





**KMF 072 03** 







**KinetiMax HPD Brushless DC Outer-Rotor Motors High Power Density, Frameless Stator-Rotor Sets** 

62 to 125 mm diameter, 0.16 to 6.30 Nm continuous torque, up to 1100 Watts output

Motion Solutions that Change the Game



## **KMF 072 03**

# **KinetiMax HPD Brushless DC Outer-Rotor Motors High Power Density, Frameless Stator-Rotor Sets**

62 to 125 mm diameter, 0.16 to 6.30 Nm continuous torque, up to 1188 Watts output



The KinetiMax HPD range of outer-rotor brushless DC motors comes in frameless stator-rotor part sets. Available in six frame sizes and three stack-heights each, the HPD series enables you to select an optimum configuration with an exact performance fit for your application.

These compact kit motors offer an ideal solution especially where total motor length is crucial in space-constrained applications.

Their large stator ID (Inner Diameter) makes integration of larger ball-bearings possible, and the large clear aperture ID permits cabling to pass through the motor.

The HPD's excellent high torque-to-weight ratio is essential in applications where weight is critical. And with an efficiency ranging from 81% to 91% in a wide speed-torque range, the KinetiMax HPD frameless motors are ideal for battery-fed applications, where they help maximize the running time per battery charge.

Their low cogging torque combined with high peak torque improves motor behavior in servo applications.

#### **Features & Benefits**

- Winding selection for other Voltages
- Rated torque 0.16 to 6.30 Nm
- High torque-to-weight ratio
- Excellent efficiency from 81% up to 91% over a wide range around the nominal working point

## **Options & Accessories**

- · Hall commutation sensor board
- Temperature sensor mounted on stator

## **Typical Applications**

- Automated Guided Vehicles (AGV)
- Robotics (arms, joints)
- Handheld hydraulic power tools
- Material handling systems
- · Medical equipment
- Rotary actuators
- Gimbals





