

All dimensions are in mm.

Motor – sensor configurations						
	Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
Sensor						
Incr. Encoder		Ⓢ		Ⓢ	Ⓢ	
Incr. Encoder + Hall		Ⓢ	Ⓢ			
Analog Sin/Cos encoder		Ⓢ		Ⓢ		
SSI		Ⓢ		Ⓢ		
BISS-C*		Ⓢ				
Linear Halls		Ⓢ				
Tacho				Ⓢ		
Open-loop (no sensor)					Ⓢ	Ⓢ

*currently in development

Producer	Part No.	Connector	Description
Camden	CTBA9208/2FL	J1	Supply input, 2x5.08 female counter part for cable
Camden	CTBA9208/4FL	J2	Motor power, 4x5.08 female counter part for cable
MOLEX	90142-0010	J3,J4	Feedback #1 and #2, 10 pin 2.54mm Pitch C-Grid III Crimp Housing Dual Rows
MOLEX	43025-0600	J5	Digital Hall, MICROFIT RECEPTACLE HOUSING, 3x2 WAY
MOLEX	43025-1400	J6	I/O, MICROFIT RECEPTACLE HOUSING, 7x2 WAY
MOLEX	43025-0800	J7	Enable and RS232, MICROFIT RECEPTACLE HOUSING, 6x2 WAY
MOLEX	43030-0007	J5,J6,J7	CRIMP PIN, MICROFIT, 5A
MOLEX	90119-0109	J3,J4	CRIMP PIN, C-Grid III
-	-	J8,J9	Standard 8P8C modular jack (RJ-45) male

Features

- Motion controller and drive in a single compact unit based on MotionChip™ technology
- Universal solution for control of rotary and linear brushless, brushed and 2 or 3-phase step motors
- Advanced motion control capabilities (PVT, S-curve, electronic cam)
- Motor supply: 12-80V; Logic supply 12-36V
- Output current: 20A cont. (BLDC mode); 40A_{PEAK}, up to 100KHz PWM
- Feedback Devices (dual-loop support)
 - 1st feedback devices supported:
 - Incremental encoder interface (single ended or differential¹)
 - Analogue sin/cos encoder interface (differential¹ 1V_{pp})
 - Digital and Linear Hall sensor interface (single-ended and open collector)
 - pulse & direction interface (single-ended) for external (master) digital reference
- 2nd feedback devices supported:
 - Incremental encoder interface (differential)
 - pulse & direction interface (differential) for external (master) digital reference

- Separate ENABLE circuit: connect both ENA1 and ENA2 inputs to +24V, to allow motor PWM output operation
- 4 digital inputs, 12-36V, PNP/NPN programmable: 2 for limit switches, 2 general-purpose
- 4 digital outputs, 5-36V, 0.5A, NPN open-collector: Ready, Error, 2 general-purpose; one output OUT0 with 3A capability
- 3 analogue inputs: 12-bit, 0-5V: Reference, Feedback, Motor temperature or general purpose
- RS-232 serial & dual RJ45 CAN connectors
- TMLCAN and CANopen (CiA 301 v4.2, CiA 305 v.2.2.13 and CiA 402 v3.0) protocols selectable by jumper
- 16 h/w addresses selectable by rotary HEX switch
- 4k x 16 SRAM memory for data acquisition (default configuration) extendable up to 20k x 16
- 16k x16 E²ROM to store setup data, TML motion programs, cam tables and other user data
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- Programmable protections: short-circuit between motor phases and from motor phases to GND, over/under-voltage, over-current, I²t, control error

¹ If Feedback #1 is differential type, 120Ω terminators between the signal lines are needed; contact Technosoft for more details

Name EP	First edition November 20, 2015	Document template: P099.TQT.564.0001	Last edition November 20, 2015	Visa : AN
		Title of document iMOTIONCUBE BX-CAN PRODUCT DATA SHEET	N° document P025.126.E201.DSH.10H	
			Page: 1 of 5	

