P24 Science & P24 Module

INSTRUCTIONS FOR USE

Hasomed®

CE

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Table of Contents

SAFETY INSTRUCTIONS

Before the start

Before starting the device, read the instructions for use completely and pay particular attention to the safety and precautionary measures.

If support is required for start-up, operation or maintenance, please contact HASOMED GmbH support. Please also report unexpected operating performance or incidents to HASOMED GmbH.

The device must be inspected by HASOMED service personnel. You are not allowed to open the device. The repair must be carried out by the manufacturer.

This user manual descripes the safe and correct use of P24 Science and P24 Module. The safety measures contained herein must be strictly observed. Accident prevention regulations that apply in the country where the device is being used, as well as general safety and hygiene regulations, must also be complied with.

Symbols and signs

The following symbols and labels are used on the P24 Science/P24 Module. The nameplate with the exact model name, the CE marking, the date of manufacture and the information on the power supply can be found on the underside of the device.

⚠	General warning and caution sign
❗	Notice sign
🧍	Applied part of type BF
☐	Class II equipment
📖	Reference to the user manual

🚮	Do not dispose of as normal household waste. Contact HASOMED for further information.
CE	CE marking
IP2X	IP Code
⎓	Direct current
☂	Keep dry
🏭	Manufacturer identification and manufacture date
🌡	Maximum and minimum temperature limits at which the device shall be stored, transported or used
%◌	Acceptable upper and lower limits of relative humidity
⊙	Acceptable upper and lower limits of atmospheric pressure

❶	The listed warnings and cautions of this manual refer exclusively to the functionality of the device but not to the safety of an overall system or system building. Users are encouraged to identify risks through their own design and to reduce or eliminate them.

Warnings

A WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠	Disregarding the proper use will result in serious injury. Follow the Instructions specified in this manual.
⚠	Do not connect the user to electrical device at the same time. This may cause injury to the user or interfere with electrical monitoring devices connected to the user.

⚠	Prevent the equipment from immersion in water or other liquids. The P24 Science/P24 Module is not waterproof. If water or foreign substances enter the interior, immediately turn OFF the stimulator. Continued use of the device may result in fire or electrical shock. Please contact the manufacturer.
⚠	Improper connection of system components could result in serious injury. Do not insert the electrode cables into live sockets!
⚠	Improper use of the cables belonging to the P24 Science/P24 Module can lead to unwanted strangulation. Do not wrap the cables around the neck or other parts of the body.
⚠	Referring to user safety the power density (amount of energy in the electrode area) of 0,1W/ cm² may not be exceeded. The maximum value of current density may not exceed 2mA/ cm².

⚠	Do not use devices with high frequency (HF) range or micro and short-wave devices or welding units in immediate vicinity of 1m. This may leads to the instability stimulator output.
⚠	The long-term effects of chronic electrical stimulation are unknown.
⚠	Stimulation should not be applied over the carotid sinus nerves, particularly in patients with a known sensitivity to the carotid sinus reflex.
⚠	Stimulation should not be applied to neck or mouth. Severe spasm of the laryngeal and pharyngeal muscles can occur and the contractions may be strong enough to close the airway or cause difficulty in breathing. Do not stimulate at the neck or mouth!
⚠	Stimulation should not be done transthoracically, because the insertion of electrical current into the heart can cause cardiac arrhythmia.

⚠	Stimulation should not be applied trans-cerebrally.
⚠	The device must not be held in the hand or carried on the body during operation.

Cautions

The term "caution" is used to explain a hazard statement that warns the reader of a potentially hazardous situations which, if not avoided, could result in minor or moderate injury of the user, or damage of the equipment or other property.

⚠	Do not open the device
⚠	Do not servicing and maintenance while the device is in use
⚠	Before cleaning or disinfection, the device, disconnect the unit from the PC.
⚠	Modification of the device is not permitted.

⚠	The device and its surfaces can get warm during a stimulation session. Areas with longer direct contact to the device should be covered with clothing to prevent skin irritations.
⚠	Electrical stimulators should be kept out of the reach of children.
⚠	Electrical stimulators should be used only with the leads and Electrodes recommended for use by the manufacturer.
⚠	Electrical stimulators should not be used while driving, operating machinery, etc..
⚠	Some users may experience irritation due to electrical stimulation or electrical conductive medium. The irritation can usually be reduced by using an alternate conductive medium.

