Vacuum Solutions | Application Support | Service

LEYBOLD VACUUM

GA 09.419/2.02 (0410)

IONIVAC IM 540

Ionization Gauge Controller

Cat.-No.
230100

Operating Manual
Incl. Declaration of Conformity

Contents

Declaration of Conformity

1 Introduction

1.1 Validity

1.1.1 Catalog Number

This document applies to the following products:

Catalog number	Product
230100	IONIVAC IM 540

The catalog number can be found on the type label which is attached to one side of the device.

1.1.2 Firmware Version

This Operating Manual is based on the firmware version 302-543-A (version V1.01 and later).

If the device does not work as described, please check if it is equipped with this firmware version. See Chapter 7.4.3 CPU / Display, 🗎 60.

1.1.3 Type Label

There is a type label attached to one side of the device. In all communication with LEYBOLD VAKUUM, please state the information on the type label. For this purpose you may want to copy the information into the space provided below:

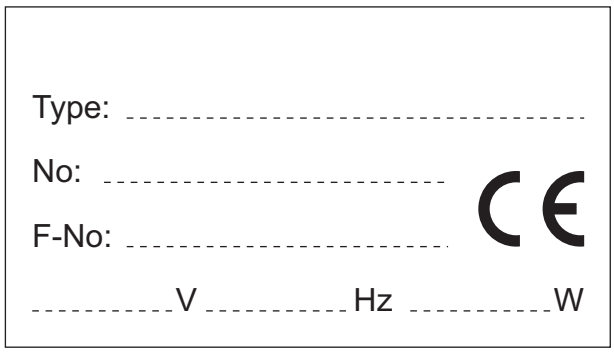

Fig. 1-1 Type label (example)

1.2 Intended Use

The IONIVAC IM 540 is a versatile microprocessor controlled ionization gauge controller for pressure measurements in the range 1×10^{-12} through 1.1×10^{3} mbar.

The concept and design of the controller allow for a reliable and complete integration in complex process control systems.

The IONIVAC IM 540 can handle four measuring systems simultaneously. An optional interface may be used for complete remote control of the device.

In the following, the IONIVAC IM 540 Ionization Gauge Controller will be referred to as «IM 540».

1.2.1 Liability and Warranty

LEYBOLD VAKUUM assumes no liability and the warranty becomes null and void if the end user or third parties

- Disregard the information in this document
- Use the product in a non-conforming manner
- Make any kind of alterations (modifications, repair work, etc.) to the product
- Use the product with accessories not listed in the corresponding product documentation

We reserve the right to make technical changes without prior notice. The figures are non-committal.

1.3 Compatibility

The IM 540 is compatible with its predecessor IONIVAC IM 520. In order to operate the IM 540 in one of the IM 520 modes, you have to change the configuration settings accordingly. See Chapter 5.4 Sensor Control (Control), 🗎 42.

NOTE:
The relays inside of the IM 540 can only be used for mains power if an optional relay box is connected.

1.4 Safety

1.4.1 Personnel Qualifications

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end user of the product.

1.4.2 Illustration of Residual Dangers

This Operating Manual illustrates safety notes concerning residual dangers as follows:

⚠DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or severe injury.

⚠WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or severe injury.

⚠CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in moderate or minor injury or in property damage.

NOTE:
Indicates particularly important, but not safety-relevant information.

1.4.3 General Safety Instructions

For all work you are going to do, adhere to the applicable safety regulations.

Also observe all safety notes given in this document and forward the information to all other users of the product.

In particular, pay attention to the following safety notes:

⚠DANGER

Mains voltage.

Contact with live parts is extremely hazardous when any objects are introduced or any liquids penetrate into the device.

Make sure that no objects enter through the louvers of the device. Keep the device dry.

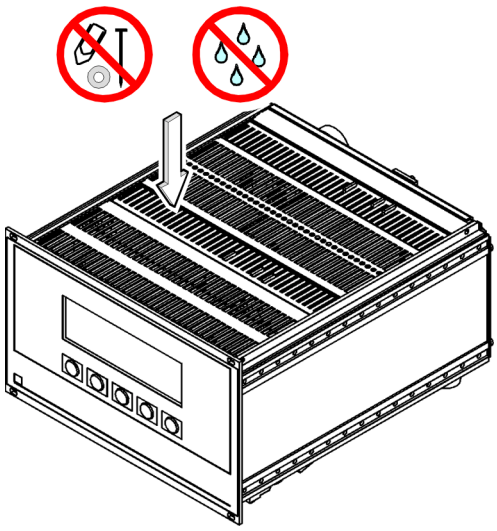

Fig. 1-2 Do not insert objects through louvers and keep device dry

⚠CAUTION

Improper use.

Improper use can damage the IM 540.

Use the IM 540 only as intended by the manufacturer. See Chapter 1.2 Intended Use, 5.

⚠CAUTION

Improper installation and operation data.

Improper installation and operation data may damage the IM 540.

Strictly adhere to the stipulated installation and operation data.

2 Technical Data

2.1 General Data

2.1.1 Mechanical Data

Dimensions	Width: 213 mm Height: 128.5 mm (3 HE) Depth: 248 mm See Fig. 2-1, 🗎 7
Weight	Max. 5.0 kg
Use	Desktop device Control panel mounted Rack mounted

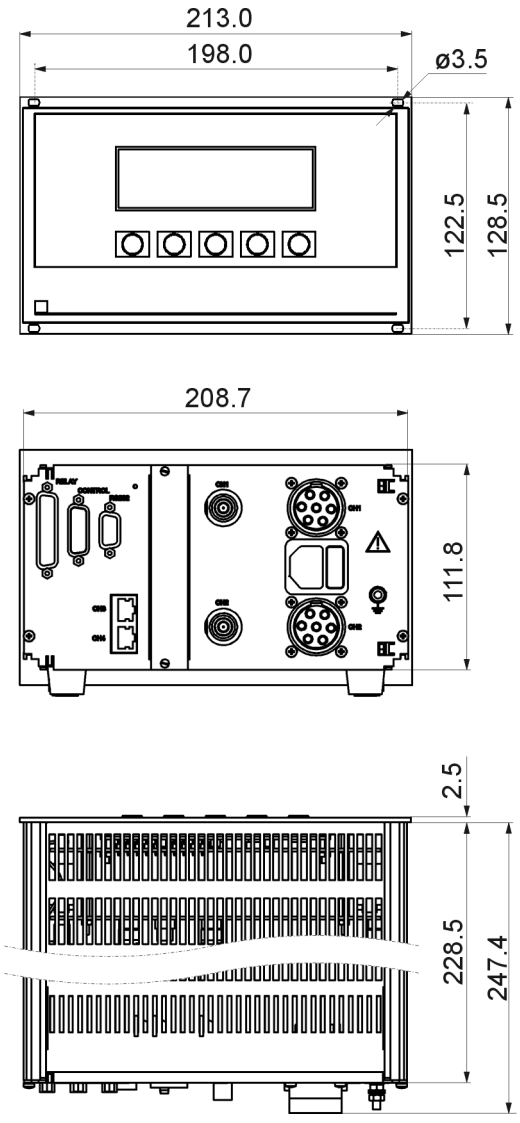

Fig. 2-1 Dimensions (in mm)

2.1.2 Ambience

Temperature	Storage: -20…+60 °C Operation: +5…+50 °C
Relative humidity	Max. 80 % (up to 31 °C), decreasing to max. 50 % (above 40 °C)
Use	Indoors only Altitude max. 2000 m NN
Pollution degree	II
Protection type	IP20

2.1.3 Operation

Manually	Via 5 control buttons on the front panel
Remote control	Via RS232 interface or via Profibus (optional)

2.1.4 Standards

Conformity with the Directive relating to electrical equipment designed for use within certain voltage limits 73/23/EWG

Conformity with the Directive relating to electromagnetic compatibility 89/336/EWG

Harmonized and international/national standards and specifications:

EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use)

EN 61000-6-2 (Electromagnetic compatibility generic immunity standard)

EN 61000-6-4 (Electromagnetic compatibility generic emission standard)

2.2 Mains Connection

Voltage	90…250 VAC
Frequency	50…60 Hz
Current consumption	Max. 4 A at 115 V Max. 2 A at 230 V
Power consumption	Max. 300 W
Overvoltage category	II
Protection class	1
Connection	European appliance connector IEC 320 C14
Fuse	3.15 A (in power supply)

2.3 Channels

2.3.1 Sensor Connections

Channels 1 and 2:

Sensor connections per channel	Metalock Bantam UTG0187SVDEU + BNC
Compatible sensors	IONIVAC sensors: Bayard-Alpert sensor IE414 Extraktor sensor IE514

Channels 3 and 4:

Sensor connections per channel	RJ45 (FCC 68)
Compatible sensors	THERMOVAC transmitters: TTR 90, TTR 90S, TTR 91, TTR91S CERAVAC transmitters (CTR): Preferably CTR 90, CTR 91

2.3.2 Sensor Supply

2.3.2.1 IONIVAC Sensors

Measuring operation:

	IE414	IE514
Anode potential	220 V	220 V
Reflector potential	- - -	205 V
Cathode potential	80 V	100 V
Emission current	0.1 mA [1])	1.6 mA
	1.0 mA [2])	
	10.0 mA [3])	

1) for increasing pressure in the range 9.99E-3…1E-4 mbar
for decreasing pressure in the range 9.99E-3…1E-5 mbar
2) for increasing pressure in the range 9.99E-5…1E-7 mbar
for decreasing pressure in the range 9.99E-6…1E-8 mbar
3) for increasing pressure in the range 9.99E-8…1E-11 mbar
for decreasing pressure in the range 9.99E-9…1E-11 mbar

Degassing:

	IE414	IE514
Anode potential	480 V	480 V
Reflector potential	- - -	205 V
Cathode potential	20 V	10 V
Emission current	90 mA	45 mA
Power	41 W	21 W

2.3.2.2 THERMOVAC and CERAVAC Transmitters

Voltage	+24 VDC ±5%
Current	0…1 A per channel

2.3.3 Measuring Ranges

Total measuring range:
$1\times10^{-13}\ldots1.3\times10^{3}$ mbar

Measuring ranges of the IONIVAC sensors

Emission current (mA)	Pressure range (mbar)	Ion current (A)
10	$10^{-11}\ldots10^{-8}$	$1.7\times10^{-12}\ldots1.7\times10^{-9}$
1	$10^{-8}\ldots10^{-5}$	$1.7\times10^{-10}\ldots1.7\times10^{-7}$
0.1	$10^{-5}\ldots10^{-2}$	$1.7\times10^{-8}\ldots1.7\times10^{-5}$

Tab. 2-1 Measuring ranges of the BAG IE414 for pressure dependent emission current

Emission current (mA)	Pressure range (mbar)	Ion current (A)
10	$10^{-11}\ldots10^{-2}$	$1.7\times10^{-12}\ldots1.7\times10^{-3}$
1	$10^{-11}\ldots10^{-2}$	$1.7\times10^{-13}\ldots1.7\times10^{-4}$
0.1	$10^{-11}\ldots10^{-2}$	$1.7\times10^{-14}\ldots1.7\times10^{-5}$

Tab. 2-2 Measuring ranges of the BAG IE414 for fixed emission current

Emission current (mA)	Pressure range (mbar)	Ion current (A)
1.6	$10^{-13}\ldots10^{-4}$	$1.6\times10^{-15}\ldots1.6\times10^{-6}$

Tab. 2-3 Measuring range of the Extraktor IE514

Measuring ranges of the CERAVAC transmitters (CTR 90, CTR 91)

CTR	Pressure range
0.1 Torr (CTR 91 only)	$1\times10^{-5}\ldots1\times10^{-1}$ Torr
1 Torr	$1\times10^{-4}\ldots1$ Torr
10 Torr	$1\times10^{-3}\ldots1\times10^{1}$ Torr
100 Torr	$1\times10^{-2}\ldots1\times10^{2}$ Torr
1000 Torr	$1\times10^{-1}\ldots1\times10^{3}$ Torr

Measuring ranges of the THERMOVAC transmitters
$5\times10^{-4}\ldots1\times10^{3}$ mbar

2.3.4 Measuring Technique

Accuracy of measurement

Current: (channels 1 and 2)
- Relative to current reading: ±1%
- Absolute: ±0.5 fA

Voltage: (channels 3 and 4)
- Relative to voltage reading: ±0.5%
- Absolute: ±1 mV

Measuring speed
The measuring speed that can be achieved with IONIVAC gauges depend on the ion current to be measured and the selected resolution. Details on this can be found in Chapter 7.4.4 Current Measuring Amplifier (Amplifier), 🗎 62.

The measuring range of the transmitters is 20 s-1 over the entire measuring range.

Filter time constants
The filter time constants depend on the measuring rate. The actual measurement is the average of the last *n* measurements. The filter settings are defined as follows:

Slow	n = 50
Normal	n = 15
Fast	n = 5

Display rate, temperature drift, unit of measurement

Display rate	$4\ s^{-1}$
Temperature drift	< 0.1 % per °C
Unit of measurement	mbar, Pa, Torr, Micron

Resolution of the A/D converter

THERMOVAC and CERAVAC	16 bit
IONIVAC	≤ 14 bit

2.3.5 Sensor Identification

The following sensors are recognized automatically by means of an identification resistor:

Sensor	ID resistor
IE514	0 Ω (shorted) ≥ 4.25 V at the A/D converter
IE414	∞ Ω (interrupted) ≤ 0.75 V at the A/D converter
THERMOVAC	27.0 kΩ ± 1 % 1.640 V at the A/D converter
CERAVAC [1])	13.2 kΩ ± 1 % 0.849 V at the A/D converter

1) All transmitters of the same type use the same identification resistor. The valid measuring range must be configured by the user. See Chapter 2.3.3 Measuring Ranges, 🗎 9.

NOTE:
Bayard-Alpert sensors cannot be identified automatically by the software. If no Extraktor sensor is found on channel 1 or 2, the controller assumes that a Bayard-Alpert sensor is connected when starting up for the first time. The setting must be corrected manually if this is not the case. See Chapter 5.6.3 Configuring the Device (Config), 🗎 47.

2.4 Interfaces

2.4.1 Relay Outputs

Name	Relay
Connection	D-Sub, 25 pins, female. See Fig. 3-8, 🗎 16.
Number of relays	2, can be extended to 7 with an additional interface board
Response time	Max. 50 ms, synchronous to channels 3 and 4, asynchronous to channels 1 and 2
Contact type	Change-over contact, floating
Load (ohmic)	Max. 50 VDC, 0.5 A

2.4.2 Control Signals, Recorder

Name	Control
Connection	D-Sub, 15 pins, male
Filter time constant	Max. 1 ms
Resolution A/D converter	16 bit
Resolution D/A converter	12 bit
Measuring and refresh rate	20 s^{-1}, synchronous to channels 3 and 4, asynchronous to channels 1 and 2
Analog input voltage	0…10 V, unipolar
Analog output voltage	0…11 V, unipolar
Input impedance	Min. 100 kΩ
Output impedance	Max. 50 Ω

2.4.3 RS232

Name	RS232
Connection	D-Sub, 9 pins, female
Baud rate	300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600
Data	7 bit, 8 bit, 9 bit
Parity	odd, even, none
Stop bits	1, 2
Flow control	XON/XOFF can be switched on and off

2.4.4 Interface Board (Option)

The following interface boards can be used:

- Interface board with RS232-C interface or with RS422 interface:

Number of relays	5
Breaking capacity for power	45 W, 75 VA
Breaking capacity for voltage	30 VDC / 50 VAC
Breaking capacity for current	1.5 A

- Interface board with Profibus DP interface

Breaking capacity for voltage	30 VDC / 50 VAC

2.5 Scope of Delivery

Designation	Number
IONIVAC IM 540	1
Operating manual	2
Mains cable, EUR version	1
Mains cable, US version	1
Casing feet, set	1
Rack mounting set (19", 3 HU), consisting of:	
• Collar screws	4
• Plastic sleeves	4

2.6 Accessories

Designation	Catalog number
Mountable measuring system IE414 DN35 CF	158 66
Mountable measuring system IE514 DN35 CF	158 67
Spare cathode for IE414	158 63
Spare cathode for IE514	158 61
Measuring line for IE414/514, 5 m	158 68
Measuring line, temperature resistant 250 °C, 5 m	158 44
Extension line for IE 414/514, 20 m	158 69

3 Installation

3.1 Unpacking

1 Visually inspect the transport packaging for signs of external damage

2 Unpack the IM 540 and put the packaging material aside

3 Remove the protective film from the display

NOTE:
Keep the packaging material for later use. The IM 540 must be stored and transported in the original packaging material only.

4 Examine the IM 540 for completeness

5 Visually inspect the IM 540 for signs of damage

⚠DANGER

Damaged product.

Putting a damaged product into operation can be extremely dangerous.

Never attempt to put a damaged product into operation. Secure the damaged product from unintended operation. Send a damage report to the haulage company or the insurer.

3.2 Mechanical Installation

The IM 540 can be used as follows: As a desk-top device, mounted in a control panel, or mounted in a 19" rack. In each of these cases you must pay attention to the following safety note:

⚠CAUTION

Ambient temperature.

Exceeding the maximum permitted ambient temperature may damage the device.

Make sure that the maximum permitted ambient temperature is not exceeded and that the air can flow freely through the louvers. Do not expose the device to direct sunlight.

3.2.1 Desk-Top Device

In order to use the IM 540 as a desk-top device, proceed as follows:

1 Switch off the IM 540 and disconnect it from mains power

2 Turn the IM 540 upside down as shown in Fig. 3-1, 12

3 The holes for the legs are covered by plastic caps. Use a screw driver and remove the plastic caps.

4 Screw the four legs on to the corners of the casing base plate

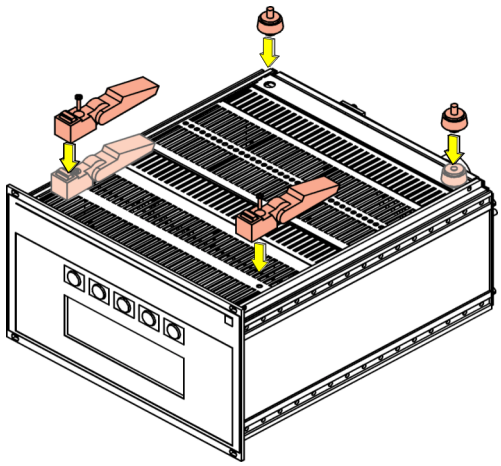

Fig. 3-1 Using the product as a desk-top device

5 If required, fold out the two front legs

6 Turn the IM 540 back to normal orientation and place it on the required location

3.2.2 Installation in a Control Panel

In order to mount the device in a control panel, the following cutout is required:

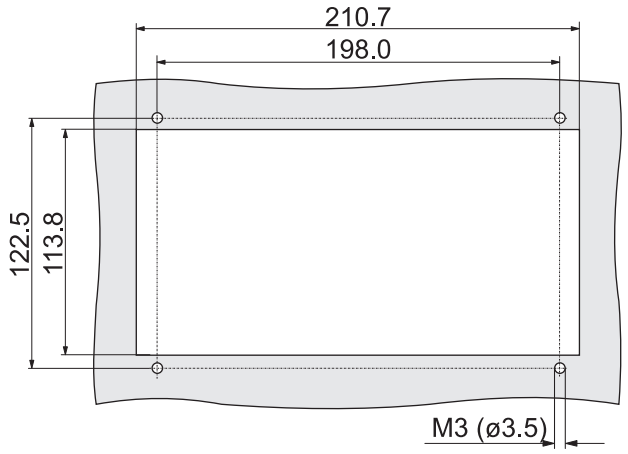

Fig. 3-2 Control panel cutout (in mm)

1 Insert the IM 540 into the cutout

2 Fasten the device with four M3 screws

NOTE:
In order to reduce the strain on the front panel it is recommended to support the bottom of the device.

3.2.3 Rack Installation

The IM 540 is designed for installation into a rack chassis adapter according to DIN 41 494 (19", 3 HU). For this purpose, 4 collar screws and 4 plastic sleeves are supplied with the device.

⚠WARNING

Protection class of the rack.

If the product is installed in a rack, it is likely to lower the protection class of the rack (protection from foreign bodies and water) e.g. according to the EN 60204-1 regulations for switching cabinets.

Take appropriate measures to restore the required protection class of the rack.