## **KMF 072 03**



## **Specifications**

Rated Output Power   Watt   250   250   253   261   250   183   139   100   Rated Speed   rgm   2542   2572   2573   2650   2540   1862   1411   1015   Rated Torque   Nm   0.94   0.94   Rated Line Current   Arms   9.0   7.2   5.2   4.1   3.0   2.2   1.7   1.3   Max. Efficiency   96   87   87   1.5   Wo. Load Speed RPM (en ominal voltage)   rgm   2676   2676   2703   2781   2676   2007   1545   1159   REMF Constant Ke   V/krpm   9.0   11.2   15.5   19.4   26.9   35.9   46.6   62.1   Motor Speed Constant Ky (=1/Ke)   rgm/V   111.5   89.2   64.4   51.5   37.2   27.9   21.5   16.1   Continuous Stall Line Current (rms)   Arms   11.2   9.0   6.5   5.2   3.7   2.8   2.2   1.6   Peak Torque   Nm   3.92   3.9   3.9   Rax. Demagnetization Line Current   A   88   70   51   41   29   22   17   13   Torque/rms Line Current Kf*   Nm/Arms   0.005   0.13   0.182   0.227   0.355   0.420   0.545   0.727   Resistance (terminal-to-terminal)   m/hm   110   170   3.20   502   995   1890   2950   5634   Inductance (terminal-to-terminal)   µH   74   116   223   348   668   1188   2004   3563   Bask EMF (@3000 RPM terminal-to-terminal)   "C/W   0.93   Thermal Resistance (stator/rotor to ambient)   "C/W   0.93   Max. Winding Temperature   °C   160   159   Rotor Inertia - Large I.D.   kgm²* F-6   163   Max. Winding Temperature   Nm   0.024   159   Rotor Inertia - Large I.D.   kgm²* F-6   163   Rotor Inertia - Large I.D.   kgm²* F-6   163   Rotor Inertia - Large I.D.   kgm²* F-6   163   Rotor Inertia - Stall I.D.   kgm²* F-6   163   Rotor Inertia - Large I.D.   kgm²* F-6   163   Rotor Inertia - Rotor Inert	Winding Identification <sup>3</sup>		С	D	Е	F	G	Н	J	К
Rated Speed   rpm	Nominal Supply Voltage DC Link	Volt	24	30	42	54	72	72	72	72
Nm	Rated Output Power <sup>1</sup>	Watt	250	250	253	261	250	183	139	100
Nm	Rated Speed	rpm	2542	2542	2573	2650	2540	1862	1411	1015
Max. Efficiency  Mo Load Speed RPM (when main voltage)  BEMF Constant <b>Ke</b> V/krpm  V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/krpm V/	Rated Torque <sup>1</sup>	Nm								
No Load Speed RPM (@ nominal voltage)  rpm	Rated Line Current <sup>1,4</sup>	Arms	9.0	7.2	5.2	4.1	3.0	2.2	1.7	1.3
(@ nominal voltage)	Max. Efficiency	%								
Motor Speed Constant Kv (=1/Ke)   rpm/V   111.5   89.2   64.4   51.5   37.2   27.9   21.5   16.1	No Load Speed RPM (@ nominal voltage)	rpm	2676	2676	2703	2781	2676	2007	1545	1159
Nm	BEMF Constant <b>Ke</b>	V/krpm	9.0	11.2	15.5	19.4	26.9	35.9	46.6	62.1
Arms   11.2   9.0   6.5   5.2   3.7   2.8   2.2   1.6	Motor Speed Constant <b>Kv</b> (=1/Ke)	rpm/V	111.5	89.2	64.4	51.5	37.2	27.9	21.5	16.1
Nam	Continuous Stall Torque <sup>1</sup>	Nm	1.18							
Max. Demagnetization Line Current         A         88         70         51         41         29         22         17         13           Torque/rms Line Current Kt²         Nm/Arms         0.105         0.131         0.182         0.227         0.315         0.420         0.545         0.727           Resistance (terminal-to-terminal)         mOhm         110         170         320         502         995         1890         2950         5634           Inductance (terminal-to-terminal)         μH         74         116         223         348         668         1188         2004         3563           Back EMF (@3000 RPM terminal-to-terminal)         Vrms         6.3         7.9         11.0         13.7         190         25.4         33.0         43.9           Thermal Resistance (stator/rotor to ambient) <sup>1</sup> °C/W         2.54         2.54         33.0         43.9           Thermal Resistance (stator/rotor to ambient) <sup>1</sup> °C/W         2.54         2.54         33.0         43.9           Thermal Resistance (stator/rotor to ambient) <sup>1</sup> kg         0.93         3.0         43.9           Max. Winding Temperature         °C         160         4.3         4.0         4.0         4	Continuous Stall Line Current (rms) <sup>1</sup>	Arms	11.2	9.0	6.5	5.2	3.7	2.8	2.2	1.6
Torque/rms Line Current Kt	Peak Torque	Nm	3.92							
Resistance (terminal-to-terminal) mOhm 110 170 320 502 995 1890 2950 5634 Inductance (terminal-to-terminal) μH 74 116 223 348 668 1188 2004 3563 Back EMF (@3000 RPM terminal-to-terminal) Vrms 6.3 7.9 11.0 13.7 19.0 25.4 33.0 43.9 Thermal Resistance (stator/rotor to ambient) °C/W 2.54 Thermal Resistance (Winding-Housing °C/W 0.93	Max. Demagnetization Line Current	А	88	70	51	41	29	22	17	13
Inductance (terminal-to-terminal)         μH         74         116         223         348         668         1188         2004         3563           Back EMF (@3000 RPM terminal-to-terminal)         Vrms         6.3         7.9         11.0         13.7         19.0         25.4         33.0         43.9           Thermal Resistance (stator/rotor to ambient)¹         °C/W         2.54	Torque/rms Line Current <b>Kt</b> <sup>4</sup>	Nm/Arms	0.105	0.131	0.182	0.227	0.315	0.420	0.545	0.727
