TRINAMIC

PRODUCT GUIDE

TRINAMIC
MOTION CONTROL

TRINAMIC – SMART SOLUTIONS FOR MOTION CONTROL

TRINAMIC
MOTION CONTROL
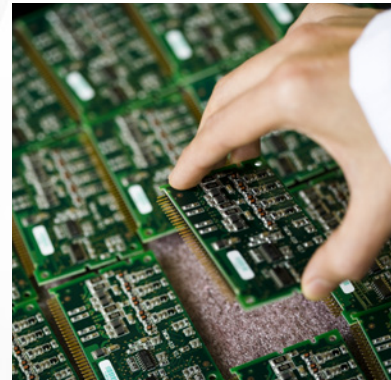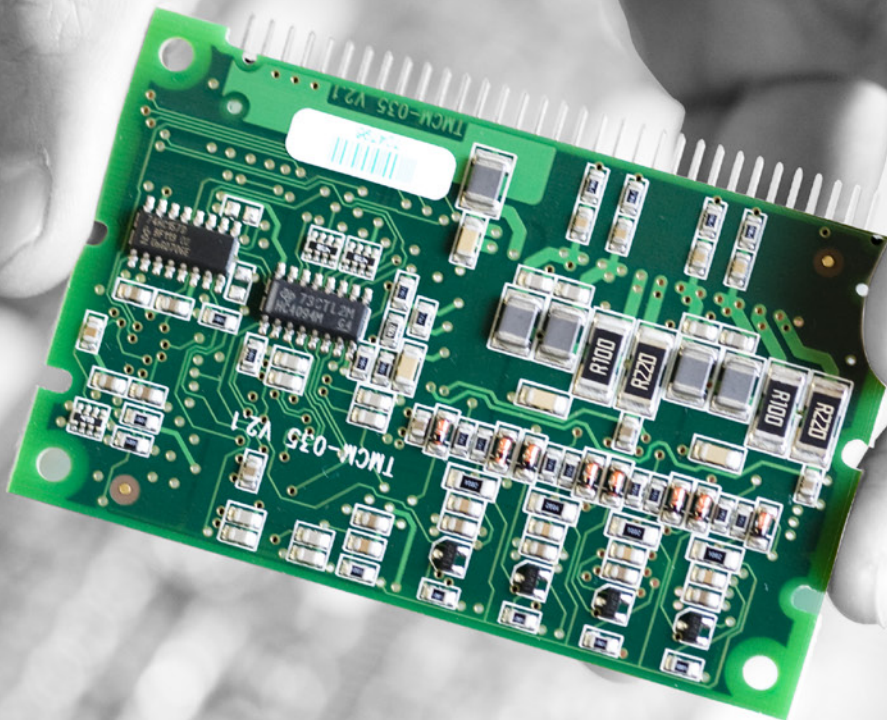
TRINAMIC is a fabless semiconductor company and serves the market with self developed integrated circuits for the control of small electrical motors in a wide variety of applications. TRINAMIC's integrated circuits are manufactured to the highest standards in the world's most advanced manufacturing plants.

While the competition often comes from semiconductor technology and focuses on it, TRINAMIC is at home in both worlds – the world of motors and the world of **IC** design.

The products – whether they are **IC**s, modules or the mechatronic systems (**PANdrive™**) – are in use all over the world and are selected because of their superior price/performance ratio.

Applications are everywhere, where small motors are deployed and the growth of such small drives is increasing rapidly. In growing markets like biotech, medical, lab automation, semiconductor handling, TRINAMIC **IC**s control complex devices with dozens of axis.

Close to the market, TRINAMIC continuously develops new products with innovative features, driven by the customers need for a higher degree of miniaturization, higher efficiency, diagnostics, and protection to enable the reliability of the complete system.

TRINAMIC customers benefit from our encompassing knowledge about motor physics and from the extensive library of application knowledge which the company has built over the years. For customers, TRINAMICs application driven approach means that they do not need an indepth knowledge about motors, DSPs, or control circuitry in general. Consequently, the design phase saves the labor and costs.
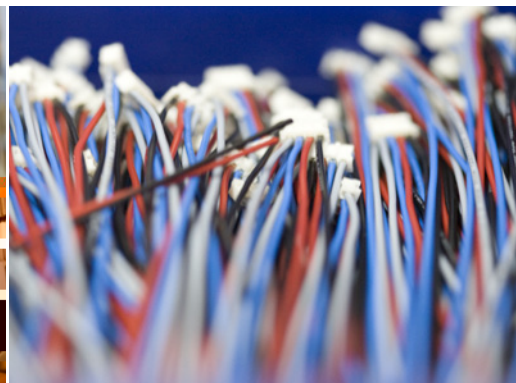
Traditional industries that are undergoing a paradigm change and are replacing complex mechanics by decentralized solutions that are synchronized via bus systems, count on TRINAMIC: Examples are the textile machines and furniture manufacturing equipment.