iMOTIONCUBE BX-CAN DATASHEET


P/N: P025.126.E201

Connector Description				
	Pin	Name	Type	Description
J1	1	+VMOT	I	Positive terminal of the motor supply: 12 to 80V _{DC} .
	2	GND	-	Negative return (ground) of the power supply
Connector Description				
	Pin	Name	Type	Description
J2	1	BR/B-	O	Brake resistor / Phase B- for step motors
	2	C/B+	O	Phase C for 3-ph motors, B+ for 2-ph steppers
	3	B/A-	O	Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
	4	A/A+	O	Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
Connector Description				
	Pin	Name	Type	Description
J7	1	ENA2	I	Enable circuit input2; connect ENA1&ENA2 to +24V to activate motor operation
	2	GND	-	Return ground
	3	GND	-	Return ground
	4	232TX	O	RS-232 Data Transmission
	5	ENA1	I	Enable circuit input1; connect ENA1&ENA2 to +24V to activate motor operation
	6	GND	-	Return ground for RS-232 pins
	7	+V _{LOG}	I	Positive terminal of the logic supply input: 9 to 36V _{DC}
	8	232RX	I	RS-232 Data Reception
Connector Description				
	Pin	Name	Type	Description
J3 ¹	1	Z1-/LH3	I	Incr. encoder Z- diff. input, or linear Hall 3 input
	2	Z1+	I	Incr. encoder1 Z single-ended, or Z+ diff. input
	3	B1-/Cos-/LH2	I	Incr. encoder B- diff. input, or analogue encoder Cos- diff. input, or linear Hall 2 input
	4	B1+/Cos+	I	Incr. encoder1 B single-ended, or B+ diff. input, or analogue encoder Cos+ diff. input
	5	A1-/Sin-/LH1	I	Incr. encoder A- diff. input, or analogue encoder Sin- diff. input, or linear Hall 1 input
	6	A1+/Sin+	I	Incr. encoder1 A single-ended, or A+ diff. input, or analogue encoder Sin+ diff. input
	7	GND	-	Return ground for sensors supply
	8	Temp Mot	I	Analogue input, 12-bit, 0-5V. Used to read an analog temperature value
	9	GND	-	Return ground for sensors supply
	10	+5V _{OUT}	O	5V output supply for I/O usage
Connector Description				
	Pin	Name	Type	Description
J4 ²	1	Z2+	I	Incr. encoder2 Z+ diff. input
	2	Z2-	I	Incr. encoder2 Z- diff. input
	3	B2-/Dir-	I	Incr. encoder2 B- diff. input, or Dir-
	4	B2+/Dir+	I	Incr. encoder2 B+ diff. input, or Dir+
	5	A2-/Pulse-	I	Incr. encoder2 A- diff. input, or Pulse-
	6	A2+/Pulse+	I	Incr. encoder2 A+ diff. input
	7	GND	-	Return ground for sensors supply
	8	FDBK	I	Analogue input, 12-bit, 0-5V. Used to read an analogue position or speed feedback (as tacho), or used as general purpose analogue input
	9	GND	-	Return ground for sensors supply
	10	+5V _{OUT}	O	5V output supply for I/O usage

	Pin	Name	Type	Description
J5	1	+5V _{OUT}	O	5V output supply for I/O usage
	2,3	GND	-	Return ground for Hall sensors
	4	Hall 1	I	Digital input Hall 1 sensor
	5	Hall 2	I	Digital input Hall 2 sensor
	6	Hall 3	I	Digital input Hall 3 sensor
	Connector Description			
	Pin	Name	Type	Description
J8, J9	1	Can-Hi	I/O	CAN-Bus positive line (dominant high)
	2	Can-Lo	I/O	CAN-Bus negative line (dominant low)
	3	GND	-	Return ground for CAN-Bus
	4, 5	n.c.	-	Not connected
	6	SHIELD	-	Shield
	7	GND	-	Return ground for CAN-Bus
	8	+V _{LOG}	I	Positive terminal of the logic supply input: 9 to 36V _{DC}
	Connector Description			
	Pins	Name	Type	Description
JP1	1 & 2	TMLCAN	-	Connect pins 1 and 2 to enable TMLCAN protocol
	2 & 3	CANopen	-	Connect pins 2 and 3 to enable CANopen protocol
Connector Description				
	Position	Name	Type	Description
SW1	0 to F	HW Axis ID selection	-	0 = axis ID 255; 1 = axis ID 1; 2 = axis ID 2; ... F = axis ID 15
Connector Description				
	Pin	Name	Type	Description
J6	1	+5V _{OUT}	O	5V output supply for I/O usage
	2	REF	I	Analogue input, 12-bit, 0-5V input. Used to read an analog position, speed or torque reference.
	3	IN0	I	12-36V general-purpose digital PNP/NPN input
	4	GND	-	Return ground for I/O pins
	5	IN3/LSN	I	12-36V digital PNP/NPN input. Negative limit switch input
	6	OUT2/Error	O	5-36V 0.5A, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
	7	+V _{LOG}	I	Positive terminal of the logic supply input: 9 to 36V _{DC}
	8	GND	-	Return ground for I/O pins
	9	GND	-	Return ground for I/O pins
	10	IN1	I	12-36V general-purpose digital PNP/NPN input
	11	IN2/LSP	I	12-36V digital PNP/NPN input. Positive limit switch input
	12	OUT0	O	5-36V 3A, general-purpose digital output, NPN open-collector/TTL pull-up
	13	OUT3/Ready	O	5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
	14	OUT1	O	5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up

