FEDERATION INTERNATIONALE
DE MOTOCYCLISME

EQUIVALENCE OF TECHNOLOGIES (EOT)
–
BALANCE OF PERFORMANCES (BOP)

2025

PRESTIGE CLASS ONLY

SUPER ENDURO
FIM WORLD CHAMPIONSHIP

FIM Equivalence Of Technologies (EOT) – Balance Of Performances (BOP)

(applicable in FIM SuperEnduro World Championship – Prestige Class only)

Version 18.09.2024

Concept definition:

To be eligible to compete in FIM SuperEnduro World Championship (Prestige class only), with the Internal Combustion Engine (ICE) motorcycles, the electric motorcycles must comply with the EOT/BOP requirements defined by the FIM hereunder.

This EOT/BOP is based on different parameters such as (but not limited to):

- minimum weight of the machine in running order: **123 kg**
- maximum electric power from the battery pack: **41 kW**
- minimum wheel-base: **1450 mm**
- maximum torque limitation: **TBA at a later stage**

The FIM reserves the right to update the EOT/BOP at its discretion (and at any time) in the case of an imbalance. In case of dispute, the decision of the FIM Technical Director is final.

Please always refer **to the latest EOT/BOP published on the FIM website** :

https://www.fim-moto.com/fr/documents?tx_solr%5Bq%5D=EOT+BOP

The motorcycle must be equipped with the following data logger and additional sensors (compulsory) in operational order/settings according to FIM requirements :

- **Logger :** LG-CANStick2C_V2-000
- **Loom :** WL-LG_CanStick_V2-007
- **GPS 25HZ :** BC-GNSS2CAN-000
- **DC Battery Voltage :**
  Voltage sensor 1000v : IN-AV_iso-000 (mounted in between plus / minus battery. The plug must be well protected).
- **DC Battery Current :**
  Current sensor : IN-AUI300B_Split-000 (mounted around the cable in between the battery and the inverter).
- **AC Current** (recommended and if possible only) :
  Current sensor : IN-AUI300B_Split-000 (mounted around the cable in between the inverter and the electric motor).

The FIM Technical Director (or delegated person) will control the above data recording at any time during the event, including after practice finish of the motorcycle, also after any race. That data recording is the base for compliance with EOT/BOP regulations.

The correct mounting (position and method) of the electronic components here above (including generated 2D data) must be checked and approved by the FIM Technical Director in prior of the event.

In addition to the above, all electric motorcycles entered in the Prestige class of FIM Super Enduro must comply in every respect with the latest update of the FIM Electric regulations (especially about electric safety requirements) :

https://www.fim-moto.com/fr/documents?tx_solr%5Bq%5D=electric+regulations

We strongly recommend to the rider and his/her team staff to carefully read and be aware of the additional FIM documents :

- **FIM CTI Guidelines for Electric Motorcycles :**

https://www.fim-moto.com/fr/documents?tx_solr%5Bq%5D=electric+procedure

- **FIM Electric Motorcycles – Procedures for Organisers and Officials :**

https://www.fim-moto.com/fr/documents?tx_solr%5Bq%5D=electric+guidelines

For any question you may have, please send an email (in this order) to :

- **Mr Eric CHAUVELIER** – FIM Electric Expert : cti.electric@fim.ch
- **Mr Miguel SANCHEZ** – FIM CTI Coordinator : miguel.sanchez@fim.ch
- **FIM International Technical Commission** – FIM CTI **:** cti@fim.ch
- **Mr Arnaud CREPIN** – FIM CEB Coordinator : arnaud.crepin@fim.ch

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LG-CANStick2C_V2-000 USB Stick CAN Logger

Key Features

- Sticklogging features
  - Stores data directly on 128 GB USB 3.0 Stick with > 600 kByte/s
  - Supports USB Stick hot swap
  - Optional CAN-Streamlogging: Create measurements with "unlimited" number of OFFLINE CAN channels & Streamreplay (*OPT-008*)

- CAN-bus features
  - 2 CAN lines up to 2 Mbit/s each
  - 32 ONLINE CAN channels can be recorded and send to other CAN-devices with sampling rate up to 200 Hz each (online CAN-DB/DBC-file decoding)
    - Optional up to 128 ONLINE CAN channels (*OPT-001*)
    - Optional CAN channels sampling rate of up to 2000 Hz (*OPT-002* & OPT-*003*)
  - Optional with CAN/CAN-FD: XCP/CCP option with "Listen only" Mode (*OPT-005*)

- 2 analog input channels – up to 1000 Hz sampling rate each
  - 1 Input can be switched to a Hybrid Input
  - Optional increased sampling rate of analog inputs (*OPT-010*)

- 1 frequency input channels (up to 50kHz)
- 24 Math (CALC) channels for online calculation
- GPS/GNSS data via CAN and Serial (RTK ready)
- Optional with built-in 6DoF-IMU (*OPT-009*)

Available options (all options can be combined freely!)

