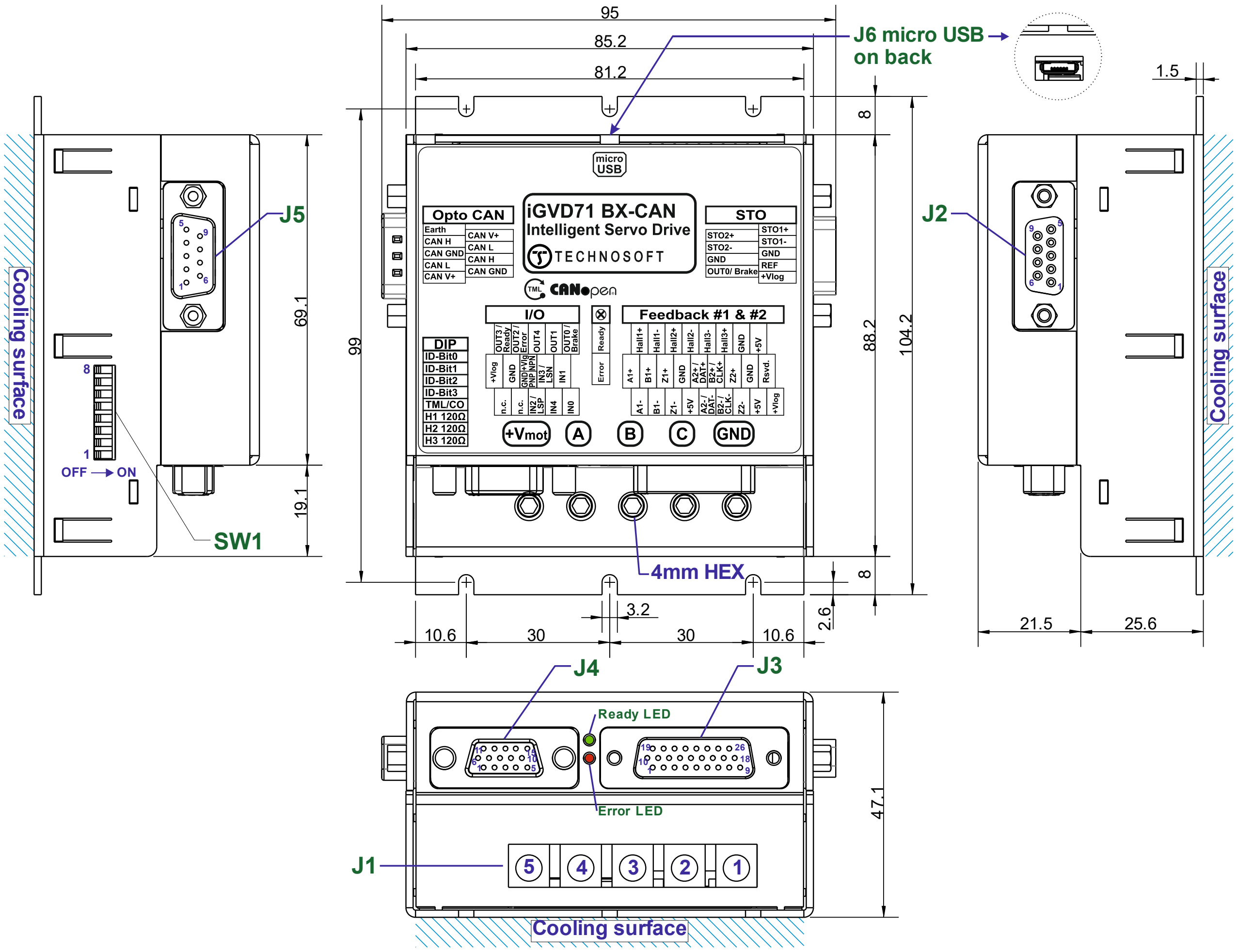

All dimensions are in mm; Drawing not to scale.