¹ If Feedback #1 is differential type, 120Ω terminators between the signal lines are needed; contact Technosoft for more details

² Feedback #2 has internal 120Ω terminators between the signal lines

Name EP	First edition November 20, 2015	Document template: P099.TQT.564.0001	Last edition November 20, 2015	Visa : AN
		Title of document iMOTIONCUBE BX-CAN PRODUCT DATA SHEET	N° document P025.126.E201.DSH.10H	
			Page: 2 of 5	

iMOTIONCUBE BX-CAN DATASHEET

P/N: P025.126.E201

Electrical characteristics

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

- Tamb = 0...40°C, VLOG = 24 VDC; VMOT = 80VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 10A
- Mounted on heat sink, T heat sink= 0...75°C

Operating Conditions		Min	Typ	Max	Units
Ambient temperature ¹		0		+40	°C
Heat sink temperature		0		+75	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure ²	Altitude (vs. sea level)	-0.1	0 ± 2	2	Km
	Ambient Pressure	0 ²	0.75 ± 1	10.0	atm
Storage Conditions		Min	Typ	Max	Units
Ambient temperature		-40		+85	°C
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
Mechanical Mounting		Min	Typ	Max	Units
Airflow		natural convection ³ , closed box			
Heat sink	mounted	Full current capability			
	not mounted	max 5A output current			

Environmental Characteristics		Min	Typ	Max	Units
Size (Length x Width x Height)	Without mating connectors	80 x 43 x 40			mm
		~3.15 x 1.69 x 1.57			inch
Weight	Without mating connectors	117			g
Power dissipation	Idle (no load)	3.6			W
	Operating	11			
Efficiency		98			%
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol- based			
Protection degree	According to IEC60529, UL508	IP00			-

Logic Supply Input (+V _{Lo})		Min	Typ	Max	Units
Supply voltage	Nominal values	9		36	V _{DC}
	Absolute maximum values, drive operating but outside guaranteed parameters	8		40	V _{DC}
	Absolute maximum values, surge (duration ≤ 10ms) [†]	-1		+45	V
Supply current	No Load on Digital Outputs	+V _{Lo} = 9V		300	mA
		+V _{Lo} = 12V		250	
		+V _{Lo} = 24V		150	
		+V _{Lo} = 36V		100	

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	-20	±10	+20	A
	Absolute maximum value, short-circuit condition (duration ≤ 10ms) [†]			45	A

Motor Outputs (A/A+, B/A-, C/B+, BR/B-)		Min	Typ	Max	Units
Nominal output current, continuous	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control			20	A
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			20	
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			14.2	A _{RMS}
Motor output current, peak	maximum 10s	-40		+40	A

¹ Operating temperature can be extended up to +65°C with reduced current and power ratings.

² iMOTIONCUBE BX 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 It is mandatory to mount the iMOTIONCUBE BX -CAN on a metallic support using the provided mounting holes, in order to achieve rated current capability

Short-circuit protection threshold				±45	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
Motor inductance (phase-to-phase)	Recommended value, for current ripple Max ±5% of full range; +V _{MOT} = 80 V	F _{PWM}			µH
		20 kHz	330		
		40 kHz	150		
		60 kHz	120		
		80 kHz	80		
		100 kHz	60		
	Minimum value, limited by short-circuit protection; +V _{MOT} = 80 V	20 kHz	120		µH
		40 kHz	40		
		60 kHz	30		
		80 kHz	15		
		100 kHz	8		
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	20 kHz	250		µs
		40 kHz	125		
		60 kHz	100		
		80 kHz	63		
		100 kHz	50		

Current measurement	FS = Full Scale accuracy		±5	±8	%FS
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Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN)⁴

		Min	Typ	Max	Units
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW"	-10	0	2.2	V
	Logic "HIGH"	6.3		36	
	Floating voltage (not connected)		0		
	Absolute maximum, continuous	-10		+39	
	Absolute maximum, surge (duration ≤ 1S) [†]	-20		+40	
Input current	Logic "LOW"; pulled to +24V		0		mA
	Logic "HIGH"		6	8	

Mode compliance		NPN			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"	-10		2.2	V
	Logic "HIGH"	6.3		36	
	Floating voltage (not connected)		V _{log-1}		
	Absolute maximum, continuous	-10		+36	
	Absolute maximum, surge (duration ≤ 1S) [†]	-20		+40	
Input current	Logic "LOW"; Pulled to GND		6	8	mA
	Logic "HIGH"; Pulled to +24V		0		