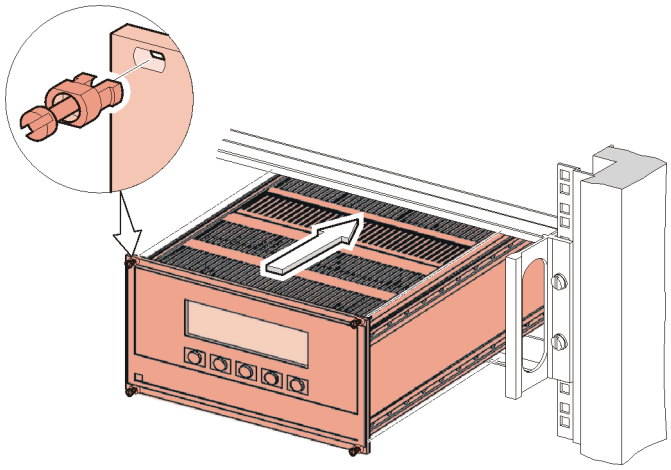

Fig. 3-3 Mounting the device in a rack

NOTE:
In order to reduce the strain on the front panel it is recommended to equip the rack chassis adapter with a guide rail.

NOTE:
For safe and easy installation of heavy rack chassis adapters, it is recommended to equip the rack frame with slide rails.

1 Fasten the rack chassis adapter in the rack

2 Insert the IM 540 into the rack chassis adapter

3 Fasten the IM 540 with the supplied collar screws and plastic sleeves to the rack chassis adapter

3.3 Connecting

3.3.1 Back Side of the Device

Fig. 3-4, 🗎 14 shows the back side of the IM 540.

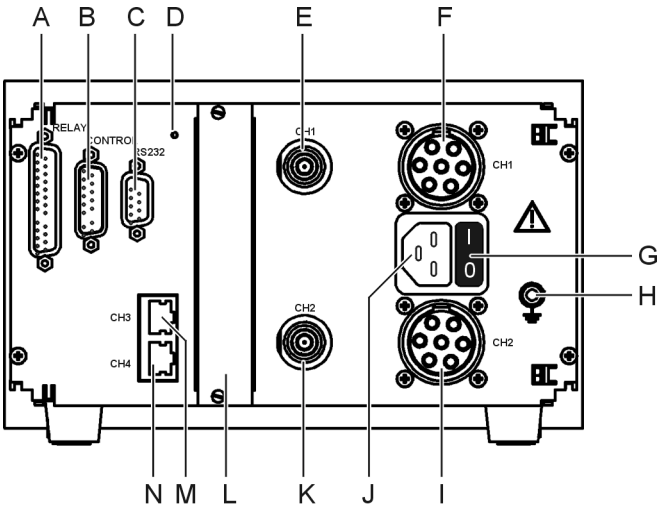

Fig. 3-4 Back side of the IM 540

A RELAY connection
B CONTROL connection
C RS232 connection
D Switch for program transfer mode
E Connection for IONIVAC measuring signal, channel 1
F Connection for IONIVAC control, channel 1
G Mains switch
H Ground screw
I Connection for IONIVAC control, channel 2
J Mains connection
K Connection for IONIVAC measuring signal, channel 2
L Extension slot
M Connection for transmitter, channel 3
N Connection for transmitter, channel 4

⚠WARNING

Screw for internal protective conductor.

The internal protective conductor is connected to the casing with a screw. In case of a failure, a device whose protective conductor is not connected to the casing may be lethal.

Do not turn or loosen this screw.

The configuration of the available connections is described in the following sections.

3.3.2 Mains Connection

The mains connection (Fig. 3-4, 🗎 14, item K) is designed for a mains cable which contains a European appliance connector on the device side.

A mains cable is supplied with the device. If the plug is not compatible with your wall socket, you have to get a suitable mains cable:

- Three-conductor cable with protective ground
- Conductor cross-section 3 × 1.5 mm^2 or larger

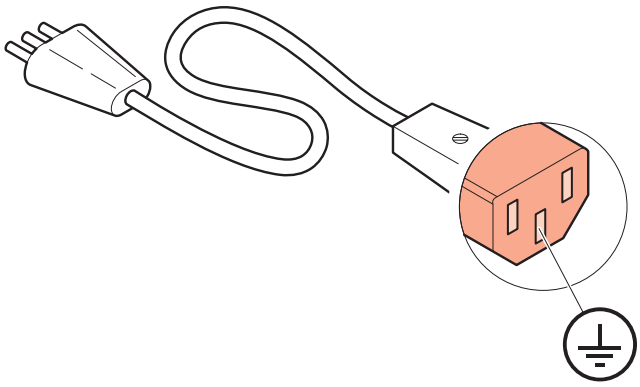

Fig. 3-5 Three-conductor cable with protective ground (example)

⚠DANGER

Mains power.

Improperly grounded devices can be extremely dangerous in the event of a fault.

Use three-wire mains or extension cables with protective ground only. Plug the mains cable into wall sockets with protective ground only.

1 Connect the European appliance connector of the mains cord with the mains connection of the device

2 Connect the plug of the mains cable with the wall socket

NOTE:
If the device is installed in a switching cabinet, the mains power can be supplied via a switchable central power distributor.

3.3.3 Ground

The ground screw (Fig. 3-4, 🗎 14, item H) can be used to connect the IM 540 with the protective ground of the pumping station.

1 If required: Connect the protective ground of the pumping station with the ground screw. Use a protective conductor.

The metal flanges of the IE414 and IE514 sensors are connected to the ground via the measuring lines inside of the IM 540.

3.3.4 CH1 and CH2

The CH1 and CH2 connections are used to connect ION-IVAC sensors.

Control signals
A 7-pin appliance socket (type Metalock Bantam) is available for each channel. See Fig. 3-4, 🗎 14, items F and I.

Pin assignment:

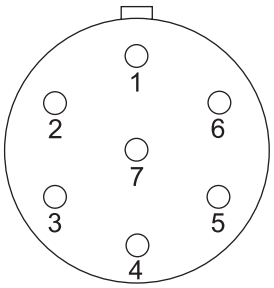

Fig. 3-6 CH1 and CH2 appliance socket (Metalock Bantam)

1 Filament
2 Cathode
3 Anode
4 Reflector (Extraktor)
5 ID res (short 1)
6 ID res (short 2)
7 Protective conductor

⚠WARNING

Hazardous voltage.

As soon as the emission is switched on, both appliance plugs carry hazardous levels of voltage, even if only one measuring system is connected. Touching one of these plugs may cause serious injuries.

The device must be switched off before any work is performed to the sensor or the measuring line. After switching off, wait approx. 15 seconds before starting the work.

Measuring signals
The measuring signals, i.e. the ion currents, of each sensor are transferred via a coaxial cable. See Fig. 3-4, 🗎 14, items E and J.

Pin assignment:

Inner conductor	Ion current
Outer conductor	Shielding

3.3.5 CH3 and CH4

The CH3 and CH4 connections are used to connect the transmitters.

An 8-pin RJ45 appliance socket is available for each channel. See Fig. 3-4, 🗎 14, items N and O.

Pin assignment

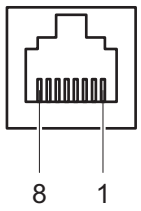

Fig. 3-7 CH3 and CH4 appliance socket (RJ45)

1 +24 VDC
2 PGND
3 U_in
4 Ident
5 Signal-GND
6 n.c.
7 n.c.
8 n.c.

n.c. not connected

⚠CAUTION

Improper transmitter.

Transmitters which are not designed for use with the IM 540 may damage the device.

Operate the IM 540 with proper transmitters only. See Chapter 2.3.1 Sensor Connections, 🗎 8.

⚠CAUTION

Multiple connection.

Only one transmitter may be connected to each of the channels. Otherwise the connected transmitters will be damaged.

Never connect more than one transmitter per channel.

Connecting

1 CH3: Connect the transmitter with the CH3 connection. Use a shielded 1:1 cable.

2 CH4: Connect the transmitter with the CH4 connection. Use a shielded 1:1 cable.

3.3.6 RELAY

The switching functions and the error monitoring system influence the states of several relays inside of the IM 540. The RELAY connection (Fig. 3-4, 🗎 14, item A) allows to utilize the relay contacts for switching purposes. The relay contacts are potential-free (floating).

Pin assignment

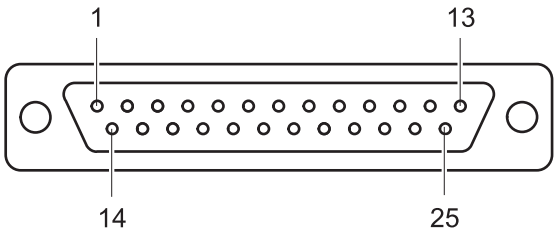

Fig. 3-8 RELAY appliance socket (D-Sub, 25-pin)

1	*GND*	*16*	*Emission off (NC)*
2	*GND*	*17*	*Emission common (COM)*
3	*Channel 2 ready (NC)*	*18*	*Emission on (NO)*
4	*Trigger 1 off (NC)*	*19*	*Degas off (NC)*
5	*Trigger 1 common (COM)*	*20*	*Degas common (COM)*
6	*Trigger 1 on (NO)*	*21*	*Degas on (NO)*
7	*GND*	*22*	*Channel 1 ready (NC)*
8	*Trigger 2 off (NC)*	*23*	*Channel 1 common (COM)*
9	*Trigger 2 common (COM)*	*24*	*Channel 1 error (NO)*
10	*Trigger 2 on (NO)*	*25*	*+24 VDC, 200 mA. Meets the requirements of a ground protective extra low voltage (SELV-E according to EN 61010).*
11	*Channel 1 selected (NC)*		
12	*Channel common (COM)*		
13	*Channel 2 selected (NO)*		
14	*Channel 2 error (NO)*		
15	*Channel 2 common (COM)*		

COM common
NC normally closed
NO normally open

NOTE:
Pin 25 is used for supplying relays with a higher breaking capacity. The supply contact is protected at 200 mA.

⚠WARNING

Hazardous voltage.

Voltages above 60 VDC or 30 VAC pose a shock hazard.

The RELAY connection may be used for switching voltages of max. 60 VDC or 30 VAC only. These voltages must meet the requirements of a ground protective extra low voltage (SELV-E according to EN 61010).

1 Connect the peripheral components with the RELAY connection. Use a shielded cable.

3.3.7 CONTROL

The CONTROL connection (Fig. 3-4, 🗎 14, item B) contains the following signal pins:

- Analog inputs for remote control of the emission
- Digital inputs for switching the emission
- Linear and logarithmic recorder output

Pin assignment

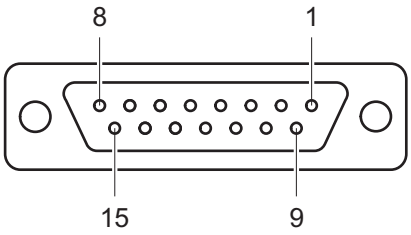

Fig. 3-9 CONTROL appliance socket (D-Sub, 15-pin)

1	*Dig. Remote Channel 1 GND*	*9*	*Dig. Remote Channel 1*
2	*Dig. Remote Channel 2 GND*	*10*	*Dig. Remote Channel 2*
3	*GND*	*11*	*GND*
4	*GND*	*12*	*Anal. Remote Channel 1*
5	*Anal. Remote Channel 1 GND*	*13*	*Anal. Remote Channel 2*
6	*Anal. Remote Channel 2 GND*	*14*	*Recorder linear output*
7	*Recorder linear GND*	*15*	*Recorder log. output*
8	*Recorder log. GND*		

1 Connect the peripheral components with the CONTROL connection. Use a shielded cable.

3.3.8 RS232

The RS232 serial interface (Fig. 3-4, 🗎 14, item C) allows remote control of the device via a computer or a terminal. See Chapter 6 Computer Interface, 🗎 48.

In addition, the interface may be used for firmware updates. See Chapter 7.2 Program Transfer Mode, 🗎 57.

Pin assignment

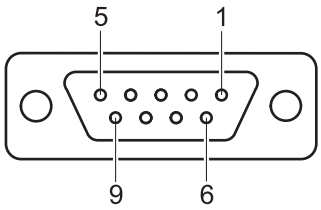

Fig. 3-10 RS232 appliance socket (D-Sub, 9-pin)

1	*DCD, +5 V external supply, max. 300 mA*	*5*	*GND*
2	*TxD*	*6*	*DSR*
3	*RxD*	*7*	*n.c.*
4	*n.c.*	*8*	*CTS*
		9	*RI*

1 Connect the serial interface of the computer with the RS232 connection. Use a shielded cable.

NOTE:
Use a serial extension cable with a 9-pin plug and a 9-pin socket. The cable must not contain any crossed wires.

3.3.9 Extension Slot (Option)

An interface board in the extension slot (Fig. 3-4, 🗎 14, item L) can be used to extend the device with 5 more relays and one more interface.

Usable interface boards

- Interface board with RS232-C interface
- Interface board with RS422 interface
- Interface board with Profibus DP interface

4 Operation

4.1 Front Panel

Fig. 4-1, 🗎 18 shows the front panel of the IM 540.

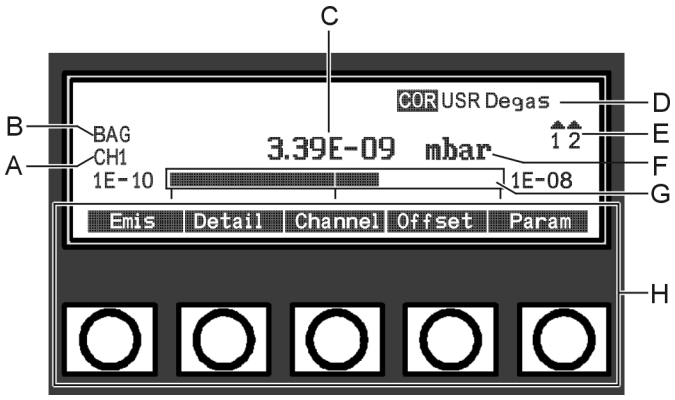

Fig. 4-1 Front panel of the IM 540 (example)

A Channel
B Sensor type
C Digital measurement display
D Status row
E Trigger relay status
F Pressure unit
G Bar graph measurement display
H Control buttons

4.1.1 Display

4.1.1.1 Status Row

The most important system states are always displayed in the top row (item D), no matter which menu is selected.

The left part of the status row displays the menu name in black letters on a white background. The right part of the status row displays the following states (from left to right) in white letters on a black background:

Field	Display	Significance
1	Emi.On	Emission is switched on
2	OFS	Offset correction for capacitive sensor is activated
3	COR	Gas type correction is programmed
4	USR	Standard parameter settings have been changed by the user
5 *	Error xy	Error no. xy has been issued • Flashing: Error has not yet been acknowledged • Static: Error has been acknowledged via the «Error» submenu. See Chapter 4.5.2 Detail Groups, 🗎 25.
	Test	Hardware test is being performed. See Chapter 7.4 Test Mode, 🗎 58.
	Degas	Sensor is being degassed (flashing)
	Offset	Offset or zero values are being determined (flashing)
	EMO	Emergency-off button has been actuated. See Chapter 4.4.6 Emergency-Off Action, 🗎 23.
	Profi	Device is controlled via Profibus. See Chapter 5.2.4 Device Control (Control), 🗎 34.
	IF300	Device is controlled via RS232 of the optional interface board. See Chapter 5.2.4 Device Control (Control), 🗎 34.
	RS232	Device is controlled via RS232 and the IM 540 protocol. See Chapter 5.2.4 Device Control (Control), 🗎 34.
	IM520	Device is controlled via RS232 and IM520 protocol. See Chapter 5.2.4 Device Control (Control), 🗎 34.
	Remote	Device is controlled via discrete remote control inputs. See Chapter 5.2.4 Device Control (Control), 🗎 34.
	(nothing)	None of the conditions mentioned above applies

Tab. 4-1 Possible display fields in the right half of the status row

** The priority of the display in field 5 corresponds with the listed order*

The fields 1…4 remain empty if the related state does not apply.

4.1.1.2 Trigger Relay Status

The states of the two trigger relays are displayed to the right of the display (item E). If the triangle above the number is illuminated, the pressure is above the lower threshold value. If the triangle below the number is illuminated, the pressure is below the upper threshold value. See Fig. 5-1, 🗎 30.

These states are only displayed if trigger relays have been selected for this. See Chapter 5.1.2 Configuring Switching Functions, 🗎 30.

4.1.1.3 Measurement Display

The current measurement is displayed digitally (item C) and as a bar graph (item G).

- Digital display: The measurement is displayed as a three-digit floating point number in scientific notation. The unit of measurement is displayed to the right: mbar, Torr, Pa, or Micron.
- Bargraph: The bar graph illustrates the increase or decrease of the measurements. The related pressure range limits can be seen at the left (lower limit) and right (upper limit) of the bar graph. Markings highlight the boundaries between decades of pressure. The unit of measurement is always identical with the digital measurement display.

4.1.1.4 Channels

The left side of the display shows both the channel (item A) and the sensor type (item B).

The following sensor types are available:

Display	Significance
EXT	Extraktor IE514
BAG	Bayard Alpert IE414
CTR	Capacitive transmitter: CTR90, CTR91
TTR	Pirani transmitter: TTR90, TTR90S

The channels 1 and 2 only accept sensors of the type BAG and EXT. Therefore the following displays are possible:

Display	Significance
BAG CH1	Channel 1 connected to a Bayard-Alpert sensor
EXT CH1	Channel 1 connected to an Extraktor sensor
BAG CH2	Channel 2 connected to a Bayard-Alpert sensor
EXT CH2	Channel 2 connected to an Extraktor sensor
TTR CH3	Channel 3 connected to a Pirani sensor
CTR CH3	Channel 3 connected to a capacitive sensor
TTR CH4	Channel 4 connected to a Pirani sensor
CTR CH4	Channel 4 connected to a capacitive sensor

Tab. 4-2 Possible display of channels

4.1.2 Control Buttons

Emi.On, Emi.Off, EM_Off, EM_Reset
This button is used for switching on and off the emission of the sensor connected to the selected channel. Switching off the sensor will also stop any running zero adjustment or degassing operation.

In the remote control state, this button is also used as an emergency-off button. See Chapter 4.4.6 Emergency-Off Action, 🗎 23.

The labeling of the button depends on the current state:

Labeling	Significance
Emi.On	Emission is switched off and can be switched on
- - - -	Emission is switched off and cannot be switched on
Emi.Off	Emission is switched on and can be switched off
EM_Off	Emergency-off. Emission has been switched on via remote control or «Auto Mode».
EM_Res	Emergency-off function can be deactivated

Channel
The channel button is used for selecting a measurement channel. This is necessary e.g. if you want to switch on or off a particular sensor.

Detail
This menu displays important parameters and error messages. In addition, you can configure the graphical display of measurements and view the related settings. See Chapter 4.5 Detail View Mode, 🗎 25.

Cmd
The Cmd button is used to display the Deg.On and Ofs.Set buttons (depending on the configuration).

With the exception of Emi.On and Emi.Off, the system returns to the measurement screen whenever a button is pressed in the command menu. The command menu can also be quit without executing a command by pressing the Return button.

Deg.On
This button is only visible in the Cmd menu.

It activates degassing of the selected sensor. The labeling of the button changes to «Deg.Off».

Ofs.Set
This button is only visible in the Cmd menu.

It activates the offset function for the selected sensor. the labeling of the button changes to «Ofs.Res».

The offset function allows you to perform a measurement with respect to a reference pressure. This also makes the zero adjustment of the sensor unnecessary.

Param
This menu is used for configuring the device. The following submenus are available for this:

Submenu	Configuration
Setpoint	Switching functions
General	General settings, interface configuration, behavior in case of an error
Sensor	Sensor parameters
Control	Sensor control
UserMode	User-defined settings
TestMode	Settings for hardware tests. This submenu is only available after activating the test mode. See Chapter 7.4 Test Mode, 🗎 58).

The related configuration parameters are described in Chapter 5 Parameters, 🗎 30.

If no button is pressed in one of the submenus within the «Timeout» period, the device returns to the measurement screen. Selected parameters (if any) will remain unchanged.

Arrow buttons (DOWN ▼ /UP ▲)
The arrow buttons are used for two different actions:

- Select the respective menu field for input of a parameter value
- Decrease or increase a default value. For this, the respective menu field must have been selected and then activated with the Enter key.

In the following, these buttons will be referred to as DOWN and UP, respectively.

Enter
The Enter button is used for two different actions:

- Activate the selected menu field which has been selected with the arrow buttons (edit mode)
- Accept the parameter value adjusted with the arrow buttons and exit the edit mode. The parameter value is stored in the EEPROM.

Return
This button is used to switch back to the previous level. The Return function cannot be executed in the edit mode.

ESC (Escape)
This button is only visible in the edit mode.

Pressing the ESC button will exit the edit mode. The parameter is reset to the value found when activating the edit mode.