Motor – sensor configurations			
Sensor \ Motor	PMSM	BLDC	DC BRUSH
Incr. Encoder	✓		✓
Incr. Encoder + Hall	✓	✓	
SSI	✓	✓	✓
BiSS-C	✓	✓	✓
Tacho			✓

- **Features**
- Motion controller and drive in a single compact unit based on MotionChip ™ technology
- Universal solution for control of rotary and linear brushless and brushed motors
- Advanced motion control capabilities (PVT,S-curve, electronic cam)
- Motor supply: 11-80V; Logic SELV/ PELV supply: 9-36V
- Output current[1]: 100A cont. (BLDC mode); 140A$_{PEAK}$ (amplitude)
- [2]STO: 2 safe torque-off inputs, 18-36V SELV/PELV supply, safety integrity level (SIL3/Cat3/PLe) acc. to EN61800-5-1;-2/ EN61508-3;-4/ EN ISO 13849-1.
- NTC/PTC analogue Motor Temperature sensor input
- 5x opto-isolated digital inputs, 12-36V, PNP/NPN compatible: 2 for limit switches, 3 general-purpose
- 4x digital outputs, 0.2A PNP/ 0.3A NPN software selectable: Ready, Error, 2 general-purpose
- 1x PNP/NPN 2A Motor brake digital output: Out0/Brake
- Feedback Devices (dual-loop support)
  - 1st feedback devices supported:
    - Incremental encoder interface (differential)
    - pulse & direction interface (differential)
  - 2nd feedback devices supported:
    - Incremental encoder interface (differential)
    - pulse & direction interface (differential)
    - BISS C/ SSI encoder interface
- Digital Hall sensor interface (single-ended and open collector or differential, selectable by DIP switch)
- 1x analogue input: 12-bit, 0-5V: Reference, Feedback or general purpose
- [3]Micro USB
- [4]Opto CAN-bus 2.0B interface
- 16 h/w addresses selectable by DIP switch
- TMLCAN and CANopen (CiA 301, CiA 305 and CiA 402) protocols selectable by DIP switch
- 16k x 16 SRAM memory for data acquisition
- 16k x 4 E^{2}ROM to store setup data, TML motion programs, cam tables and other user data
- Operating ambient temperature: 0-40°C (over 40°C with derating)

[1] Nominal output current possible only with external radiator (not included) that can maintain lower plate temperature below 75ºC; The radiator is mounted under the drive using thermal paste or direct metal contact. Its size is application dependent
[2] The STO circuit must be supplied with minimum 18V to enable PWM output
[3] Micro USB cable not provided
[4] CAN V+ and CAN_GND must be supplied for CAN communication

Mating Connectors		
Ref	**Part No.**	**Description**
J1		High AMP wire. 4mm HEX socket. Strip max 12mm, min 8mm. AWG 6-16 wire gauge **Avoid generating metal debris/filings into drive from the wire leads !**
J2	generic 9-pin Sub-D male	STO, OUT0/Brake, Analog Ref
J3	generic 26-pin High Density D-Sub male	Feedback #1 + Feedback #2 + Digital Hall input
J4	generic 15-pin High Density D-Sub male	I/O
J5	generic 9-pin Sub-D female	Opto CAN
J6	Standard Micro USB cable	

Connectors Description

	Pin	Name	Type	Description
J1	1	GND	-	Negative return (ground) of the power supply
J1	2	C	O	**Phase C** for 3-ph motors
J1	3	B	O	**Phase B** for 3-ph motors, Motor- for DC brush motors
J1	4	A	O	**Phase A** for 3-ph motors, Motor+ for DC brush motors
J1	5	$+V_{MOT}$	I	Positive terminal of the motor supply: 11 to $80V_{DC}$.