OPT-000	Serial GPS/GNSS mouse connectivity
OPT-001	Additional 32 ONLINE CAN channels (max. total 128 CAN channel)
OPT-002	Increased max. sampling rate of **1000 Hz** (for **all** channels)
OPT-003	Increased max. sampling rate of **2000 Hz** (for **all** channels)
OPT-004	Full ONLINE channel Routing/Interface
OPT-005	CAN/CAN-FD/Ethernet - CCP/XCP Protocol (Online Decoding)
OPT-008	**CAN-Streamlogging**: Create measurements with "unlimited" number of OFFLINE CAN channels & Streamreplay
OPT-009-A	Integrated 6 DoF IMU with individual range selection for Acc (±2/4/8/16 G) and Gyros (±250/500/1000/2000 °/s)
OPT-009-B	Integrated 6 DoF IMU with individual range selection for Acc (±4/8/16/30 G) and Gyros (±500/1000/2000/4000 °/s)
OPT-010	Increased sampling rate of **analog** channels to 16000 Hz each
OPT-012	Waterproof USB Stick incl. Connectors/connector cables

CAN DB decoding

- Every Setting change in the module creates automatically a CAN DB in ***C:/ProgramData/Race20xx/System/CAN-DB***

USB Stick Compatibility

Proper functioning of the logger is only guaranteed with USB Sticks sold by 2D!

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Technical specifications

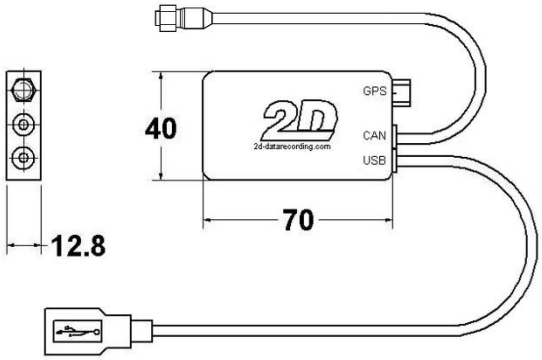
CAN characteristics		
ONLINE CAN channels		32
optional		Up to 128
CAN Lines		2
CAN powered		yes
Baud rate	kBd	125 /250 /500 /1000/2000
Sampling rate CAN channels	Hz	200
optional	Hz	Up to 2000
Storage characteristics	USB	supports 2.0/3.0
Max USB Stick size	GB	128
format		xFAT32
Max block size	GB	2
Analog input channels		
Single ended inputs		2
Analog Input Filter (6dB)	Hz	4400
Resolution	bit	16
Input voltage range	V	0 to 5
Internal sampling rate analog channels	Hz	32000
Sampling rate analog input channels	Hz	Up to 16000
3 Axis acceleration (optional)		
Range switchable with 3 axes	G	±2/±4/±8/±16/±30
Error of linearity	FS	<1 %
Lowpass filter (programmable)	Hz	5 to 250
Sampling rate	Hz	1000
3 Axis yaw-rate (optional)		
Sensitivity	°/s	±250/±500/±1000/ ±2000/±4000
Error for linearity	FS	<1%
Lowpass filter (programmable)	Hz	5 to 250
Sampling rate	Hz	1000

Mechanical characteristics		
Aluminum housing		
Dimensions	mm	70x 40x13
Weight	g	105
Cable CAN line		
Wire cross section		12 x AWG24
Type		Metrofunk
Length	mm	200
Connector type CAN		Deutsch IMC 200, 12PM
Cable USB line		
Length	mm	500
Connector type		USB Type A, socket
Connection GPS/serial		
Connector type		Binder 712, 4 PF
Electrical characteristics		
Supply voltage	V	5 to 30
Current consumption w/o. GPS	mA	<140
Current consumption with GPS	mA	<180
Operation mode status indicator		
LED green/red blinking		
Environmental data		
Protection class		IP67
Ambient operating range	°C	-20 to +75
Humidity	%	5 to 95
Vibration resistance		
Shock	G	40
During time period of	ms	10
Vibration tested at	G	12
Measured with	Hz	1000