4.2 Switching On and Off

4.2.1 Switching On

1 Switch the mains switch on. See Fig. 3-4, 🗎 14, item G.

After switching on, the IM 540 will perform the following actions:

- Self test
- Identify all sensors. See Chapter 2.3.5 Sensor Identification, 🗎 10).
- Restore the previously set parameters
- Activate measurement mode
- Adapt parameters (if a sensor type has changed meanwhile)

4.2.2 Switching Off

1 Switch the mains switch off. See Fig. 3-4, 🗎 14, item G.

4.2.3 Delay Time

NOTE:
After switching off, the IM 540 requires approximately 10 seconds to initialize again.
Wait for at least 10 seconds before you switch the IM 540 on again.

If the IM 540 has been installed in a control panel or a rack, it can also be switched on and off via the central power distributor.

4.3 Operating Modes

The IM 540 can be set to one of the following operating modes:

Measurement mode
The measurement mode is the standard operating mode. It displays the pressure readings of the sensors. In case of an error, a status message is displayed instead. See Chapter 4.4 Measurement Mode, 🗎 22.

Detail view mode
The detail view mode is used to display various values and error messages (if any) in a clear layout. See Chapter 4.5 Detail View Mode, 🗎 25.

Parameter mode
The parameter mode gives you access to various parameters. You can modify the parameter settings using the arrow buttons. This allows you to configure the IM 540. See Chapter 4.6 Parameter Mode, 🗎 26.

User mode
The user mode allows you to control and, if necessary, change these standard parameters. Siehe Chapter 5.6 User Parameters (UserMode), 🗎 47.

Program transfer mode
The program transfer mode is used to transfer the latest version of the firmware to the IM 540. See Chapter 7.2 Program Transfer Mode, 🗎 57.

Test mode
The test mode is used for service purposes. Here you can query and change device data and also perform device tests. See Chapter 7.4 Test Mode, 🗎 58.

4.4 Measurement Mode

4.4.1 Selecting Measurement Mode

The IM 540 automatically selects the measurement mode after it has been switched on.

From any other mode, you can return to the measurement mode by pressing the Return button once or several times.

When the device is set to the parameter mode, it will automatically return to the measurement mode if no button is pressed within the «Timeout» period.

4.4.2 Description

The measurement mode is the standard operating mode. It displays the pressure readings of the sensors. A status message is displayed if the pressure exceeds the permissible range.

Channels which are not connected to a sensor are not displayed.

4.4.3 Selecting a Channel

1 Press the Channel button

If the display is set to the automatic mode (see Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44), the automatic mode will be interrupted and the active channel is displayed. The «Auto Control» signal in the status row is dark.

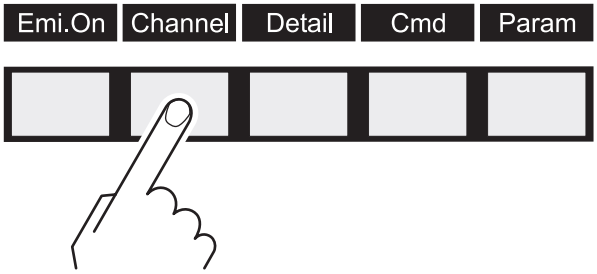

Fig. 4-2 Press the Channel button

2 Press the Channel button once or several times until the required channel is displayed

Every time the Channel button is pressed, the display changes to the next channel connected to a sensor. The channel number and the sensor type are always displayed. The automatic mode is resumed after all channels have been displayed.

4.4.4 Switching Emission On

⚠CAUTION

Excessive gas pressure.

Excessive gas pressure at the measurement position can damage the sensor.

Before switching the emission on, check to make sure that the pressure at the measurement position does not exceed the following values:

- BAG: $p \leq 9.98 \times 10^{-3}$ mbar
- Extraktor: $p \leq 9.98 \times 10^{-5}$ mbar

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press the Emi.On button

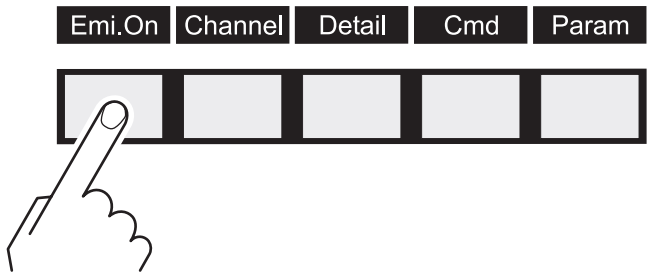

Fig. 4-3 Press the Emi.On button

- The sensor of the selected channel is switched on
- The measurement value is displayed
- The status row shows the «EMI» signal
- The button label changes to «Emi.Off»

⚠WARNING

Hazardous voltage.

As soon as the emission is switched on, both appliance plugs carry hazardous levels of voltage, even if only one measuring system is connected. Touching one of these plugs may cause serious injuries.

The device must be switched off before any work is performed to the sensor or the measuring line. After switching off, wait approx. 15 seconds before starting the work.

4.4.5 Switching Emission Off

The emission can always be switched off manually. This is also true if the device is in the remote control state.

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press the Emi.Off button

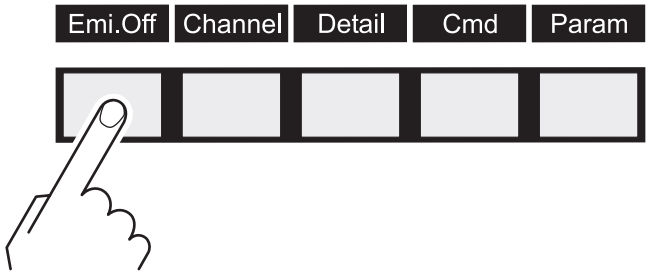

Fig. 4-4 Press the Emi.Off button

- The sensor of the selected channel is switched off
- The «EMI» signal is dark
- Switching off the emission will also stop any running zero adjustment or degassing operation
- The button label changes to «Emi.On»

4.4.6 Emergency-Off Action

If the device is in the remote control state, it can be switched off by pressing the EM_Off button. The button label then changes to «EM_Reset». See Chapter 4.4.5 Switching Emission Off, 🗎 23.

Fig. 4-5 Press the EM_Off button in the remote control state

The «EMO» signal in the status row indicates this state. See Chapter 4.1.1 Display, 🗎 18.

The emergency-off function remains active until the EM_Reset button is pressed.

4.4.7 Switching Degas Function On

Ionization sensors with a hot cathode are sensitive with regard to depositions on the electrodes. These depositions can cause signal fluctuations.

The degas function is used to bakeout and thereby clean the electrode system of the sensor.

The degas function is only available for Bayard-Alpert and Extraktor sensors. It can only be activated if the emission of the sensor is already switched on and the pressure is below the following values:

- $p < 1 \times 10^{-4}$ mbar for the Bayard-Alpert sensor
- $p < 1 \times 10^{-5}$ mbar for the Extraktor sensor

You can switch on the degas function as follows:

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press the Cmd button

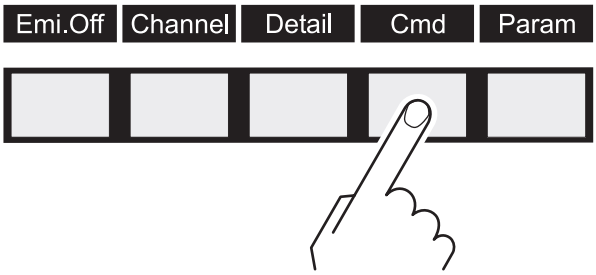

Fig. 4-6 Press the Cmd button

3 Press the Deg.On button

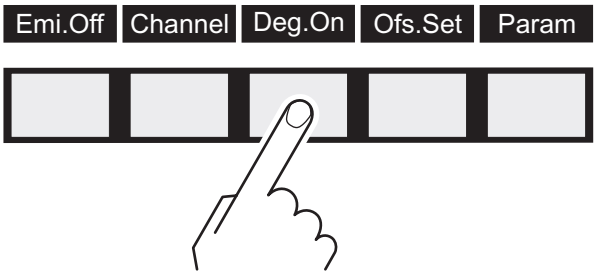

Fig. 4-7 Press the Deg.On button

- The degas function for the sensor of the selected channel is switched on
- The «Degas» signal in the status row flashes
- During degassing, pressure measurements cannot be performed. The measurement display either shows the last measurement (flashing) or «----», if no measurement is available.

4.4.8 Switching Degas Function Off

The degas function is switched off automatically after 10 minutes. You may also deactivate this function manually at any time:

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press:
- the Emi.Off button, or
- the Cmd button and then the Deg.Off button

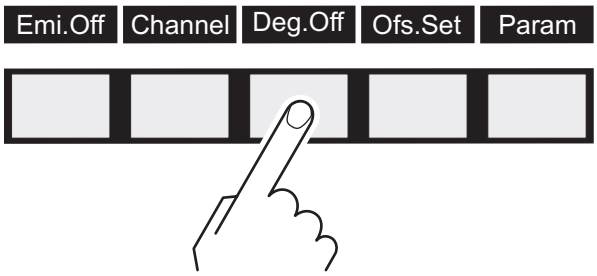

Fig. 4-8 Press the Deg.Off button

- The degas function for the sensor of the selected channel is switched off
- The «Degas» signal in the status row is dark

4.4.9 Defining and Activating Offset

The offset function is only available for ion vacuum gauges and capacitive sensors. The zero adjustment can only be performed if the emission is switched on.

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press the Cmd button (Fig. 4-6, 🗎 23)

3 Press the Ofs.Set button

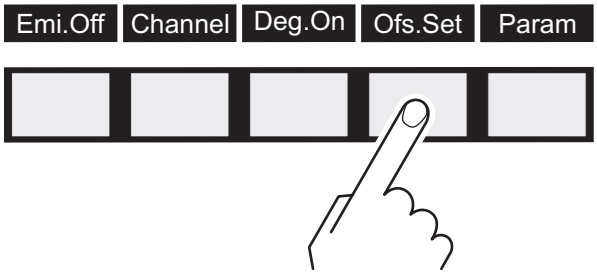

Fig. 4-9 Press the Ofs.Set button

In the case of capacitive sensors, pay attention to the following:

- When pressing the Ofs.Set button, the current pressure reading becomes the new offset value
- The stored offset value will be subtracted from all pressure readings
- The «OFS» signal in the status row is illuminated
- The «Offset» signal in the status row flashes as long as the zero adjustment is being performed

In the case of ion vacuum gauges, an offset adjustment of the current amplifier is performed instead.

The current offset values can be inspected in the detail view mode. See Chapter 4.5.2 Detail Groups, 🗎 25.

NOTE:
The zero adjustment procedure takes a few seconds. During this period, no measurements will be read and processed.
Switching off the emission will stop the zero adjustment procedure.

The zero adjustment can also be performed automatically. See Chapter 5.4.3 Automatic Offset (OFSCtrl), 🗎 43.

4.4.10 Deactivating Offset

1 Select the required channel. See Chapter 4.4.3 Selecting a Channel, 🗎 22.

2 Press the Cmd button (Fig. 4-6, 🗎 23)

3 Press the Ofs.Res button

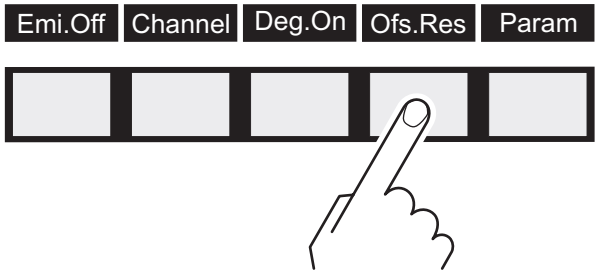

Fig. 4-10 Press the Ofs.Res button

- The offset value is reset to 0
- The «OFS» signal in the status row is dark

4.5 Detail View Mode

4.5.1 Selecting Detail View Mode

1 Press the Detail button

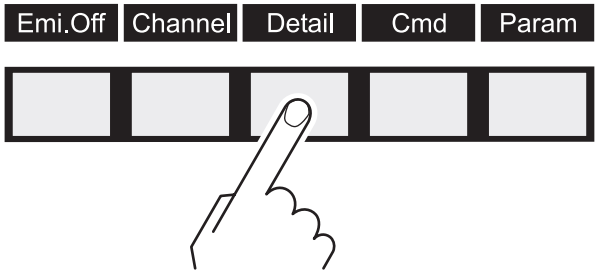

Fig. 4-11 Press the Detail button

The device changes to the detail view mode. Several groups are being offered for selection on the display. See Chapter 4.5.2 Detail Groups, 🗎 25.

You can exit the detail view mode by pressing the Return button.

4.5.2 Detail Groups

For clarity, the values displayed in the detail view mode are arranged in groups.

The following groups are available:

Error
Error messages in plain language. See Chapter 4.8 Displaying and Handling System Errors, 🗎 29.

Graphic
This group allows you to define and start one trend graphic per channel. The related graphic parameters are described in Chapter 5.5 Graphic Parameters (Detail Graphic), 🗎 46.

Pressure
Display the pressure readings for the 4 channels in the current pressure unit

Setpoint
Display all switching functions. See Chapter 5.1 Switching Function Parameters (Setpoint), 🗎 30.

Gauge
Display the following parameters of the current sensor:

Parameter	Significance
Anode	Anode voltage in V
Cathode	Cathode voltage in V
Reflector	Reflector voltage in V
Emission	Emission current in mA
U_Filam	Filament voltage in V
I_Filam	Filament current in A

The values are only displayed if the emission is switched on.

Info
Display of offset value settings, operating hours and of print data.

The following submenus are available:

Submenu	Display / function
Offset	Display the current offset value settings. Ranges: • CH1 and CH2: 0…4095 • CH3 and CH4: -3.000 V…+3.000 V (if CTR is connected) The adjustment of offset values is described in Chapter 4.4.9 Defining and Activating Offset, 🗎 24.
OPTCnt.	Operating hours of the four channels. The individual gauges are counted separately. The operating hours can be reset to zero. See Chapter 7.1.2 Resetting the Operating Hours, 🗎 57.
EMOCnt.	Number of the emergency off events in channel 1 and 2. An emergency-off event occurs if the emission must be switched off because the pressure is too high, a tolerance has been exceeded, or another error has occurred. See Chapter 5.2.7 Behavior of the IM 540 in Case of an Error (Error), 🗎 37. The device distinguishes between the following two emergency off events: • Pre.: Pressure too high • Oth.: Other reasons The values can be reset to zero. See Chapter 7.1.2 Resetting the Operating Hours, 🗎 57.

Submenu	Display / function
Miscel.	Watchdog: Cause for the most recent triggering of the watchdog • Power_fail: The device has been disconnected from the mains voltage (switched off, power failure) • Watchdog: The watchdog has responded and the device has been restarted (failure, exception,...) Total: Display the operating hours of the entire device. This value cannot be reset.
MC board (micro controller) IQ board (ion source) VP board (connection print) IV board (ion amplifier)	Display of: • HW-Vers.: Article number • Seri.No.: Serial number • Cal-Date: Calibration date • FW-Vers.: Firmware version

4.6 Parameter Mode

4.6.1 Selecting Parameter Mode

1 Press the Param button

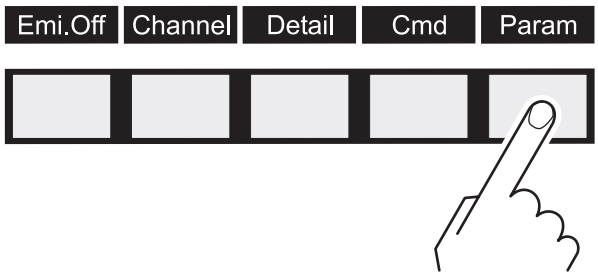

Fig. 4-12 Press the Param button

The device changes to the parameter mode. Several submenus are being offered for selection on the display. See Chapter 4.6 Parameter Mode, 🗎 26.

When the device is set to the parameter mode, it will automatically return to the measurement mode if no button is pressed within the «Timeout» period.

4.6.2 Parameter Groups

The parameter mode gives you access to various parameters. You can check the parameter settings or modify them using the arrow buttons. This allows you to configure the IM 540.

Tab. 4-3, 🗎 27 shows all available parameter groups and parameters.

Parameter group	Subgroup	Parameter
Setpoint		Setpoint Channel Display Mode Spt.Low Spt.High Trigger
General		Device Control
	Setup	Unit Torr Set.Lock Light Contrast Men.Time

Parameter group	Subgroup	Parameter
	RS232	Com.Chan Baudrate DataBits Parity Stopbits FlowCont
	Recorder	Channel Source Mode P_Low P_High Scale
	Threshold	U1_Low U1_High U2_Low U2_High
	Error	FailCont FailRel1 FailRel2 Emi.Warn Emi.Tol. Emi.Pow.
Sensor		Channel Cal_Full Filter Fil.Pow. Cor.Mode Cor.Gain
	Disp_Bar	Channel Digit Mode P_Low P_High
Control		Channel Emission OFSCtrl Mode Source P_On P_Off PIRCtrl
User Mode	Gauge	Channel Anode Cathode Emission U_A_Degas U_C_Degas I_Degas
	Amplifier	Channel Range Resolut. Time
	Config	Chan_1 Chan_2 Chan_3 Chan_4 MainFreq Interface
Test Mode	See Chapter 7.4.2 Test Parameters and Functions, 🗎 59.	

Tab. 4-3 Parameter groups and their parameters

The available parameters are subdivided into the following parameter groups:

Switching function parameters (Setpoint)
These parameters are used to assign pressure dependent switching functions to the channels. See Chapter 5.1 Switching Function Parameters (Setpoint), 🗎 30.

General parameters (General)
These parameters are used for general configuration of the device. The parameters affect all channels. See Chapter 5.2 General Parameters (General), 🗎 32.

Sensor parameters (Sensor)
These parameters concern the sensor on the currently selected channel only. There is an individual set of sensor parameters for each channel. See Chapter 5.3 Sensor Parameters (Sensor), 🗎 38.

Sensor control (Control)
These parameters are used to configure the control inputs. See Chapter 5.4 Sensor Control (Control), 🗎 42.

4.7 Basic Operation

Starting at the measurement menu, you can select and modify a specific parameter as follows:

1 Press the Param button

2 Use the arrow buttons to select the required parameter group
- Parameter groups are marked with >>>
- The selected parameter group is displayed with white letters on a black background

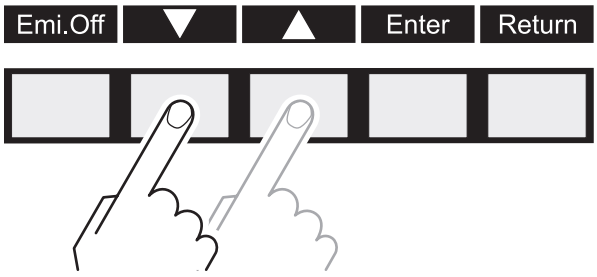

Fig. 4-13 Press the arrow buttons

3 Press the Enter button

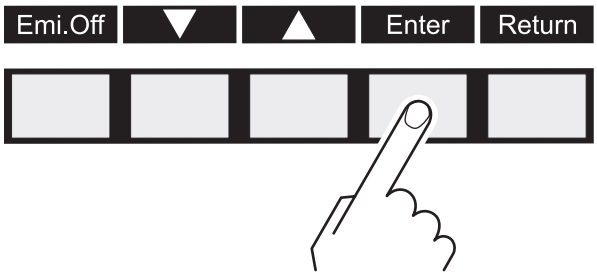

Fig. 4-14 Press the Enter button

4 In the parameter group, use the arrow buttons to select the required parameter
- The selected parameter is displayed with white letters on a black background

5 Press the Enter button
- The cursor appears at the selected parameter value
- The IM 540 is now in the edit mode. The Return button is replaced by the Escape button.

6 Use the arrow buttons to adjust the required parameter value
- The displayed parameter value is effective immediately
- The selection of a parameter value can be aborted by pressing the Escape button. This will exit the edit mode and reset the parameter to the value found when activating the edit mode.

7 Accept the selected parameter value by pressing the Enter button
- The parameter value is stored in the EEPROM
- The edit mode is quit

8 Repeat the steps 2…7 to change further parameters. In order to change to another parameter group, press the Return button to return to the next higher level.

9 Return to the measurement mode. See Chapter 4.4.1 Selecting Measurement Mode, 22.

4.8 Displaying and Handling System Errors

4.8.1 Displaying System Errors

The IM540 can store up to 20 different errors. Any error that occurs is stored in the error list, provided that it has not been stored in the list already. New errors are no longer added to the list if the list is full.