TRINAMIC also offers complete modules, including hardware and software for specific motor control requirements. The modules combine TRINAMIC's dedicated stepper control and driver **IC**s with extensive experience in designing custom and off-the-shelf motion control solutions.

TRINAMIC makes the difference!

INNOVATION – MADE BY TRINAMIC

TRINAMIC is an innovative company with over 14 years of experiences in design and marketing of motion control chips, modules, and mechatronic drives.

Within its history, TRINAMIC engineers have been granted many patents including Dual Interface Control, and Automatic Mixed Decay. Our innovations address the needs of the OEM market and provide ideal solutions for our customers' applications.

This significantly reduces project time and cost as well as design risk. An average of 6 months faster time to market compared to an in-house development can be achieved.

stallGuard™

TRINAMIC's patented sensorless stall detection **stallGuard™** enables customers to detect mechanical overload conditions and stall conditions without external sensors, by measuring the load at a predefined point where a step loss has not yet occurred. Thus, eliminates the need for reference or end switches. This reduces cost and complexity of applications, where a reference point is required. When compared to pure mechanical referencing, stress on the mechanic and noise is reduced.

stallGuard2™

Improved version of the successfull **stallGuard™** feature. **stallGuard2™** is the world's first sensorless high resolution load detection implemented in a standard stepper motor driver. This gives the user easy and cost effective real time feedback of his application. It enables to scan the motion system without additional sensors. This can help to find the right motor and mechanics during development phase or to detect abrasion or mechanical stiffness

coolStep™

Sensorless load dependent current control using the **stallGuard2™** feature. First time **coolStep™** enables to drive a stepper motor in a energy efficient way. Up to now stepper motors are driven with constant current. The new TMC260, TMC261 and TMC262 stepper motor driver series detects the actual load of the motor and adjusts the current accordingly. This eliminates the security current margin and allow also to boost the motor avoiding stall and step loss to improve the reliability of the entire system.

spreadCycle

New patent pending constant Toff chopper scheme. Using the spreadCycle chopper the µStep current sine wave is always well formed with a smooth zero crossing. Due to this effect the stepper motor can be driven very fast without resonance effects. All the coolStep™ drivers are using this new technology.

hallFX™

hallFX™ generates back EMF based hallsensor like signals for the sensorless commutation of BLDC (also two phase motor when using 2 TMC603 as gate driver) motors. **hallFX**™ can be easily integrated into your drive, since it directly emulates hall sensors and does not require complex software components to be added to your controller.

chopSync™

The patented **chopSync™** feature allows very high velocity operation of stepper motors using the standard TRINAMIC [stepper motor] drivers TMC236, TMC239, TMC246 and TMC249. This is achieved by reducing resonances occurring when operating the motor at velocities where the EMF voltage exceeds the level of the supply voltage. With **chopSync™**, motor velocities of several 1000 RPM can be reached.

sensOstep™

sensOstep™ is based on a magnetic angular position encoder system with low to medium resolution for **PANdrive™** mechatronic solutions. It consists of a small magnet positioned at the back end of a stepper motor axis and a Hall-sensor **IC** with integrated digital signal processing (e.g. for automatic gain control, temperature compensation etc.) placed above the magnet on the back side of a motor mounted printed circuit board. Starting at resolutions of 8 bit (256 steps) per revolution – which is completely sufficient for detecting step losses with standard 1.8° stepper motors – it is currently available with up-to 12bit (4096 steps). This increased resolution is sufficient for regaining position after step-loss for many applications without requiring any additional reference procedure.

TMCL™

TMCL™ – the TRINAMIC Motion Control Language – is a programming language dedicated to motion control applications. The software includes commands for moving one or more motor axes at certain velocities or to certain positions and for setting all relevant parameters of the motion controller. It is possible to access additional general purpose digital and analog inputs and outputs. **TMCL**™ is available on most TRINAM**IC** modules with integrated motion controller. Program development is supported by the **TMCL-IDE** – a **PC** based integrated development environment which is available free of charge.