	Pin	Name	Type	Description
J2	1	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
J2	2	REF	I	Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or used as general purpose analogue input
J2	3	GND	-	Negative return (ground)
J2	4	STO1-	I	Safe Torque Off input 1, negative return(opto-isolated, 18÷36V)
J2	5	STO1+	I	Safe Torque Off input 1, positive input (opto-isolated, 18÷36V)
J2	6	OUT0/Brake	O	Digital output used for an electro-mechanical brake,12-36V, 2A PNP/ 2A NPN software selectable
J2	7	GND	-	Negative return (ground)
J2	8	STO2-	I	Safe Torque Off input 2, negative return(opto-isolated, 18÷36V)
J2	9	STO2+	I	Safe Torque Off input 2, positive input (opto-isolated, 18÷36V)

	Pin	Name	Type	Description
J3	1	A1-	I	Incr. encoder1 A- diff. input
J3	2	B1-	I	Incr. encoder1 B- diff. input
J3	3	Z1-	I	Incr. encoder1 Z- diff. input
J3	4	$+5V_{OUT}$	O	5V output supply
J3	5	A2- /Pulse-/ Data-/SL-	I	Incr. encoder2 A- diff. input, or Pulse-, or Data- for SSI, or Slave- for BiSS; has internal 120Ω resistor between pins 5 and 14
J3	6	B2-/Dir-/CLK- /MA-	I/O	Incr. encoder2 B- diff. input, or Dir-, or Clock- for SSI, or Master- for BiSS; has internal 120Ω resistor between pins 6 and 15
J3	7	Z2-	I	Incr. encoder2 Z- diff. input; has internal 120Ω resistor between pins 7 and 16
J3	8	$+5V_{OUT}$	O	5V output supply for sensors usage
J3	9	$+V_{LOG}$	I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
J3	10	A1+/ Pulse	I	Incr. encoder1 A+ diff. input, or Pulse
J3	11	B1+/Dir	I	Incr. encoder1 B+ diff. input, or Dir
J3	12	Z1+	I	Incr. encoder1 Z+ diff. input
J3	13	GND	-	Return ground for sensors supply
J3	14	A2+/Pulse+/ Data+/SL+	I	Incr. encoder2 A+ diff. input, or Pulse+, or Data+ for SSI, or Slave+ for BiSS; has internal 120Ω resistor between pins 5 and 14
J3	15	B2+/Dir+/CLK +/MA+	I/O	Incr. encoder2 B+ diff. input, or Dir+, or Clock+ for SSI, or Master+ for BiSS; has internal 120Ω resistor between pins 6 and 15
J3	16	Z2+	I	Incr. encoder2 Z+ diff. input ; has internal 120Ω resistor between pins 7 and 16
J3	17	GND	-	Return ground for sensors supply
J3	18	n.c.		not connected
J3	19	Hall 1+	I	Digital input Hall 1+ diff. sensor input; SW1 pin 3 can connect an 120Ω resistor between pins 19 and 20
J3	20	Hall 1-	I	Digital input Hall 1- diff. sensor input; SW1 pin 3 can connect an 120Ω resistor between pins 19 and 20
J3	21	Hall 2+	I	Digital input Hall 2+ diff. sensor input; SW1 pin 2 can connect an 120Ω resistor between pins 21 and 22
J3	22	Hall 2-	I	Digital input Hall 2- diff. sensor input; SW1 pin 2 can connect an 120Ω resistor between pins 21 and 22
J3	23	Hall 3-	I	Digital input Hall 3- diff. sensor input; SW1 pin 1 can connect an 120Ω resistor between pins 23 and 24
J3	24	Hall 3+	I	Digital input Hall 3+ diff. sensor input; SW1 pin 1 can connect an 120Ω resistor between pins 23 and 24
J3	25	GND	-	Return ground for sensors supply
J3	26	$+5V_{OUT}$	O	5V output supply