The error list is displayed in the Detail > Error menu. Selecting this menu will automatically acknowledge the current errors and the most recent error is shown in the display. The following information is displayed for errors:

No: Position number. The error that has occurred first (oldest error) has the position number 01 and is located at the end of the error list.

Code: Error code

Description: Brief description of the error in clear text

The display shows «NoErrorsPending» if the device does not hold any pending errors.

If an error occurs, the «Error» display and the related two-digit error number in the status row start flashing. If several errors occur simultaneously, the error registered most recently is displayed in the status row.

You find a list of the error codes and the related error messages in Section «Error Messages», 🗎 74.

4.8.2 Acknowledging Errors

Selection of the Detail > Error menus automatically acknowledges the error messages and the «Error xy» status stops flashing. However, the error is displayed as long as the error exists and the error message is stored in the error list.

4.8.3 Deleting Errors from the Error List

The Detail > Error menu allows you to delete entries in the error list. The error display in the status line disappears if the error list is empty.

1 Change to the detail view mode. See Chapter 4.5.1 Selecting Detail View Mode, 🗎 25.

2 Select the Error detail group and then press the Enter button
- The labeling of the Enter button changes to «Reset»

3 Use the arrow buttons to select the error message you want to delete

4 Press the Reset button
- The selected error message is deleted from the list
- If the error still exists, it is immediately added to the list as a new error
- The position numbers of the error messages that have occurred after the deleted one are decreased by one
- The display shows «NoErrorsPending» if all error messages have been deleted

5 Parameters

5.1 Switching Function Parameters (Setpoint)

This parameter group allows you to configure the switching functions. The following switching function parameters are available:

- Setpoint
- Channel
- Display
- Mode
- Spt.Low
- Spt.High
- Trigger

5.1.1 Fundamental Terms

Switching functions
The IM 540 is equipped with four relays which switch in dependence of the measured pressure. These relays will be referred to as «relay 1» and «relay 2». The number of relays can be increased to 7 by upgrading the device with an interface board. These relays will be referred to as «relay 3»…«relay 7».

Each of the relays can be assigned to any of the channels. The relay contacts are potential-free and can be used for switching via the RELAY connection and the relay connections of the optional interface board. See Chapter 3.3.6 RELAY, 🗎 16 and Chapter 3.3.9 Extension Slot (Option), 🗎 17.

Threshold values
Depending on the connected sensor, each channel covers a specific pressure range. Within this pressure range, a lower and an upper threshold value are defined in order to determine the switching behavior of the respective relay.

- Lower threshold value Spt.Low
  The lower threshold value is responsible for activating the assigned switching function. The relay switches on as soon as the pressure falls below the lower threshold value. This means that the common contact of the relay is connected to the make contact.
- Upper threshold value Spt.High
  The upper threshold value is responsible for deactivating the assigned switching function. The relay switches off as soon as the pressure rises above the upper threshold value. This means that the common contact of the relay is connected to the make contact.

Hysteresis
In the pressure range between the two threshold values, the previous relay state is maintained. The relay does not switch in this range, and the relay state depends on the pressure curve history. See Fig. 5-1, 🗎 30.

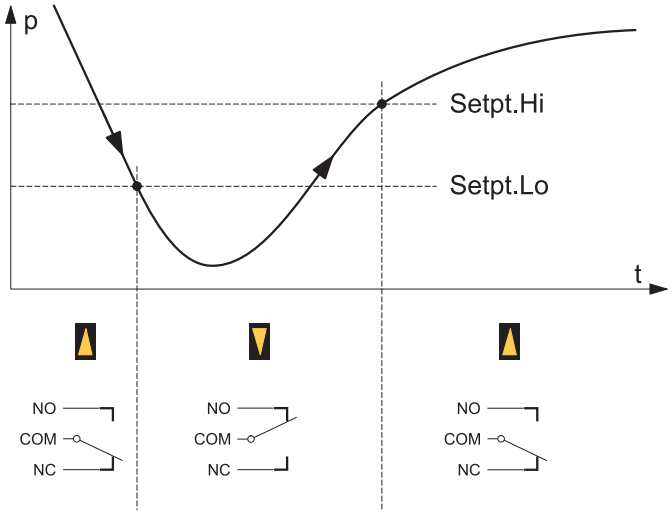

Fig. 5-1 Behavior of a switching function when the pressure changes

p Pressure
t Time
NC Normally closed contact (break contact)
NO Normally open contact (make contact)
COM Common contact

The region between the threshold values generates a hysteresis (lag) between activating and deactivating of the relay. The hysteresis prevents the switching function from rapidly switching on and off when the pressure is close to one of the threshold values.

5.1.2 Configuring Switching Functions

Prerequisite: The parameter group Setpoint is selected.

1 In the Setpoint parameter, select the relay to be configured

2 In the Channel parameter, select the channel to be assigned to the relay mentioned above

3 In the Display parameter, select if the status of the selected relay is to be displayed in the measuring screen
- Only two relay states can be displayed on the measuring screen. If you set more than two relays to «yes» in the Display parameter, the two relays with the smallest numbers will be displayed. For checking purposes, these two relay states are also displayed at the bottom of the setpoint menu.

4 Adjust the upper and the lower threshold value of the selected relay
- The threshold values depend on the connected sensor. See Section «Threshold Values, Trigger Values», 🗎 70.

5 Enable or disable the switching function of the selected relay
- If the switching function is disabled (Trigger disable), the relay status will not be displayed even if the Display parameter is set to «yes»

6 Adjust the functionality of the IM 540 using the parameter mode. See Tab. 5-1, 🗎 31.
- The default setting «IM 540» needs to be changed only if you want to operate the IM 540 in one of the two IM 520 modes.

Value	Functionality
IM 540	Switching functions as described above This value is not available if the Device parameter has been set to «IM520». See Chapter 5.2.3 Device Mode (Device), 🗎 34.
IM520_Lev	Switching functions compatible with the IM 520 in the level-trigger mode. • The relays 1 and 2 are addressed only • Both relays are independent from each other • The input fields Channel and Spt.High are irrelevant • The Display parameter is always set to «Yes» • The Trigger parameter is always set to «Enable» • The threshold value is set to Spt.Low • The hysteresis is set to 20 % of the decade value. As a consequence, Spt.High = 1.2×Spt.Low. • Only measurements from channel 1 or 2 are used as an input for the switching functions. The channel whose emission is switched on is selected automatically.
IM520_Int	Switching functions compatible with the IM 520 in the interval trigger mode: • The relays 1 and 2 are addressed only • Relay 1 is switched on if the pressure falls below Spt.Low of relay 1 • Relay 1 is switched off if the pressure exceeds Spt.Low of relay 2 • Spt.Low of relay 1 must be below Spt.Low of relay 2 • Relay 2 operates in the level-trigger mode (see above) • The input fields Channel and Spt.High are irrelevant • The Display parameter is always set to «Yes» • The Trigger parameter is always set to «Enable» • The hysteresis must be at least 20 % of the decade value • Only measurements from channel 1 or 2 are used as an input for the switching functions. The channel whose emission is switched on is selected automatically.

Tab. 5-1 Values of the switching function parameter Mode

5.1.3 Setting Range

The setting ranges for the lower and upper threshold values of a switching function are listed in Section «Threshold Values, Trigger Values», 🗎 70.

The hysteresis amounts to 10 % (IE514, IE514 and TTR90) and to 1 % (capacitive sensors) of the lower threshold value at least. If there is a conflict when adjusting threshold values, the threshold value which causes the conflict will be shifted within the permitted range.

5.2 General Parameters (General)

These parameters are used for general configuration of the device. The parameters affect all channels.

5.2.1 General Settings (Setup)

5.2.1.1 Unit of Measurement (Unit)

Unit of measurement for pressure values. The unit affects displayed pressure readings, threshold values, etc.

Display	Significance
mbar	Pressure unit mbar or bar
Torr	Pressure unit Torr
Pascal	Pressure unit Pascal
Micron	Pressure unit Micron

Tab. 5-2 Unit parameter values

The unit of measurement is shown on the display. See Fig. 4-1, 🗎 18, item F.

NOTE:
The pressure unit «Micron» is not available in the IM520 mode. Changing to this mode will automatically switch from «Micron» (if selected) to «mbar». See Chapter 5.2.3 Device Mode (Device), 🗎 34.

NOTE:
The pressure unit «Torr» can be locked. In this case Torr is not available for selection. See Chapter 5.2.1.2 Torr-Lock (Torr), 🗎 32.

5.2.1.2 Torr-Lock (Torr)

This parameter affects the general parameter Unit. If the lock is enabled, the unit of measurement «Torr» cannot be selected anymore. See Chapter 5.2.1.1 Unit of Measurement (Unit), 🗎 32.

Display	Significance
Yes	Unit of measurement «Torr» can be selected
No	Unit of measurement «Torr» cannot be selected

Tab. 5-3 Torr parameter values

Enabling the torr lock will automatically switch from «Torr» (if selected) to «mbar».

5.2.1.3 Setup Lock (Set.Lock)

The setup lock affects the parameter mode. If the lock is enabled, the user can inspect but not modify parameter settings.

Display	Significance
Enable	Setup lock is enabled. Parameters can be inspected only.
Disable	Setup lock is disabled. Parameters can be modified.

Tab. 5-4 Set.Lock parameter values

The Set.Lock parameter itself is not affected by the setup lock. It can always be modified.

5.2.1.4 Display Background Illumination (Light)

The brightness of the background illumination can be adjusted in the range 0…100 % in 1 % steps.

5.2.1.5 Display Contrast (Contrast)

The display contrast can be adjusted in the range 30…50 % in 1 % steps.

5.2.1.6 Menu Timeout (Men.Time)

The menu timeout determines the period of time after which the parameter menu switches back to the measurement screen if no button has been pressed.

Display	Significance
off	Device does not switch back automatically
10…10000 s	Period of time until switching back, adjustable in 1 second steps.

Tab. 5-5 Men.Time parameter values

5.2.2 Interface Parameters (RS232)

5.2.2.1 Interface (Com.Chan)

Interface to be configured.

Display	Significance
Standard	RS232 interface of the IM 540 standard version
IF300	RS232 interface of the optional interface board

Tab. 5-6 Com.Chan parameter values

5.2.2.2 Baud Rate (Baudrate)

Transfer rate of the RS232 interface. Nine different baud rates in the range 300…57600 baud can be selected.

5.2.2.3 Number of Data Bits (DataBits)

Number of data bits used for the transmission of a character. 7, 8 or 9 bits can be selected.

5.2.2.4 Parity Bit (Parity)

A bit which is transmitted in addition to the data bits. The parity bit is used to check the integrity of the data.

Display	Significance
None	The parity bit is not used
Odd	The parity bit is set if the number of data bits in the character is even
Even	The parity bit is set if the number of data bits in the character is odd

Tab. 5-7 Parity parameter values

5.2.2.5 Stop Bit (Stopbits)

Number of bits which are transmitted in addition to the data bits. Stop bits are used to check the proper transmission of a character. A maximum of two stop bits can be set.

5.2.2.6 Flow Control (FlowCont)

Is used to control the flow of data in order to prevent data loss.

Display	Significance
None	No flow control
Full	Full flow control
OnRec. (On Receive)	The IM540 does not react to XON/XOFF. However, it sends a XOFF after receiving an end character and a XON after executing the related command. In the IM 520, the flow control is defined as follows: • Receiving XOFF: Transmit Interrupt disabled. No more data will be sent. • Receiving XON: Transmit Interrupt enabled. The remaining data will be sent. • Sending XOFF: After receiving an end character • Sending XON: After processing a command If no data exchange takes place, a XON is sent every 2 seconds if handshake is switched on.

Tab. 5-8 FlowCont parameter values

5.2.3 Device Mode (Device)

The IM 540 can be operated in the IM 540 standard mode as well as in the IM 520 compatibility mode. This allows replacement of an IM 520 by an IM 540 at any time and without the need for changes in the software.

Display	Significance
IM540	The IM 540 is in the standard mode. The Control parameter setting (see Chapter 5.2.4, 🗎 34) determines how the device is controlled.
IM520	The IM 540 is in the IM 520 compatibility mode. The device can only be controlled remotely via the CONTROL input or the standard RS232 interface. The Control parameter (see Chapter 5.2.4, 🗎 34) is no longer available. When selecting this mode, the following settings are made automatically: • The functionality mode changes to «IM520_Lev». See Chapter 5.1.2 Configuring Switching Functions, 🗎 30. • The recorder output channel is set to «IM520_Au». See Chapter 5.2.5.1 Output Channel (Channel), 🗎 35. • The parameters for the RS232 interface are set to the IM 520 compatible default values • The control mode is set to «Manual». See Chapter 5.2.4 Device Control (Control), 🗎 34. • The pressure unit is set to «mbar» • The Pirani mode is set to «Disable». See Chapter 5.4.7 Pirani Mode (PIRCtrl), 🗎 45. • The error signal relay is assigned to channel 1. See Chapter 5.2.7.2 Error Signal Relays (FailRel1, FailRel2), 🗎 37. • The error signal relay 2 is assigned to channel 2. See Chapter 5.2.7.2 Error Signal Relays (FailRel1, FailRel2), 🗎 37. • The Spt.High value is set to 1.2×Spt.Low. See Chapter 5.1.2 Configuring Switching Functions, 🗎 30.

5.2.4 Device Control (Control)

The Control parameter determines how the IM 540 is operated and controlled. This parameter is only available in the standard operating mode.

Display	Significance
Manual	Operation and control via: • Buttons • CONTROL interface (Analog Remote, Digital Remote)
IF300	Operation and control via: • Buttons • RS232 interface of the optional interface board The status row displays «IF300». The buttons (except for emergency-off) can be locked via RS232.
RS232	Operation and control via: • Buttons • Standard RS232 interface The status row displays «RS232». The buttons (except for emergency-off) can be locked via the RS232 interface.

Tab. 5-9 Control parameter values

5.2.5 Recorder Outputs (Recorder)

The IM 540 is equipped with two recorder outputs which can be configured.

The recorder output voltage is kept at a constant level during the following actions:

- Switching the measuring system (to IM 520 compatibility mode and back)
- Zero adjustment (Offset)
- Degassing (Degas)
- Switching the measuring range

In these cases, the most recent valid reading is flashing in the display.

5.2.5.1 Output Channel (Channel)

Recorder output to be configured. You can select between the two recorder outputs Record_1 and Record_2 or one of the following compatibility settings.

IM520_Au
Compatibility mode for IM520 with autorange. This means:

- Only measurements from channel 1 or 2 are output. The channel whose emission is switched on is selected automatically.
- The output voltage is proportional to the mantissa of the pressure
- The Record_1 output is always used as a linear output
- The Record_2 output is always used as a logarithmic output. The voltage range 0…10 V is equivalent to the pressure range 1×10^{-12}…1×10^{-2} mbar (1 volt per decade)
- The Channel parameter is always set to «Channel 1»
- The Source parameter is irrelevant
- The Scale parameter is always set to «lin»
- The P_Low and P_High parameters are irrelevant

IM520_Fi
Compatibility mode for IM 520 with a fixed range. This means:

- Only measurements from channel 1 or 2 are output. The channel whose emission is switched on is selected automatically.
- The upper limit of the pressure range is specified with the parameter P_High. In this case, the exponent of the parameter specifies the decade whose end value is equivalent to an output signal of 10 V.
- The output voltage is proportional to the pressure in the specified pressure range. The output voltage is limited to 10.2 V if the pressure gets higher.
- The Record_1 output is always used as a linear output
- The Record_2 output is always used as a logarithmic output. The voltage range 0…10 V is equivalent to the pressure range 1×10^{-12}…1×10^{-2} mbar (1 volt per decade)
- The Channel parameter is always set to «Channel 1»
- The Source parameter is irrelevant
- The Scale parameter is always set to «lin»
- The P_Low parameter is irrelevant

If the device mode is set to «IM 520» (see Chapter 5.2.3 Device Mode (Device), 🗎 34), the Channel parameter is set to «IM520_Au» automatically and only the two compatibility settings are available for selection.

5.2.5.2 Measuring Channel (Source)

Measuring channel which is assigned to the selected recorder output. In addition to the measuring channels listed in Tab. 4-2, 🗎 19, the following settings are available:

Display	Significance
1–No_Sen	Measuring channel 1 without sensor
2–No_Sen	Measuring channel 2 without sensor
3–No_Sen	Measuring channel 3 without sensor
4–No_Sen	Measuring channel 4 without sensor
Auto	This value is only available if the Mode parameter has been set to «Auto». See Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44. In this case, the sensors and the measuring range are specified by the combination of the sensors defined in the automatic run. When switching from one gauge to the next one, the last valid value is output until valid readings are available from the new gauge.

5.2.5.3 Pressure Range (Mode)

The Mode parameter is used to specify the pressure range used for the output. Within the specified pressure range, the recorder output voltage is proportional to the pressure. The pressure range limits are equivalent to output voltages of 0 and 10 volts. An output voltage between 10.5 and 11 volts indicates a fault.

Display	Output
Full	The entire pressure range of the selected sensor is transformed to an output voltage of 0…10 V. If «Auto» has been selected for the sensor activation mode, this range is defined by the sum of all gauges in the automatic run. See Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44.
Expo	The exponent of the current reading is output with 0.5 V per decade according to the equation U = 0.5 V(exp+14). This scaling is independent of the Scale parameter. See Chapter 5.2.5.5 Characteristic Curves (Scale), 🗎 36.
Auto	Use the pressure decade containing the current pressure reading
User	The pressure range specified by the «P_Low» and «P_High» parameters is transformed to an output voltage of 0…10 V. See Chapter 5.2.5.4 Pressure Range Limits (P_Low, P_High), 🗎 36.

Tab. 5-10 Mode parameter values

5.2.5.4 Pressure Range Limits (P_Low, P_High)

The P_Low and P_High parameters specify the pressure range limits in the user mode. See Chapter 5.2.5.3 Pressure Range (Mode), 🗎 35.

The adjustable ranges for the lower and upper range limits are described in Section «Threshold Values, Trigger Values», 🗎 70.

The distance of the range limits must amount to 10 % of the lower limit at least. If there is a conflict when adjusting range limits, the range limit which causes the conflict will be shifted within the permitted range.

5.2.5.5 Characteristic Curves (Scale)

Fundamentally, we have to distinguish between logarithmic and linear characteristic curves.

Display	Significance
lin	A linear characteristic curve is useful if the pressure range covers only a few orders of magnitude in the measurement. In this case the recorder output voltage is proportional to the pressure value. 10 volts relate to the upper limit, 0 V to the lower limit of the pressure range.
log	A logarithmic characteristic curve is useful if the pressure range covers several orders of magnitude in the measurement. In this case it is appropriate to take the logarithm of the pressure and then scale the result in a suitable manner. The range limits are defined by output voltages of 0 and 10 volts.

5.2.6 Threshold Values (Threshold)

The two «Analog Remote» remote control inputs of the CONTROL connection can be used to switch the emission on and off via an external voltage signal. The switching points are adjusted via the parameters of the Threshold submenu.

Display	Significance
U1_Low	Lower threshold voltage for channel 1
U1_High	Upper threshold voltage for channel 1
U2_Low	Lower threshold voltage for channel 2
U2_High	Upper threshold voltage for channel 2

For both inputs, the emission is switched on if the input voltage is falling below the lower threshold value (pressure drop) and switched off if the input voltage is rising above the upper threshold value.

The setting range is 0.00…10.00 volts. The difference between the upper and the lower threshold level must be 50 mV at least. If there is a conflict when adjusting threshold values, the threshold value which causes the conflict will be shifted within the permitted range.

5.2.7 Behavior of the IM 540 in Case of an Error (Error)

The behavior of the IM 540 in special or error situations can be configured by the user.

Fundamentally, three types of errors must be distinguished:

Error type	Risk	Reaction
Fatal	High	Emission is switched off Error relay is activated Error message is generated
Warning	Moderate	Warning or error message is generated The action according to the «Emi.Warn» setting is executed. See Chapter 5.2.7.3, 37.
NoReact.	Low	No reaction (no message, emission is not switched off, error relay is not activated)

5.2.7.1 Automatic Sensor Switching in Case of an Error (FailCont)

Display	Significance
Enable	Failure of a Bayard-Alpert or Extraktor sensor causes automatic switching to the other sensor. However, it is not possible to switch from a Bayard-Alpert sensor to an Extraktor sensor if the last valid pressure reading is $\geq 10^{-4}$ mbar.
Disable	No automatic switching

The originally selected parameter value is preserved after automatic sensor switching has been triggered. It will be restored after the faulty sensor has been replaced, the device reset (mains switch turned off and on), and two working sensors are found at the IM 540.