Our engineering team and customer service offers:

▶ High-level specification, -jointly with customer

▶ Technical specification and system architecture

▶ **ICs** and **PCB** in-house design

▶ Software development

▶ Fast prototyping

▶ Testing and qualification

▶ Logistic warehouse

▶ After sales & technical support

▶ Online support forum: www.trinamic.com/ttdg

▶ **RMA** repair

LONG LIFE AVAILABILITY

TRINAMIC offers lifecycles of up to 10 years for almost all of our products, which reduces costs of re-designing, re-qualification and re-certifying for our customers. This does not only save valuable resources but reduces time-to-market.

QUALITY

Today TRINAMIC has strategic alliances with partners to ensure access to the latest technologies and processes.
TRINAMIC is ISO 9001:2000 certified by Germanischer Lloyd and EN ISO 13485 certified for "Medical Components" by Medcert.

RESPONSIBILITY –
PROVIDED BY TRINAMIC

TRINAMIC MEMBERSHIPS

TRINAMICs ambitions are to commence different innovation platforms, where various industries and leading suppliers join forces to support, promote and advance the technology.

TRINAMIC is member of the following organizations:

The **EtherCAT** Technology Group is a global organization in which OEM, End Users and Technology Providers join in order to support and promote the technology development. EtherCAT sets new standards for real-time performance and topology flexibility, whilst meeting or undercutting field bus cost levels.

www.ethercat.org

TRINAMIC GREEN

We refer to the Directive 2002/95/EC of the European Parliament and the Council on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment.

That means, all electrical and electronic equipment put on the market by TRINAMIC does not contain lead, mercury, cadmium, hexavalent chromium, polybromiated biphenyls (PBB) or polybromiated diphenyl ethers (PBDE) in terms of the RoHS Directive.

INNOMAG is an innovate platform for Magnetic Microsystems that combines the interests and potentials of manufacturers, service providers and users in a network. The target is to develop applications of magnetic Microsystems and nanotechnologies in Germany.

www.innomag.org

CiA is the international users' and manufacturers' group that develops and supports CANopen and other CAN-based higher-layer protocols. The nonprofit group was founded in 1992 to provide CAN-based technical, product and marketing information.

www.can-cia.de

MOTION & INTERFACE CONTROLLER

PRODUCT	TMC428	TMC429	TMC457	TMC424
Motion controller	✓	✓	✓	–
Interface controller	–	–	–	–
Number of axes	3	3	1	3
Motor type	Stepper	Stepper	Steper / Piezo	–
CPU interface	SPI	SPI	SPI or S/D	SPI
Driver interface	SPI	S/D or SPI	SPI or S/D or classic	–
Dyn. range	12 bit * 2^4 bit	12 bit * 2^4 bit	32 bit	16 Mcnt/s
Position range	24 bit	24 bit	32 bit	24 bit
Acceleration ramp	linear	linear	linear + S-shape	–
On the fly target	✓	✓	✓	–
easyPID™	–	–	✓	–
Sequencer	✓	✓	✓	–
Max microstep resolution	64	64 (SPI) / 256 (S/D)	2048	–
Encoder interface	–	–	ABN	3x ABN
chopSync™	–	–	✓	–
Ref. inputs	3 x 2	3 x 2	2 x 2 virtual	–
Supply voltage DC	3.3 - 5V	3.3 - 5V	3.3 & 1.5V	3.3 & 1.5V
Package	SS0P16 SO24	SOP24 QFN32 (5x5) SSOP16	FBGA144	TQFP100

INTEGRATED MOTION CONTROLLER AND DRIVER FOR STEPPER MOTORS

PRODUCT	TMC222	TMC223
Stepper type	2 phase	2 phase
Peak current	800mA	800mA
Motor voltage	8 – 29V	8 – 29V
Number of microsteps	16	16
Interface	IIC	IIC
Full protection/ diagnostics	✓	✓
Stall detection	–	✓
Dyn. range	16 velocities	16 velocities
Position range	4096 fullsteps	4096 fullsteps
Package	SO20 / QFN32	SO20 / QFN32

BLDC DRIVER WITH BACK-EMF SUPPORT, PROTECTION AND CURRENT MEASUREMENT

* also two phase motor when using 2 TMC60x as gate driver

PRODUCT	TMC603	
Motor type*	3 phase	
Peak current (depends on NFET type)	20A	
Voltage	12V – 50V	
Current sensing (w/o sense resistor)	✓	
Short to GND protection	✓	
hallFX Sensorless commutation support	✓	
Hardware block commutation	–	
Integrated switching regulator	✓	12V
Integrated linear regulator	✓	5V
Internal BBM logic	✓	
Slope control	✓	
Package	QFN52	