Device Description

Intended Use

The P24 Science/P24 Module is a device that can be controlled by a computer system via a specified interface to generate and output electrical pulses. The P24 Science/P24 Module is intended for research applications only and is not intended to be used for medical purposes on human beings according to Regulation (EU) 2017/745.

Regarding possible prospective developments, the P24 Science/P24 Module were developed and tested taking into account additional requirements not resulting from the intended use. The P24 Science/P24 Module thus fulfil, among other things, requirements for electrical safety and electromagnetic compatibility for medical devices without having an intended medical purpose and being a medical device.

An intended medical purpose may result of the integration of the P24 Science/P24 Module as non-medical device into a medical device or medical system under the responsibility of the customer or user. In this case, the customer or user is responsible for the conformity of the medical device or medical system.

Description of function

The P24 Science/P24 Module is a device for electrical stimulation. Therefore, the device generates electrical pulses based on external control, to stimulate on up to 8 channels simultaneously. The stimulator needs to be controlled and powered externally. The device has no battery. A USB-C interface with a well-defined protocol is available for this purpose.

The individual adjustment to the needs of the respective user concerning intensity and temporal sequence of pulses is possible by using different parameters.

The user is responsible for the intensity of stimulation.

ⓘ	The P24 Science/P24 Module is electrical equipment and complies with the essential requirements of the Low Voltage Directive (LVD) 2014/35/EU and the Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC. The P24 Science/P24 Module is no medical device according to the Regulation (EU) 2017/745 on medical devices.

P24 Science vs. P24 Module

The P24 Science has a housing, while the P24 Module does not. That is the only difference. The device variants are identical in all other respects. The P24 Module is intended for integration into another device in compliance with regulatory requirements.

Applied parts

The whole device is considered as type BF applied part.

Contraindications

The contraindications are to be determined by the user, considering possible hazards that may arise from electrostimulation.

⚠	Electrical stimulators should not be used on patients with cardiac demand pacemakers
⚠	Safety of electrical stimulators for use during pregnancy has not been established.
⚠	Caution should be exercised by users with suspected or diagnosed heart problems.
⚠	Caution should be exercised advised for users with suspected or diagnosed epilepsy.

	Stimulation should not be applied over swollen, infected, or inflamed areas or skin eruptions, e.g., phlebitis, thrombo-phlebitis, varicose veins, etc.
⚠	Stimulation should not be applied over, or in proximity to, cancerous lesions
⚠	Caution should be used in the presence of the following: • When there is a tendency to hemorrhage following acute trauma or fracture; • Following recent surgical procedures when muscle contraction may disrupt the healing process; • Over the menstruating or pregnant uterus; and • Over areas of the skin which lack normal sensation

Delivered items
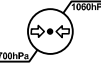
QTY	Description	Part. No.
1	P24 Science/Electrical Stimulator	FES02400
1	P24 Module/Stimulation Module	FES02410
1	Electrode cable yellow Channel 1-4	FES01188
1	Electrode cable green Channel 5-8	FES01189
1	USB Cable Type C to C	FES02401
1	USB Flash drive	FES01212
2	1 Set, containing 4 electrodes of size 5 x 9 cm	FES00200
2	1 Set, containing 4 electrodes of size 4 x 6,4 cm)	FES00202
1	ScienceMode Transport Box	FES02402
1	Instructions for use	

OPERATION INSTRUCTIONS

 The control of the stimulator and the setting of the stimulation parameters should only be performed by qualified users. Incorrect setting of wrong values may result in unexpected side effects and hazards due to wrong or too high currents. The responsibility for this lies with the user.

Preconditions

Use the device only under these environmental conditions:

| Temperature limitation | Humidity limitation | Atmospheric pressure |

The device is operated in combination with a computer system, which provides power and control of the device via USB. Please notice:

 The computer to be used with P24 Science/P24 Module must fulfil the requirements according to IEC/EN 60950-1 or IEC/EN 60601-1 or IEC/EN 62368-1 standard.

 The P24 Science/P24 Module has integrated two means of protection (2MOPP) for 250VAC working voltage according to the requirements of IEC 60601-1.