Ordering information

LG-CANStick_2C_V2-000

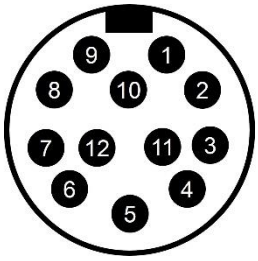
Dimensions



Connector layout — Connector type

CAN-1 line, Deutsch IMC 200, 12PM

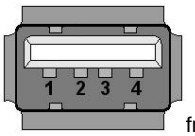
Pin	Name	Description	Color
1	Vext	Power supply 8-14V	red
2	BGND	Board ground	black
3	CAN-1 Hi	CAN-1 High	white
4	CAN-1 Lo	CAN-1 Low	green
5	Lap out	LAP out signal	grey
6	KL15	KL15/switched power	blue
7	CAN-2 Hi	CAN-2 High	yellow
8	CAN-2 Lo	CAN-2 Low	brown
9	AIN2	Analog 2	white/black
10	AIN1	Analog 1	white/brown
11	+12V	+12V/VBat out	orange
12	+5V	+5V sensor supply	purple



front view

USB, Type A socket

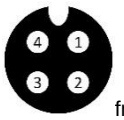
Pin	Name	Description	Color
1	VCC	Power supply +5V	red
2	Data -	Data line -	white
3	Data +	Data line +	green
4	GND	Ground	black



front view

GPS/Serial, Binder 712, 4PF

Pin	Name	Description	Color
1	Data	Data line	green
2	Data	Data line	white
3	GND	Ground	black
4	VCC	Power supply +5V	red



front view

Connector and cable length can be modified on customer request!

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BC-GNSS2CAN-000 **CAN(-FD) GNSS module with optional integrated IMU**

Key Features

- GPS/GNSS features
  - 25 Hz GNSS receiver (GPS, Galileo, GLONASS and BeiDou are received concurrently)
  - SBAS and QZSS augmentation support
  - Typical accuracy of CEP < 1.00 m
  - Speed, Course and Position accuracy channels
  - Automatic GPS laptrigger detection for more than 330 racetracks worldwide
  - Additional user configurable GPS position for individual GPS lap time calculation
- Interface type: CAN(-FD) Bus
- Optional with built-in 6DoF-IMU (*_3A3G*)
  - Integrated 6 DoF (optional 9DoF)
  - IMU with range +/- 16 G (optional +/- 30 G)
  - Up to 1000 Hz IMU signal output
  - Internal calibration and temperature compensation
  - Built-in orientation correction to rotate mounting position of the module internally to the vehicles coordinate system
  - Additional first order IIR filter for individual filtering for all axes
- Speed pulse signal or lap trigger output
- Math (CALC) channels for online calculations
- Online roll angle calculation
- Module can work with GPS laptriggers as TransponderX2 simulator
- Mechanical features
  - Compact and light weight housing (Rugged and waterproof (IP67))
  - Mounting by screws

Available options

_3A3G-1	Integrated 6 DoF IMU with individual range selection for Acc (±2/4/8/16 G) and Gyros (±250/500/1000/2000 °/s)
_3A3G-2	Integrated 6 DoF IMU with individual range selection for Acc (±4/8/16/30 G) and Gyros (±500/1000/2000/4000 °/s)

_3A3G-options are enabled/disabled via firmware update of the module!