POWER DRIVER FOR STEPPER MOTORS

PRODUCT	TMC236	TMC239	TMC246	TMC249
Stepper motor type	2 phase	2 phase bipolar	2 phase bipolar	2 phase bipolar
Peak current	1.5A	up to 6A	1.5 A	up to 6A
Motor supply voltage	7 – 34V	7 - 34 V	7 - 34 V	7 - 34 V
Max. microstep resolution	16 / 64	16 / 64	16 / 64	16 / 64
Interface	classic / SPI	classic / SPI	classic / SPI	classic / SPI
Full potection / diagnosis	classic / SPI	✓	✓	classic / SPI
Interface voltage	3.3 – 5V	3.3 – 5V	3.3 – 5V	3.3 – 5V
RDSon (Tj=150°C)	0,2/0,37 Ohm	MOSFET dep.	0,2/0,37 Ohm	MOSFET dep.
slope control	resistor	resistor	resistor	resistor
stallGuard™	–	–	✓	✓
Temperature range	-40 - 125°C	-40 - 125°C	-40 - 125°C	-40 - 125°C
Driver MOSFET type	int.	ext. (N & P)	int.	ext. (N & P)
Package	PQFP44	QFN32 (7x7mm)	PQFP44	QFN32 (7x7mm)

S/D Step/Direction

PRODUCT	TMC260	TMC261	TMC262
Stepper motor type	2 phase bipolar	2 phase bipolar	2 phase bipolar
Peak current	1.7 A	1.7 A	up to 6A
Motor supply voltage	9 - 39 V	9 - 59 V	9 - 59 V
Max. microstep resolution	256	256	256
Interface	S/D + SPI	S/D + SPI	S/D + SPI
Full potection / diagnosis	✓	✓	✓
Interface voltage	3.3 - 5V	3.3 - 5V	3.3 - 5V
RDSon (Tj=150°C)	0,21/0,31 Ohm	tbd.	MOSFET dep.
slope control	programmable	programmable	programmable
stallGuard2™	✓	✓	✓
coolStep™	✓	✓	✓
spreadCycle chopper	✓	✓	✓
microPlyer (µStep multiplier)	16 to 256 µSteps	16 to 256 µSteps	16 to 256 µSteps
Temperature range	-40°C - 125°C	-40°C - 125°C	-40°C - 125°C
Driver MOSFET type	int.	int.	ext. (N & P)
Package	PQFP44	PQFP44	QFN32 (5x5mm)

coolStep™

BL DC MOTOR CONTROLLER/DRIVER

PRODUCT	TMCM-160	TMCM-163	TMCM-170	TMCM-171	TMCM-1630 -2C	TMCM-1630 -4U
Number of axes	1	1	1	1	1	1
Rated motor current [A]	5	10	10	20	10	10
Supply voltage [V]	12-36	14-28	14-48	12-48	12-48	12-48
Block commutation with hall sensors	✓	✓	✓	✓	✓	✓
Sine commutatuon with incremental encoders	–	–	✓	✓	✓	✓
Sensorless block commutation w. hallFX™	–	–	–	–	✓	✓
TMCL controller	✓	✓	✓	✓	✓	✓
TMCL programm memory [commands]	–	–	64	2048	2048	2048
Interface: UART (RS232/RS485)	–	–	–	–	–	–
Interface: RS-232	opt	opt	opt	–	✓	–
Interface: RS-485	opt	opt	opt	✓	–	✓
Interface: CAN	–	–	✓	✓	–	✓
Interface: USB	–	–	–	–	✓	–
Interface: EtherCAT - E-Bus	–	–	–	–	–	–
Driver interface	–	–	–	S/D	–	–
CANopen ready	–	–	–	–	–	✓
Encoder interface	–	–	ABN	ABN	ABN	ABN
General purpose input (digital+analog)	2 a (10V)	1 a (10V)	1 a (10V)	1 a (10V) + 3 a (5V)	2 d (24V) + 2 a (10V)	2 d (24V) + 2 a (10V)
General purpose output (digital)	1 (5V)	–	–	2 (OD Vdd)	3 (OD Vdd)	3 (OD Vdd)
stand alone operation with analog input	✓	✓	✓	✓	✓	✓
Size [mm]	59*92	43*43*20	d=61	145*96*33	50*92	50*92
connector type	2*26pin	flat & JST	screw & JST	screw & JST	2*26pin	2*26pin
Protection type	open frame	open frame	open frame	AL box	open frame	open frame
Related baseboard	BB-160	–	–	–	BB-1630	BB-1630
Remarks		motor mountable NEMA 17				

