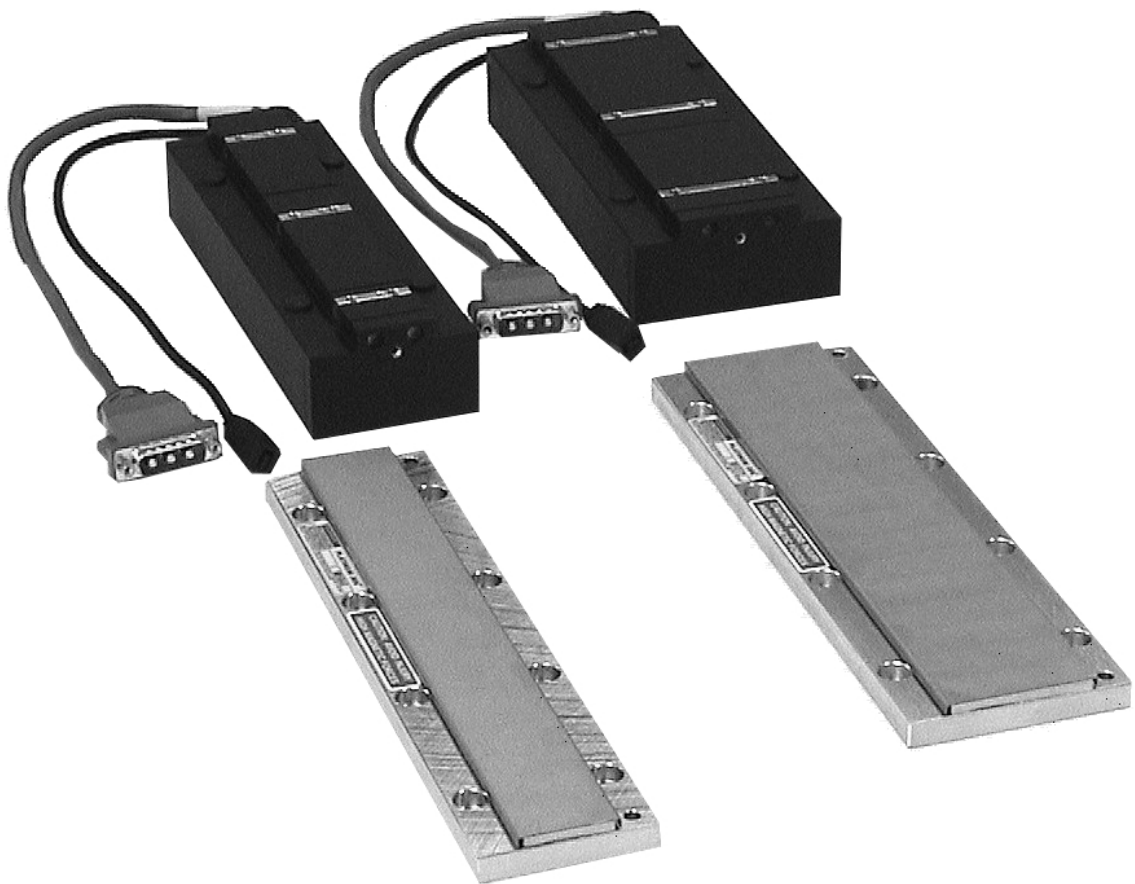


Linear motors

PLATINUM™ DDL



Previous editions

Edition	Comment
03/2001	First edition

Symbols used in this manual

	danger to personnel, from electricity and its effects		general warning general instruction mechanical hazard
	See Chapter... (cross-reference)	●	emphasis