5.2.7.2 Error Signal Relays (FailRel1, FailRel2)

The two error signal relays can be assigned to the four measurement channels as follows:

Display	Significance
Chan_1	Error signal relay switches off if an error occurs in channel 1
Chan_2	Error signal relay switches off if an error occurs in channel 2
Chan_3	Error signal relay switches off if an error occurs in channel 3
Chan_4	Error signal relay switches off if an error occurs in channel 4
Chan.1–4	Error signal relay switches off if an error occurs in any of the four channels
Global	Error signal relay switches off if any device error occurs
None	Error signal relay is always switched on

In this case, the relay position is linked to the state of the measuring system as follows:

Relay	Assigned measuring system
Switched off	Ready for operation
Switched on	Operational fault

5.2.7.3 Emission Shutdown in Case of an Error (Emi.Warn, Emi.Tol, Emi.Pow)

Emi.Warn
If a «fatal error» occurs, the emission is switched off on principle. The response to a «warning error», however, can be configured.

Display	Significance
LeaveOn	Emission remains switched on. The error signal relay is not activated. Exception: The value «Global» has been assigned to the error signal relay. See Chapter 5.2.7.2 Error Signal Relays (FailRel1, FailRel2), 37
Swit.Off	Emission is switched off. The error signal relay is activated. This event is considered an emergency off. See Section «Info», 25.

Emi.Tol
The following sensor parameters are monitored constantly during operation:

- Anode voltage
- Cathode voltage
- Reflector voltage
- Emission current
- Filament voltage
- Filament current
- Filament power
- Output signal of the emission current regulator

Two tolerance ranges are defined for each parameter. No error is reported within the first tolerance range. If the value is outside of the first but still inside of the second tolerance range, one can select from the three possible types of error (Fatal, Warning, NoReact.).

If the value is outside of the second tolerance range, a «fatal error» is issued on principle.

Emi.Pow
The voltage of the power supply, its temperature and the electrically isolated peripheral voltages are monitored. The case that one or more voltages are outside of the tolerance range or that the power supply is too hot can be assigned to one of the three types of error via the «Emi.Pow» parameter.

If the power supply gets too hot, the supply voltage for the channels 3 and 4 will be switched off on principle. A warning or error message is generated even if the value «NoReact.» has been selected. If this message is deleted from the error list, the supply for the channels 3 and 4 is switched on again. However, the emission is not switched on again automatically if it has been shut down.

5.3 Sensor Parameters (Sensor)

There is an individual set of sensor parameters for each channel.

The number of available parameters depends on the sensor type which is connected to the selected channel. See Tab. 5-11, 🗎 38.

Sensor	Cal_Full	Filter	Disp_Bar	Fil.Pow.	Cor.Mode	Cor.Gain	Corr.Gas
IE 514	✓	✓	✓	✓	✓	✓	✓
IE 414	✓	✓	✓	✓	✓	✓	✓
CTR (all)	✓	✓	✓		✓	✓	✓
TTR90		✓	✓		✓	✓	✓

Tab. 5-11 Available sensor parameters

5.3.1 Measuring Channel (Channel)

Before a sensor can be configured, you have to select the channel to which the sensor is connected. This is done with the Channel parameter.

Display	Significance
1–BAG	Channel 1 connected to a Bayard-Alpert sensor
1–EXT	Channel 1 connected to an Extraktor sensor
2–BAG	Channel 2 connected to a Bayard-Alpert sensor
2–EXT	Channel 2 connected to an Extraktor sensor
3–TTR	Channel 3 connected to a Pirani sensor
3–CTR	Channel 3 connected to a capacitive sensor
4–TTR	Channel 4 connected to a Pirani sensor
4–CTR	Channel 4 connected to a capacitive sensor

Tab. 5-12 Channel parameter values

5.3.2 Sensitivity Adjustment (Cal_Full)

In this menu you can adjust the sensitivity of the sensors.

The sensitivity is adjusted via the respective sensor constant (IE514, IE414) or the measuring range (CTR). It is not possible to adjust the sensitivity for Pirani sensors.

Sensor constant (IE414, IE514)
The following values can be input for the sensor constant:

Sensor	Range ($mbar^{-1}$)	Resolution ($mbar^{-1}$)
IE514	1.00…20.00	0.01
IE414	5.00…30.00	0.01

The ion current i^+, emission current i^-, sensor constant C and the pressure p are related with each other as follows:

$$\frac{i^+}{i^-} = C \times p$$

Measuring range (CTR)
In the case of a capacitive sensor, select its upper measuring range limit. See Chapter 2.3.3 Measuring Ranges, 🗎 9.

5.3.3 Measurement Filter (Filter)

The filter improves measurements if the signal is noisy or disturbed. The filter affects the readings on the display, all interface outputs (RS232, Profibus), the recorder outputs and the switching functions. If selected, a filter is active in the entire pressure range.

The same filter settings are available for all sensors. The filter time constant, however, depends on the connected sensor.

The filter can be set to one of the following values:

None (n = 1)
The filter is deactivated.

Fast (n = 5)
The IM 540 responds quickly to signal changes. This makes it rather sensitive to signal noise.

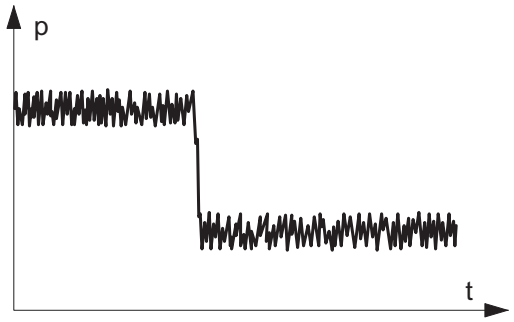

Fig. 5-2 Filter set to «Fast» (example)

Normal (n = 15)
This is the default setting. It offers a good compromise between the response time and the sensitivity to noise.

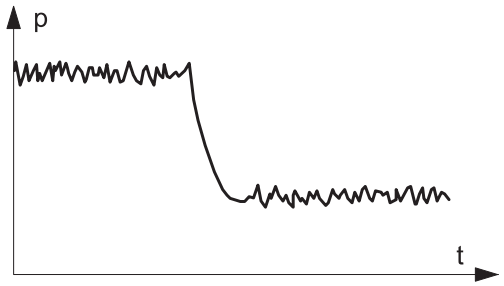

Fig. 5-3 Filter set to «Normal» (example)

Slow (n = 50)
The IM 540 responds slowly to signal changes. This makes it less sensitive to signal noise. This setting is recommended for precise comparison measurements.

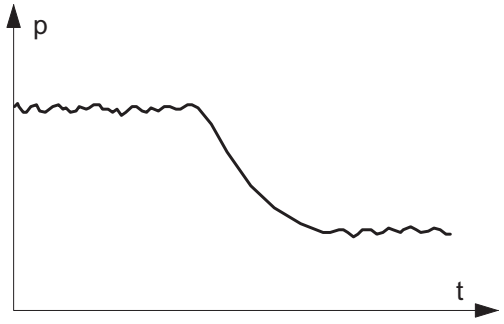

Fig. 5-4 Filter set to «Slow» (example)

5.3.4 Display, Bargraph (Disp_Bar)

In this submenu you can configure the display and the bar graph.

Measuring channel (Channel)
Before a sensor can be configured, you have to select the channel to which the sensor is connected. This is done with the Channel parameter. See Tab. 5-12, 🗎 38.

Number of digits (Digit)
The display of readings can be configured to a precision of up to five digits.

Display	Significance
Auto	Automatic setting
1	One digit e.g. 2E-1 or 400
2	Two digits e.g. 2.5E-1 or 370
3	Three digits e.g. 2.47E-1 or 373
4	Four digits e.g. 2.473E-1 or 373.2
5	Five digits e.g. 2.4733E-1 or 373.19

Bar graph scaling (Mode)
The pressure range to be displayed by the bar graph is configured with the Mode parameter. The following values are available:

Display	Significance
Full	Entire pressure range of the selected sensor
Auto	Use the pressure decade containing the current pressure reading
Auto_2	Similar to «Auto», but use a range of two decades
Auto_3	Similar to «Auto», but use a range of three decades
User	Pressure range specified by the «P_Low» and «P_High» parameters. See Chapter 5.2.5.4 Pressure Range Limits (P_Low, P_High), 🗎 36.

Tab. 5-13 Mode parameter values

Bar graph range limits (P_Low, P_High)
P_Low and P_High parameters specify the pressure range limits in the user mode. They depend on the respective sensor. See Section «Threshold Values, Trigger Values», 🗎 70.

Decades between P_Low and P_High are always displayed logarithmically. The length of the bar graph within the current decade is always displayed in a linear manner.

5.3.5 Filament Power Control (Fil.Pow)

The filament power control steps in if a pressure surge occurs or if the gauge is switched on at a gas pressure that is too high. However, the measured filament power also contains the power consumed by the sensor cable. If a long measuring cable or extension cable is used, the power loss along the cable can approach the actual filament power.

The «Fil.Pow» parameter is used to define the monitoring limits for the filament power. See Chapter 5.2.7.3 Emission Shutdown in Case of an Error (Emi.Warn, Emi.Tol, Emi.Pow), 🗎 37.

The setting range is between 1.0 W and 15.0 W.

5.3.6 Automatic Gas Type Correction (Cor.Mode)

Sensors are normally calibrated for a measurement in nitrogen or in air. If pressure measurements are being performed with other gases, is necessary to correct the reading accordingly.

The Cor.Mode parameter is used to adjust the correction factor for the respective gas type. The actual pressure is obtained by multiplying the measured pressure with the correction factor.

The gas type correction becomes a function of the pressure if the pressure exceeds 0.5 mbar. This fact is taken into consideration for all gas types that can be selected.

Display	Significance
None	No gas type correction
Ar, H_2, He, Ne, Kr, Xe, CO_2	Automatic gas type correction with a gas type specific correction factor. The status row displays the «COR» signal for the respective channel.
User	Automatic gas type correction according to correction factors input by the user. See Chapter 5.3.8 User-Defined Correction Factors (Corr.Gas), 🗎 41.

Tab. 5-14 Cor.Mode parameter values

5.3.7 Additional Correction Factor (Cor.Gain)

In special cases, a pressure-independent additional correction of the measured pressure may be wanted. The Cor.Gain parameter can be used to define the required correction factor in the range 0.10…9.99. The actual pressure results from a multiplication of the measured pressure with the correction factor.

If a value other than 1.00 is selected, the «COR» signal is illuminated for the related channel.

The correction factor affects all values and function (display, setpoints, RS232, etc.) on principle.

5.3.8 User-Defined Correction Factors (Corr.Gas)

The IM 540 allows you to define your own correction factors. The correction factors are based on a table of anchor points. Each anchor point consists of a pressure value (Press) and the related correction factor (Factor). Linear interpolation is used between neighboring anchor points if necessary.

The user-defined correction factors will be applied to the measurements if you set the Cor.Mode parameter to «User». See Chapter 5.3.6 Automatic Gas Type Correction (Cor.Mode), 🗎 40.

The correction factor affects all values and function (display, setpoints, RS232, etc.) on principle.

NOTE:
The user-defined correction factors are preserved even if the entire device is reset to the default parameters. See Chapter 7.3 Starting the IM 540 With Default Parameters, 🗎 58.

5.3.8.1 Defining Anchor Points

A maximum number of 50 anchor points can be input per table. An anchor point can be selected via its index.

Anchor points may be input in arbitrary order. Proceed as follows:

1 Switch the Channel parameter to the edit mode

2 Use the arrow buttons to select the channel for which the anchor points are to be defined. Then press the Enter button.

3 The values of the anchor point with the index number 1 are displayed

4 Switch the Factor parameter to the edit mode

5 Use the arrow buttons to select a correction factor. Then press the Enter button.
- You can adjust the correction factors in the range 0.100…9.999

6 Switch the Pressure parameter to the edit mode

7 Use the arrow buttons to select a pressure value for the anchor point. Then press the Enter button.
- The range of pressure values is identical with the measuring range of the connected sensor. See Chapter 2.3.3 Measuring Ranges, 🗎 9.

8 Press the Enter button
- The first anchor point is defined
- The index number is automatically increased by one
- The parameter index is in the edit mode

9 Press the Enter button

10 Repeat steps 3…8 to define more anchor points

If the maximum permitted number of anchor points has been reached, the message «Table full» will be shown instead of a selection for the correction factor.

NOTE:
If two different factors are input for the same pressure value, the last input will overwrite the first one.

5.3.8.2 Locating Defined Anchor Points

The defined anchor points can be located easily by keeping an arrow button pressed and scrolling through the pressure values. Scrolling is stopped whenever an anchor point is found. In order to continue scrolling, release the arrow button and then press it again.

5.3.8.3 Deleting Single Anchor Points

If you want to delete a single anchor point, proceed as follows:

1 Use the Index parameter to select the anchor point to be deleted

2 Switch the Factor parameter to the edit mode

3 Press one of the arrow buttons and hold it until the input field displays «Clear»
- «Clear» is displayed after the lower limit (0.100) or the upper limit (9.999) of the setting range has been exceeded

4 Press the Enter button

The anchor point is deleted from the table.

5.3.8.4 Deleting all Anchor Points from the Table

If you want to delete all anchor points from the table, proceed as follows:

1 Switch the Channel parameter to the edit mode

2 Use the arrow buttons to select the channel whose table is to be deleted. Then press the Enter button.

3 Switch the ClearAll parameter to the edit mode

4 Use the arrow buttons and select «Yes». Then press the Enter button.

All anchor points of the table are reset to the default values.

5.3.8.5 Automatic Check of the Correction Table

If the device starts up or recognizes a new sensor, it first checks if the correction table of the respective channel has already been edited. The result of this check determines the further settings:

- Correction table has not been edited:
  The table is initialized with the default values for the recognized sensor
- Correction table has been edited:
  The device checks if the table is suitable for the connected sensor. If this is not the case, an error message is output and the Cor.Mode parameter is set to «None». See Chapter 5.3.6 Automatic Gas Type Correction (Cor.Mode), 🗎 40. Any attempt to set the Cor.Mode parameter to «User» also causes an error message.

5.4 Sensor Control (Control)

The IM 540 offers several ways of operation and remote control. See Chapter 5.2.4 Device Control (Control), 🗎 34. The Control menu allows you to adjust the required control input configuration.

5.4.1 Measuring Channel (Channel)

In addition to the channels described in Chapter 4.1.1.4 Channels, 🗎 19, additional values are available for the Channel parameter to ensure compatibility with the IM 520:

Display	Significance
IM520_No	The IM 540 is controlled using the IM 520 mode. Equivalent to the IM 520 remote control mode with EC = 0. This setting only makes sense in combination with the Pirani mode. See Chapter 5.4.7 Pirani Mode (PIRCtrl), 🗎 45.
Analog	Emission is switched on and off according to the voltage at the «Analog Remote» input. Equivalent to the IM 520 remote control mode with EC = A. See Chapter 5.2.6 Threshold Values (Threshold), 🗎 36.
Contact	Emission is switched on if the contact of the respective «Digital Remote» input is closed. It is switched off if the contact is open. Equivalent to the IM 520 remote control mode with EC = C.
Ana+Con	Logical AND operation of the Analog and Contact functions. Emission is switched on only if the prerequisites are met for both functions. Equivalent to the IM 520 remote control mode with EC = b.

For compatibility with the IM 520, a Bayard-Alpert sensor must be connected to channel 1 and an Extractor sensor to channel 2.

Each of the channels 1 and 2 is equipped with an analog and a digital control input. The sensors connected to the channels 3 and 4 cannot be switched on or off.

The following rules apply if one of the IM 520 remote control modes (Analog, Contact or Ana+Con) is activated:

- The status row displays «Remote»
- In the Sensor Control menu, only the P_On, P_Off and PIRCtrl are available. See Chapter 5.4 Sensor Control (Control), 🗎 42.
- If a CTR sensor is connected to channel 3 or 4, it will be switched to «Manual». See Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44.
- If a Pirani sensor is connected to channel 3 or 4, it will be switched to «Hot». See Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44.
- The values of P_On and P_Off are stored in the parameter set of channel 1. For this reason, the limits of the sensor on channel 1 apply to P_On and P_Off.
- The emission can no longer be switched on via the buttons. The EM_Off button, however, still acts as an emergency-off button. The emergency-off state can be reset via the EM_Reset button, and the remote control continues controlling the emission.

Rules for Switching On/Off in the Compatibility Mode

- The Pirani mode, if activated, will set the preconditions for switching on via «Remote». This means that it signals clearance for switching on, but it does not switch on by itself.
- If two different sensors (Bayard-Alpert and Extraktor) are connected and both of them are switched on via «Remote», the Extraktor sensor will take priority over the Bayard-Alpert sensor. If the Extraktor sensor should fail, the device will automatically switch to the Bayard-Alpert sensor.
- The following rules for switching on/off apply if two identical sensors are connected:
  - Two Bayard-Alpert sensors:
    The «Analog Remote Channel 2» input is disabled, i.e. «Analog Remote Channel 1» can only be used to switch on/off the sensor on channel 1
  - Two Extraktor sensors:
    The «Analog Remote Channel 1» input is disabled, i.e. «Analog Remote Channel 2» can only be used to switch on/off the sensor on channel 1
- The «Digital Remote» input works normally, i.e. «Digital Remote Channel 1» will switch on/off the sensor on channel 1, and «Digital Remote Channel 2» will switch on/off the sensor on channel 2
- In case of a conflict (both channels switched on), channel 1 will gain priority
- If the sensor on channel 1 should fail, the device will automatically switch to the sensor on channel 2

5.4.2 Switching the Emission Current (Emission)

The Emission parameter is only offered for channel 1 or 2, and only if a Bayard-Alpert sensor is connected.

Display	Significance
Auto	The emission current is switched automatically depending on the pressure range. See Chapter 2.3.2.1 IONIVAC Sensors, 🗎 8.
0.1 mA 1.0 mA 10 mA	The emission current is kept at the specified value over the entire pressure range. The «USR» signal is displayed in the status row.

⚠CAUTION

Excessive emission current.

A high emission current at relatively high pressure levels can damage the sensor.

Only set the emission current to a fixed value if you can be sure that the sensor will operate at sufficiently low pressure levels. See Chapter 2.3.2.1 IONIVAC Sensors, 🗎 8.

5.4.3 Automatic Offset (OFSCtrl)

This menu is only offered for channel 3 and 4, and only if a capacitive sensor is connected.

Display	Significance
Enable	Offset control enabled. The «OFS» signal is displayed in the status row.
Disable	No automatic offset control

If the offset control is enabled, the offset of the capacitive sensor is adjusted automatically. When crossing below or above a pressure limit which is at least 2 decades below the lower measuring limit of the sensor, the offset value of the sensor is measured and stored.

Even if this automatic function is switched on, a manual zero adjustment can be performed at any time. See Chapter 4.4.9 Defining and Activating Offset, 🗎 24. The most recently stored offset value is always valid.

5.4.4 Sensor Activation Mode (Mode)

The sensors can be switched on in different ways:

Manual
Emission is switched on and off by pressing the Emi.On and Emi.Off buttons, respectively. Except for monitoring of the upper pressure range for Bayard-Alpert and Extraktor sensors, there is no automatism for switching on and off.

This value is available for all channels.

Self (Selfcontrol)
This value is only available for the channels 1 and 2. These channels are always monitored for a maximum pressure of:

- 1×10^{-4} mbar for the Extraktor sensor
- 1×10^{-2} mbar for the Bayard-Alpert sensor

The Selfcontrol function allows you to move this pressure limit to a lower value. In this case the sensor will monitor itself, i.e. if the pressure exceeds the value P_Off, the emission will be switched off. See Chapter 5.4.6 Activation and Deactivation Values (P_On, P_Off), 🗎 44. The sensor must then be switched on manually or via the interface.

Auto
The sensors are switched on and off automatically.

For switching the emission on, the pressure of the gauge specified under «Source» is evaluated. See Chapter 5.4.5 Activation Source (Source), 🗎 44. If the pressure falls below the value P_On, the emission is switched on. If the pressure rises above the value P_Off, the emission is switched off again. At the same time, the sensor which earlier switched on the emission is switched on again. See Chapter 5.4.6 Activation and Deactivation Values (P_On, P_Off), 🗎 44.

In addition to the emission, the display is controlled as well. The displayed pressure always relates to the sensor which is currently being used for pressure measurements. Pirani and capacitive sensors, which are always performing measurements, are also switched on and off with this regard.

Hot
This value is only available for the channels 3 and 4.

After the device has been switched on, the sensor is switched on and the measured pressure is displayed. However, this is only done if automatic control has not been selected. Otherwise the automatic control has priority.

The «Hot» value can only be assigned to one of the two channels. If a conflict occurs, the current input will be accepted and the other one is deleted. After switching off the emission on channel 1 or 2, the «hot channel» is displayed automatically.