	Pin	Name		Type	Description
J4	1	n.c.		-	not connected
J4	2	n.c.		-	not connected
J4	3	IN2/LSP		I	12-36V digital PNP/NPN opto-isolated input. Positive limit switch function
J4	4	IN4		I	12-36V general-purpose digital PNP/NPN opto-isolated input.
J4	5	IN0		I	12-36V general-purpose digital PNP/NPN opto-isolated input.
J4	6	$+V_{LOG}$		I	Positive terminal of the logic supply: 9 to $36V_{DC}$. Internally connected to other +Vlog pins.
J4	7	GND		-	Return ground for I/O pins
J4	8	GND PNP	+Vlog NPN	-	PNP/NPN Inputs type selector. Connect to GND to use inputs as PNP; Connect to +Vlog to use inputs as NPN
J4	9	IN3/LSN		I	12-36V digital PNP/NPN opto-isolated input. Negative limit switch function
J4	10	IN1		I	12-36V general-purpose digital PNP/NPN opto-isolated input.
J4	11	OUT3/Ready		O	12-36V drive Ready digital output, 0.2A PNP/ 0.3A NPN, software selectable
J4	12	OUT2/Error		O	12-36V drive Error digital output, 0.2A PNP/ 0.3A NPN, software selectable
J4	13	OUT4		O	12-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
J4	14	OUT1		O	12-36V general-purpose digital output, 0.2A PNP/ 0.3A NPN, software selectable
J4	15	OUT0/Brake		O	Digital output used for an electro-mechanical brake,12-36V, 2A PNP/ 2A NPN software selectable

	Pin	Name	Type	Description
J5	1&9	CAN V+	-	Positive terminal for the Opto-isolated CAN supply 12-28V
J5	2&8	CAN L	I/O	CAN-Bus negative line (dominant low)
J5	3&6	CAN GND	-	Return ground for the Opto-isolated CAN supply; Not connected to other GND pins.
J5	4&7	CAN H	I/O	CAN-Bus positive line(dominant high)
J5	5	Etarth	-	Earth connection; Internally connected to the metallic side of J2,3,4 and 5

	Pin	Name	Type	Description
J6		USB	-	Standard micro USB port. Is identified in Windows as RS232 COM port.

	Pin	Name	Position	Description
SW1	1	H3 120Ω	up(ON)	Internally connect an 120Ω termination resistor between Hall 3+ and Hall 3- pins
	2	H2 120Ω	up(ON)	Internally connect an 120Ω termination resistor between Hall 2+ and Hall 2- pins
	3	H1 120Ω	up(ON)	Internally connect an 120Ω termination resistor between Hall 1+ and Hall 1- pins
	4	TML/CO	up(ON)	Select CANopen communication protocol
			down(OFF)	Select TMLCAN communication protocol
	5	ID-Bit3	-	Hardware AxisID selection switches They represent the first 4 LSB bits of an 8 bit Axis ID number. When all bits are 0 then AxisID=255; If AxisID = 255 in CANopen, the drive will be in “LSS inactive” state and the Green LED will flash at 1 second intervals
	6	ID-Bit2	-	
	7	ID-Bit1	-	
	8	ID-Bit0	-	

Electrical characteristics

All parameters measured under the following conditions (unless otherwise specified):

- VLOG = 24 VDC; VMOT = 80VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 100A

Operating Conditions		**Min.**	**Typ.**	**Max.**	**Units**
Ambient temperature		0		40[1, 3]	ºC
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure[2]	Altitude (vs. sea level)	-0.1	0 ÷ 2.5	[2]	Km
	Ambient Pressure	0[2]	0.75 ÷ 1	10.0	atm
Storage Conditions		**Min.**	**Typ.**	**Max.**	**Units**
Ambient temperature		-40		105	ºC
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
ESD capability (Human body model)	Not powered; applies to any accessible part			±0.5	kV
	Original packaging			±15	kV
Mechanical Mounting		**Min.**	**Typ.**	**Max.**	**Units**
External heatsink (cooling plate)	Current capability depends on heat transfer, heatsink dimension, cooling technique (natural or forced). Keep lower plate temperature at maximum 75ºC				