Device Components

The input and output interfaces of the P24 Science are shown in the following figure. Their description can be found in the table. The P24 Module has the same connectors, but without housing.
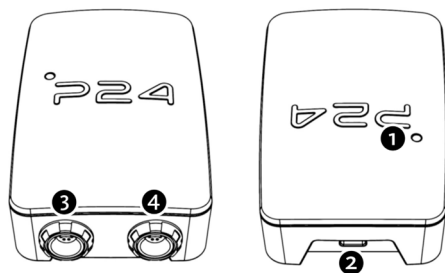
No.	Description
1	Device control lamp (LED)
2	USB-C receptacle
3	Output socket green
4	Output socket yellow

Device control lamp

The control lamp indicates the current operating status of the P24 Science/P24 Module. The following states are distinguished.

Color	Meaning
Violet	Device is in start-up routine
Green	Device application is running without active stimulation
Yellow	Stimulation is active
Red	An error has occurred
Yellow/Red blinking	An error has occurred, but stimulation continues to be performed

⚠️ The electrode cables must not be connected or disconnected when the device control lamp shows a red and/or yellow color.

Set-up

At first the two electrodes for each used channel needs to be placed using the following procedure:

1) Find the correct placement for the electrodes
2) Prepare the skin so that the area is clean and dry. Trim extensive body hair.
3) The lifespan of the electrodes can be prolonged by applying one or two drops of water on the gel surface. The electrode itself must not get wet.
4) Place the electrodes

The user must replace the electrodes:

- Not later than after 30 sessions,
- After a maximum utilization time of 3 months,
- If a problem occurs during the product specific use,
- If irritations occur or
- The electrodes exceeded the use-by date indicated on the package.

	Different muscles require different electrode positioning appropriate to their muscle fiber direction. Other muscles which are close to the stimulation area may contract with antagonistic functions.

After placing the electrodes, the electrode cables can be connected to the electrodes. Each channel is color coded to avoid wrong application. The electrode cable must be connected to the socket of the P24 Science/Module with the same color. Connect the cable only into the P24 Science/Module when the device control lamp is not yellow and or red.

	Plugs and connectors of P24 Science/Module electrode cables are color coded and coded by pin and groove. Inverting the connections can damage the stimulator and cause unwanted reactions.

The P24 Science/Module needs to be connected to the computer using the USB-C cable. Insert the USB-C plug into the corresponding receptacle. Connect the other side of the USB cable to the USB-A port of the computer.
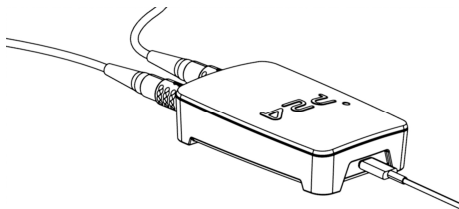
	Position the P24 Science/P24 Module so that it can be easily disconnected from the power supply, but so that the USB cable cannot be accidentally pulled off by a person or object (no tripping hazards). Make sure the USB cable is safely plugged in. Keep it away from hot surfaces and sharp edges.

After use

Always remove the electrodes by lifting one of the edges. Do not pull on the cable! After use, always stick the electrodes back onto the "ON" side of the storage liner. Store the electrodes in their original packaging in a dry and cool place.

	Do not use the same electrodes on different users – each user must have his own set.
⚠	Do not pull on cables to unplug electrodes. Pulling the cable can damage the plug connection. Also using other electrode types can cause a too strong connection between electrode and electrode cable and can damage or breakaway the cable. HASOMED gives no warranty for obvious misuse.

SCIENCEMODE

ScienceMode is a communication protocol between an external device (e. g. a PC) and the electrical stimulator P24 Science/P24 Module, which is produced by HASOMED. Using the ScienceMode commands, the external device can control the stimulation to execute complex stimulation patterns for a wide range of research applications.

Serial communication through the comport

To initiate stimulation, the virtual comport, which is opened on the computer after connecting the P24 Science/P24 Module device, needs to be opened and commands need to be sent to the device.

The serial settings for the P24 Science/P24 Module protocol are listed in Table 1.