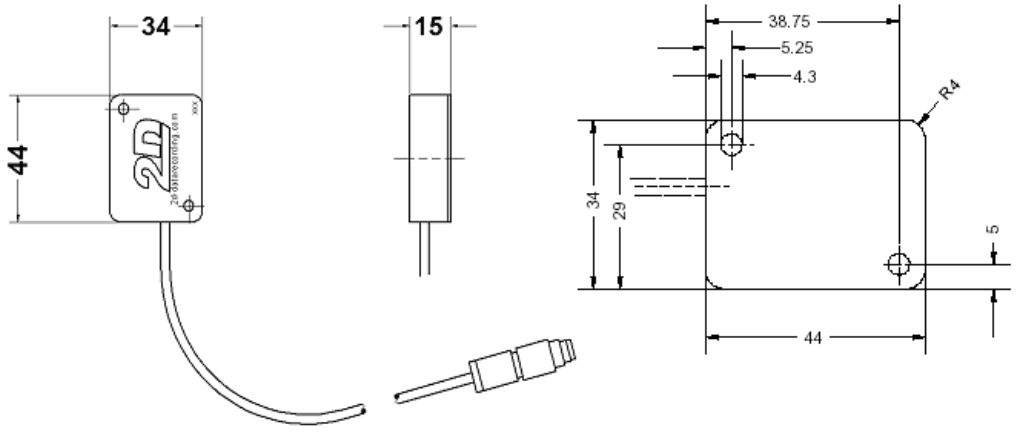
Technical specifications

CAN characteristics		
CAN(-FD) lines		1
CAN Baud rate	kBd	up to 2000
CAN-FD Baud rate	Mbit	2 / 4 / 5 / 8
Transmission rate CAN channels	Hz	max. 1000
3 axis accelerometers (optional)		
Range (switchable for all 3 axes)	G	±2/±4/±8/±16
Error of linearity	FS	±0.5%
Lowpass filter (programmable)	Hz	10 to 250
Sampling rate	Hz	1000
3 axis gyroscopes (optional)		
Range (switchable for all 3 axes)	°/s	250 /500/1000 /2000
Error for linearity	FS	±0.1%
Low-pass filter (programmable)	Hz	10 to 250
Sampling rate	Hz	1000
3 axis magnetometer (optional)		
Range	µT	±4900
Sampling rate	Hz	100
Speed Pulse / Laptrigger out		
Pulse output via open collector	P/min	max. 1000
Sink current	mA	20

Mechanical		
Dimensions	mm	44 x 34 x 15
Weight Bike (cable included)	g	80
Housing material		Aluminum / PC
Connector		Binder 712, 5PM
Cable Type		Raychem
Wire cross section		5x AWG26
Length	mm	400
Electrical		
Power supply	V	4 to 28
Current consumption @ 5V	mA	80 to 85
Current consumption @ 12V	mA	40 to 55
Environmental		
Sealing class		IP67
Operating temperature	°C	-40 to +85

Ordering information	
BC-GNSS2CAN-000	
BC-GNSS2CAN_IMU-000	with IMU (200Hz)
BC-GNSS2CAN_IMU_Full-000	with IMU (1000Hz)
with 2000mm cable length	
BC-GNSS2CAN-001	
BC-GNSS2CAN_IMU-001	
BC-GNSS2CAN_IMU_Full-001	

Dimensions

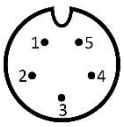


Connector layout

Connector type

CAN line, Binder 712 5PM

Pin	Name	Description	Color
1	CAN H	CAN high	white
2	CAN L	CAN low	green
3	GND	Ground	black
4	Speed/Lap	Speed Pulse / Laptrigger	blue
5	Vext	Power supply	red



front view

Connector and cable length can be modified on customer request

Default CAN identifiers

CAN-ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x790	V_Sat		ValidSat		SSHH		Course	
0x791	Lat_dez				Lon_dez			
0x792	Altitude		MMDD		HHMM			
0x793	HorAccu		VerAccu		SpAccu		CourAccu	
	Speed_N		Speed_E		Speed_D		Speed_3D	
	HDOP		GDOP		PDOP		VDOP	
	Year	Month	Day	Hour	Min	Sec	hSec	
	Latitude				Longitude			
	A_Lat		A_Lon		Banking		Yawrate	
with integrated IMU								
	ACC_X_RAW		ACC_Y_RAW		ACC_Z_RAW		ACC_N_RAW	
	Gyro_X_RAW		Gyro_Y_RAW		Gyro_Z_RAW		Vext	
	MAG_X_GNSS		MAG_Y_GNSS		MAG_Z_GNSS		V_Dout	
	ACC_X_IIR		ACC_Y_IIR		ACC_Z_IIR		ACC_N_IIR	
	Gyro_X_IIR		Gyro_Y_IIR		Gyro_Z_IIR		TEMP_GYRO	
0x450	ACC_X_GNSS		ACC_Y_GNSS		ACC_Z_GNSS		ACC_N_GNSS	
0x458	Gyro_X_GNSS		Gyro_Y_GNSS		Gyro_Z_GNSS		TEMP_GNSS	

Mounting Instructions

Improper mounting of the GNSS Receiver can result in bad GNSS accuracy!