S/D Step/Direction

PIEZO MOTOR DRIVER

	TMCM-1640	TMCM-1631	TMCM-1632
	1	1	1
	5	5	5
	12-28,5	12-48	12-28.5
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓
	✓	✓	✓
	2048	2048	2048
	–	✓	✓
	–	–	–
	–	–	–
	–	–	–
	✓	––	–
	–		
	–	–	–
	–	–	–
	ABN	ABN	ABN
	1 a (10V), 2 d (24V)	2 + 2 d (48V)	2 + 2 d (24V)
	2	2 (OD Vdd)	2 (OD Vdd)
	✓	–	–
	42*42	42*64	42*72
	JST/Tyco	16+32pin	16+32pin
	open frame	open frame	open frame
	–	✓	✓
	motor mountable NEMA 17	on demand product	on demand product

PRODUCT	TMCM-090
Number of axes	1
Supply voltage DC [V]	48
External logic voltage DC [V]	5
Max. microstep resolution	2048
Driver interface	S/D + SPI
size [mm]	50 x 80
Connector type	68 pin
Protection type	open frame
Remarks	for Piezo-LEGS motors

STEPPER MOTOR DRIVER
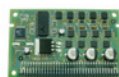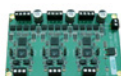
PRODUCT	TMCM-013	TMCM-023	TMCM-035	IDX 7505	TMCM-078
Number of axes	1	3	1	1	1
Max. motor current RMS [A]	1.1	2.0	3.5	5	7
Supply voltage DC [V]	30	28.5	48	75	75
External logic voltage [V]	–	–	5	–	–
Max. resolution [µSteps]	256	16	64	256	256
S/D driver interface	5 – 24V optically isolated	24V optically isolated	TTL/CMOS level	5 – 24V optically isolated	differential optically isolated
Alternative driver interface	–	–	SPI, Analog	–	–
Parameter setting	RS-485	jumper	pin connector	RS-485	DIP-switch, RS-485 opt
ASCII protocol for low end motion control	✓	–	–	✓	✓
Ref./End switch input	✓	–	–	✓	✓
Size [mm]	42*42	60*100	80*50	65*64*24	145*96*33
Connector type	JST	screw	68 pin	screw	screw / JST
Motor mountable	42mm	–	–	–	–
Housing	–	–	–	Aluminum & INOX	Aluminum
stallGuard™	✓	–	✓	✓	✓
chopSync™	–	–	–	–	✓
Remarks					

S/D Step/Direction

STEPPER MOTOR DRIVER + CONTROLLER WITH COOLSTEP™

coolStep™

PRODUCT	TMCM-1060	TMCM-1180
Number of axes	1	1
Max. phase current RMS [A]	2.8	5.5
Supply voltage DC [V]	9 - 51	18 - 55
Max. microstep resolution	256	256
TMCL controller	✓	✓
TMCL program memory [commands]	2048	2048
Acceleration ramps	linear	linear
Interface: RS-232	–	✓
Interface: RS-485	✓	✓
Interface: CAN	✓	✓
Interface: USB	✓	✓
CANopen ready	✓	✓
Driver interface	S/D	S/D
Encoder interface	–	ABN
senOstep™ encoder resolution [ppr]	256	256
Ref./End switch inputs	1+2 (24V)	1+2 (24V)
Shutdown input	✓	✓
GP inputs (digital / analog)	2 d + a (5/24V)	2 d + a (5/24V)
GP outputs (digital)	2 (OC, Vdd)	2 (OC, 24V)
Encoder interface	–	ABN
Size [mm]	60 x 60	86 x 86
Connector type	JST	JST
Protection type	open frame	open frame
stallGuard2™	✓	✓
coolStep™	✓	✓
spreadCycle Chopper	✓	✓
microPlyer [µSteps]	16 to 256	16 to 256
Motor mountable	NEMA 23/24	NEMA 34
Remarks		