**Technical changes to improve the performance of the equipment
may be made without prior notice!**

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Safety Instructions

- The strong magnetic fields which are produced constitute a hazard for persons with implants, such as cardiac pacemakers, that can be influenced by magnetic fields. As a general rule, all persons who may suffer impairment to health through the influence of strong magnetic fields must keep at a safe distance of at least 1 meter from the motor.
- Always wear gloves when working on the linear motor. During work on or in the vicinity of linear motors make sure that at least two finely pointed wedges of tough non-magnetic material - e.g. V2A - (with a wedge angle of approx. 10°-15°) and a hammer (approx. 3 kg) are to hand. In an emergency you can then use these tools to detach objects that are magnetically bound to the magnet track (for instance, to free trapped parts of the body).
- Because of the high forces of attraction, special care must be taken within a range of about 50 mm from the magnet track. Inside this area, heavy (>1kg) or large-area (>1dm²) objects of steel or iron must not be held in the hand.
- Keep watches and magnetic data media (credit cards, diskettes, etc.) out of the immediate vicinity (<100 mm) of the linear motor.
- Only properly qualified persons are permitted to perform activities such as transport, installation, commissioning and maintenance. Properly qualified persons are those who are familiar with the transport, assembly, installation, commissioning and operation of motors, and who have the appropriate qualifications for their job. Qualified personnel must know and observe the following standards and directives:
 - IEC 364 and/or CENELEC HD 384 or DIN VDE 0100
 - IEC Report 664 or DIN VDE 0110
 - national accident prevention regulations, or BGV A2
- Read the available documentation before installation and commissioning. Incorrect handling of the motor can cause injury and damage to persons and equipment.
- It is mandatory to ensure that the magnet track is properly grounded to the PE (protective earth) busbar in the switchgear cabinet. Safety for personnel cannot be assured without a low-resistance protective earth.
- Never pull out a connector during operation. This creates a hazard with the risk of death, severe injury, or material damage.
- Power connections may still be live, even though the motor is not moving. Never undo the electrical connections to the motor while a voltage is present. In unfavorable cases this can cause arcing, with injury and damage to persons and equipment.
- After disconnecting the servo amplifier from the supply power, wait at least five minutes before touching live parts (such as contacts or studs) or breaking connections. To be sure, measure the voltage in the DC-link circuit and wait until it has fallen below 40V.
- During operation, motors can have very hot surfaces, depending on their enclosure rating. Surface temperatures can reach 100°C. Measure the temperature, and wait until the motor has cooled down to below 40°C before touching it.

Safety Instructions

- **Attach easily visible warning signs (e.g. permanent self-adhesive labels) to the machine:**
 - Caution:**
 - The linear drives on this machine are fitted with strong permanent magnets.
 - STRONG MAGNETIC FIELDS + HIGH MAGNETIC ATTRACTION FORCES !**

- **The magnet track must never be stored in an unpacked condition. Use non-magnetic packaging material that is at least 2 cm thick. The storage location must be dry and protected from heat. Put up signs where the motors are stored:**
 - Caution: STRONG MAGNETS**

- **If machines or sections of machines are transported with linear motors already mounted on the motion axes, then these axes must be blocked, to prevent unintended movement.**

Manufacturer's Declaration

in accordance with the EC Machine Directive 89/392/EEC, Appendix II B

We, the company

Kollmorgen Seidel GmbH & Co. KG
 Wacholderstraße 40-42
 40489 Düsseldorf

hereby declare that the linear motors of the series PLATINUM™ DDL,

Types ICD05-xxx, ICD10-xxx, IC11-xxx, IC22-xxx, IC33-xxx, IC44-xxx

in the standard implementation are exclusively intended for installation in other machines, and that their operation is forbidden until it has been ascertained that the machines in which these products are incorporated fulfil the requirements in the edition 89/392/EEC of the EC Directive.

We confirm that the products designated above conform to the standards listed below:

73/23/EEC	EN 60950	UL 1004
EN 60034	EN 60529	UL 547
EN 60204-1	IEC 721-3	UL 674
IEC 34-1	NEMA MG7	

Authorized: for the company management

Lawrence D. Kingsley

This declaration does not constitute an assurance of specific features. The safety and protection instructions in the documentation must be followed in all cases.

I General Information

I.1 About this manual

This manual describes the PLATINUM™ DDL series of linear motors.



This manual is intended for use by qualified and experienced personnel in the electrical and mechanical engineering industries.

The motors are operated within drive systems, together with the SERVOSTAR™ 400/600 servo amplifiers. Please observe therefore the complete system documentation, consisting of:

- Installation/commissioning instructions for the servo amplifier
- Installation/commissioning instructions for any expansion cards which are also installed
- Technical description of the PLATINUM™ DDL series of motors

I.2 Use as directed

Linear motors in the PLATINUM™ DDL series are specially designed as drives for machines with very demanding dynamic requirements.

The motors **may only be operated** within the environmental conditions and limits defined in this documentation.

Motors in the PLATINUM™ DDL series are designed to be controlled exclusively by digital servo amplifiers of the SERVOSTAR™ 400/600 series, in a speed and/or torque and/or position control loop. If these motors are driven by any other equipment, we will not accept any responsibility for the functional characteristics of the drive.

The motors are installed as components in electrical plant or machinery, and may only be operated as integral parts of such plant or machinery.

These motors must never be connected directly to the electrical supply.

The temperature monitoring that is built into the motor windings must be evaluated in the SERVOSTAR™ 400/600.

We can only guarantee the conformance of the servo system with the standards named in the *Manufacturer's Declaration* on Page 6 when the components used are exclusively those delivered by us (servo amplifier, motor, cables etc.).