Input frequency		0		150	kHz
Minimum pulse		3.3			µs
ESD protection	Human body model	±15			kV

⁴ The digital inputs are software selectable as PNP or NPN

Name	First edition	Document template: P099.TQT.564.0001	Last edition	Visa :
EP	November 20, 2015		November 20, 2015	AN
 TECHNOSOFT	Title of document		N° document	
	iMOTIONCUBE BX-CAN PRODUCT DATA SHEET		P025.126.E201.DSH.10H	
				Page: 3 of 5


iMOTIONCUBE BX-CAN DATASHEET

P/N: P025.126.E201

Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready)		Min	Typ	Max	Units
Mode compliance	All outputs (OUT0, OUT1, OUT2/Error, OUT3/Ready)	NPN 24V			
Default state	Not supplied (+V _{LOG} floating or to GND)	High-Z (floating)			
	Immediately after power-up	Logic "HIGH"			
	Normal operation	Logic "LOW"			
Output voltage	Logic "LOW"; output current = 0.5A; (3A for OUT0)			0.8	V
	Logic "HIGH"; output current = 0, no load	2.9	3	3.3	
	Logic "HIGH", external load to +V _{LOG}	4	4.5	5	
	Absolute maximum, continuous	-0.5		V _{LOG} +0.5	
	Absolute maximum, surge (duration ≤ 1S) [†]	-1		V _{LOG} +1	
Output current	Logic "LOW", sink current, continuous (except OUT0)			0.5	A
	Logic "LOW", sink current, continuous for OUT0			3	A
	Logic "LOW", sink current, pulse ≤ 5 sec. (except OUT0)			1	A
	Logic "LOW", sink current, pulse ≤ 5 sec. for OUT0			4	A
	Logic "HIGH", source current; external load to GND; V _{OUT} ≥ 2.0V			2	mA
	Logic "HIGH", leakage current; external load to +V _{LOG} ; V _{OUT} = V _{LOG} max = 40V		0.1	0.2	mA
Minimum pulse width		2			μs
ESD protection	Human body model	±15			kV
Digital Hall Inputs (Hall1, Hall2, Hall3)		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"	1.8			
	Floating voltage (not connected)		4.5		
	Absolute maximum, surge (duration ≤ 1S) [†]	-10		+15	
Input current	Logic "LOW"; Pull to GND		5	3	mA
	Logic "HIGH"; Internal 1KΩ pull-up to +5	0	0	0	
Minimum pulse width		2			μs
ESD protection	Human body model	±5			kV
Linear Hall Inputs (LH1, LH2, LH3)		Min	Typ	Max	Units
Input voltage	Operational range	0	0.5+4.5	4.9	V
	Absolute maximum values, continuous	-7		+7	
	Absolute maximum, surge (duration ≤ 1S) [†]	-11		+14	
Input current	Input voltage 0...+5V	-1	±0.9	+1	mA
Interpolation Resolution	Depending on software settings			11	bits
Frequency		0		1	kHz

ESD protection	Human body model	±1			kV
Encoder #1 Inputs (A2+, A2-, B2+, B2-, Z2+, Z2-) ¹		Min	Typ	Max	Units
Single-ended mode compliance	Leave negative inputs disconnected	TTL / CMOS / Open-collector			
Input voltage, single-ended mode A/A+, B/B+	Logic "LOW"			1.6	V
	Logic "HIGH"	1.8			
Input voltage, single-ended mode Z/Z+	Floating voltage (not connected)		4.7		V
	Logic "LOW"			1.2	
Input current, single-ended mode A/A+, B/B+, Z/Z+	Logic "HIGH"	1.4			mA
	Floating voltage (not connected)		4.7		
Differential mode compliance	Logic "LOW"; Pull to GND		2.5	3	mA
	Logic "HIGH"; Internal 2.2KΩ pull-up to +5	0	0	0	
Differential mode compliance	For full RS422 compliance, see ²	TIA/EIA-422-A			
Input voltage, differential mode	Hysteresis	±0.06	±0.1	±0.2	V
	Common-mode range (A+ to GND, etc.)	-7		+7	
Input impedance	A1+, B1+, Z1+ to GND		2.2		kΩ
	A1-, B1-, Z1- to GND		3.6		
Input frequency	Single-ended mode	0		500	kHz
	Differential mode	0		10	
Input voltage, any pin to GND	Absolute maximum, surge duration ≤ 1s [†]	-11		+14	V
ESD protection	human body model	±1			kV
Encoder #2 Inputs (A2+, A2-, B2+, B2-, Z2+, Z2-) ³		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
	Common-mode range (A+ to GND, etc.)	-11		+14	
Input impedance	Differential mode		120		Ω
Input frequency	Differential mode	0		10	MHz
Input voltage, any pin to GND	Absolute maximum, surge duration ≤ 1s [†]	-11		+14	V
ESD protection	human body model	±1			kV
Sin-Cos Encoder Inputs (Sin+, Sin-, Cos+, Cos-) ¹		Min	Typ	Max	Units
Input voltage, differential	Sin+ to Sin-, Cos+ to Cos-	0.8	1	1.25	V _{PP}
	Operational range	-1	2.5	4	
	Absolute maximum values, continuous	-7		+7	
Input voltage, any pin to GND	Absolute maximum, surge (duration ≤ 1S) [†]	-11		+14	V
	Differential, Sin+ to Sin-, Cos+ to Cos-		120		
Input impedance	Common-mode, to GND		2.2		kΩ
Resolution with interpolation	Software selectable, for one sine/cosine period	2		10	bits
Frequency	Sin-Cos interpolation	0		450	kHz
	Quadrature, no interpolation	0		10	
ESD protection	Human body model	±2			kV