STEPPER MOTOR CONTROLLER/DRIVER

PRODUCT	TMCM-102	TMCM-103	TMCM-110	TMCM-113	TMCM-140	TMCM-142	MONOpackII V2
Number of axes	1	1	1	1	1	1	1
Max. phase current [A] (RMS)	3.5	2.0	1.1	2.8	2.0	5.0	3.5
Supply voltage DC [V]	18 - 55	7 - 28.5	7 - 34	7 - 28.5	7 - 28.5	18 - 75	12 - 48
External logic voltage DC [V]	–	–	–	–	–	–	–
Max. microstep resolution	64	64	16	16	16	1024	406
TMCL controller	✓	✓	✓	✓	✓	✓	✓
TMCL program memory [commands]	2048	2048	2048	2048	2048	2048	2048
Acceleration ramps	linear	linear	linear	linear	linear	linear & S-shape	linear & S-shape
Interface: RS-232	✓	✓	opt	opt	opt	✓	✓
Interface: RS-485	x	–	opt	opt	opt	✓	✓
Interface: UART (RS232/485)	–	–	–	–	–	–	–
Interface: IIC	–	–	opt	–	–	–	–
Interface: CAN	✓		opt	–	opt	✓	✓
Interface: USB	✓	–	–	–	✓	✓	–
CANopen ready	–		–	–	✓	✓	–
Driver interface	–	–	–	–	–	–	–
Encoder interface	ABN	ABN	–	–	–	ABN	ABN
Ref./End switch inputs	1+2 (5V)	2 (5/24V)	2 (5V)	2 (5V)	2 (5V)	1+2 (5V)	2
Shutdown input	–	✓	–	–	–	–	–
GP inputs (digital / analog)	2 d+a (5V)	2 d+a (24V)	1 d+a (5V)	1 d+a (5/24V)	1 d+a (5/24V)	2 d+a (5V)	–
GP outputs (digital)	3 (OC)	2 (OC)	1 (OC, 40V)	1 (OC, Vdd)	1 (OC, Vdd)	3 (OC)	–
Size [mm]	76 x 70 x 33	43 x 50	42 x 42	60 x 60	42 x 42	76 x 70 x 33	130 x 132 x 45
Connector type	push/screw	2x 16 pin	JST	JST / Molex	JST	push/screw	screw
Protection type	open frame	open frame	open frame	open frame	open frame	open frame	IP30, AL-box
stallGuard™	✓	✓	✓	✓	✓	–	–
chopSync™	–	✓	–	✓	✓	–	✓
Remarks	RS-422, IMS-commands		Motor mountable NEMA17	Motor mountable NEMA 23/24	Motor mountable NEMA17	RS-422, IMS-commands	special protocoll or TMCL

S/D Step/Direction

TMCM-310	TMCM-323	TMCM-341	TMCM-342	TMCM-343	TMCM-351	TMCM-610	PRODUCT
3	3	3	3	3	3	6	Number of axes
1.1	–	–	–	1.1	2.8	1.1	Max. phase current [A] (RMS)
8 - 34	–	–	–	7 - 34	7 - 28.5	7 - 34	Supply voltage DC [V]
–	5	5	5	5	–	–	External logic voltage DC [V]
16	–	–	–	64	64	16	Max. microstep resolution
✓	–	✓	✓	✓	✓	✓	TMCL controller
2048	–	2048	2048	2048	2048	2048	TMCL program memory [commands]
linear	–	linear	linear	linear	linear	linear	Acceleration ramps
✓	–	–	–	–	✓	✓	Interface: RS-232
–	–	–	–	–	✓	–	Interface: RS-485
–	–	✓	✓	✓	–	–	Interface: UART (RS232/485)
–	–	–	–	–	–	–	Interface: IIC
opt	–	✓	✓	✓	✓	–	Interface: CAN
–	–	–	–	–	✓	✓	Interface: USB
–	–	✓	✓	✓	✓	–	CANopen ready
–	–	SPI	S/D	–	–	–	Driver interface
–	3x ABN	*1)	*1)	*1)	3x ABN	–	Encoder interface
3 x 2 (5V)	–	3 x 2 (5V)	3 x 2 (5V)	3 x 2 (5V)	3 x 2	6 x 2 (5V)	Ref./End switch inputs
–	–	–	–	–	✓	–	Shutdown input
8 d+a (5V)	–	8 d+a (5V)	8 d+a (5V)	8 d+a (5V)	8d (24V) + 4a (3.3/10V)	8 d+a (5V)	GP inputs (digital / analog)
8	–	8	8	8	8 (OC)	8	GP outputs (digital)
100 x 160	50 x 80	50 x 80	50 x 80	50 x 80	100 x 160	120 x 160	Size [mm]
screw	68 pin	68 pin	68 pin	68 pin	JST + screw	screw	Connector type
open frame	open frame	open frame	open frame	open frame	open frame	open frame	tProtection type
✓	–	–	–	✓	✓	✓	stallGuard™
–	–	–	–	–	–	–	chopSync™
	SPI interface				additional SPI interface		Remarks