Back EMF (@3000 RPM terminal-to-terminal)  Vrms 6.3 7.9 11.0 13.7 19.0 25.4 33.0 43.9  Thermal Resistance (stator/rotor to ambient)¹  °C/W  C/W  C-W  Thermal Resistance Winding-Housing  °C/W  Max. Winding Temperature  °C  160  Number of Pole Pairs  Weight  Resident - Large I.D.  Resident - Large I.D.  Retor Inertia - Small I.D.  Mechanical Time Constant  ms  1.6  Electrical Time Constant  ms  Cogging Torque (typical, peak to peak)  Nm/sqrt(W)  Cogging Torque  Nm  Nm/rpm  Nm/rpm  Nm/rpm  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Retor Uniner Diameter [V]²  mm  Retor Uniner Diameter [V]²  mm  Total Height [X]²  mm  Total Height [X]²  mm  Total Height [X]²  mm  Total Height [X]²  Total He	Resistance (terminal-to-terminal)	mOhm	110	170	320	502	995	1890	2950	5634
Thermal Resistance (stator/rotor to ambient)  Thermal Resistance (stator/rotor to ambient)  Thermal Resistance Winding-Housing  Max. Winding Temperature  C  160  Number of Pole Pairs  Weight  Rotor Inertia - Large I.D.  Rotor Inertia - Small I.D.  Megm²* E-6  Rotor Inertia - Small I.D.  Mechanical Time Constant  ms  1.6  Electrical Time Constant  ms  0.7  Motor Constant Km  Nm/sqrt(W)  Cogging Torque (typical, peak to peak)  Nm  0.024  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V]²  mm  Rotor Outer Diameter [V]²  mm  39.0  Total Height [X]²  mm  37.5	Inductance (terminal-to-terminal)	μΗ	74	116	223	348	668	1188	2004	3563
Thermal Resistance Winding-Housing  Max. Winding Temperature  C  160  Number of Pole Pairs  Weight  kg  0.43  Rotor Inertia - Large I.D.  kgm²* E-6  159  Rotor Inertia - Small I.D.  kgm²* E-6  163  Mechanical Time Constant  ms  1.6  Electrical Time Constant  ms  0.7  Motor Constant Km  Nm/sqrt(W)  Cogging Torque (typical, peak to peak)  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V]²  mm  Rotor Outer Diameter [V]²  mm  39.0  Total Height [X]²  mm  37.5	Back EMF (@3000 RPM terminal-to-terminal)	Vrms	6.3	7.9	11.0	13.7	19.0	25.4	33.0	43.9
Max. Winding Temperature       °C       160         Number of Pole Pairs       15         Weight       kg       0.43         Rotor Inertia - Large I.D.       kgm²* E-6       159         Rotor Inertia - Small I.D.       kgm²* E-6       163         Mechanical Time Constant       ms       1.6         Electrical Time Constant       ms       0.7         Motor Constant Km       Nm/sqrt(W)       0.257         Cogging Torque (typical, peak to peak)       Nm       0.024         Drag Torque       Nm       0.022         Viscous Damping       Nm/rpm       1.7E-05         Thermal Time Constant of Winding only       s       14         Adiabatic Heating of Winding at Peak Torque       K/s       11         Rotor Inner Diameter [V]²       mm       44         Rotor Outer Diameter [W]²       mm       16         Rotor Outer Diameter [Z]²       mm       72.3         Stator Inner Diameter [Y]²       mm       39.0         Total Height [X]²       mm       37.5	Thermal Resistance (stator/rotor to ambient) <sup>1</sup>	°C/W				2.	.54			
Number of Pole Pairs         15           Weight         kg         0.43           Rotor Inertia - Large I.D.         kgm²* E-6         159           Rotor Inertia - Small I.D.         kgm²* E-6         163           Mechanical Time Constant         ms         1.6           Electrical Time Constant         ms         0.7           Motor Constant Km         Nm/sqrt(W)         0.257           Cogging Torque (typical, peak to peak)         Nm         0.024           Drag Torque         Nm         0.022           Viscous Damping         Nm/rpm         1.7E-05           Thermal Time Constant of Winding only         s         14           Adiabatic Heating of Winding at Peak Torque         K/s         11           Rotor Inner Diameter [V] 2         mm         44           Rotor Unner Diameter [W] 2         mm         16           Rotor Outer Diameter [Z] 2         mm         72.3           Stator Inner Diameter [Y] 2         mm         39.0           Total Height [X] 2         mm         37.5	Thermal Resistance Winding-Housing	°C/W	0.93							
Weight         kg         0.43           Rotor Inertia - Large I.D.         kgm²* E-6         159           Rotor Inertia - Small I.D.         kgm²* E-6         163           Mechanical Time Constant         ms         1.6           Electrical Time Constant         ms         0.7           Motor Constant Km         Nm/sqrt(W)         0.257           Cogging Torque (typical, peak to peak)         Nm         0.024           Drag Torque         Nm         0.022           Viscous Damping         Nm/rpm         1.7E-05           Thermal Time Constant of Winding only         s         14           Adiabatic Heating of Winding at Peak Torque         K/s         11           Rotor Inner Diameter [V]²         mm         44           Rotor Outer Diameter [W]²         mm         16           Rotor Outer Diameter [Z]²         mm         72.3           Stator Inner Diameter [Y]²         mm         39.0           Total Height [X]²         mm         37.5	Max. Winding Temperature		160							