Table 1: *Serial settings*

Parameter	Value
Baud rate	3 000 000
Data bits	8
Stop bits	2
Parity	None
Flow control RTS/CTS	Yes

In the following the packet structure is described which is need for communication.

Packet Structure

The protocol packet structure is shown in Table 2. Every packet starts with the start byte and ends with the stop byte (see constants in Table 3).

The protocol uses byte stuffing. Every constant from Table 3, except the stuffing key, is escaped with the stuffing byte. The value is then XORed with the stuffing key, e.g. if the command data

has a byte which is identical to the start byte value, this start byte (0xF0) is stuffed to 0x81, 0xA5.

The packet length (2 Byte) is the full length of the packet including the start and the stop byte. It is always stuffed and therefore uses 4 Bytes. The maximum packet length including stuffing is 1200 Bytes.

The check sum is the CRC-CCITT 2 Byte (16 Bit) and is generated from the stuffed packet data (see Table 2). It is always stuffed and therefore uses 4 Bytes.

The packet number (6 Bit) and command number (10 Bit) combined use 2 Bytes (Shown as command prefix in Table 2). The packet number ranges from 0 to 63 and is echoed by the stimulator response. It can be used for debugging purposes.

The command is represented by a number for the different commands, responses and information packets, whereas the command data is reserved for the parameter of the command.

The protocol uses big endian byte order.

Table 2: *Packet structure*

Start byte	Packet length	Check sum	Command prefix	Command data	Stop byte
1 Byte	4 Byte	4 Byte	2 Byte	n Byte	1 Byte
			<- Packet data ->		
			<- Stuffing ->		
			<- Check sum ->		
	<- Packet length ->				
<- Packet (Header, Data, Footer) ->					

Table 3: *Byte constants*

Constants	Hex	Binary
Start byte	0xF0	11110000
Stop byte	0x0F	00001111
Stuffing byte	0x81	10000001
Stuffing key	0x55	01010101

Commands and Responses

The stimulator functions can be controlled by sending a request command. Most of these request commands have a corresponding stimulator response (ending with ack), containing the result, the requested data and sometimes additional information. The commands, its responses and their parameters are describted in the next sections.

There are three layers: general, low- and mid-level. The general layer contains commands for requesting basic information like device id or general status. The low and mid-level layers contain the commands for the corresponding stimulation modes.

When the command data size is 0, no command data table is provided for the command and the packet length is 12.

General commands

Table 4: *General commands list*

Cmd. No.	Command	Type	Length Bytes
052	Get_device_id	Cmd	12
053	Get_device_id_ack	Rsp	23
058	Reset	Cmd	12
059	Reset_ack	Rsp	13
062	Get_stim_status	Cmd	12
063	Get_stim_status_ack	Rsp	15
068	Get_extended_version	Cmd	12
069	Get_extended_version_ack	Rsp	25
066	General_error	Rsp	13
067	Unknown_cmd	Rsp	13

Table 5: *Command data Get_device_id_ack*

Bit	Bytes	Description
	1	See result and errors
	10	Device-ID coded as chars

Table 6: *Command data Reset_ack*

Bit	Bytes	Description
	1	See result and errors

Table 7: *Command data Get_stim_status_ack*

Bit	Bytes	Description
	1	00 – Successful 01 – Transfer error
	1	0 No Level initialized 1 Low-Level initialized 2 Mid-Level initialized 3 Mid-Level running
	1	1 High voltage off 6 High voltage 150 V

Table 8: *Command data Get_extended_version_ack*

Bit	Bytes	Description
	1	00 – Successful 01 – Transfer error
	1	Firmware-version major
	1	Firmware-version minor
	1	Firmware-version revision
	1	ScienceMode-Version major
	1	ScienceMode-Version minor
	1	ScienceMode-Version revision
	4	Firmware hash
	1	1 – git hash 2 – elf md5 hash 3 – elf sha256 hash
	1	0 – not valid hash 1 – valid hash

Table 9: *Command data General_error*

Bit	Bytes	Description
	1	See result and errors

Table 10: *Command data Unknown_cmd*

Bit	Bytes	Description
	1	11 – Unknown command

Low-Level commands

Table 11: *Low-level commands list*

Cmd. No.	Command	Type	Length Bytes
000	Ll_init	Cmd	13
001	Ll_init_ack	Rsp	13
002	Ll_channel_config	Cmd	17-77
003	Ll_channel_config_ack	Rsp	14
004	Ll_stop	Cmd	12
005	Ll_stop_ack	Rsp	13