Environmental Characteristics		**Min.**	**Typ.**	**Max.**	**Units**
Size (Length x Width x Height)	Without mating connectors		104.2 x 95 x 47.1		mm
			~4.1 x 3.74 x 1.85		inch
Weight	Without mating connectors		300		g
Power dissipation	Idle (no load)		3		W
	Operating		80÷100		W
Efficiency			98		%
Cleaning agents	Dry cleaning is recommended		Only Water- or Alcohol- based		
Protection degree	According to IEC60529, UL508		IP20		-
Logic Supply Input (+V_{LOG})		**Min.**	**Typ.**	**Max.**	**Units**
Supply voltage	Nominal values	12	24	36	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8	24	40	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms)†	-1		+45	V
Supply current	+V_{LOG} = 12V		170		mA
	+V_{LOG} = 24V		110		mA
	+V_{LOG} = 36V		90		mA

Motor Supply Input (+V_{MOT})		**Min.**	**Typ.**	**Max.**	**Units**
Supply voltage	Nominal values	12	80	90	V_{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	11		94	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms)†	-1		95	V
Supply current	Idle		1	5	mA
	Operating	-130	±100	+130	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms)†			140	A
Motor Outputs (A/A+, B/A-, C/B+, BR/B-)		**Min.**	**Typ.**	**Max.**	**Units**
Nominal (recommended) output current, continuous[3] *As long as drive lower plate does not exceed 75ºC	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control			100	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			100	A
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			70.7	A
Motor output current, peak	*As long as drive back plate does not exceed 75ºC	-135		+135	A
Short-circuit protection threshold				±140	A
Short-circuit protection delay		5	10		μs
On-state voltage drop	Nominal output current; including typical mating connector contact resistance		±0.3	±0.5	V
Off-state leakage current			±0.5	±1	mA

		F_{PWM}	**Min.**	**Typ.**	**Max.**	**Units**
Motor inductance (phase-to-phase)	Recommended value, for current ripple max. ±5% of full range; +V_{MOT} = 60 V	20 kHz	300			μH
		40 kHz	150			μH
		60 kHz	100			μH
		80 kHz	75			μH
	Minimum value, limited by short-circuit protection; +V_{MOT} = 60 V	20 kHz	150			μH
		40 kHz	75			μH
		60 kHz	50			μH
		80 kHz	38			μH
Motor electrical time-constant (L/R)	Recommended value for ±5% current measure-ment error	20 kHz	250			μs
		40 kHz	125			μs
		60 kHz	100			μs
		80 kHz	63			μs
Current measurement	FS = Full Scale accuracy			±4	±8	%FS

Digital Inputs – opto-isolated- (IN0, IN1, IN2/LSP, IN3/LSN, IN4)		**Min.**	**Typ.**	**Max.**	**Units**
Mode compliance	PNP (J4, pin8 connected to GND)	Connect digital input pin to +Vlog to change its state			
	NPN (J4, pin8 connected to +Vlog)	Connect digital input pin to GND to change its state			
Default state	Input floating (wiring disconnected)		Logic LOW		
Input voltage	Logic LOW	0		2.5	V
	Logic HIGH	5		36	V
	Absolute maximum	-5		50	V
Input current	Logic LOW	0		14	mA
	Logic HIGH	8	10	14	mA
	Absolute maximum	0		14	mA
Input frequency			2		kHz
Minimum pulse			500		μs
ESD protection	Human body model	±15			kV

[1] Operating temperature at higher temperatures is possible with reduced current and power ratings
[2] iGVD71 can be operated in vacuum (no altitude restriction), but at altitudes over 2,500m, current and power rating are reduced due to thermal dissipation efficiency.
[3] @20Khz F_{PWM}