5.4.5 Activation Source (Source)

The Source parameter is used to specify the channel which is used for switching on/off the sensor selected in «Channel».

The Source function is subject to the following restrictions:

- A sensor cannot be switched on by itself. For this reason, the respective channel is not available for selection.

Sensors on the channels 1 and 2:

- One of the sensors can be switched on via channel 3 or 4. This selection cannot be made for the other sensor because there is only one voltage supply for both channels. If a conflict occurs, the current input will be accepted and the other one is deleted.
- One of the two sensors can be switched on by the other one. However, the sensors cannot control each other mutually because only one can be switched on at a time. If a conflict occurs, the current input will be accepted and the other one is deleted.

Sensors on the channels 3 and 4:

- One of the two sensors can be switched on by the other one. However, the sensors cannot switch on each other mutually. If a conflict occurs, the current input will be accepted and the other one is deleted.
- The sensors cannot be switched via the channels 1 and 2. For this reason, only the values «Chan_3» and «Chan_4» are available for selection.

NOTE:
Also note the rules for switching on/off in the compatibility mode. See Chapter 5.4.1 Measuring Channel (Channel), 🗎 42.

5.4.6 Activation and Deactivation Values (P_On, P_Off)

If the pressure falls below the activation value P_On, the respective sensor is switched on. If the pressure rises above the deactivation value P_Off, the respective sensor is switched off.

The setting ranges for the P_On and P_Off parameters are listed in Section «Pressure Range Limits», 🗎 70.

The minimum distance amounts to 10 % (IE514, IE514 and TTR90) and to 1 % (capacitive sensors) of the activation value at least. If there is a conflict when adjusting activation and deactivation values, the value which causes the conflict will be shifted within the permitted range.

5.4.7 Pirani Mode (PIRCtrl)

The PIRCtrl parameter is only available if «Channel» is set to one of the four IM 520 compatibility modes.

Display	Significance
Disable	Pirani mode is disabled
Chan_3	Emission can only be switched on if the pressure reading on channel 3 is below P_On. Emission will be switched off again if the pressure reading exceeds P_Off.
Chan_4	Emission can only be switched on if the pressure reading on channel 4 is below P_On. Emission will be switched off again if the pressure reading exceeds P_Off.

When activating the Pirani mode, P_On is automatically set to 5.00×10^{-3}, and P_Off to 1.00×10^{-2}. These values agree with the settings of the IM 520. They can be changed in the IM 540.

The Pirani mode, if activated, will set the preconditions for switching on via the buttons, RS232, Profibus or remote control. This means that it signals clearance for switching on, but it does not switch on by itself. However, the emission is switched off directly.

If the sensor connected to channel 3 or 4 fails while the emission is switched on, the emission will not be switched off.

The activation mode of a Pirani sensor which has been activated via PIRCtrl is set to «Hot» automatically. The activation mode of a capacitive sensor (if present) will then be set to «Manual» automatically. See Chapter 5.4.4 Sensor Activation Mode (Mode), 44.

5.5 Graphic Parameters (Detail Graphic)

5.5.1 Parameters and Functions

The Detail > Graphic menu is used to adjust parameters for the trend graphic and to start recording a graphic.

Value	Display/ Selection	Significance
Channel	1–BAG, 1–EXT 2–BAG, 2–EXT 3–TTR, 3–CTR 4–TTR, 4–CTR	Selection of a channel whose trend graphic is to be specified or displayed
Command	Ready	Ready for recording of a graphic
	Start_fix	The trend graphic runs for the time specified under «Time» and then stops automatically
	Start_var	The trend graphic always covers the period specified under «Time». The graphic runs until it is stopped with «Stop».
	Stop	Stops the running recording. The recording so far is still displayed.
	Clear	Delete the current or the most recent recording. A running recording is stopped.
Status	Idle Running	Current state of the trend graphic: • Recording of a graphic can be started • Running: Recording of a graphic is running
P_Low	See Section «Pressure Range Limits», 🗎 70	Lower pressure value for scaling the pressure axis
P_High	See Section «Pressure Range Limits», 🗎 70	Upper pressure value for scaling the pressure axis
Time	0.01…99.99	Duration of the recording (in hours)
Display	>>>	Displays the running or the most recent trend graphic. See Chapter 5.5.2 Trend Graphic, 🗎 46.

5.5.2 Trend Graphic

The Detail > Graphic > Display submenu is used to display the trend graphic of the selected channel according to the parameter settings. See Chapter 5.5.1 Parameters and Functions, 🗎 46.

The graphic is displayed in a right-angled system of coordinates.

Ordinate
The vertical axis uses a logarithmic scale and represents the pressure. The axis labeling contains the channel number with the selected vacuum gauge type and the pressure limits (P_Low, P_High).

The current state of the trend graphic is displayed above the ordinate:

- →: Recording of a graphic is running
- S: Recording of a graphic has been stopped

The current pressure value is displayed above the trend graphic.

Abscissa
The horizontal axis uses a linear scale and represents the time. The entire range is specified by the «Time» parameter. This parameter is displayed in the upper right corner of the display.

5.6 User Parameters (UserMode)

The IM 540 is able to detect the connected sensors and interface boards and the current mains frequency automatically. It will use the optimum settings for each sensor.

The user mode allows you to control and, if necessary, change these standard parameters. The status row displays «USR» if any standard parameter settings have been changed.

5.6.1 Parameters for Sensor Operation (Gauge)

Sensors are normally operated with the parameters described in Chapter 2.3.2 Sensor Supply, 🗎 8. The Gauge menu is used to edit these parameter settings.

Display	Significance
Channel	Sensor whose parameters will be edited
Anode	Anode potential for measurement operation
Cathode	Cathode potential for measurement operation
Emission	Emission current for measurement operation
U_A_Degas	Anode potential for degassing
U_C_Degas	Cathode potential for degassing
I_Degas	Emission current for degassing

A modified parameter will be adjusted automatically only after the value «Auto» has been assigned to it.

5.6.2 Parameters For Current Amplifiers (Amplifier)

The current measuring amplifier is normally operated with the optimum parameter values. You can change these parameter values in the Amplifier menu.

Display	Significance
Channel	Vacuum gauges whose parameter values are to be changed
Range	Measuring range of the current measuring amplifier
Resolution	Resolution of the measurement
Time	Measuring time: Not yet implemented

A modified parameter will be adjusted automatically only after the value «Auto» has been assigned to it.

5.6.3 Configuring the Device (Config)

This menu allows you to check the automatic detection of the connected sensors and interface boards and of the current mains frequency. The settings can be changed if necessary. This is also possible if no sensor is connected.

Display	Significance
Chan_1 Chan_2 Chan_3 Chan_4	Type of sensor connected to the related channel. For channel 1 and 2 it can happen that the settings «None» and «BAG» must be selected according to the system. This is because Bayard-Alpert sensors cannot be identified automatically by the software. If no Extraktor sensor is found on one of these channels, the controller assumes that a Bayard-Alpert sensor is connected when starting up for the first time. The setting changes described here are not indicated by the «USR» signal in the status row.
Main Freq	Mains frequency
Control	Type of interface board mounted in the extension slot

A modified parameter will be adjusted automatically only after the value «Auto» has been assigned to it.

6 Computer Interface

NOTE:
At the moment, communication with a superordinate computer is only possible in the IM 520 compatibility mode. See Chapter 5.2.3 Device Mode (Device), 🗎 34. For this reason, the information in this chapter is only valid if the IM 540 is running in this mode.

6.1 Basics

6.1.1 Connection

The IM 540 is able to communicate with a computer via a serial interface (RS232). The connection socket and the required connection cable are described in Chapter 3.3.8 RS232, 🗎 17.

6.1.2 Terminology

The following terms and symbolic styles will be used in the description of the computer interface:

Term	Significance
Host	Computer or terminal
Sending (S)	Data transfer from the Host to the IM 540
Receiving (R)	Data transfer from the IM 540 to the Host
ASCII	American Standard Code for Information Interchange

Tab. 6-1 Terms

Square brackets [...]
Square brackets identify optional parameters. The items enclosed by the brackets may appear, but they are not essential. The brackets are not actually used in the command.

Angle brackets <...>
Abbreviations enclosed by angle brackets identify control characters. The entire expression including the brackets is replaced by a numerical value. See Tab. 6-3, 🗎 49.

6.2 Communication

6.2.1 Protocol

The protocol which is configured in the general parameter RS232 menu is used for the communication. See Chapter 5.2.2 Interface Parameters (RS232), 🗎 33 and Chapter 5.2.4 Device Control (Control), 🗎 34.

Messages are transferred as ASCII strings. Blanks (spaces) in the string are ignored. The information is exchanged bidirectionally, i.e. data and control commands can be exchanged in both directions.

6.2.2 Command Format

Messages of the Host are composed of mnemonics and parameters. Mnemonics are command abbreviations and always consist of three ASCII characters. See Chapter 6.3 Mnemonics, 🗎 50.

The device can send two types of messages: Write commands and read commands. The two types of messages are distinguished by a character which is sent right after the mnemonic. See Tab. 6-2, 🗎 48.

Character	Significance
W	Write. Mnemonic is used as a write command.
R	Read. Mnemonic is used as a read command.

Tab. 6-2 Characters used to specify the command type

The IM 540 does not send to the host by itself. It replies to a read command only. Automatic measurement output and interface error messages can be exempt from this rule. See Chapter 6.3.18 MOC, 🗎 54 and Chapter 6.3.20 SIE, 🗎 54.

6.2.3 End Identifier

The end of a message from the host to the device is signaled by a control character. The IM 540 expects one of the control characters listed in Tab. 6-3, 🗎 49 as an end identifier.

End identifier	Value	Significance
<ETX>	03h	End of text
<LF>	0Ah	Line feed

End identifier	Value	Significance
<CR>	0Dh	Carriage return
<ETB>	17h	End of transmission block

Tab. 6-3 Permitted end identifiers

NOTE:
Use one end identifier per message only. Otherwise the next message will not work properly.

For messages which are sent from the device to the host, you may define up to two consecutive end identifiers. See Chapter 6.3.12 ESO, 🗎 53.

In the following, the <EOM> symbol is used to represent the end of message identifier.

Examples:

Host --> Device: <EOM> represents e.g. <ETX>

Device --> Host: <EOM> represents e.g. <CR><LF>

6.2.4 Sending (Host --> Device)

The host may send data to the device. For this, the host sends a write command to inform the device about the data type.

In a symbolic representation this process can be illustrated as follows:

S: Mnemonic W [Parameter]<EOM>

The host may request data from the device. For this, the host sends a read command to specify what kind of data are requested.

S: Mnemonic R [Parameter]<EOM>

6.2.5 Receiving (Device --> Host)

In general, the IM 540 will only send data to the host if these have been requested from it with a read command. See Chapter 6.2.4 Sending (Host --> Device), 🗎 49.

In a symbolic representation, the reply to a read command can be illustrated as follows:

E: Mnemonic [Parameter]<EOM>

In the case of interface operating errors, the IM 540 will send an error message to the host without a read command. See Chapter 6.3.11 ERS, 🗎 53.

6.2.6 Examples

Adjust sensitivity of the Bayard-Alpert sensor on channel 1

S: CAL W1 17.0<CR>

Query state of the pressure-dependent shutdown system

S: APS R<CR>

E: APS 1<CR><LF>

Adjust trigger level for relay 1

S: TRG W1,6.3E-04<ETB>

Query end identifier used for output

S: ESO R<ETX>

E: ESO3,1<EOM>

Response to an interface operating error (improper end identifier)

S: EMI W1<CT>

E: ERI 5<CR><LF>

6.2.7 Measurement Output

Depending of the measuring range, the IM 540 generates a new reading every 50 ms to 1 s. The maximum output rate is therefore between 1200 min^{-1} and 60 min^{-1}.

The measurements are output in the following format:

UNITn.nnEsmm<EOM>

Parameter	Significance
UNIT	Pressure unit: mbar, Torr, Pa, Micron
n.nn	Mantissa
s	Sign of the exponent
mm	Exponent

Each measurement is sent just once. If the MES_R command is used to request more readings than the device can deliver, an empty message is sent instead:

<Space><Space><EOM>

Measurement output to the printer (Print Only)
In «Print Only» operation, the measurement and the current device status are sent to the printer according to the adjusted output rate. The following format is used for this:

UNITn.nnEsmm STS [xxxxxxxx]B<EOM>

See also Chapter 6.3.18 MOC, 🗎 54 and Chapter 6.3.22 STS, 🗎 55.

6.2.8 Parameter Output

Messages in response to a parameter query have a parameter dependent format. The format is described for each parameter in Chapter 6.3 Mnemonics, 🗎 50.

In some cases, a parameter query makes internal calculations necessary. This may cause a delay of up to 50 ms between the query and the output of the parameter. If additional characters are sent to the device while the device is responding to a query, the device will stop processing or sending and receive the new command.

6.3 Mnemonics

6.3.1 Overview

Mnemonic	Significance
ANO	Analog output.
APS	Automatic pressure dependent gauge switching.
CAL	Calibrate. Calibrate the channels.
DCL	Device Clear. Reset the device.
DEG	Degas. Degas sensors.
ECH	Echo Mode.
ECO	Emission Control.
EMI	Emission. Switch emission on and off.
ERI	Error Interface. An interface error has occurred.
ERS	Error System. A device error has occurred.
ESO	End Sign Output. End identifier used for output.
FCO	Fault Control Switching.
GAU	Gauge. Select a sensor and request status information.
GTL	Go To Local. Quit remote control operation.
LLO	Local Lockout. Lockout the control buttons.
MES	Measurement. Output a measurement.
MOC	Measurement Output Control.
PCO	Pirani Control.
SIE	Send Interface Error Messages.
SRQ	Service Request.
STS	Status. Device status.
SWH	Software handshake XON/XOFF.
TRG	Trigger. Trigger levels for switching functions.
TRM	Trigger Mode.

Mnemonic	Significance
UNI	Unit. Unit of measurement.
ZER	Zero. Automatic zero adjustment.

Tab. 6-4 Mnemonics

6.3.2 ANO

Analog output.

See Chapter 5.2.5 Recorder Outputs (Recorder), 🗎 35.

S: ANO W[a]<EOM>

S: ANO R[v]<EOM>

E: ANO [x]<EOM>

Parameter	Values	Significance
a	0	Recorder output 1 with mode = IM520_Au (Chapter 5.2.5.1 Output Channel (Channel), 🗎 35)
	E-n	Analog output, fixed exponent n
		3 ≤ n ≤ 12 for mbar/Torr 1 ≤ n ≤ 10 for Pa
v	0	Read settings of the analog output
	1	Read voltage of the linear analog output
x	0,0	Reply to v = 0: Autorange
	0,E-n	Reply to v = 0: Fixed exponent -n
	1,mm.mmV	Reply to v = 1: Voltage mm.mm in volts
		00.00 ≤ mm.mm ≤ 10.50

6.3.3 APS

Automatic pressure dependent gauge switching.

See Chapter 5.4.4 Sensor Activation Mode (Mode), 🗎 44.

S: APS W[a]<EOM>

S: APS R<EOM>

E: APS [a]<EOM>

Parameter	Values	Significance
a	0	Pressure dependent gauge switching off
	1	Pressure dependent gauge switching on

6.3.4 CAL

Calibrate. Calibrate the channels.

See Chapter 5.3.2 Sensitivity Adjustment (Cal_Full), 🗎 39.

S: CAL W[a mm.m]<EOM>

S: CAL R[a]<EOM>

E: CAL [a,mm.m YY]<EOM>

Parameter	Values	Significance
a	1	System on channel 1
	2	System on channel 2
mm.m	10.0…19.6	Sensor constant of the Bayard-Alpert sensor
	03.7…14.8	Sensor constant of the Extraktor sensor
		Sensitivity of the capacitive sensor
YY	BA	Bayard-Alpert sensor
	EX	Extraktor sensor
		Capacitive sensor
	--	Sensor not connected or faulty

6.3.5 DCL

Device Clear. Reset the device.

This is a pure write command which will reset the short status of the device from an error state to the operating state.

S: DCL<EOM>

6.3.6 DEG

Degas. Degas sensors.

See Chapter 4.4.7 Switching Degas Function On, 🗎 23 and Chapter 4.4.8 Switching Degas Function Off, 🗎 24.

S: DEG W[a]<EOM>

S: DEG R<EOM>

E: DEG [a]<EOM>

Parameter	Values	Significance
a	0	Degassing off
	1	Degassing on

NOTE:
The degas function switches off automatically after 10 minutes. It can be stopped manually at any time.

6.3.7 ECH

Echo Mode.

S: ECH W[a]<EOM>

S: ECH R<EOM>

E: ECH [a]<EOM>

Parameter	Values	Significance
a	0	Echo mode off
	1	Echo mode on

6.3.8 ECO

Emission Control.

S: ECO W[a]<EOM>

S: ECO R<EOM>

E: ECO [a]<EOM>

Parameter	Values	Emission control via:
a	0	Buttons / computer
	1	Analog inputs
	2	Digital inputs
	3	Analog and digital inputs

6.3.9 EMI

Emission. Switch emission on and off.

See Chapter 4.4.4 Switching Emission On, 🗎 22 and Chapter 4.4.5 Switching Emission Off, 🗎 23.

S: EMI W[a]<EOM>

S: EMI R<EOM>

E: EMI [a]<EOM>

Parameter	Values	Significance
a	0	Emission off
	1	Emission on

6.3.10 ERI

Error Interface. An interface error has occurred.

Error messages which are caused by interface operating errors are sent to the host without a request.

E: ERI [a]<EOM>

Parameter	Values	Significance
a	1	Invalid ASCII character
	2	Input buffer full
	3	Output buffer full
	4	Command cannot be interpreted
	5	Improper end identifier. See Chapter 6.2.2 Command Format, 🗎 48.
	6	Setting is below or above permitted range
	7	Incorrect command parameters
	8	Function cannot be executed / operating error
	9	Protocol error / handshake error

NOTE:
The automatic output of interface error messages can be switched off using the SIE command. See Chapter 6.3.20 SIE, 🗎 54.

6.3.11 ERS

Error System. A device error has occurred.

S: ERS R<EOM>

E: ERS [a]<EOM>

Parameter	Values	Error status
a	0	No error
	1	No measuring system present
	2	Cathode voltage error
	3	Cathode disruption
	4	THERMOVAC defective
	5	Pressure too high
	6	Degassing not possible

6.3.12 ESO

End Sign Output. End identifier used for output.

S: ESO W[a,b]<EOM>

S: ESO R<EOM>

E: ESO [a,b]<EOM>

Parameter	Values	Significance
a		First end character
	1	ETX (03h): End of text
	2	LF (0Ah): Line feed
	3	CR (0Dh): Carriage return
	4	ETB (17h): End of transmission block
b		Second end character
	see a	see a

When sending the data, the selected end characters are appended to the end of the character string.

6.3.13 FCO

Fault Control Switching.

See Chapter 5.2.7 Behavior of the IM 540 in Case of an Error (Error), 37.

S: FCO W[a]<EOM>

S: FCO R<EOM>

E: FCO [a]<EOM>

Parameter	Values	Significance
a	0	Fault control switching off
	1	Fault control switching on

6.3.14 GAU

Gauge. Select a sensor and request status information.

S: GAU W[a]<EOM>

S: GAU R<EOM>

E: GAU [x,A,B,C,D]<EOM>

The read command always requests the status information for all channels.

Parameter	Values	Significance
a	1	Select sensor on channel 1
	2	Select sensor on channel 2
x	0	No sensor present
	1	Sensor on channel_1 active
	2	Sensor on channel_2 active
A, B		Status of the sensor on channel 1, 2
	0	Not connected
	1	Bayard-Alpert sensor
	2	Extraktor sensor
	3	System faulty

6.3.15 GTL

Go To Local. Quit remote control operation.

This is a pure write command which will end remote control operation and enable operation via the buttons.

S: GTL<EOM>

6.3.16 LLO

Local Lockout. Lockout the control buttons.

This is a pure write command which will lockout the command buttons. It is only used for remote control operation.

S: LLO<EOM>

NOTE:
The EM_Off (emergency-off) button can still be used to switch off the emission even if the keyboard is locked.

6.3.17 MES

Measurement. Output a measurement.

This is a pure read command. It requests the current measurement from the IM 540.

S: MES R<EOM>

E: MES [UNITm.mm]E[snn]<EOM>

Parameter	Significance
UNIT	Pressure unit: mbar, Torr, Pa, Micron
m.mm	Mantissa
s	Sign of the exponent
nn	Exponent

NOTE:
Measurements can also be output automatically. See Chapter 6.3.18 MOC, 🗎 54.

