TEST REPORT
IEC 60034-1
Rotating Electrical Machines – Part 1: Rating and Performance

Report Reference No. :	4789794128
Date of issue :	2021-12-22
Total number of pages, including attachments. :	21
Testing Laboratory :	Hiwin Mikrosystem Corp.
Address :	6 Jingke Central Rd., Taichung Precision Machinery Park, Taichung, 40852 Taiwan
Applicant's name :	Hiwin Mikrosystem Corp.
Address :	6 Jingke Central Rd., Taichung Precision Machinery Park, Taichung, 40852 Taiwan
Test specification:	
Standard :	☒ IEC 60034-1, Edition 12, 2010-02
Test procedure :	Informative Test Report
Non-standard test method :	N/A
National Deviations :	
Test Report Form No. :	
Test Report Form(s) Originator :	UL LLC
Master TRF :	
Test item description :	Linear motors
Trade Mark :	HIWIN®
Manufacturer :	Hiwin Mikrosystem Corp.
Model/Type reference :	LMFP24-F40, LMFP24-H40, LMFP31-Q10, LMFP31-Q20, LMFP32-Q20, LMFP32-Q40, LMFP33-Q30, LMFP33-Q60, LMFP34-Q40, LMFP34-Q80, LMFP41-Q10, LMFP41-Q20, LMFP42-Q20, LMFP42-Q40, LMFP43-Q30, LMFP43-Q60, LMFP44-Q40, LMFP44-Q80, LMFP52-Q20, LMFP52-Q40, LMFP53-Q30, LMFP53-Q60, LMFP54-Q40, LMFP54-Q80, LMFP62-Q20, LMFP62-Q40, LMFP63-Q30, LMFP63-Q60, LMFP64-Q40, LMFP64-Q80, LMFP54-S40, LMFP62-N40
Ratings :	See Model List

Evaluated by :	Andy C. Wu	Andy C. Wu
	(printed name)	(signature)
Approved by :	Andrew Yang	Andrew Yang
	(printed name)	(signature)

Summary of testing:	
Tests performed (name of test and test clause): **1. Rating for equivalent loading / IEC 60034-1 CL5.2.6** **2.Thermal performance and tests / IEC60034-1 CL8** **3.Resistance of winding (cold) / IEC60034-1 CL9.1** **4. Withstand voltage test / IEC60034-1/CL 9.2 & IEC60204-1 CL 18.4** **5. Momentary excess torque (thrust) for motors / IEC60034-1 CL 9.4.3** **6. Insulation Resistance Tests / IEC60204-1 CL 18.3**	**Testing location:** **Hiwin Mikrosystem Corp.** **6 Jingke Central Rd., Taichung Precision Machinery Park, Taichung, 40852 Taiwan** **Tested by:** **Win Ding Luo (Hiwin Mikrosystem Corp.)** **Witnessed by:** **Andy C. Wu (Underwriters Laboratories Taiwan Co., Ltd.)**
Summary of compliance with National Differences: These motors have been also evaluated for the requirements of EN 60034-1:2010/AC: 2010. See page No. 12.	

Test item particulars ..... :	LMFP24-F40
Classification of installation and use ..... :	Linear motor
Supply Connection ..... :	A specified motor controller manufactured by: Hiwin Mikrosystem Corp., Model D1-N-90-S2-6-0-00, Input 220Vac,50/60Hz, 3 phases, 30 Arms, Output: 3-phase, 21Arms(continued), 63.6Arms(maximum).
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Possible test case verdicts:	
- test case does not apply to the test object ..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
Testing ..... :	
Date of receipt of test item ..... :	2021-11-18
Date (s) of performance of tests ..... :	2021-11-18 ~ 2021-12-02

General remarks:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.
Throughout this report a comma (point) is used as the decimal separator.

A verification of thermal conditions (normal and abnormal operation) as well as the protection against electric shock, ingress of solid foreign objects and water has to be done in conjunction with the appliance.

General product information:

These motors are designed for use with the intended drivers, manufactured by Hiwin Mikrosystem Corp., Model D1-N-90-S2-6-0-00, and the motors have PTC temperature sensor, which connect to drivers.