I.3 Design of the motors

PLATINUM™ DDL linear motors (series ICxx and ICDxx) are 3-phase, flat linear motors for sinusoidal commutation, with a patented construction of the laminated winding section. They can be fitted with almost every type of linear measurement system which is suitable for operation with linear motors.

The winding sections (primary sections) are completely enclosed and encapsulated, and thus have excellent protection for use under tough industrial conditions. The T-profiles which are fitted for mounting them onto the framework of the machine provide a versatile but nevertheless firm mechanical coupling system.

Thanks to this patented design, you can achieve

- very high continuous driving forces
- very high peak forces
- extremely low cogging
- a comparatively low motor inductance

in spite of the compact external dimensions.

These features mean that PLATINUM™ DDL linear motors are not only suited for applications in the machine tool industry, but present advantages for all applications that require

- low levels of motor heating combined with high continuous driving forces
- outstanding control loop characteristics and high precision
- high static and dynamic stiffness (low compliance) in the drive chain

Linear motor series ICxx

If an occasion should arise where even the substantial continuous driving force of an uncooled ICxx linear motor is insufficient, then every size of motor in this series can also be fitted with integral water cooling. This enables a doubling of the already considerable driving force. The external dimensions remain the same, thus offering the option of simply retrofitting a motor with water cooling in situations where the machine stays the same, but the demands have been increased. The electrical connections and the water feed are at the front, but on opposite sides, which simplifies cabling and reduces the susceptibility to interference.

If very high demands are placed on the thermal insulation of the motor (i.e. to prevent expansion of the machine) then it is a good idea to plan in an additional cooling plate, as a thermal isolation device.

Linear motor series ICDxx

For applications where component height and weight are the decisive criteria, we recommend the ICDxx motor series. ICDxx motors produce similarly high peak forces to the ICxx motors, but with significantly smaller masses, thus permitting extremely high acceleration. They are therefore very suitable for applications with extreme dynamic requirements, which would otherwise require coreless motors.

ICDxx linear motors can **not** be fitted with internal water cooling.

I.4 General technical data

Climatic class	3K3 as per EN 50178
Ambient temperature (under rated conditions)	+5 to +40°C at site altitudes up to 1000m a.m.s.l. You must consult our applications department for ambient temperatures above 40°C with encapsulated motors.
Permissible humidity (under rated conditions)	85% relative humidity, no condensation
Power derating (current and force)	1% per °C in the range 40°C to 50°C and up to 1000m a.m.s.l. For sites above 1000m a.m.s.l. and 40°C 6% for 2000m a.m.s.l. 17% for 3000m a.m.s.l. 30% for 4000m a.m.s.l. 55% for 5000m a.m.s.l. No derating for sites above 1000m a.m.s.l. if temperature is reduced by 10°C per 1000m
Technical data	I.6

I.5 Standard features

I.5.1 Frame size

There are no standardized frame sizes for linear motors, but the modular design of the ICxx and ICDxx motors nevertheless makes it possible to find a mechanically suitable motor for just about every drive situation.

The magnets and windings are constructed in such a manner that they have a pole interval (from one North pole to the next North pole) of 32 mm. This corresponds to one complete rotation of the current vector.

The performance figures that are given in the technical data are valid for motors which are mounted on an aluminium plate that is at least 10mm thick, and has an area that is 3 times as large as the motor flange. If full loading of the motor is planned, then an area that matches this cooling plate must be designed into the machine to provide adequate heat removal, to prevent the motor overheating (see the corresponding remarks in the technical data).

When dimensioning vertical axes, take note of the "standing load" on the motor caused by the applied weight.

For the correct selection of the motor to fit the ambient conditions and installation situation, we recommend that you take advantage of the support provided by our sales and applications engineers (especially if it is a first-time application).

I.5.2 Secondary section (magnet track)

All the magnet tracks in the ICxx and ICDxx motors are fitted with high-magnetization NeFeB magnets (32mm from one North pole to the next North pole).

The magnets are glued onto a steel plate. The steel plate and the magnets are nickel-plated, to prevent corrosion and other environmental problems.

The magnet track is fitted with a stainless steel cover over the magnets, to protect them from possible mechanical damage.

The entire magnet track can be assembled from modules with lengths of 64, 128 or 256mm. When ordering the motor, please specify the quantities of the individual module types, as well as the type of motor.

I.5.3 Primary section (windings)

The primary sections (winding assemblies) of the linear motors are completely cast in an epoxy resin, and painted black. This ensures a high level of protection and optimum sealing of the windings. Aluminium end covers and steel side covers shield the surroundings from the electromagnetic influence of the winding heads.