Rotor Inertia - Large I.D.         kgm²* E-6         159           Rotor Inertia - Small I.D.         kgm²* E-6         163           Mechanical Time Constant         ms         1.6           Electrical Time Constant         ms         0.7           Motor Constant Km         Nm/sqrt(W)         0.257           Cogging Torque (typical, peak to peak)         Nm         0.024           Drag Torque         Nm         0.022           Viscous Damping         Nm/rpm         1.7E-05           Thermal Time Constant of Winding only         s         14           Adiabatic Heating of Winding at Peak Torque         K/s         11           Rotor Inner Diameter [V]²         mm         44           Rotor Inner Diameter [W]²         mm         16           Rotor Outer Diameter [Z]²         mm         72.3           Stator Inner Diameter [Y]²         mm         39.0           Total Height [X]²         mm         37.5	Number of Pole Pairs		15							
Rotor Inertia - Small I.D.  Mechanical Time Constant  ms  1.6  Electrical Time Constant  ms  0.7  Motor Constant Km  Nm/sqrt(W)  Cogging Torque (typical, peak to peak)  Nm  0.024  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V] <sup>2</sup> mm  16  Rotor Outer Diameter [X] <sup>2</sup> mm  39.0  Total Height [X] <sup>2</sup> mm  37.5	Weight	kg				0.	.43			
Mechanical Time Constant  ms  1.6  Electrical Time Constant  ms  0.7  Motor Constant Km  Nm/sqrt(W)  Cogging Torque (typical, peak to peak)  Nm  0.024  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  s  14  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V] <sup>2</sup> mm  16  Rotor Outer Diameter [Z] <sup>2</sup> mm  39.0  Total Height [X] <sup>2</sup> mm  37.5	Rotor Inertia - Large I.D.	kgm <sup>2</sup> * E-6	159							
Electrical Time Constant  ms  0.7  Motor Constant Km  Nm/sqrt(W)  0.257  Cogging Torque (typical, peak to peak)  Nm  0.024  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  s  14  Adiabatic Heating of Winding at Peak Torque  K/s  Rotor Inner Diameter [V] 2  mm  16  Rotor Outer Diameter [Z] 2  mm  39.0  Total Height [X] 2  mm  37.5	Rotor Inertia - Small I.D.	kgm <sup>2</sup> * E-6	163							
Motor Constant Km  Cogging Torque (typical, peak to peak)  Nm  0.024  Drag Torque  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V] 2  mm  16  Rotor Outer Diameter [Z] 2  Stator Inner Diameter [Y] 2  mm  39.0  Total Height [X] 2  mm  37.5	Mechanical Time Constant	ms	1.6							
Cogging Torque (typical, peak to peak)  Nm  0.022  Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  K/s  Rotor Inner Diameter [V] 2 mm  Rotor Inner Diameter [W] 2 mm  Rotor Outer Diameter [Z] 2 mm  Stator Inner Diameter [Y] 2 mm  39.0  Total Height [X] 2 mm  37.5	Electrical Time Constant	ms	0.7							
Drag Torque  Nm  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  Rotor Inner Diameter [V] 2 mm  Rotor Inner Diameter [W] 2 mm  Rotor Outer Diameter [Z] 2 mm  Stator Inner Diameter [Y] 2 mm  39.0  Total Height [X] 2 mm  37.5	Motor Constant <b>Km</b>	Nm/sqrt(W)	0.257							
Viscous Damping  Nm/rpm  1.7E-05  Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  K/s  Rotor Inner Diameter [V] 2 mm  Rotor Inner Diameter [W] 2 mm  16  Rotor Outer Diameter [Z] 2 mm  72.3  Stator Inner Diameter [Y] 2 mm  39.0  Total Height [X] 2 mm  37.5	Cogging Torque (typical, peak to peak)	Nm				0.0	024			
Thermal Time Constant of Winding only  Adiabatic Heating of Winding at Peak Torque  K/s  Rotor Inner Diameter [V] 2 mm  Rotor Outer Diameter [Z] 2 mm  Stator Inner Diameter [Y] 2 mm  Total Height [X] 2 mm  37.5	Drag Torque	Nm	0.022							
Adiabatic Heating of Winding at Peak Torque  K/s  Rotor Inner Diameter [V] 2 mm 44  Rotor Inner Diameter [W] 2 mm 16  Rotor Outer Diameter [Z] 2 mm 72.3  Stator Inner Diameter [Y] 2 mm 39.0  Total Height [X] 2 mm 37.5	Viscous Damping	Nm/rpm				1.7	E-05			
Rotor Inner Diameter [V] 2 mm 44  Rotor Inner Diameter [W] 2 mm 16  Rotor Outer Diameter [Z] 2 mm 72.3  Stator Inner Diameter [Y] 2 mm 39.0  Total Height [X] 2 mm 37.5	Thermal Time Constant of Winding only	S								
Rotor Inner Diameter [W] 2 mm 16 Rotor Outer Diameter [Z] 2 mm 72.3 Stator Inner Diameter [Y] 2 mm 39.0 Total Height [X] 2 mm 37.5	Adiabatic Heating of Winding at Peak Torque	K/s								
Rotor Outer Diameter [Z] 2 mm 72.3 Stator Inner Diameter [Y] 2 mm 39.0 Total Height [X] 2 mm 37.5	Rotor Inner Diameter [V] <sup>2</sup>	mm	44							
Stator Inner Diameter [Y] 2 mm 39.0 Total Height [X] 2 mm 37.5	Rotor Inner Diameter [W] <sup>2</sup>	mm	16							
Total Height [X] <sup>2</sup> mm 37.5	Rotor Outer Diameter [Z] <sup>2</sup>	er Diameter [Z] <sup>2</sup> mm 72.3								
Total Height [X] <sup>2</sup> mm 37.5	Stator Inner Diameter [Y] <sup>2</sup>	mm	39.0							
	Total Height [X] <sup>2</sup>	mm				3	7.5			
14   14   14   20   20   20   20	Motor lead wire AWG size		14	14	14	14	20	20	20	20