Digital Outputs (OUT0/Brake,OUT1, OUT2, OUT3, OUT4)		Min.	Typ.	Max.	Units
Mode compliance		PNP 24V			
Default state	Not supplied (+VLOG floating or to GND)	High-Z (floating)			
	Normal operation	Logic "High"			
Output voltage	Logic "HIGH"; output current = 0.2A		V_{LOG}-0.2	V_{LOG}-0.8	V
	Logic "LOW"; output current = 0, no load	open-collector			V
	Logic "HIGH", external load to GND		0		V
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	V
	Absolute maximum, surge (duration ≤ 1s)†	-0.5		V_{LOG}+0.5	V
Output current	Logic "HIGH", source current, continuous	OUT1,2,3,4		0.2	A
		OUT0/Brake		2	A
	Logic "HIGH", source current, pulse ≤ 5 s	OUT1,2,3,4		0.4	A
		OUT0/Brake		3	A
	Logic "LOW", means High-Z				mA
Minimum pulse width		2			μs
ESD protection	Human body model	±15			kV

Mode compliance		NPN 24V			
Default state	Not supplied (+VLOG floating or to GND)	High-Z (floating)			
	Normal operation	High-Z			
Output voltage	Logic "LOW"; output current = 0.3A		0.2	0.8	V
	Logic "HIGH"; output current = 0, no load	open-collector			V
	Logic "HIGH", external load to $+V_{LOG}$		V_{LOG}		V
	Absolute maximum, continuous	-0.3		V_{LOG}+0.3	V
	Absolute maximum, surge (duration ≤ 1s)†	-0.5		V_{LOG}+0.5	V
Output current	Logic "LOW", sink current, continuous	OUT1,2,3,4		0.3	A
		OUT0/Brake		2	A
	Logic "LOW", sink current, pulse ≤ 5 s	OUT1,2,3,4		0.5	A
		OUT0/Brake		2	A
	Logic "HIGH", means High-Z				mA
Minimum pulse width		2			μs
ESD protection	Human body model	±15			kV

Brake output (OUT0/Brake)			Min.	Typ.	Max.	Units
Out0/Brake : solenoid driver, 2A.						
Default state	Not supplied ($+V_{LOG}$ floating or to GND)		High-Z (floating)			
	Immediately after power-up	Brake-	High-Z (floating)			
	Normal operation	Brake-	High-Z (floating)			
Output voltage	Logic "LOW" (Brake-)				0.2	V
	Logic "HIGH"; load present			+Vlog		V
	Logic "HIGH", no load present			+5V		V
	Absolute maximum, continuous		-0.5		55	V
Output current	Logic "LOW", sink current, continuous, Brake-				1.5	A
	Logic "HIGH", leakage current; external load to $+V_{LOG}$; $V_{OUT} = V_{LOG}$ max = 55V				0.2	mA

Digital Hall Inputs (Hall1+, Hall1-, Hall2+, Hall2-, Hall3+, Hall3-)[1]		Min.	Typ.	Max.	Units
Mode compliance		TTL / CMOS / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"		0	0.8	V
	Logic "HIGH"	2	5		V
	Floating voltage (not connected)		4.4		V
	Absolute maximum, surge (duration ≤ 1s)†	-10		+15	V
Input current	Logic "LOW"; Pull to GND			1.2	mA
	Logic "HIGH"; Internal 4.7KΩ pull-up to +5	0	0	0	mA
Minimum pulse width		2			μs

Differential mode compliance	RS422 compliance	TIA/EIA-422-A			
Input voltage	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	V
	Common-mode range (A+ to GND, etc.)	-11		+14	V
Input impedance, differential			120		Ω
Input frequency	Differential mode	0		10	MHz
Minimum pulse width	Differential mode	50			ns
ESD protection	Human body model	±5			kV

Encoder #1 and #2 Inputs (A1+, A1-, B1+, B1-, Z1+, Z1-, A2+, A2-, B2+, B2-, Z2+, Z2-)[2]		Min.	Typ.	Max.	Units
Differential mode compliance	For full RS422 compliance, see [1]	TIA/EIA-422-A			
Input voltage	Hysteresis	±0.06	±0.1	±0.2	V
	Differential mode	-14		+14	V
	Common-mode range (A+ to GND, etc.)	-11		+14	V
Input impedance, differential	A1+/A1-, B1+/B1-, Z1+/Z1-, A2+/A2-, B2+/B2-, Z2+/Z2-		120		Ω
Input frequency	Differential mode	0		10	MHz
Minimum pulse width	Differential mode	50			ns