*1) optional with additional TMCM-323
*2) General Purpose

PANdrives™ WITH STEPPER MOTOR

PRODUCT	PD-108-28-SE	PD-013-42	PD-110-42	PD-140-42-SE	PD-109-57 V2	PD-113-57-SE	PD57-1060
Motor flange size [mm]	28 * 28	42 * 42	42 * 42	42 * 42	57 * 57	57 * 57	57 * 57
Motor flange size NEMA	11	17	17	17	23	23	23
Supply voltage DC [V]	9 -28	7 - 30	7 - 34	7 - 28.5	18 - 55	7 - 28.5	9 - 51
Max. resolution [µStep/rev]	3200	51200	3200	3200	3200	3200	51200
Fullstep angle	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°	1.8°
TMCL controller	✓	–	✓	✓	✓	✓	✓
TMCL program memory [commands]	64	–	2048	2048	2048	2048	2048
Acceleration ramps	linear	–	linear	linear	linear	linear	linear
Interface: RS-232	–	–	opt	opt	✓	opt	–
Interface: RS-485	✓	for setup	opt	opt	✓	opt	✓
Interface: IIC	–	–	opt	–	–	–	–
Interface: CAN	–	–	opt	opt	–	–	✓
Interface: USB	–	–	–	✓	–	–	✓
CANopen ready	–	–	–	✓	–	–	✓
S/D driver interface (opto coupler)	–	✓	–	–	–	–	✓
Ref./End switch inputs	–	–	2 (5V)	2 (5V)	2 (5V)	2 (5V)	1+2 (24V)
Shut down input	–	–	–	–	✓	–	✓
General purpose input (digital / analog)	2 d+a (5/24V)	–	1 d+a (5V)	2 d+a (5/24V)	3 d (5V)	2 d+a (5/24V)	2 d+a (5/24V)
General purpose outputs (digital)	2 (OC, 5V)	–	1 (OC, 40V)	2 (OC, Vdd)	1 (OC, 40V)	2 (OC, Vdd)	2 (OC, Vdd)
Connector type	JST	JST	JST	JST	screw	JST / Molex	JST
Protection type	open frame	open frame	open frame	open frame	IP20, plastic	open frame	open frame
Integrated sensOstep™ encoder resolution [ppr]	256	–	–	4096	–	256	256
stallGuard™	–	–	✓	✓	✓	✓	–
chopSync™	–	–	–	✓	–	✓	–
stallGuard2™	–	–	–	–	–	–	✓
coolStep™	–	–	–	–	–	–	✓
spreadCycle chopper	–	–	–	–	–	–	✓
microPlyer [µSteps]	–	–	–	–	–	–	16 to 256
PD-1… torque [Nm]/[oz in]	0,06 / 8,5	0,27 / 38	0,27 / 38	0,22 /	0,55 / 78	0,55 / 78	0,55 / 78
PD-2… torque [Nm]/[oz in]	–	0,35 / 50	0,35 / 50	0,36 /	1,01 / 143	1,01 / 143	1,01 / 143
PD-3… torque [Nm]/[oz in]	0,12 / 17	0,49 / 69	0,49 / 69	0,44 /	1,26 / 164	1,26 / 164	1,26 / 164
PD-4… torque [Nm]/[oz in]	–	–	–	–	1,89 / 268	1,89 / 268	1,89 / 268

S/D Step/Direction

PANdrives™ WITH BLDC MOTOR

	PD-113-60-SE	PD-146-60-SE	PD60-1060	PD86-1180
	60 * 60	60 * 60	60 * 60	86 * 86
	24	24	24	34
	7 - 28.5	7 - 34	9 - 51	18 - 55
	3200	204800	51200	51200
	1.8°	1.8°	1.8°	1.8°
	✓	✓	✓	✓
	2048	2048	2048	2048
	linear	linear & S-shape	linear	linear
	–	–	✓	✓
	–	–	–	–
	–	–	–	–
	–	✓	✓	✓
	–	–	✓	✓
	–	✓	✓	✓
	–	–	✓	✓
	2 (5V)	1+2 (24V)	1+2 (24V)	1+2 (24V)
	–	✓	✓	✓
	2 d+a (5/24V)	2 d+a (24V)	2 d+a (5/24V)	2 d+a (5/24V)
	2 (OC, Vdd)	3 (OD, Vdd)	2 (OC, Vdd)	2 (OC, 24V)
	JST / Molex	D-SUB 9+15	JST	JST
	open frame	IP10, plastic	open frame	IP10, light cover
	256	4096	256	256
	✓	–	–	–
	✓	✓	–	–
	–	–	✓	✓
	–	–	✓	✓
	–	–	✓	✓
	–	–	16 to 256	16 to 256
	1,10 / 156	1,10 / 156	1,10 / 156	–
	1,65 / 234	1,65 / 234	1,65 / 234	–
	2,10 / 297	2,10 / 297	2,10 / 297	7,0 / 991
	3,10 / 439	3,10 / 439	3,10 / 439	–