These motors have been evaluated as a component with the following Conditions of Acceptability when these components are employed in the end-use equipment:

1. The suitability of or need for an ultimate enclosure shall be determined in the end-use application.
2. The suitability of motor-mounting means, motor leads, strain relief, and lead terminations shall be investigated for each end-use application.
3. The slider has a metal base with grounding connection. The body of slider is made by epoxy potting compound.
4. Model LMFP24-F40 is used as a representative model for LMFP24-H40, LMFP31-Q10, LMFP31-Q20, LMFP32-Q20, LMFP32-Q40, LMFP33-Q30, LMFP33-Q60, LMFP34-Q40, LMFP34-Q80, LMFP41-Q10, LMFP41-Q20, LMFP42-Q20, LMFP42-Q40, LMFP43-Q30, LMFP43-Q60, LMFP44-Q40, LMFP44-Q80, LMFP52-Q20, LMFP52-Q40, LMFP53-Q30, LMFP53-Q60, LMFP54-Q40, LMFP54-Q80, LMFP62-Q20, LMFP62-Q40, LMFP63-Q30, LMFP63-Q60, LMFP64-Q40, LMFP64-Q80, LMFP54-S40, LMFP62-N40 by client declaration.

Model list:

	Symbol	Unit	LMFP24-F40	LMFP24-H40	LMFP31-Q10	LMFP31-Q20	LMFP32-Q20	LMFP32-Q40	LMFP33-Q30	LMFP33-Q60	LMFP34-Q40	LMFP34-Q80	LMFP41-Q10	LMFP41-Q20	LMF
Continuous force	Fc	N	874	874	413	413	827	827	1240	1240	1653	1653	495	495	
Continuous current	Ic	A(rms)	5.7	8.6	4.1	8.2	8.2	16.5	12.4	24.7	16.5	32.9	3.4	6.8	
Continuous force(WC)	F_{c}	N	1747	1747	827	827	1653	1653	2480	2480	3307	3307	990	990	
Continuous current(WC)	I_{c}	A (rms)	11.4	17.2	8.2	16.5	16.5	32.9	24.7	49.4	33	65.9	6.8	13.6	
Peak force for 1 sec.	F_{p}	N	3477	3477	1797	1797	3593	3593	5390	5390	7187	7187	2820	2820	
Peak current for 1 sec.	I_{p}	A (rms)	35.3	53.2	25.6	51.2	51.2	102.4	76.8	153.6	102.4	204.8	22.7	45.4	
Force constant	K_f	N/A (rms)	153.6	101.8	100.3	50.2	100.3	50.2	100.3	50.2	100.3	50.2	145.7	72.9	
Attraction force	F_a	N	4583	4583	3121	3121	6243	6243	9364	9364	12485	12485	4682	4682	
Max. winding temp.	T_{coil}	℃	120	120	120	120	120	120	120	120	120	120	120	120	
Electrical time constant	K_e	ms	8.1	7.9	12	12	12	10.8	12	12	12	13.5	12.6	12.4	
Resistance (line to line at 25℃)	R_{25}	Ω	7.1	3.2	3.6	0.9	1.8	0.5	1.2	0.3	0.9	0.2	5.1	1.3	