- Mount the GNSS Receiver solid / rigid to the vehicle, avoid vibrations and do not use velcro or similar.
- Mount the GNSS Receiver to a stable and low or non-vibrating part of the vehicle
- The GNSS Receiver must be mounted on the top of the vehicle and be oriented parallel to the horizon.
- The optimum receiver location must have “unshaded” direct view to the sky.
- When mounting the receiver on non-metal surfaces, please use the self-adhesive ground plane - AC-GNSS_ground_plane-000

Documentation reference
For more information about *Mounting Instructions* please see manual **GPS – General description** on our website:
http://2d-datarecording.com/downloads/manuals/

Downloads

- GPS – General description
- Revision of GNSS
- Overview 2D GPS/GNSS modules

IIR Filter Channel Group (xxx_IIR)

Each IIR channel is directly linked to the raw channel of the IMU (xxx_RAW). Using the parameter “filter” you can set the desired filter frequency as follows:

$$f_{IIR} = \frac{f_{sampling\ rate\_raw}}{2^{Filterstep}}$$

Example: Filterstep 4; sampling rate of raw channel = 200Hz
→ IIR filter frequency = 12.5Hz

Averaging
If the sampling rate of an IIR channel is set lower than the rate of the raw channel, an average is calculated by the ratio of raw channel to the IIR channel.

Example: If the raw channel is set to 1000Hz and the IIR channel is set to 100Hz, an additional average of 10 samples is calculated.

Rotation Channel Group (xxx_ROT)

The rotation channels are linked directly to the IIR channels, every change of standard and IIR channel will influence the rotation channel. The misalignment can be compensated by entering the mounting angles in comparison to the orthographic system to the rotation channels.

Example: If the sensor is tilted 10 degrees forward and mounted upright,
→ mounting angles to insert: x=90°; y=10°; z=10°

Maximum Sampling Rate

The sampling rate for the IIR / ROT channel can never exceed sampling rate of the raw channel

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IN-AUIxxx_Split-000 — Current amplifier interface

Function:

- For the electronic measurement of currents: DC, pulsed, mixed with a galvanic isolation between the primary circuit (high power) and the secondary circuit (electronic circuit)

Features:

- Closed loop (compensated) current transducer using the Hall effect
- Unipolar voltage supply
- Compact design
- Multiple bipolar measurement ranges available (30A, 50A, 100A, 200A 300A, 600A)

Advantages:

- Excellent accuracy
- Very good linearity
- Very low temperature drift
- Optimised response time
- Wide frequency bandwith
- No insertion losses
- High immunity to external interferences

Technical specifications — IN-AUIxxx_Split-000

Electrical characteristics		
Primary current (measuring range).....	xxx	A
Supply voltage (± 5%).....	12	V
Analog output voltage (@I_P =0 | T_A=25 °C)	0..5	V
Current consumption (@IP =0,VC=5V)	≤25	mA
Isolation voltage	2.5	kV
Dynamic performance data		
Accuracy (@I_{PN},T_A=25 °C).....	<±1	%
Linearity.....	<±0.5	%
Thermal drift of Offset Voltage	<±1.0	mV/°C
Thermal drift of Output Voltage (-10..50°C)		
Reaction time @10% of I_{Pmax}.....	< 1	ms
Response time @90% of I_{Pmax}.....	< 400	ns
Response time at 90% of I_P (f=1kHz)	> 1	ms
Frequency bandwith (@ -3dB).....	0..20	kHz
Mechanical characteristics		
Dimensions (sensor).....	55 x 55 x 15	mm
Weight (w/ cable).....	typ. 28	g
Housing material (amplifier | sensor).....	aluminium | PBT	
Cable (type | wire-cross section | length)...	Raychem EPD, 4 x AWG26, 800mm	
Environmental data		
Ambient operating temperature.....	-25 to +85	°C
Ambient storage temperature.....	-40 to +100	°C
Ordering information		
Art.No:	IN-AUIxxx_Split-000	