PRODUCT	PD-163-42	PD-170-57-E
Motor size [mm]	42*42	d=57
Supply voltage DC [V]	14 - 38	12 - 48
Block commutation with hall sensors	✓	✓
Sine commutation with incremental encoder	–	✓
Number of poles	8	4
Nominal RPM	4000	4000
TMCL controller	✓	✓
TMCL program memory [commands]	–	64
Interface: RS-232	opt	opt
Interface: RS-485	opt	opt
Interface: CAN	–	✓
Interface: S/D	–	–
CANopen ready	–	–
Incremental encoder	–	2000 ppr
Ref./End switch inputs	✓	✓
General purpose inputs (digital+analog)	1	1
General purpose outputs (digital)	–	–
stand alone operation with analog input	✓	✓
Connector type	JST	JST
Motor mountable	42mm	d=57mm
Housing	–	–
Rated torque [Nm] PD1-...	–	–
Rated torque [Nm] PD2-...	–	–
Rated torque [Nm] PD3-...	0.185	–
Rated torque [Nm] PD4-...	0.250	0.32
Rated torque [Nm] PD5-...	–	0.42
Remarks		

BIPOLAR HYBRID STEPPER MOTORS

PRODUCT FAMILY	QSH2818		QSH4218			QSH5718				QSH6018			
Product extension	32-07-006	51-07-012	35-10-027	41-10-035	51-10-049	41-28-055	51-28-101	56-28-126	76-28-189	45-28-110	56-28-165	65-28-210	86-28-310
Flange size [mm]	28*28		42*42			57*57				60*60			
NEMA size	11		17			23				24			
Phases	2		2			2				2			
Step angle	1.8°		1.8°			1.8°				1.8°			
Steps / rev.	200		200			200				200			
Max. phase current [A]	0.7		1.0			2.8				2.8			
Max. voltage [V]	40		40			75				75			
No. of leads	4		4			4				4			
Holding torque [Nm]	0,060	0,120	0,27	0,35	0,49	0,55	1,01	1,16	1,89	1,10	1,65	2,10	3,10
Holding torque [oz in]	8,50	17,0	38	50	69	78	143	164	268	156	234	297	439
Motor length [mm]	32	51	35	41	51	41	51	56	76	45	56	65	86
Shaft diameter [mm]	5.0		5.0			6.35				8.0			
Shaft length [mm]	20		24			20.6				24			
Shaft characeristic	D-cut		D-cut			D-cut				D-cut			
Weight (Mass) [Kg]	0.11	0.2	0.22	0.28	0.35	0.45	0.65	0.7	1.0	0.6	0.77	1.2	1.4

BRUSHLESS DC MOTOR WITH INTEGRATED HALL SENSORS

QSH8618

65-59-340	80-55-460	96-55-700	118-60-870	156-62-1280
86*86				
32				
2				
1.8°				
200				
5.9	5.5	5.5	6.2	6.9
100	140	140	140	160
8	4	4	4	4
3,40	4,60	7,00	8,70	12,80
481	651	991	1232	1813
65	80	96	118	156
12.0	12.7	12.7	12.7	15.875
31.75				
	D-cut	D-cut	key & slot	key & slot
1.7	2.3	2.8	3.8	5.4

PRODUCT	QBL4208				QBL5704	
Product extension	41-04-006	61-04-013	81-04-019	100-04-025	94-04-032	116-04-042
Flange size [mm]	42*42				d = 57	
NEMA size	17					
No. of phases	3				3	
No. of poles	8				4	
Rated speed [rpm]	4000				4000	
Rated current [A]	1,79	3,47	5,14	6,95	5,08	6,67
Max. peak current [A]	5,4	10,6	15,5	20	16,5	20,5
Rated motor voltage DC [V]	24				36	
Max. motor voltage DC [V]	48				60	
Rated torque [Nm]	0,063	0,125	0,185	0,250	0,32	0,42
Rated torque [oz in]	9	18	26	35	45	59
Max. peak torque [Nm]	0,190	0,380	0,560	0,750	0,98	1,30
Max. peak torque [oz in]	27	54	79	106	139	184
Torque constant [Nm/A]	0,036				0,063	
Hall sensor supply DC [V]	5 - 24				5 - 24	
Motor length [mm]	41	61	81	100	94	116
Shaft diameter [mm]	5				8 + 6	
Shaft length [mm]	19				25 + 17	
Shaft characeristic					double	
Weight (Mass) [Kg]	0,3	0,45	0,65	0,8	1,0	1,25

TRINAMIC
MOTION CONTROL