I.5.4 Protective devices

The ICD motors are fitted with thermistors. IC motors, on the other hand, have thermostats fitted (floating n.c./break contacts). The resistance value or switching point can be found in the technical data. Thermal monitoring does **not** provide protection against sudden overloading. The thermal monitoring must be integrated into the monitoring system of the SERVOSTAR™ 400/600 digital servo amplifier.

I.5.5 Insulation material class

The windings in the primary (winding) section meet insulation class F as per DIN 57530.

I.5.6 Connections

The motors are fitted with connectors for the power feed and the thermal protection devices.

The mating connectors are not included in the delivery package. We can supply pre-assembled cables for the power feed and thermal protection. Follow the wiring diagram in Chapter II.2.

If the primary (winding) section is the moving part of the drive, then high-flexibility cables must be used, suitable for trailing applications.

I.5.7 Feedback unit

As an option, the winding sections can be fitted with a digital Hall-effect sensor unit for commutation.

Follow the wiring diagram in Chapter II.2.

The performance of a linear motor drive is decisively affected by the length measurement system which is used. We therefore recommend that only high-resolution linear measurement systems are used, with $1V_{pk-pk}$ sine-cosine signals, such as:

optical length measurement system

LIDA 185 from Heidenhain, resolution 25 intervals / mm

Further information can be found on the Internet, under: <http://www.heidenhain.de>

magnetic length measurement system

from Siko, resolution 1 interval / mm

Further information can be found on the Internet, under: <http://www.siko.de>

optical tape length measurement system

from Renishaw, resolution 50 intervals / mm with 120 termination resistance

Further information can be found on the Internet, under: <http://www.renishaw.com>

I.5.8 Options

-Hall- Hall sensor for commutation

I.6 Technical data

I.6.1 Terminology

Peak force F_{peak} [N]

The peak force is used as a design parameter for the acceleration and braking of the load. The motor should not be required to generate this force for more than 5 seconds. The direction of the force is defined as positive when the winding section moves towards the bolted cable connections (see dimensioned drawing in Chapter II.1).

Peak current I_{peak} [Arms]

This is the current required to produce the peak force F_{peak} . The direction of the force is defined as positive when the winding section moves towards the bolted cable connections (see dimensioned drawing in Chapter II.1).

Continuous force F_{cont} [N]

This is the force that the motor can generate continuously, provided that appropriate heat removal can be provided. The performance data are valid for motors which are cooled by an aluminium plate that is at least 10mm thick, and has an area that is 3 times as large as the motor flange.

The rest of the cooling is provided by natural air convection.

Continuous current I_{cont} [Arms]

This is the current required to produce the continuous force F_{cont} . Current that exceeds this value for some time is likely to result in overheating of the motor.

Motor constant K_M [$\text{N}/\sqrt{\text{W}}$]

A figure for the efficiency of the motor. The larger the motor constant, the lower the power losses for a given force. At full power, K_M is somewhat reduced as the borderline of magnet saturation is approached.

Voltage constant K_E [$\text{Vpeak}/\text{m}/\text{s}$]

The voltage constant is the motor e.m.f. (as a peak value between two terminals) that is induced at 1 meter per second.

Force constant K_F [N/Arms]

The ratio of continuous force to continuous current. This constant enables the calculation of the driving force as a function of the current.

Theoretical maximum acceleration [g]

The maximum off-load acceleration at peak current.

Magnetic attraction force [N]

The attractive force that the magnet track exerts on the winding section when no current is flowing. This increases by about 15% when current flows through the winding.