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IN-AUIxxx_Split-000 — Current amplifier interface

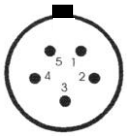
Connector layout

Analog-line Binder 719, 5pin

Pin	Name	Description	Color (standard)
1	AGND	Analog Ground	black
3	+12V	Supply voltage	red
4			
5	Signal	Analog signal	white

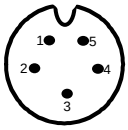
Connector type

Mating plug



Binder 719, 5 PF
(front side)

Connector at sensor



Binder 719, 5 PM
(front side)

Possible options (=concerning the plug & cable) on customer request!

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IN-AV_iso-000 — Isolated High-Voltage Transducer

Key Features

- Isolated high-voltage transducer for measuring high voltages up to 1000 V with 2D analog inputs

Options:

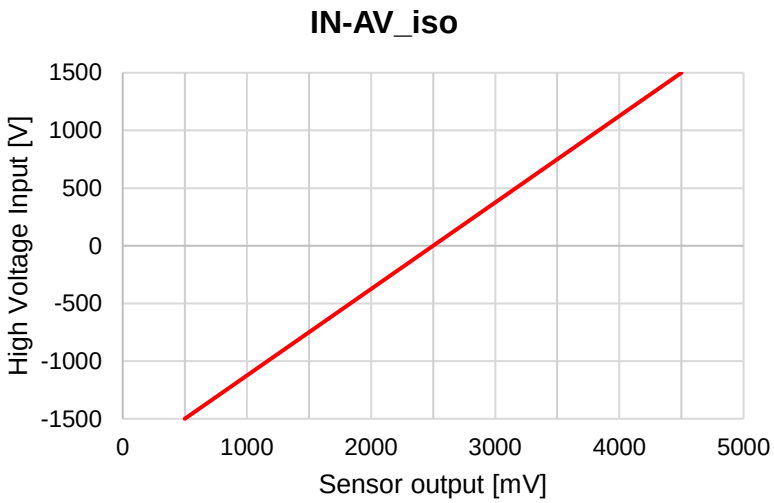
- Connectors and cable length can be modified on customer request

Technical specifications

Electrical characteristics		
Supply voltage	V	4.75 to 5.25
Current consumption @5V	mA	30
Output Voltage	V	0.5 to 4.5
max. input voltage (RMS)	V	1000
max. measuring range	V	± 1500
isolation rating	V	4200
Environmental data		
Protection class	IP	67
Ambient operating range	°C	-10 to +80
Humidity	%	5 to 95
Vibration resistance		
Shock	G	40
During time period of	ms	10
Vibration tested at	G	12
Measured with	Hz	1000

Mechanical characteristics		
Housing material		ABS
Dimensions	mm	85x56x39
Weight (cable included)	g	145
Analog Line		Binder 719, 5PM
Type		Raychem 3x AWG24
Length	mm	500
HV Input		4mm high-voltage Banana Jacks for accepting plugs with rigid insulating sleeves
Ordering information		
Art.-No.:IN-AV_iso-000		

Calibration

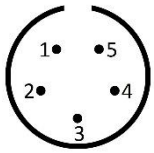


Connector layout

Connector type

Analog line, Binder 719, 5PM

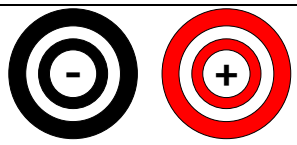
Pin	Name	Description	Color
1	AGND	Analog Ground	black
2	+5V	+5V Power Supply	red
3	n.c.	not connected	-
4	n.c.	not connected	-
5	Signal	Signal Output	white



front view

HV Input, 4mm Banana Jack

Name	Description	Color
HV-	HV Negative	black
HV+	HV Positive	red



front view

Warning!

The module is used in high-voltage applications. Improper use of the module may result in life-threatening electrical shocks.

- ➔ Make sure that these modules are only handled by qualified and trained personnel.
- ➔ Use only plugs with rigid insulating sleeves
  e.g. Stäubli XL-410, Stäubli SLS425-SL, SKS LAS S G, Cal Test CT2989
- ➔ Connect the HV connection only in complete de-energized state
- ➔ Do not open the module housing.
- ➔ Do not perform any mechanical or electrical modifications on the module.

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