6.3.18 MOC

Measurement Output Control.

S: MOC W[a]<EOM>

S: MOC R<EOM>

E: MOC [a]<EOM>

Parameter	Values	Significance
a	0	Measurements are not sent automatically
	1…999	Send measurements and status byte automatically with a rate of *a* per hour

6.3.19 PCO

Pirani Control.

See Chapter 5.4.7 Pirani Mode (PIRCtrl), 🗎 45.

S: PCO W[a]<EOM>

S: PCO R<EOM>

E: PCO [a]<EOM>

Parameter	Values	Significance
a	0	THERMOVAC control off
	1	THERMOVAC control on
	3 (reply)	THERMOVAC control faulty

6.3.20 SIE

Send Interface Error Messages.

S: SIE W[a]<EOM>

S: SIE R<EOM>

E: SIE [a]<EOM>

Parameter	Values	Significance
a	0	Do not send an error message if an interface error occurs
	1	Send an error message if an interface error occurs. See Chapter 6.3.10 ERI, 🗎 52.

6.3.21 SRQ

Service Request.

The SRQ mode specifies an event or a status change which will cause the device to send a status byte string.

S: SRQ W[a]<EOM>

Parameter	Values	Significance
a	0	No SRQ
	1	Toggle between «Measurements possible» and «No measurements possible». The status bit changes from 1 to 0 or from 0 to 1.
	2	Reading available
	3	Trigger relays have changed their state
	4	Measuring system has been changed
	5	Event 1 or 2
	6	Event 1 or 3
	7	Event 1 or 4
	8	Event 1 or 3 or 4

6.3.22 STS

Status. Device status.

The device status can be requested from the IM 540 as a status byte.

S: STS R<EOM>

E: STS [xxxxxxxx]B<EOM>

Parameter	Values	Significance
x	0 or 1	From left to right: Status bit 8…status bit 1. See Tab. 6-5, 🗎 55 and Tab. 6-6, 🗎 55.

Depending on the state of the leftmost bit (bit 8), the status byte has two different meanings:

Bit 8 = 0: Operating status

Bit	Significance	Bit = 0	Bit = 1
8	Measurements possible		
7	SRQ status	Idle	Active
6	Emission	Off	On
5	Degassing or zero point adjustment	Off	On
4	Reading available	No	Yes
3	Activated measuring system	CH1	CH2
2	Below threshold level 2	No	Yes
1	Below threshold level 1	No	Yes

Tab. 6-5 Status byte in the operating state

Error status: Bit 8 = 1

Bit	Significance	Bit = 0	Bit = 1
8	No measurements possible		
7	SRQ Status	Idle	Active
6	Emission off because KBM/KPF error occurred	No	Yes*
5	Emission off because pressure is too high	No	Yes*
4	Emission was switched off by activated THERMOVAC or remote control inputs	No	Yes*
3	THERMOVAC status	o.k. or n.c.**	Faulty*
2	Status of sensor on channel 2	o.k. or n.c.**	Faulty*
1	Status of sensor on channel 1	o.k. or n.c.**	Faulty*

Tab. 6-6 Status byte in the error state

* *These events are setting the STS bit 8 to 1*
** *n.c. = not connected*

By reading the status byte, the device is reset from the error state to the operating state.

6.3.23 SWH

Software handshake XON/XOFF.

See Chapter 5.2.2.6 Flow Control (FlowCont), 🗎 33.

S: SWH W[a]<EOM>

S: SWH R<EOM>

E: SWH [a]<EOM>

Parameter	Values	Significance
a	0	No handshake
	1	XON/XOFF is required for receiving. It is not used for sending. (On Receive, see Chapter 5.2.2.6 Flow Control (FlowCont), 🗎 33.)
	2	Full handshake. (Full, see Chapter 5.2.2.6 Flow Control (FlowCont), 🗎 33.)

6.3.24 TRG

Trigger. Trigger levels for switching functions.

See Chapter 5.1 Switching Function Parameters (Setpoint), 🗎 30.

S: TRG W[a,m.mmE[snn]<EOM>

S: SWH R[a]<EOM>

E: SWH [a,m.mm]E[snn]<EOM>

Parameter	Values	Significance
a	1, 2	Trigger levels for trigger 1 or 2
m.mm	1.00…9.99	Mantissa of the trigger level
s	±	Sign for the exponent of the trigger level
nn	03…11	Exponent of the trigger level for the pressure units mbar and Torr
	01…09	Exponent of the trigger level for the pressure unit Pa

6.3.25 TRM

Trigger Mode.

See Chapter 5.1.2 Configuring Switching Functions, 🗎 30.

S: TRM W[a]<EOM>

S: TRM R<EOM>

E: TRM [a]<EOM>

Parameter	Values	Significance
a	0	«Level Trigger» mode
	1	«Interval Trigger» mode

6.3.26 UNI

Unit. Unit of measurement.

See Chapter 5.2.1.1 Unit of Measurement (Unit), 🗎 32.

S: UNI W[a]<EOM>

S: UNI R<EOM>

E: UNI [a]<EOM>

Parameter	Values	Significance
a	0	Millibar (mbar)
	1	Pascal (Pa)
	2	Torr

6.3.27 ZER

Zero. Automatic zero adjustment.

The write command is used to perform the automatic zero adjustment procedure. See Chapter 5.4.3 Automatic Offset (OFSCtrl), 🗎 43.

S: ZER W<EOM>

S: ZER R<EOM>

E: ZER [a]<EOM>

Parameter	Values	Significance
a	0	Automatic zero adjustment is not being performed
	1	Automatic zero adjustment is being performed

7 Maintenance and Service

7.1 Maintenance

The IM 540 does not require any special maintenance work.

7.1.1 Cleaning

For cleaning the outside of the device, a slightly moistened cloth will usually do. Do not use any aggressive or abrasive cleaning agents.

⚠DANGER

Mains voltage.

Components inside of the IM 540 are components to mains voltage. Touching these parts cause a lethal electric shock.

Do not insert any objects through the louvers of the device. Protect the device from liquids. Do not open the device.

7.1.2 Resetting the Operating Hours

After a vacuum gauge has been replaced by an identical vacuum gauge type, the related operating hour counter must be reset to zero.

Proceed as follows for this:

1 Change to se Detail > Info menu

2 Use the arrow buttons to select the OPTCnt submenu. Then press the Enter button.

3 Use the arrow buttons to select the channel with the vacuum gauge whose operating hours you want to reset to zero

4 Press the Enter button
- The labelling of the Enter button changes to «Reset»

5 Press the Reset button
- The operating hour counter is reset to zero

7.2 Program Transfer Mode

If your IM 540 requires an updated firmware version, e.g. for using a new sensor type, please contact your local LEYBOLD VAKUUM service center.

The user parameter settings are no longer available after the firmware update. They are reset to the default parameter settings. See Section «Default Parameters», 67.

7.2.1 Preparations

1 Switch the IM 540 off

2 Connect the RS232 socket (Fig. 3-4, 14, item C) with a serial interface of the PC (e.g. COM1). See Chapter 3.3.8 RS232, 17.

7.2.2 Program Transfer

The firmware for the IM 540 is delivered as a setup file.

1 Execute the setup file at the PC by double-clicking it with the mouse

2 Select the serial interface of the PC which is connected to the RS232 socket of the IM 540

3 Click the [Start] button in the setup program

4 Switch the IM 540 on
- The program transfer starts automatically
- The program transfer is being displayed

5 After the program transfer has been completed, check if errors have occurred. Repeat the transfer process if any errors have occurred.

7.2.3 Restarting

The IM540 starts automatically after the firmware has been transferred completely. The device is ready for operation again.

7.3 Starting the IM 540 With Default Parameters

The parameters required for operation of the IM 540 are stored in an EEPROM after they have been input by the user. If the stored data are damaged in any way, it is possible that the IM 540 will no longer start up properly. In this case the IM 540 can only be started with the default parameter settings.

1 While pressing the two rightmost control buttons, switch the IM 540 on.
- A safety query appears on the display

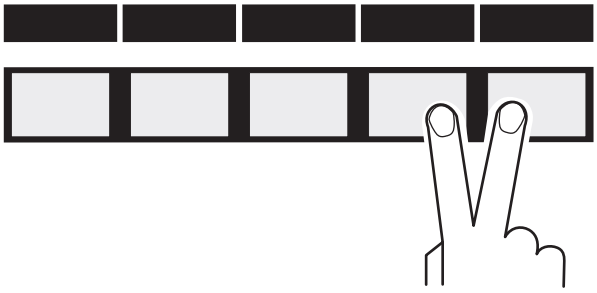

Fig. 7-1 Starting the IM 540 with default parameters

2 Confirm the safety query by pressing the left button

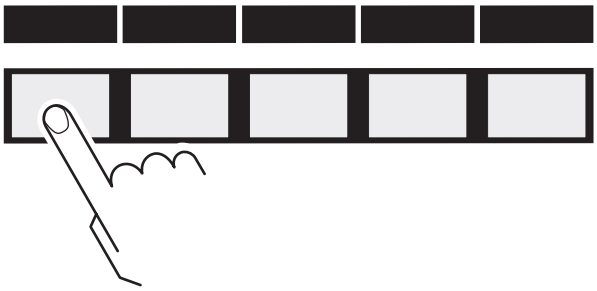

Fig. 7-2 Confirm the safety query

NOTE:
After starting the IM 540 with default parameters, the user parameters which have been adjusted by you are no longer available. For this reason, we recommend that you make a note of the parameters settings on a regular basis.

7.4 Test Mode

⚠CAUTION

Test mode.

All monitoring functions of the IM 540 software are switched off in the test mode. Improper operation can cause damage to the device.

Only authorized personnel are allowed to select and to use the test mode.

The test mode is used for service purposes. Here you can query and change device data. All monitoring functions are switched off, so you can set any output values. In addition, you can check individual device functions with test programs.

The «Test» field in the status row flashes if the device is in the test mode.

7.4.1 Selecting the Test Mode

Access to the test mode requires a special restart of the device. Proceed as follows:

1 Switch the IM 540 off

2 Wait for at least 10 seconds to make sure that the IM 540 can initialize

3 Keep the second and the fourth button pressed (Fig. 7-3, 🗎 58) and switch the IM 540 on
- A warning message informs you that the test mode has been enabled

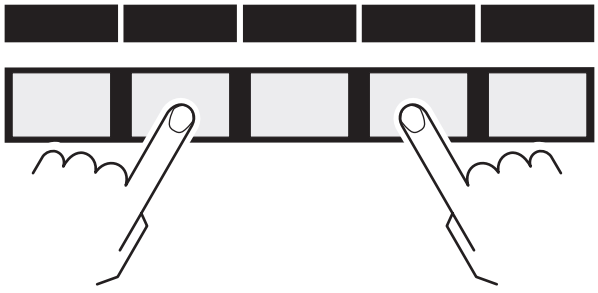

Fig. 7-3 Start the IM 540 with enabled test mode

4 Confirm the warning message by pressing the leftmost button (Fig. 7-4, 🗎 59)
- If you press the rightmost button instead, the IM 540 will start in the measuring mode. The test mode is not available in this case.

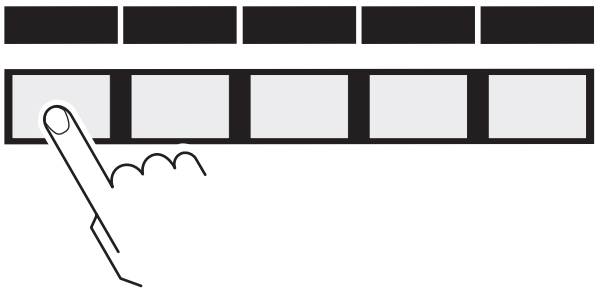

Fig. 7-4 Acknowledge the warning message

5 After the IM 540 has started, press the Param button

6 Use the arrow buttons to select the test mode parameter group. Then press the Enter button.
- The subgroups of the test mode parameter group are displayed. See Chapter 7.4.2 Test Parameters and Functions, 🗎 59.

7 Use the arrow buttons to select the required subgroup. Then press the Enter button.
- The IM 540 is now in the test mode. The «Test» field in the status row is flashing.

7.4.2 Test Parameters and Functions

The test parameters and functions can be found in the subgroups of the Test Mode parameter group. Tab. 7-1, 🗎 60 lists all available subgroups and the related parameters and functions.

1. Subgroup	2. Subgroup	Function
CPU/Disp	Commands	Default Reset
	Configuration	Calibra. Load.Cor FatalErr EEPR-MC EEPR-IQ EEPR-VP EEPR-IV
	Test	RAM CRC-ROM EEPROM Display Contrast Brightn. COM-Loop
Amplifier	Parameter	Input ModFreq Resolut. Mod.Cap Range Offset High-Drv
	Display	Temp. Measure Range Offset Integra.
	HD_Cor.	Calc_f Uint_1 Uint_2 New_DA Uint

1. Subgroup	2. Subgroup	Function
Power	Power	Overtemp MainsFr I_Shunt Emi.Cntr ID_Meas1 ID_Meas2
	Voltage	-15V +5VA +5V +15V +24V
	Control	Cathode Emission Anode I_Shunt F_Inhib. Channel
	Gauge	Anode Cathode Reflect. Emission U_Filam. I_Filam.
I/O	Voltage	+24V_ 3 +24V_ 4 +24V_KL1 +5VRS +15V -15V
	Gauge	Meas_3 Meas_4 Ident_3 Ident_4 Supl.Ch3 Supl.Ch4 IoniChan IoniSupl
	Control	Rec_1 Rec_2 Analog_1 Analog_2 Digital Relais
	RS232	Receive Transmit
	IF300x	Relays Receive Transmit Ident.

Tab. 7-1 Subgroups of the Test Mode parameter group

7.4.3 CPU / Display

The following actions can be performed in this menu:

- Enter special commands
- Start test programs
- Adjust the software configuration

Commands

Display	Significance
Default	All Parameters are reset to the default values
Reset	Warm start

Configuration
This subgroup is used to configure certain software functions:

Display	Significance
Calibration	• Enable: The offset of the current measuring amplifier is adjusted automatically, if necessary • Disable: The offset of the current measuring amplifier is not adjusted automatically The offset is always adjusted when changing from disable to enable or when activating this function. Also see Chapter 5.4.3 Automatic Offset (OFSCtrl), 43.
Load Correction	Switching relays and other interferences (e.g. the movement of a measuring cable) create charge injections which may drive the integrator into saturation or out of its operating range. Depending on the input current, the recovery time may be very long (> 10 minutes). The purpose of the load correction is to bring the integrator back into the rated operating range as quickly as possible. • The charge of the current measuring amplifier is adjusted automatically, if necessary • Disable: The charge of the current measuring amplifier is not adjusted automatically The charge is always corrected when changing from disable to enable or when activating this function.

Display	Significance
Fatal Errors	For certain tests it may be necessary that the device continues measuring even after a «fatal error» has occurred. • Enable: A «fatal error» will switch off the emission and, if necessary, also the supply voltages for the channels 3 and 4 • Disable: The IM 540 continues measuring even after a «fatal error» has occurred, i.e. the emission and the supply voltages for the channels 3 and 4 remain switched on. This is also the case if the power supply temperature is too high.
EEPROM_MC (MC540 board, micro controller) EEPROM_IQ (IQ540 board, power supply) EEPROM_VP (VP540 board, connection board) EEPROM_IV (IV540 board, current measuring amplifier)	Calibration data in the EEPROM on the respective circuit board. • Enable: The parameters stored in the EEPROM are used for all related calculations • Disable: Instead of the parameters stored in the EEPROM, the default values are used for all calculations. However, the information (article number, serial number, etc.) is still displayed as it is stored in the EEPROM. The check sum is not checked when starting up.

In contrast to all other actions in the test mode, changes made to these settings do not cause the «Test» field in the status row to flash after the test mode has been left.

Tests

The following hardware tests can be started in this submenu:

Display	Significance
RAM *	Test the main memory
Flash *	Check the check sum of the program memory
EEPROM *	Check the check sums of all EEPROMs
Display *	Every second, all pixels of the display are displayed (dark) and then cleared again (invisible)
Contrast	Every second, the contrast is changed between 0 % and 100 %
Bright	Every second, the background illumination is changed between 0 % and 100 %
COM-Loop	Loopback test: Every character received via the RS232 interface is sent back to the interface

Tab. 7-2 Hardware tests

**) This test is being performed at every program start*

Proceed as follows to start a test:

1 Select the CPU/Display > Tests menu

2 Use the arrow buttons to select the required test. See Tab. 7-2, 61.

3 Press the Enter button

4 Use the arrow buttons to select the «Start» function. Then press the Enter button.
- The selected test is started. The display shows «Busy».
- The display shows «Ready» after the test has been completed

An error message is displayed if an error has occurred during a test. The absence of an error message implies that the test has been completed successfully.

7.4.4 Current Measuring Amplifier (Amplifier)

The related submenus are used to adjust the parameters for the current measuring amplifier and to display all measurements.

7.4.4.1 Parameters

The following parameters are available to configure the current measuring amplifier:

Display	Significance
Input	Select the measuring channel
Mod.Freq	Clock frequency of the modulator
Resolut.	Resolution of the measurement
Mod.Cap	Select the modulator capacitance
Range	Select the measuring range
Offset	Input an offset value. Range of values: 0…4095
High-Drv	Control bit DAC High Drv

Integrator level control (range, modulator capacitance, modulator frequency)
The operating range of the integrator ends at 8 volts. This level must not be exceeded. For this reason, measurements may be incorrect if the modulator frequency is too low. Depending on the desired measuring range, the modulator capacitance must be selected as follows:

Range	Modulator capacitance
100fA	1.5pF
1pA	1.5pF
10pA	1.5pF
100pA	1.5pF
1nA	1.5pF
10nA	1.5pF
100nA	1.5pF
1µA	100pF
10µA	100pF
100µA	10nF
2mA	10nF

Tab. 7-3 Modulator capacitance for various range values

The clock allows the use of various modulator frequencies. Depending on the selected range, only a subset of these fixed frequencies is useful. For an overview of these frequencies, refer to the table in Section «Integrator Level Control», 🗎 72.

Measuring rate (resolution, modulator frequency)
The measuring time, and therefore also the achieved measuring rate, depends on the selected modulator frequency and the desired resolution. The table in Section «Measuring Speed», 🗎 71 lists the measuring times.

Please note that the modulator frequency cannot be selected freely. This is because the desired measuring range must be considered. See Section «Integrator Level Control», 🗎 72.

How to determine the parameters for the current measuring amplifier
You can determine the parameters for the current measuring amplifier as follows:

1 Specify a current measuring range

2 Use the table in Section «Integrator Level Control», 🗎 72 to determine the possible modulator frequencies

3 Specify the resolution or the measuring time:

3.1 For a given resolution: Use the table in Section «Measuring Speed», 🗎 71 to determine the resulting measuring times.

3.2 For a given measuring time: Use the table in Section «Measuring Speed», 🗎 71 to determine the resulting resolutions.

7.4.4.2 Display

The following data are displayed in this menu:

Display	Significance
Temp.	Display the temperature in °C Display range: 0…100 °C Resolution: 0.1°C
Measure	Display the current reading
Range	Display the currently selected measuring range
Offset	Display the offset value
Integrator	Display the output voltage of the integrator in volts

7.4.4.3 HD_Correction

For internal use only.

7.4.5 Power Supply

This menu displays data which are related to the power supply and to the supply of the vacuum gauges. Furthermore, the power supply can be operated manually.

7.4.5.1 Power (Power Supply)

Display	Significance
Overtemp	Temperature in the power supply is too high
MainsFr	Display the detected mains frequency: 50 Hz or 60 Hz
EmiCntr	Output signal of the emission current regulator. Display range: 0…5 V
ID_Meas1	Reading of the ID resistor in channel 1. Display range: 0…5 V
ID_Meas2	Reading of the ID resistor in channel 2. Display range: 0…5 V

7.4.5.2 Voltage (Primary Voltages)

The displayed primary voltages originate directly from the A/D converter on the CPU board.

7.4.5.3 Control (Control Bits)

Display and adjust the control bits.

Display	Significance
Cathode	Cathode potential
Emission	Emission current
Anode	Anode potential
I_Shunt	Add or remove the shunt resistor for the emission current
F_Inhib.	Switch the mains frequency measurement on or off
Channel	Select the measuring channel

7.4.5.4 Gauge

The following data are displayed:

- Anode: Anode potential
- Cathode: Cathode potential
- Reflector: Reflector potential
- Emission: Emission current
- U_Filament: Filament voltage
- I_Filament: Filament current

7.4.6 Inputs / Outputs

This menu displays all digital and analog inputs of the «Relay» and «Control» interfaces. See Chapter 2.4.1 Relay Outputs, 🗎 10 and Chapter 2.4.2 Control Signals, Recorder, 🗎 10. The related outputs can be set.

