	0-2000 RPM	Rigid Removable	Gray	79												
MTPM-P50-1L18	1/2		1.46													80												
MTPM-P75-1L18	3/4		2.19													81												
MTPM-001-1L18	1		2.92													79												
MTPM-1P5-1L18	1-1/2		4.38													80												
MTPM-P33-1M18	1/3	180 VDC	0.97													1.35	40°C (104°F)	F	6203	6203	Top Mounted	Junction Box	Keyed	90-1800 RPM	0-2000 RPM	Rigid Removable	Gray	79
MTPM-P50-1M18	1/2		1.46																									80
MTPM-P75-1M18	3/4		2.19																									81
MTPM-001-1M18	1		2.92																									79
MTPM-1P5-1M18	1-1/2		4.38																									80
MTPM-002-1M18	2	5.84	85																									

\* See Additional information in form factor table

### Form Factor

The voltage used to power a permanent magnet (PM) DC motor is not pure DC. It is derived by rectifying a supplied AC voltage. The resulting DC voltage has a ripple that is related to the frequency of the AC input.

Form factor is the ratio of Irms to Idc and indicates how close the driving voltage is to pure DC. The form factor for a DC battery is 1.0. The higher the form factor is above 1.0, the more it deviates from pure DC. The Form Factor Table shows examples of commonly used voltages.

Form factor should not exceed 1.35 for continuous operation. Half wave rectification is not recommended as it drastically increases form factor.

Operating IronHorse PMDC motors with DC voltages with form factors higher than 1.35 can result in premature brush failure and excessive motor heating.

Form Factor Table	
Form factor	DC voltage source
1.0	Battery (pure DC)
1.05	Pulse width modulation (PWM)
1.35	Full wave rectification (single phase)*
1.9	Half wave rectification (single phase)**

\* Most Common DC Drive for Applications .33 - 2HP

\*\* Not Recommended

Company Information

Systems Overview

Programmable Controllers

Field I/O

Software

C-more & other HMI

Drives

Soft Starters

Motors & Gearbox

Steppers/ Servos

Motor Controls

Proximity Sensors

Photo Sensors

Limit Switches

Encoders

Current Sensors

Pressure Sensors

Temperature Sensors

Pushbuttons/ Lights

Process

Relays/ Timers

Comm.

Terminal Blocks & Wiring

Power

Circuit Protection

Enclosures

Tools

Pneumatics

Appendix

Product Index

Part # Index