I.6.2 Technical data PLATINUM™ DDL

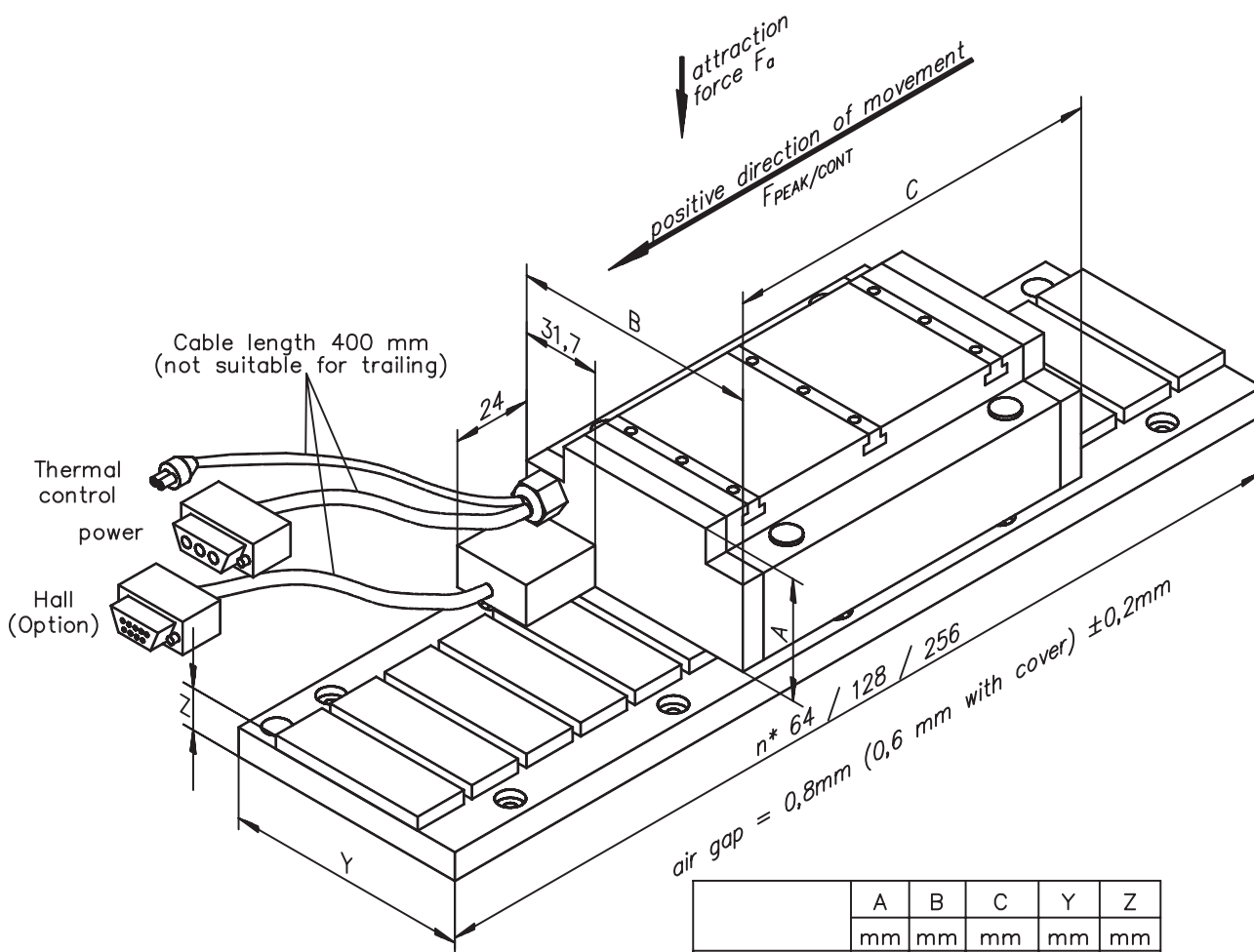
Data	Symbol	Unit	IC05-050	IC10-050	IC10-100	IC11-030	IC11-050	IC22-030	IC22-050	IC22-100	IC33-150	IC44-150	
Peak force	F _{peak}	N	280	560	1130	375	625	750	1250	2500	5625	7500	
Peak current	I _{peak}	A	8.5	15.8	15.8	11.3	11.3	11.0	11.0	22.0	33.1	44.1	
Continuous force (at 130°C)	F _{cont}	N	87	171	315	151	276	298	548	1198	2718	3617	
Continuous current (at 130°C)	I _{cont}	A	2.0	3.8	3.5	4.0	4.4	3.9	4.4	9.5	14.4	19.2	
DC-link voltage	U _{DC}	V	330				560						
Motor constant (at 130°C)	K _M	N/√W	14.5	20.5	31.3	18.9	26.9	26.4	37.7	58.5	90.7	105	
Voltage constant (peak, at 25°C)	K _E	V/m/s	36.3	36.4	72.8	30.9	51.4	61.7	103	103	154	154	
Force constant (rms, at 25°C)	K _F	N/A	44.5	44.6	89.2	37.8	62.9	75.6	126	126	189	189	
Max. continuous dissipation	P _c	W	36	69	101	64	106	128	212	420	897	1193	
Winding resistance phase-phase, at 25°C	R ₂₀		4.5	2.2	3.9	1.9	2.6	3.9	5.3	2.2	2.1	1.5	
Winding inductance phase-phase, with rated air gap	L	mH	14.4	7.3	13.9	16.7	26.7	33.4	53.4	26.0	25.8	19.3	
Rated air gap without cover	-	mm	0.8 (± 0.2)										
Rated air gap with cover	-	mm	0.6 (± 0.2)										
Thermal transfer resistance from Cu winding to external structure	R _{th}	°C/W	2.9	1.52	1.04	1.64	0.99	0.82	0.50	0.25	0.12	0.088	
Magnetic attractive force	F _a	kN	0.9	1.8	3.6	1.1	1.9	2.3	3.9	7.8	17.7	23.5	
Theoretical max. acceleration	a _{max}	g	30.2	30.7	33.7	15.3	17.7	15.9	18.5	20.4	21.0	21.0	
Enclosure protection class	-	-	IP 55										
Insulation class	-	-	F(DIN 57530)										
Thermostat switching point	-	°C	-				120 ±5						
Thermistors	-	/120°C	1650				-						
Magnet track type (k = length)	-	-	MC-050-k	MC-050-k	MC-100-k	MC-030-k	MC-050-k	MC-030-k	MC-050-k	MC-100-k	MC-150-k	MC-150-k	
Magnet track, effective width	b	mm	50	50	100	30	50	30	50	100	150	150	
Magnet track, length	k	mm	64, 128, 256										
Winding section, weight ±15%	m _p	kg	1	2	3.5	2.5	3.5	5	7	12.5	27	36	
Magnet track, weight ±15% / length	m _s	kg/m	4	4	7	5.5	7.5	5.5	7.5	13	21	21	