Data for the channels 3 and 4 are also displayed.

7.4.6.1 Voltage (Peripheral Voltages)

The displayed peripheral voltages originate directly from the A/D converter on the VP540 circuit board.

7.4.6.2 Gauge

Display	Significance
Meas_3	Reading at the channel 3. Display range: -3V…+13V
Meas_4	Reading at the channel 4. Display range: -3V…+13V
Ident_3	Reading of the ID resistor at channel 3. Display range: 0…5V
Ident_4	Reading of the ID resistor at channel 4. Display range: 0…5V
Supl.CH3	Voltage supply for the gauge at channel 3 on/off
Supl.CH4	Voltage supply for the gauge at channel 4 on/off
IoniChan	Channel to which a ion vacuum gauge is connected
IoniSupl	Emission of the ion vacuum gauge on/off

7.4.6.3 Control (Relay / Remote / Recorder)

Display	Significance
Rec_1	Recorder output 1. Setting range: 0…11000 mV The test mode for this value is switched off if «auto» is selected.
Rec_2	Recorder output 2. Setting range: 0…11000 mV The test mode for this value is switched off if «auto» is selected.
Analog_1	Input voltage at the Analog Remote Channel 1. Display range: 0…11 V

Display	Significance
Analog_2	Input voltage at the Analog Remote Channel 2. Display range: 0…11 V
Digital	Digital Remote. Binary information on the input channels «Digital Remote Channel 1» and «Digital Remote Channel 2»: • 0 0: Both inputs are idle • 1 0: Input 1 is active, input 2 is idle • 0 1: Input 1 is idle, input 2 is active • 1 1: Both inputs are active
Relays	Display and control of the relays. The states are displayed in binary: • 0000001: Channel 2 ready • 0000010: Channel 1 ready • 0000100: Degas • 0001000: Emission • 0010000: Channel • 0100000: Trigger 2 • 1000000: Trigger 1 The test mode for this value is switched off if «auto» is selected.

7.4.6.4 RS232

This menu displays the most recently received and transmitted string of the RS232 interface.

Display	Significance
Receive	Most recently received string
Transmit	Most recently transmitted string

7.4.7 IF 300x

This menu is only available if the device is equipped with an optional interface board or if this board has been configured. See Chapter 5.6.3 Configuring the Device (Config), 🗎 47.

Display	Significance
Relais	Display and control of the five relays. The states are displayed in binary: • 00001: Relay 1 is switched on • 00010: Relay 2 is switched on • 00100: Relay 3 is switched on • 01000: Relay 4 is switched on • 10000: Relay 5 is switched on The test mode for this value is switched off if «auto» is selected.
Receive	Most recently received string of the RS232 interface
Transmit	Most recently transmitted string of the RS232 interface
Ident	ID resistor voltage, measured via the analog input on the CPU. Display range: 0…5V

8 Storage and Disposal

8.1 Packaging

Please keep the original packaging. The packaging is required for storing the IM 540 and for shipping it to an LEYBOLD VAKUUM service center.

8.2 Storage

The IM 540 may only be stored in a dry room. The following requirements must be met:

Ambient temperature	-20…+60 °C
Humidity	As low as possible. Preferably in an air-tight plastic bag with a desiccant.

8.3 Disposal

The product must be disposed of in accordance with the relevant local regulations for the environmentally safe disposal of systems and electronic components.

Notes

Appendix

Default Parameters

Detail Graphic

Display	Default	User
Channel	1	
Command	Ready	
Time	1.00 h	
P_Low P_High	See Section «Threshold Values, Trigger Values», 🗎 70	

Setpoint Parameter

Display	Default	User
Setpoint	Relay1	
Channel	1	
Display	Yes	
Spt.High Spt.Low	See Section «Threshold Values, Trigger Values», 🗎 70	
Trigger	Enable	
Mode	IM 540	

General Parameter

Display	Default	User
Device	IM540	
Control	Manual	

General Para Setup

Display	Default	User
Unit	mbar	
Torr	Yes	
Set.Lock	Disable	
Light	80%	
Contrast	40%	
Men.Time	off	

General Para RS232

Display	Default	User
Com.Chan	Standard	
Baudrate	9600	
DataBits	8 Bit	
Parity	1	
Stopbits	1	
FlowCont	None	

General Para Record.

Display	Default	User
Channel	Record_1	
Source	1	
Mode	Full	
P_Low P_High	See Section «Threshold Values, Trigger Values», 🗎 70	
Scale	Log	

General Para Thresh.

Display	Default	User
U1_Low	0.10 V	
U1_High	0.50 V	
U2_Low	0.10 V	
U2_High	0.50 V	

General Para Error

Display	Default	User
FailCont	Disable	
FailRel1	Chan_1	
FailRel2	Chan_2	
Emi.Warn	LeaveOn	
Emi.Tol	Fatal	
Emi.Pow	Warning	

Sensor Parameter

Display	Default	User
Channel	1	
Cal_Full	IE514: 6.6 $mbar^{-1}$	
	IE414: 16.6 $mbar^{-1}$	
	CTR: 1000 Torr	
Fil.Pow	5.0 W	
Cor.Mode	None	
Cor.Gain	1.00	

Sensor Correct. Gas

Display	Default	User
Channel	1	
ClearAll	No	
Index	1	
Factor	1.000	
Press	Upper range limit of the gauge	

Sensor Para Display

Display	Default	User
Channel	Channel which has been active when changing to the menu	
Digit	TTR90: 2	
	CTR: 5	
	IE414, IE514: Auto	
Mode	Auto_2	
P_Low	See Section «Pressure Range Limits», 70	
P_High		

Sensor Control

Display	Default	User
Channel	1	
Emission	Auto	
OFSCtrl	Disable	
Mode	Manual	
Source	None	
P_On	See Section «Pressure Range Limits», 70	
P_Off		
PIRCtrl	Disable	

User Gauge

Display	Default	User
Channel	1	
Anode	Auto	
Cathode	Auto	
Emission	Auto	
U_A_Deg.	Auto	
U_C_Deg.	Auto	
I_Degas	Auto	

User ParaAmplifier

Display	Default	User
Channel	1	
Range	Auto	
Resolut.	Auto	
Time	Auto	

User Config

Display	Default	User
Chan_1	Auto	
Chan_2	Auto	
Chan_3	Auto	
Chan_4	Auto	
MainFreq	Auto	
Interf.	Auto	

Test CPUCommands

Display	Default	User
Default	Ready	
Reset	Ready	

Test CPUConfiguration

Display	Default	User
Calibration	Enable	
Load Corr.	Enable	
Fatal Errors	Enable	
EEPR-MC	Enable	
EEPR-IQ	Enable	
EEPR-VP	Enable	
EEPR-IV	Enable	

Test CPUDisplay

Display	Default	User
RAM	Ready	
CRC-ROM	Ready	
EEPROM	Ready	
Display	Ready	
Contrast	Ready	
Brightness	Ready	
COM-Loop	Disable	

Test AmplifierParameter

Display	Default	User
Input	Auto	
Mod.Freq	Auto	
Resolution	Auto	
Mod.Cap	Auto	
Range	Auto	
Offset	Auto	
High-Drv	Auto	

Test Control

Display	Default	User
Cathode	Auto	
Emission	Auto	
Anode	Auto	
I_Shunt	Auto	
F_Inhib.	Auto	
Channel	Auto	

Test I/O Control

Display	Default	User
Rec_1	Auto	
Rec_2	Auto	
Relays	Auto	

Test IF300x

Display	Default	User
Relays	Auto	

Setting ranges

Threshold Values, Trigger Values

Sensor	Spt.Low min. (standard for Spt.Low) P_On min. [mbar]	Spt.Low max. P_On max. [mbar]	 Standard for P_On [mbar]	Spt.High min. P_Off min. [mbar]	Spt.High max. (standard for Spt.High) P_Off max. [mbar]	 Standard for P_Off [mbar]
IE514	2.00×10^{-13}	7.20×10^{-5}	1.00×10^{-5}	2.20×10^{-13}	8.00×10^{-5}	2.00×10^{-5}
IE414	2.00×10^{-11}	7.20×10^{-3}	1.00×10^{-4}	2.20×10^{-11}	8.00×10^{-3}	2.00×10^{-4}
CTR 0.10 Torr	2.00×10^{-5}	1.24×10^{-1}	1.00×10^{-2}	2.02×10^{-5}	1.25×10^{-1}	2.00×10^{-2}
CTR 1 Torr	2.00×10^{-4}	1.24×10^{0}	1.00×10^{-1}	2.02×10^{-4}	1.25×10^{0}	2.00×10^{-1}
CTR 10 Torr	2.00×10^{-3}	1.24×10^{1}	1.00×10^{0}	2.02×10^{-3}	1.25×10^{1}	2.00×10^{0}
CTR 100 Torr	2.00×10^{-2}	1.24×10^{2}	1.00×10^{1}	2.02×10^{-2}	1.25×10^{2}	2.00×10^{1}
CTR 1000 Torr	2.00×10^{-1}	1.24×10^{3}	1.00×10^{2}	2.02×10^{-1}	1.25×10^{3}	2.00×10^{2}
TTR90	1.00×10^{-3}	4.50×10^{2}	5.00×10^{-3}	1.10×10^{-3}	5.00×10^{2}	1.00×10^{-2}

Pressure Range Limits

Sensor	P_Low min. (standard for P_Low) [mbar]	P_Low max. [mbar]	P_High min. [mbar]	P_High max. (standard for P_High) [mbar]
IE514	1.00×10^{-13}	9.00×10^{-5}	1.10×10^{-13}	1.00×10^{-4}
IE414	1.00×10^{-11}	9.00×10^{-3}	1.10×10^{-11}	1.00×10^{-2}
CTR 0.10 Torr	1.00×10^{-5}	1.20×10^{-1}	1.50×10^{-5}	1.00×10^{0}
CTR 1 Torr	1.00×10^{-4}	1.20×10^{0}	1.50×10^{-4}	1.00×10^{1}
CTR 10 Torr	1.00×10^{-3}	1.20×10^{1}	1.50×10^{-3}	1.00×10^{2}
CTR 100 Torr	1.00×10^{-2}	1.20×10^{2}	1.50×10^{-2}	1.00×10^{3}
CTR 1000 Torr	1.00×10^{-1}	1.20×10^{3}	1.50×10^{-1}	1.00×10^{4}
TTR90	1.00×10^{-4}	1.00×10^{2}	1.10×10^{-4}	1.00×10^{3}

Measuring Speed

The listed times are valid for normal measuring operation without transient effects and switching.

The Rejection column shows you for which mains frequency an optimum noise rejection can be achieved for the selected modulator frequency. Noise rejection only works properly if the measuring time is an integer multiple of the mains frequency period.

Modulator frequency [Hz]	Resolution						Rejection [Hz]
	6 Bit	8 Bit	10 Bit	11 Bit	12 Bit	14 Bit	
128	500.000 ms	2.000 s	8.000 s	16.000 s	32.000 s	128.000 s	50, 60
640	100.000 ms	400.000 ms	1.600 s	3.200 s	6.400 s	25.600 s	50, 60
2560	25.000 ms	100.000 ms	400.000 ms	800.000 ms	1.600 s	6.400 s	50, 60
3072	20.833 ms	83.333 ms	333.333 ms	666.667 ms	1.333 s	5.333 s	60
3200	20.000 ms	80.000 ms	320.000 ms	640.000 ms	1.280 s	5.120 s	50
3840	16.667 ms	66.667 ms	266.667 ms	533.333 ms	1.067 s	4.267 s	60
12800	5.000 ms	20.000 ms	80.000 ms	160.000 ms	320.000 ms	1.280 s	50
15360	4.167 ms	16.667 ms	66.667 ms	133.333 ms	266.667 ms	1.067 s	60
17067	3.750 ms	15.000 ms	59.999 ms	119.998 ms	239.995 ms	959.981 ms	50
24576	2.604 ms	10.417 ms	41.667 ms	83.333 ms	166.667 ms	666.667 ms	60
25600	2.500 ms	10.000 ms	40.000 ms	80.000 ms	160.000 ms	640.000 ms	50
30720	2.083 ms	8.333 ms	33.333 ms	66.667 ms	133.333 ms	533.333 ms	60
40960	1.563 ms	6.250 ms	25.000 ms	50.000 ms	100.000 ms	400.000 ms	50, 60
51200	1.250 ms	5.000 ms	20.000 ms	40.000 ms	80.000 ms	320.000 ms	50
61440	1.042 ms	4.167 ms	16.667 ms	33.333 ms	66.667 ms	266.667 ms	60
68270	937.454 µs	3.750 ms	14.999 ms	29.999 ms	59.997 ms	239.988 ms	50

Integrator Level Control

The implemented clock allows the use of various modulator frequencies. All combinations of the modulator frequency and the measuring range that are marked with a ✓ symbol can be used.

Modulator frequency [Hz]	Measuring range										
	100fA	1pA	10pA	100pA	1nA	10nA	100nA	1uA	10uA	100uA	2mA
68270				✓	✓	✓	✓	✓	✓	✓	✓
61440				✓	✓	✓	✓	✓	✓	✓	✓
51200				✓	✓	✓	✓	✓	✓	✓	✓
40960				✓	✓	✓	✓	✓	✓	✓	
30720				✓	✓	✓	✓	✓	✓	✓	
25600				✓	✓	✓	✓	✓	✓	✓	
24576				✓	✓	✓	✓	✓		✓	
17067				✓	✓	✓	✓	✓		✓	
15360				✓	✓	✓		✓		✓	
12800			✓	✓	✓	✓		✓		✓	
3840			✓	✓	✓	✓		✓		✓	
3200			✓	✓	✓	✓		✓		✓	
3072			✓	✓	✓	✓		✓		✓	
2560		✓	✓	✓	✓	✓		✓		✓	
640	✓	✓	✓	✓	✓						
128	✓	✓	✓	✓							

Supply Voltages

MC540 Print	Normal	1. tolerance band	2. tolerance band
-15V	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%
+5V analog	≤ ±2 %	> ±2% and ≤ ±5%	> ±5%
+5V	≤ ±2 %	> ±2% and ≤ ±5%	> ±5%
+15V	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%
+24V	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%

VP540 Print	Normal	1. tolerance band	2. tolerance band
+24V' 3	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%
+24V' 4	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%
+24VI KL1	≤ ±5 %	> ±5% and ≤ ±10%	> ±10%
+15V'	≤ ±2 %	> ±2% and ≤ ±5%	> ±5%
-15V'	≤ ±2 %	> ±5% and ≤ ±10%	> ±10%

Output Signal of the Emission Current Regulator

Normal	1. tolerance band	2. tolerance band
≥ 1.5 V, ≤ 3.5 V	≥ 1.0 V and < 1.5 V or > 3.5 V and ≤ 4.0 V	< 1 V or > 4 V

Error Messages

Number	Text in clear
00	No Errors Pending
01	MC Board EEPROM Operation Timeout
02	Ampl. EEPROM Operation Timeout
03	IQ Board EEPROM Operation Timeout
04	VP Board EEPROM Operation Timeout
05	IF Board EEPROM Operation Timeout
06	MC Board Contrast Device Timeout
07	MC Board AD Device Timeout
08	VP Board AD4MUX Device Timeout
09	VP Board AD8MUX Device Timeout
10	VP Board DA Device Timeout
11	Ampl. Command Device Timeout
12	Ampl. AD Device Timeout
13	Ampl. DA Device Timeout
14	Ampl. Temp. Device Timeout
15	Different SW-Version, Load Default
16	CRC Check MC Board Parameter
17	CRC Check MC Board OPT Counter
18	CRC Check MC Board Gas CH1
19	CRC Check MC Board Gas CH2
20	CRC Check MC Board Gas CH3
21	CRC Check MC Board Gas CH4
22	Default MC Board HW Data
23	Default VP Board HW Data
24	Default IQ Board HW Data
25	Default Ampl. Board HW Data
26	CRC Check MC Board HW Data
27	CRC Check VP Board HW Data
28	CRC Check IQ Board HW Data
29	CRC Check Ampl Board HW Data
30	Channel 1 No Coding
31	Channel 2 No Coding
32	Channel 3 No Coding
33	Channel 4 No Coding
34	BAG Degas Press To High
35	EXT Degas Press To High
36	BAG Press Greater P Max. Abs.
37	EXT Press Greater P Max. Abs.
38	Ioni Amplifier Offset Failure
39	RAM Test Failure ! -> Service
40	RS232_1 Overrun Error
41	RS232_1 Framing Error
42	RS232_1 Parity Error
43	RS232_1_Write_Not_Enabled
44	Power Supply Overtemp
45	Emis. Current Regulator Timeout
46	No Mains Frequency Signal
47	No Dynamic RAM Available
48	Set Cor.Mode To NONE.Sensor Change!
49	Gas.Cor Table Mismatch To Sensor!
50	Amplifier Load Correction Failure
51	Amplifier Calibration Failure
52	Amplifier neg. Input Current
53	CRC ROM Test Failure ! -> Service
54	MC-Board Power Supply -15V Warning
55	MC-Board Power Supply +5VA Warning
56	MC-Board Power Supply +5V Warning
57	MC-Board Power Supply +15V Warning
58	MC-Board Power Supply +24V Warning
59	MC-Board Power Supply -15V Error
60	MC-Board Power Supply +5VA Error
61	MC-Board Power Supply +5V Error
62	MC-Board Power Supply +15V Error
63	MC-Board Power Supply +24V Error
64	VP-Board Power Supply +24VS3 Warn.

Number	Text in clear
65	VP-Board Power Supply +24VS4 Warn.
66	VP-Board Power Supply +24VKL Warn.
67	VP-Board Power Supply +5V RS Warn.
68	VP-Board Power Supply +15V Warn.
69	VP-Board Power Supply -15V Warn.
70	VP-Board Power Supply +24VS3 Error
71	VP-Board Power Supply +24VS4 Error
72	VP-Board Power Supply +24VKL Error
73	VP-Board Power Supply +5V RS Error
74	VP-Board Power Supply +15V Error
75	VP-Board Power Supply -15V Error
76	Ioni Supply U_Anode Warning
77	Ioni Supply U_Cathode Warning
78	Ioni Supply I_Emis Warning
79	Ioni Supply U_Filament Warning
80	Ioni Supply I_Filament Warning
81	Ioni Supply U_Reflector Warning
82	Ioni Supply U_Andode Error
83	Ioni Supply U_Cathode Error
84	Ioni Supply I_Emis Error
85	Ioni Supply U_Filament Error
86	Ioni Supply I_Filament Error
87	Ioni Supply P_Filament Error
88	Ioni Supply U_Reflector Error
89	Emis Regulator Limit Warning
90	Emis Regulator Limit Error
91	Emis Regulator Deviation Warning
92	Emis Regulator Deviation Error

Literature

[1] Operating Manual
THERMOVAC-Transmitter TTR 90
GA 09.220
LEYBOLD VAKUUM GmbH, D-50968 Köln

[2] Operating Manual
THERMOVAC-Transmitter TTR 90S
GA 09.220
LEYBOLD VAKUUM GmbH, D-50968 Köln

[3] Operating Manual
CERAVAC-Transmitter CTR 90
GA 09.040
LEYBOLD VAKUUM GmbH, D-50968 Köln

[4] Operating Manual
CERAVAC-Transmitter CTR 91
GA 09.040
LEYBOLD VAKUUM GmbH, D-50968 Köln

[5] Operating Manual
IONIVAC-Sensor IE414
GA 09.406
LEYBOLD VAKUUM GmbH, D-50968 Köln

[6] Operating Manual
IONIVAC-Sensor IE514
GA 09.406
LEYBOLD VAKUUM GmbH, D-50968 Köln

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Declaration of Conformity

CE

We, LEYBOLD VAKUUM, hereby declare that the equipment mentioned below complies with the provisions of the Directive relating to electrical equipment designed for use within certain voltage limits 73/23/EEC and the Directive relating to electromagnetic compatibility 89/336/EEC.

Product
IM 540

Catalog number
230100

Standards
Harmonized and international/national standards and specifications:

EN 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use)

EN 61000-6-2 (Electromagnetic compatibility generic immunity standard)

EN 61000-6-4 (Electromagnetic compatibility generic emission standard)

Signatures

LEYBOLD VAKUUM GmbH, Köln

April 7, 2004	April 7, 2004
Marcus Eisenhuth	Harald Brinkmann
Product Development	Product Support Manager

Notes

Notes

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