<sup>(1)</sup> Assuming the stator-rotor set is mounted on a bracket with an aluminium flange diameter 1.5 times rotor diameter.

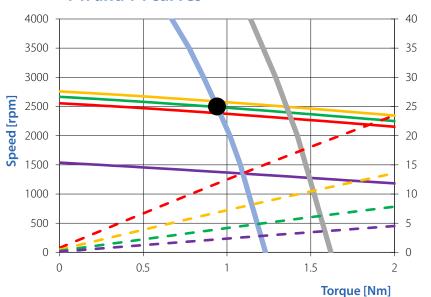
<sup>(4)</sup> Line currents are the AC currents running into the three terminals of the stator.



<sup>(2)</sup> See the dimensions in the drawing on the next page.

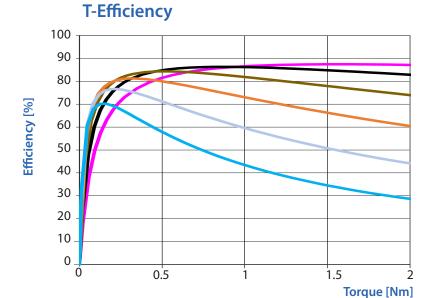
 $<sup>(3) \</sup> Windings \ C, D, G \ and \ H \ are \ delta \ connected, \ windings \ E, F, J \ and \ K \ are \ wye \ connected.$ 

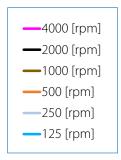




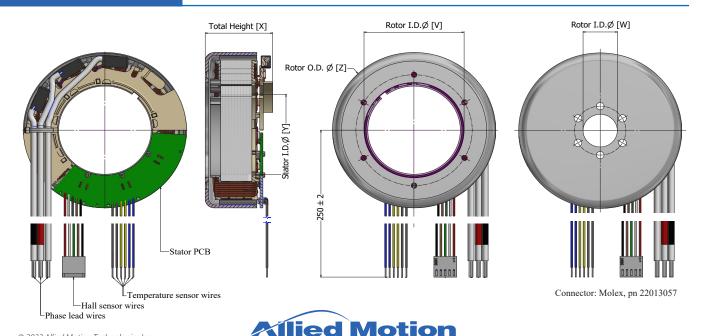


Supply current is the DC current taken from the DC power supply by the drive. The torque-speed curves and torque-current curves are made assuming a FOC drive is used.