Low-Level Initialization

Requests the initialization of the low-level mode and switches the high voltage source on

Table 12: *Command data Ll_init*

Bit	Bytes	Description
1	1	Reserved, should be 0
3		0 – No measurement 1 – Stim current 2 – Stim voltage 3 – High voltage source
3		0 – Standard (150 V) 1 – Off
1		Reserved, should be 0

Table 13: *Command data Ll_init_ack*

Bit	Bytes	Description
	1	See result and errors

Low-Level channel configuration

Requests the execution of a stimulation pulse. The stimulator can buffer up to 10 commands in its internal buffer. This is useful for the execution of stimulation pulses with a high frequency.

Table 14: *Command data Ll_channel_config*

Bit	Bytes	Description
1	1	0 – No stimulation 1 – Stimulation will be executed
2		Channel selection (0-3)
1		Connector (0-1)
4		Number of points (1-16, Values 0-15)
For each point		
32	4	See point definition

Table 15: *Point definition*

Bit	Bytes	Description
12	4	Duration: [0 .. 1 .. 4095] us
10		Current: [-150.. -149.5 ..150] mA, where the set values are [0 .. 1 .. 600] with the function $f(x) = 2x + 300$
10		Reserved

Ll_channel_config_ack

Response for Ll_channel_config; The command is sent after the stimulation has been executed. It contains information about possible errors.

Table 16: *Command data Ll_channel_config_ack*

Bit	Bytes	Description
	1	00 – Successful
		01 – Transfer error
		02 – Parameter error
		03 – Timeout Stimulation
4	1	Connector (0-1)
4		Channel (0-3)
	1	0 – No measurement
		1 – Stim current
		2 - Stim voltage
		3 – High voltage source

When a measurement is selected, the following is added to the command data:

Table 17: *Command data Ll_channel_config_ack part 2*

Bit	Bytes	Description
	2	Sampling time in microseconds
	256	128 measurement samples with data type uint16

Low-Level Stop

Ll_stop requests the stop of low-level mode; Switches off the high voltage

Ll_stop_ack

Response to Ll_stop

Table 18: *Command data Ll_stop_ack*

Bit	Bytes	Description
	1	See result and errors

Mid-Level commands

Table 19: *Mid-level commands list*

Cmd.-No.	Command	Type	Length Bytes
030	Ml_init	Cmd	13
031	Ml_init_ack	Rsp	13
032	Ml_update	Cmd	13-549
033	Ml_update_ack	Rsp	13
034	Ml_stop	Cmd	12
035	Ml_stop_ack	Rsp	13
037	Ml_get_current_data	Cmd	13
038	Ml_get_current_data_ack	Rsp	19

Mid-Level initialization

Requests the initialization of the mid-level mode; The high voltage is enabled.

Table 20: *Command data Ml_init*

Bit	Bytes	Description
	1	0 – Continue on error (channel with error is stopped) 1 – Stop on all errors

Table 21: *Command data Ml_init_ack*

Bit	Bytes	Description
	1	See result and errors

Mid-Level Update

Requests the start or the update of the stimulation with the provided parameters. The stimulation has an automatic timeout of 2 s. To keep the stimulation alive, you need to send the keep-alive-signal (Ml_get_current_data) or a Ml_update. After a timeout the stimulation can be started again with Ml_update.

Table 22: *Command data Ml_update*

	Bit	Bytes	Description
	4	1	Bitwise channel activation (1-4)
	4		Bitwise channel activation (5-8)
For each active channel (1-8)	4	1	Number of points (1-16, Values 0-15)
	4		Ramp with values 0 -15; Number of linear increasing lower current pulse pattern until the full current is reached; The ramp is executed when the channel is enabled
	15	2	1 – 32767; Period in ms, value is calculated from transfer function below.
	1		0 – f(x) = 2x, e.g. 1 ms -> 2 1 – f(x) = 4x, e.g. 1 ms -> 4
	For each point		
	32	4	See point definition (see Table 15)

Table 23: *Command data Ml_update_ack*

Bit	Bytes	Description
	1	See result and errors

Mid-Level Stop

Requests the stop of the stimulation; The high voltage is switched off.