The performance data are valid for cooling by an aluminium plate that is at least 10mm thick, and has an area that is 3 times as large as the motor flange.

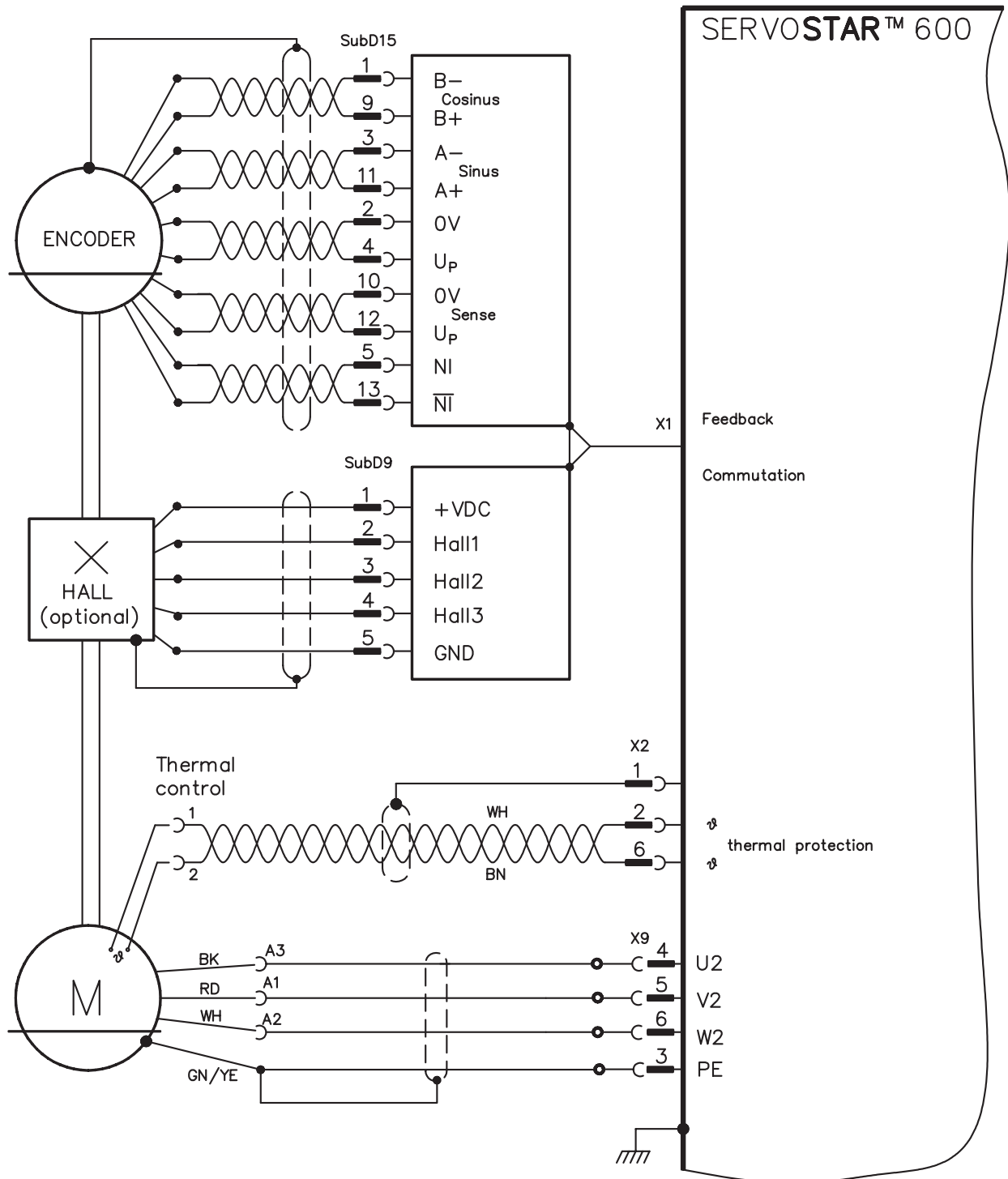
II Drawings

II.1 Dimensions



	A	B	C	Y	Z
	mm	mm	mm	mm	mm
ICD05-050	23,2	75	103,5	80	14
ICD10-050	23,2	75	183,5	80	14
ICD10-100	23,2	125	183,5	130	14
IC11-030	43,1	65	200,2	60	14
IC11-050	43,1	85	200,2	80	14
IC22-030	43,1	65	376,2	60	14
IC22-050	43,1	85	376,2	80	14
IC22-100	43,1	135	376,2	130	14
IC33-150	43,1	185	552,2	180	16
IC44-150	43,1	185	728,2	180	16

II.2 Wiring diagram for Hall-effect option



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Vertrieb und Service / Sales and Service / Agence et Services

<u>Bundesrepublik Deutschland / Germany / Allemagne</u> Kollmorgen Seidel GmbH & Co. KG Verkaufsniederlassung Nord Wacholderstr. 40-42 40489 Düsseldorf Tel.: +49(0)203 - 99 79 214 Fax: +49(0)203 - 99 79 182	<u>Dänemark / Denmark / Danemark</u> DIGIMATIC ApS Peder Skrams Vej 31A 5220 Odense SØ Tel.: +45 - 70 20 16 70 Fax: +45 - 70 20 16 71	<u>Italien / Italy / Italie</u> M.C.A. s.r.l. Via f. Turati 21 20016 Pero (Mi) Tel.: +39(0)02 - 33 91 04 50 Fax: +39(0)02 - 33 90 85 8
Kollmorgen Seidel GmbH & Co. KG Verkaufsniederlassung West Lilienstraße 3 42719 Solingen Tel.: +49(0)212 - 2 30 77 99 Fax: +49(0)212 - 2 30 77 97	<u>Finnland / Finland / Finlande</u> Drivematic OY Hevosenkä 4 28430 Pori Tel.: +358 - 20 11 23 - 111 Fax: +358 - 20 11 23 - 358	<u>Niederlande / Netherlands / Pays-Bas</u> Dynamic Drives Wattstraat 26f 2723 RC Zoetermeer Tel.: +31(0)79 - 59 39 214 Fax: +31(0)79 - 59 39 840