¹ Encoder #1 differential input pins do not have internal 120Ω termination resistors connected across. Contact Technosoft in case they are needed.
² For full RS-422 compliance, 120Ω termination resistors must be connected across the differential pairs
³ Encoder #2 differential input pins have internal 120Ω termination resistors

Name	First edition	Document template: P099.TQT.564.0001	Last edition	Visa :
EP	November 20, 2015		November 20, 2015	AN
		Title of document	N° document	
		iMOTIONCUBE BX-CAN	P025.126.E201.DSH.10H	
PRODUCT DATA SHEET			Page: 4 of 5	

iMOTIONCUBE BX-CAN DATASHEET


P/N: P025.126.E201

Analog 0...5V Inputs (REF, FDBK, Tmot)		Min	Typ	Max	Units
Input voltage	Operational range	0		4.95	V
	Absolute maximum values, continuous	-12		+18	
	Absolute maximum, surge (duration ≤ 1S) †			±36	
Input impedance	To GND		8		kΩ
Resolution			12		bits
Integral linearity				±2	bits
Offset error			±2	±10	bits
Gain error			±1%	±3%	% FS ¹
Bandwidth (-3dB)	Software selectable	0		1	kHz
ESD protection	Human body model	±2			kV
RS-232		Min	Typ	Max	Units
Compliance		TIA/EIA-232-C			
Bit rate	Software selectable	9600		115200	Baud
Short-circuit	232TX short to GND	Guaranteed			
ESD protection	Human body model	±2			kV
CAN-Bus		Min	Typ	Max	Units
Compliance		ISO11898, CiA-301v4.2, CiA 305 v2.2.13, 402v3.0			
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 Hex switch	1 ÷ 15 & LSS non-configured (CANopen); 1-15 & 255 (TMLCAN)			
	Software	1 ÷ 127 (CANopen); 1- 255 (TMLCAN)			
Voltage, CAN-Hi or CAN-Lo to GND	Absolute maximum, continuous	-36		36	V
ESD protection	Human body model	±15			kV

Enable circuit (ENA1, ENA2)		Min	Typ	Max	Units
Enable function		Disables motor power when either ENA1 or ENA2 is disconnected from the power source			
Mode compliance		PNP			
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW"	-10		2.2	V
	Logic "HIGH"	6.3		36	
	Absolute maximum, continuous	-10		+39	
Input current	Logic "LOW", pulled to GND		0		mA
	Logic "HIGH", pulled to +Vlog		9	13	
Pulse duration	Ignored low-high-low			1	ms
	Ignored high-low-high			1.5	
	Accepted pulse	tbd			
Fault reaction time	From internal fault detection to register DER bit 14 = 1 and OUT2/Error high-to-low			tbd	ms
ESD protection	Human body model	±2			kV
Supply Output (+5V)		Min	Typ	Max	Units
Output voltage	Current sourced = 500mA	4.8	5	5.2	V
Output current		600	650		mA
Short-circuit		NOT protected			
Over-voltage		NOT protected			
ESD protection	Human body model	±2			kV

† 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.

¹ "FS" stands for "Full Scale"

Name	First edition	Document template: P099.TQT.564.0001	Last edition	Visa :
EP	November 20, 2015		November 20, 2015	AN
 TECHNOSOFT		Title of document	N° document	
		iMOTIONCUBE BX-CAN	P025.126.E201.DSH.10H	
		PRODUCT DATA SHEET		Page: 5 of 5