Table 24: *Command data Ml_stop_ack*

Bit	Bytes	Description
	1	See result and errors

Ml_get_current_data

Requests the live data and keep alive signal

Table 25: *Command data Ml_get_current_data*

Bit	Bytes	Description
	1	4 – Returns all error from all channels

Table 26: *Command data Ml_get_current_data_ack*

Bit	Bytes	Description
	1	See result and errors
	1	4 - Returns all error from all channels
	1	1 Bit for each channel 1 – 8 0 – No stimulation 1 - Stimulation active
	4	4 Bits for each channel 1 – 8 (see Results and errors for description) 0 – No Error 1 – Electrode error 2 – Pulse Timeout error 3 – Pulse low current error

Result and errors

Table 27: *Result and errors*

Value	Result	Description
00	No error	The command was executed, or the execution started.
01	Transfer error	The check sum and/or length included in the packet do not match with the calculated value.
02	Parameter error	Any of the following conditions is true: • At least one parameter has an invalid value. • The packet contains too few parameters.
07	Not initialized	The command cannot be executed, because •The level (mode) is not initialized. •Another level is currently initialized.
10	Electrode error	One or both Electrodes are not sufficiently connected to the skin. Try to clean and dry the skin and replace the electrodes. When not sufficient use new ones.
16	Pulse timeout error	The stimulation pulse could not be executed in the correct time frame. Reduce either the stimulation period or the stimulation pulse width.
28	Pulse low current error	The measured pulse current is lower than expected. Reduce either the pulse current or the pulse width, so that the provided voltage is sufficient to drive the set current.

TROUBLESHOOTING

Device is not responding

Try to restart the device by reconnecting the USB cable. Please check if there is a new virtual com port, when plugging in the device. Try a different USB 3.0 port on the PC which can deliver at least 2.4 A.

Device restarts randomly

Restarting occurs when the used USB port does not provide sufficient current. Connection problems could also trigger a restart.

Com port cannot be opened

Check if the correct com port is tried to be opened. Check if there is a different program running that has opened the com port already.

Error during stimulation is indicated through the device LED

When stimulating in low-level mode, evaluate the Ll_channel_config_ack command data. When stimulating in mid-level mode, send a Ml_get_current_data command and evaluate the Ml_get_current_data_ack command data.

A description of possible error cases is given in Result and errors. Try the given solution or follow the protocol description.

MAINTENANCE

Cleaning and Disinfection (only P24 Science)

Clean the P24 Science regularly for hygienic reasons. To clean and disinfect the device, please first disconnect it from the supply source. Remove coarse dirt by gently shaking it or using a hand vacuum cleaner or a small

brush. Impurities can be removed with a damp cloth. Use a dry or slightly moist cloth. If there are persistent stains, you can also soak the cloth in alcohol or a universal (BMF) cleaner. Never use strong detergents, soaps or solvents.

Let the P24 Science dry out completely before using it again.

Contact HASOMED if there is any heavy-duty dirt that cannot be removed.

Disinfect the P24 Science before every training session, thus preventing cross contamination between users. Wipe the device's surfaces with disinfectant.

Clean and disinfect parts in direct contact with the user's skin after each training session.

We strongly recommend that you use detergents which feature in the list of disinfectants and disinfectant processes as tested and approved by the Robert Koch Institute.

Maintaining the technical safety

The manufacturer recommends for the stimulator a maintenance interval of 2 years to guarantee the safety standards for further use. Hence, please send your P24 Science/Module on your own account to the manufacturer. HASOMED will examine the adherence to technical parameters and the function of the monitoring elements.

The service life for the stimulator is 5 years.

General information on disposal: Please contact HASOMED GmbH for the respective information on returning.