Resistance (line to line at 120℃)	R_{120}	Ω	9.7	4.4	4.9	1.2	2.5	0.7	1.6	0.4	1.2	0.3	7	1.8	
Inductance (line to line)	L	mH	57.6	25.3	43.2	10.8	21.6	5.4	14.4	3.6	10.8	2.7	64.5	16.1	
Pole pair pitch	2τ	mm	30	30	46	46	46	46	46	46	46	46	46	46	
Back emf constant(line to line)	K_e	Vrms/(m/s)	88.7	58.8	57.9	29	57.9	29	57.9	29	57.9	29	84.1	42.1	
Motor constant(at 25℃)	Km	N/√ W	47	46.4	43.3	43.3	61.4	57.9	74.5	74.8	86.2	91.7	52.6	52.1	
Thermal resistance	R_{th}	℃/W	0.2	0.19	0.77	0.76	0.38	0.33	0.26	0.26	0.19	0.2	0.78	0.76	
Thermal resistance (WC)	R_{th}	℃/W	0.05	0.05	0.19	0.19	0.09	0.08	0.06	0.06	0.05	0.05	0.2	0.19	
Thermal time constant (WC)	T_{th}	s	150	150	150	150	150	150	150	150	150	150	150	150	
Minimum flow rate	-	L/min	4	4	4	4	5.2	5.2	5.7	5.7	6.2	6.2	5.2	5.2	
Temperature of cooling water	-	℃	20	20	20	20	20	20	20	20	20	20	20	20	
Pressure drop	ΔP	bar	3.18	3.18	0.57	0.74	0.74	0.96	0.96	1.28	1.28	0.89	0.89		
Thermal switch	-	-	1 x Pt1000 + 1 x (3 PTC SNM 120 In Series)												
Maximum velocity at maximum force	$v_{MAX,PMAX}$	m/s	0.7	1.3	2.4	5.1	2.4	5.1	2.4	5.1	2.4	5.1	1.7	3.7	
Maximum electric power input	$P_{EL,MAX}$	W	20565	23200	9130	13883	18454	29334	27092	41645	36123	55528	10205	15999	
Maximum dissipated heat output	$Q_{TH,MAX}$	W	1891	1953	494	490	1021	1137	1464	1464	1960	1954	486	499	
Stall force(WC)	F_s	N	1227	1220	574	584	1170	1153	1730	1737	2314	2316	699	692	
Stall current(WC)	I_s	A (rms)	8	12	5.7	11.6	11.6	23	17.3	34.6	23.1	46.1	4.8	9.5	
Max. DC bus voltage	-	V	750	750	750	750	750	750	750	750	750	750	750	750	
Mass of forcer	M_f	kg	11	11	6.9	6.9	12.1	12.1	17.8	17.8	23.1	23.1	9.9	9.9	
Unit mass of stator	M_s	kg/m	9.8	9.8	16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2	22.3	22.3	
Length of forcer / Dimension n	L_f	mm	465	465	221	221	382	382	543	543	704	704	221	221	
Width of stator	W_s	mm	118	118	134	134	134	134	134	134	134	134	180	180	
Length of stator/Dimension N	L_s	mm	120mm/N=2 + 180mm/N=3 + 300mm/N=5						184mm/N=2 + 276mm/N=3 + 460mm/N=5						
Stator mounting distance	W_{s1}	mm	104	104	115	115	115	115	115	115	115	115	161	161	
Total height	H	mm	59.5	59.5	64.1	64.1	64.1	64.1	64.1	64.1	64.1	64.1	66.1	66.1	