Kollmorgen Seidel GmbH & Co. KG Verkaufsniederlassung Mitte Bussardweg 38 61118 Bad Vilbel Tel.: +49(0)6101 - 55 866 00 Fax: +49(0)6101 - 55 866 06	<u>Frankreich / France / France</u> Kollmorgen Seidel GmbH & Co. KG Parc technologique St.Jacques 2 rue Pierre et Marie Curie 54320 Maxéville Tel.: +33(0)3 83 95 44 80 Fax: +33(0)3 83 95 44 81	<u>Schweden / Sweden / Suède</u> S D T AB 25467 Helsingborg Tel.: +46(0)42 - 380 800 Fax: +46(0)42 - 380 813 Stockholm 12030 Stockholm Tel.: +46(0)8 - 640 77 30 Fax: +46(0)8 - 641 09 15 Göteborg 42671 Västra Frölunda Tel.: +46(0)31 - 69 62 60 Fax: +46(0)31 - 69 62 69
Kollmorgen Seidel GmbH & Co. KG Verkaufsniederlassung Süd-West Lessingstr. 41 75015 Bretten Tel.: +49(0)7252 - 97 39 040 Fax: +49(0)7252 - 97 39 055	<u>Großbritannien / Great Britain / Royaume-Uni</u> Kollmorgen PO Box 147, KEIGHLEY West Yorkshire, BD21 3XE Tel.: +44(0)15 35 - 60 76 88 Fax: +44(0)15 35 - 68 05 20	<u>Schweiz / Switzerland / Suisse</u> Kollmorgen Seidel GmbH & Co. KG Buhnrain 30 8052 Zürich Tel.: +41(0)1 - 300 29 65 Fax: +41(0)1 - 300 29 66
Kollmorgen Seidel GmbH & Co. KG Verkaufsniederlassung Süd-Ost Landsbergerstr. 17 86947 Weil Tel.: +49(0)8195 - 99 92-50 Fax: +49(0)8195 - 99 92-33	<u>Großbritannien / Great Britain / Royaume-Uni</u> Heason Technologies Group Claremont Lodge Fontwell Avenue Eastergate Chichester PO20 6RY Tel.: +44(0)12 43 - 54 54 00 Fax: +44(0)12 43 - 54 45 90	<u>Spanien / Spain / Espagne</u> BROTOMATIC S.L. C/San Miguel de Acha, 2 Pab.3 01010 Vitoria (ALAVA) Tel.: +34 945 - 24 94 11 Fax: +34 945 - 22 78 32
Servo-Dyn Technik GmbH Münzgasse 10 01067 Dresden Tel.: +49(0)351 - 49 05 793 Fax: +49(0)351 - 49 05 794		