Analog 0…5V Inputs (REF)		Min.	Typ.	Max.	Units
Input voltage	Operational range	0		5	V
	Absolute maximum values, continuous	-12		+18	V
	Absolute maximum, surge (duration ≤ 1s)†			±36	V
Input impedance	To GND		18		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS[3]
Bandwidth (-3Db)	Software selectable	0		1	kHz
ESD protection	Human body model	±5			kV

[1] Differential input pins have internal 120Ω termination resistors connected across when SW1 pins 1,2,3 are ON
[2] All differential input pins have internal 120Ω termination resistors connected across
[3] "FS" stands for "Full Scale"

Safe Torque OFF (STO1+; STO1-; STO2+; STO2-)		**Min.**	**Typ.**	**Max.**	**Units**
Safety function	According to EN61800-5-2	STO (Safe Torque OFF)			
EN 61800-5-1/ -2 and EN 61508-5-3/ -4 Classification	Safety Integrity Level	safety integrity level 3 (SIL3)			
	PFHd (Probability of Failures per Hour - dangerous)	$8*10^{-10}$	$hour^{-1}$ (0.8 FIT)		
EN13849-1 Classification	Performance Level	Cat3/PLe			
	MTTFd (meantime to dangerous failure)	377	years		
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic “LOW” (PWM operation disabled)	-20		5.6	V
	Logic “HIGH” (PWM operation enabled)	18		36	
	Absolute maximum, continuous	-20		+40	
Input current	Logic “LOW”; pulled to GND		0		mA
	Logic “HIGH”, pulled to +Vlog		5	13	
Pulse duration	Ignored high-low-high			5	ms
	Accepted pulse			20	Hz
PWM operation delay	From Enabled low-high transition to PWM operation enabled			30	ms
ESD protection	Human body model	±2			kV

CAN-Bus (opto-isolated)		**Min.**	**Typ.**	**Max.**	**Units**
Compliance		ISO11898, CiA 402v3.0			
Supply voltage	Nominal values	8	24	28	V_{DC}
	Absolute maximum values, surge (duration ≤ 10ms)	-0.5		30	V
Supply current	CAN-Bus idle		TBD	TBD	mA
	CAN-Bus operating at 1Mbit/s		TBD	TBD	
Isolation voltage rating	Between $-V_{CAN}$ and drive GND			200	V_{RMS}
Bit rate	Software selectable	125		1000	Kbps
Bus length	1Mbps			25	m
	500Kbps			100	
	≤ 250Kbps			250	
Resistor	Between CAN-Hi, CAN-Lo	none on-board			
Node addressing	Hardware: by SW1 switches	1-15 & 255			TMLCAN
		1-15 & 255(LSS inactive)			CANopen
	Software	1 ÷ 127 (CANopen); 1- 255 (TMLCAN)			
ESD protection	Human body model	±15			kV
Supply Output (+5V)		**Min.**	**Typ.**	**Max.**	**Units**
Output voltage	Current sourced = 250mA	4.8	5	5.2	V
Output current		600	650		mA
Short-circuit		Protected			
Over-voltage		NOT protected			
ESD protection	Human body model	±1			kV
Conformity		**Min.**	**Typ.**	**Max.**	**Units**
EU Declaration	Pending	2014/30/EU (EMC), 2014/35/EU (LVD), 2011/65/EU (RoHS), 1907/2006/EC (REACH), 93/68/EEC (CE Marking Directive), EC 428/2009 (non dual-use item, output frequency limited to 590Hz)			

† Stresses beyond values listed under “absolute maximum ratings” may cause permanent damage to the device. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.