	Symbol	Unit	LMFP42-Q40	LMFP43-Q30	LMFP43-Q60	LMFP44-Q40	LMFP44-Q80	LMFP52-Q20	LMFP52-Q40	LMFP53-Q30	LMFP53-Q60	LMFP54-Q40	LMFP54-Q80	LMFP54-S40
Continuous force	F_c	N	990	1485	1485	1979	1979	1422	1422	2133	2133	2844	2844	2844
Continuous current	Ic	A(rms)	13.6	10.2	20.4	13.6	27.1	7.4	14.8	11.1	22.2	14.8	29.6	19.6
Continuous force(WC)	F_c	N	1979	2969	2969	3958	3958	2844	2844	4266	4266	5688	5688	5688
Continuous current(WC)	I_c	A (rms)	27.1	20.4	40.7	27.2	54.3	14.8	29.6	22.2	44.4	29.6	59.2	39.5
Peak force for 1 sec.	F_p	N	5640	8460	8460	11280	11280	7000	7000	10500	10500	14000	14000	14000
Peak current for 1 sec.	I_p	A (rms)	90.9	68.2	136.4	90.9	181.8	46.3	92.7	69.5	139	92.7	185.3	120
Force constant	K_f	N/A (rms)	72.9	145.7	72.9	145.7	72.9	192.3	96.1	192.3	96.1	192.3	96.1	143.9
Attraction force	F_a	N	9363	14045	14045	18727	18727	12467	12467	18700	18700	24933	24933	24933
Max. winding temp.	T_{coil}	℃	120	120	120	120	120	120	120	120	120	120	120	120
Electrical time constant	K_e	ms	13.5	12.6	13.5	12.4	13.3	12.6	13.4	12.4	12	12.6	13.5	13.3
Resistance (line to line at 25℃)	R_{25}	Ω	0.6	1.7	0.4	1.3	0.3	3.4	0.8	2.3	0.6	1.7	0.4	0.9
Resistance (line to line at 120℃)	R_{120}	Ω	0.8	2.3	0.5	1.8	0.4	4.7	1.1	3.2	0.8	2.3	0.5	1.2
Inductance (line to line)	L	mH	8.1	21.5	5.4	16.1	4	42.9	10.7	28.6	7.2	21.5	5.4	12
Pole pair pitch	2τ	mm	46	46	46	46	46	46	46	46	46	46	46	46
Back emf constant(line to line)	K_e	Vrms/(m/s)	42.1	84.1	42.1	84.1	42.1	111	55.5	111	55.5	111	55.5	83.1
Motor constant(at 25℃)	Km	N/√ W	76.7	91.2	94	104.2	108.9	95.1	97.7	103.5	101.3	120.3	124	123.6
Thermal resistance	R_{th}	℃/W	0.43	0.26	0.3	0.19	0.22	0.25	0.26	0.16	0.16	0.13	0.14	0.13
Thermal resistance (WC)	R_{th}	℃/W	0.11	0.07	0.08	0.05	0.06	0.06	0.07	0.04	0.04	0.03	0.04	0.03
Thermal time constant (WC)	T_{th}	s	150	150	150	150	150	150	150	150	150	150	150	150
Minimum flow rate	-	L/min	5.2	5.7	5.7	6.2	6.2	6.3	6.3	6.8	6.8	7.3	7.3	7.3
Temperature of cooling water	-	℃	20	20	20	20	20	20	20	20	20	20	20	20
Pressure drop	ΔP	bar	1.17	1.45	1.45	1.8	1.8	1.77	1.77	1.77	1.77	2.3	2.3	2.3
Thermal switch	-	-	1 x Pt1000 + 1 x (3 PTC SNM 120 In Series)											
Maximum velocity at maximum force	$v_{MAX,PMAX}$	m/s	3.7	1.7	3.7	1.7	3.7	1.2	2.7	1.2	2.7	1.2	2.7	1.74
Maximum electric power input	$P_{EL,MAX}$	W	30783	30429	45256	41486	61567	23513	33079	35785	51535	45447	63552	50280
Maximum dissipated heat output	$Q_{TH,MAX}$	W	881	1498	1242	1998	1769	1544	1446	2366	2366	3023	2628	2808
Stall force(WC)	F_s	N	1383	2082	2075	2765	2775	1998	1989	2979	2988	3978	3978	3979
Stall current(WC)	I_s	A (rms)	19	14.3	28.5	19	38	10.4	20.7	15.5	31.1	20.7	41.4	27.7
Max. DC bus voltage	-	V	750	750	750	750	750	750	750	750	750	750	750	750
Mass of forcer	M_f	kg	16.7	25	25	29.8	29.8	24.8	24.8	33.5	33.5	42.3	42.3	42.3
Unit mass of stator	M_s	kg/m	22.3	22.3	22.3	22.3	22.3	25	25	25	25	25	25	25
Length of forcer / Dimension n	L_f	mm	382	543	543	704	704	382	382	543	543	704	704	704
Width of stator	W_s	mm	180	180	180	180	180	240	240	240	240	240	240	240
Length of stator/Dimension N	L_s	mm	184mm/N=2 / 276mm/N=3 / 460mm/N=5											184mm/N=2 / 276mm/N=3 / 460mm/N=5
Stator mounting distance	W_{s1}	mm	161	161	161	161	161	222	222	222	222	222	222	222
Total height	H	mm	66.1	66.1	66.1	66.1	66.1	64.1	64.1	64.1	64.1	64.1	64.1	64.1