Systempartner / System partners / Partenaires du système

<u>Bundesrepublik Deutschland / Germany / Allemagne</u> Werner P. Hermes Ingenieurbüro Turmstr. 23 40750 Langenfeld Tel.: +49(0)212 - 65 10 55 Fax: +49(0)212 - 65 10 57	<u>Großbritannien / Great Britain / Royaume-Uni</u> Motor Technology Ltd. Unit 1 Chadkirk Industrial Estate Otterspool Road Romiley, Stockport Cheshire SK6 3LE Tel.: +44(0)161 - 42 73 641 Fax: +44(0)161 - 42 71 306	<u>Italien / Italy / Italie</u> Servo Tecnica Viale Lombardia 20 20095 Cusano Milanino (MI) Tel.: +39 (0)02 - 66 42 01 Fax: +39 (0)02 - 66 40 10 20
EAT GmbH Elektronische Antriebstechnik Hanferstraße 23 79108 Freiburg Tel.: +49(0)761 - 13 03 50 Fax: +49(0)761 - 13 03 555	<u>Niederlande / Netherlands / Pays-Bas</u> Kiwiet Ingenieurbüro Helenaveenseweg 35 5985 NK Panningen (Grashoek) Tel.: +31(0)77 - 30 76 661 Fax: +31(0)77 - 30 76 646	<u>Türkei / Turkey / Turquie</u> Robotek Otomasyon Teknolojileri Ali Nihat Tarlan CAD. Kartal Sk. No: 16/7 Üstbostancı YSTANBUL Tel: +90 216 464 50 64 pbx Fax: +90 216 464 50 72
IBK Ingenieurbüro Keßler GmbH Dachtmisser Str. 10 21394 Kirchgellersen Tel.: +49(0)4135 - 12 88 Fax: +49(0)4135 - 14 33	<u>Schweiz / Switzerland / Suisse</u> Bobby Servo Electronic AG Zentralstr. 6 6030 Ebikon Tel.: +41(0)41- 440 - 77 22 Fax: +41(0)41 - 440 - 69 43	<u>Griechenland / Greece / Grèce</u> Alpha Motion 5 - 7 Alkamenoy's Str. 104.39 Athens Tel.: +30 1 82 27 470 Fax: +30 1 82 53 787
MACCON GmbH Kühlbachstr. 9 81543 München Tel.: +49(0)89 - 65 12 20-0 Fax: +49(0)89 - 65 52 17	<u>Ungarn / Hungary / Hongrie</u> Q-TECH Mérnöki Szolgáltató Kft. 1161 Budapest Batthyány u. 8. Tel.: +36 (1) 405 - 33 38 Fax: +36 (1) 405 - 91 34	<u>Australien / Australia / Australie</u> Motion Technologies PTY. Ltd. 1/65 Alexander Avenue Taren Point NSW 2229 Sydney Tel.: +61 (0)295 24 47 82 Fax: +61 (0)295 25 38 78

Kollmorgen Seidel GmbH & Co. KG

Hausanschrift

Wacholderstr. 40-42
D - 40489 Düsseldorf
Tel.: +49(0)203 - 99 79 - 0
Fax: +49(0)203 - 99 79 - 155
Internet : <http://www.kollmorgen-seidel.de>

Postanschrift

Postfach 34 01 61
D-40440 Düsseldorf

Kollmorgen

Motion Technologies Group
201 Rock Road
Radford, VA 24141, USA
Tel.: +1 540 - 639 - 24 95
Fax: +1 540 - 731 - 08 47
Internet : <http://www.kollmorgen.com>