TECHNICAL SPECIFICATION

Size and weight		
	P24 Science	P24 Module
Width	68.4 mm	55 mm
Depth	112 mm	107.5 mm
Height	28.3 mm	18.3 mm
Weight	130 g	60 g

USB Port	
USB data specification	USB 2.0 Upstream
Supply voltage	5 V DC
Max. current consumption	2,4 A
USB connector	USB Type-C
Transfer rate	12 MB/s (Full Speed)
Isolation voltage	4 kV
Clearance and creepage distance	>8 mm

Stimulation	
Maximum voltage output	150 V
Maximum number of channels	8
Output current amplitude	0 - 130 mA @1 kΩ load
Waveform	Balanced biphasic square pulses or variable (adjustable using 16 discrete characteristic points)
Pulse width	10 - 65520 µs
Impulse repetition period	0.5 - 16383 ms
DC Component (Low-level-pulses)	0 – 40 mA @1 kΩ load 1 Channel

Environmental requirements	
In use	+5 °C to +27 °C; RH 0 % to 80 %, not condensing, AP 700 to 1060 hPa
Transport / storage	+5 °C to +27 °C; RH 0 % to 80 %, not condensing, AP 700 to 1060 hPa

EMC INFORMATIONS

Warnings

⚠	The P24 Science/P24 Module should not be used directly next to other devices or stacked with other devices. If such use is nevertheless necessary, the correct operation of the devices should be observed
⚠	Portable RF communication devices and their accessories should not be used closer than 30 cm (12 inches) to any parts and cables of the P24 Science/P24 Module. Otherwise, the performance of this device may be affected.

Cautions

⚠	Use of accessories, transducers, and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment
	and result in improper operation.

Electromagnetism

The device is suitable for use in all establishments including those directly connected to the public low-voltage power supply network that supplies to buildings power used for domestic purposes.

Emission

Test	Limit	Electromagnetic environment guidance
Conducted emission	CISPR 11, Group 1, Class B	Device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Radiated emission	CISPR 11, Group 1, Class B	

Interference immunity

Electrostatic Discharge (IEC 61000-4-2)	
Compliance level	*Electromagnetic environment - guidance*
Contact Discharge: ±8 kV Air Discharge: ±2 kV, ±4 kV, ±8 kV, ±15 kV	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.

Radiated RF EM filed (IEC 61000-4-3)	
Compliance level	*Electromagnetic environment - guidance*
80-2700 MHz; 1kHz AM 80 %; 10 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.2\sqrt{P}$ for 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ for 800 MHz to 2,7 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).

Proximity fields form RF wireless communications equipment (IEC 61000-4-3)	
Compliance level	*Electromagnetic environment - guidance*
385 MHz; Pulse Modulation: 18 Hz; 27 V/m 450 MHz, FM + 5 Hz Deviation: 1 kHz sine; 28 V/m 710, 745, 780 MHz; Pulse Modulation: 217 Hz; 9 V/m 810, 870, 930 MHz; Pulse Modulation: 18 Hz; 28 V/m 1720, 1845, 1970 MHz; Pulse Modulation: 217 Hz; 28 V/m 2450 MHz; Pulse Modulation: 217 Hz; 28 V/m; 5240, 5500, 5785 MHz; Pulse Modulation: 217 Hz; 9 V/m	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance 30 cm.

Electrical fast transients / bursts (IEC 61000-4-4)	
Compliance level	*Electromagnetic environment - guidance*
Power lines: 2 kV; 100 kHz repetition frequency Signal lines: 1 kV; 100 kHz repetition frequency	Mains power quality should be that of a typical environment.

Conducted disturbances inducted by RF fields (IEC 61000-4-6)	
Compliance level	*Electromagnetic environment - guidance*
0.15-80 MHz; 1kHz AM 80 %; 3 Vrms, 6 Vrms in ISM and amateur radio band	Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.2\sqrt{P}$ for 150 kHz to 80MHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).

Rated power frequency magnetic fields (IEC 61000-4-8)	
Compliance level	*Electromagnetic environment - guidance*
30 A/m, 50 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Voltage dips / Voltage interruptions (IEC 61000-4-11)	
Compliance level	*Electromagnetic environment - guidance*
0 % UT for 0.5 cycle at 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315° 0 % UT for 1 cycle at 0° 70 % UT for 25/30 cycles at 0° 0 % UT for 250/300 cycles 0°	Mains power quality should be that of a typical environment. If the user of the device requires continued operation during power mains interruptions, it is recommended that the device is powered from an uninterruptible power supply or battery.