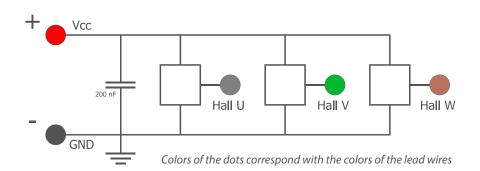
## **Outline Dimensions**



## Sensors

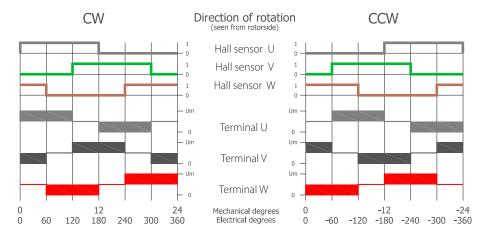
## Hall sensors

## Hall sensor connections / specifications:



Specification Item	Value [Typ.]		
Supply Voltage [VCC]	3.0 - 32 V		
Supply Current	4.8 mA		
Temperature Range	-40 °C + 170 °C		
Output Type	Open drain		
Max Output Voltage	32 V		
Max Output Current	25 mA		

## Hall sensors switching sequence:

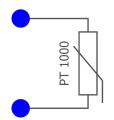


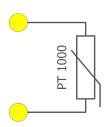
The colors of the 3 Hall sensor signals correspond with the 3 colors of the Hall lead wires.

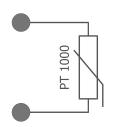
The colors of the 3 signals of the terminals U, V, W, correspond with the 3 colors of the motor lead wires.

## **Temperature sensors**

## Temperature sensor connections / specifications:







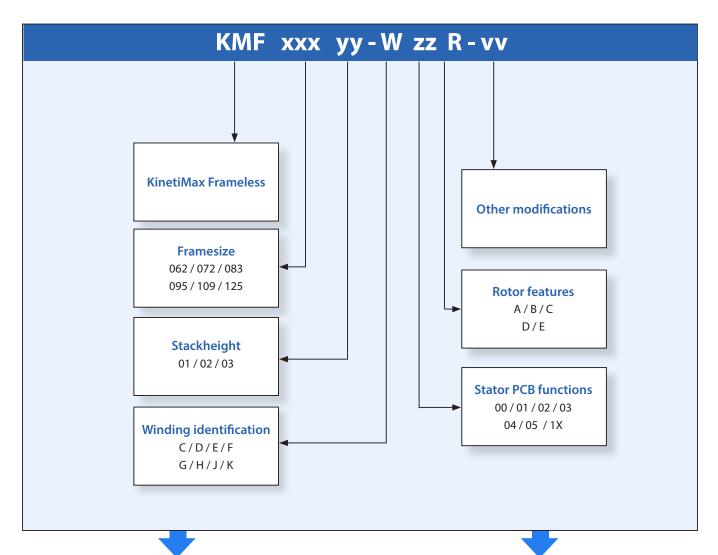
Specification Item	
Resistance at 0 °C	1000 Ohm
Temperature coefficient	+ 3850 ppm/K
Temperature Range	-40 °C to +175 °C
ΔT <sup>(1)</sup>	T.B.D.

Colors of the dots correspond with the colors of the lead wires, each wire color is used for a different motor phase.

(1) Due to the thermal coupling between the winding and sensor, the temperature measured by the sensor will be lower than the actual temperature of the winding.

Optional sensor types are possible after consulting the factory (PTC, NTC).





	<u> </u>
ZZ	Stator PCB functions
00	No PCB
01	PCB with 3 Hall sensors
02	PCB with 1 Temperature sensor only
03	PCB with 3 Hall sensors and 1 Temperature sensor
04	PCB with 3 Temperature sensors only
05	PCB with 3 Hall sensors and 3 temperature senors
1X	Starting with 1 are custom PCB's

Rotor features
Large bore hole, G40 balancing class
Small bore hole, G40 balancing class
Large bore hole. G16 balancing class
Small bore hole, G16 balancing class
Custom rotor or balancing

With **Other modifications** are meant custom added parts to stator or rotor like a stator bracket, other leadwires with connector or a rotor nave/shaft etc.





### **Allied Motion Solution Centers**

Allied Motion Solution Centers provide support to customers around the world from five geographically-strategic locations. Each facility is staffed by experienced application engineers and customer service teams to assist you with all aspects of your motion control needs. We also have a global network of factory-trained Allied Motion Sales Partners to serve you. For contact information on the location nearest you, please see below or visit our website.



## North America (US, Canada, Mexico)

### Amherst, New York (HQ)

+1 (716) 242-7535 inquiry@alliedmotion.com

## **Europe**

## Kelheim, Germany

+49 9441/707 - 0 inquiry.eu@alliedmotion.com

#### **Dordrecht, Netherlands**

+31 (78) 621 9940 inquiry.nl@alliedmotion.com

#### Bromma, Sweden

+46 (8) 546 11 100 inquiry.eu@alliedmotion.com

#### Asia

### Changzhou, Jiangsu, China

+86-(0)519-8511 3625 inquiry@alliedmotion.com



www.alliedmotion.com





