Instruction Manual

Evaluation Instrument

IBT100

Current revision date
2010-06-22
Firmware from V4.76

CE

Foreword

This manual applies to the Supply and Evaluation Instrument, IBT100 for Torque Sensors.

The specifications in this manual can change at any time without prior notification. Futek reserves the right to improve and to change the product for the purpose of technical progress without the obligation to inform persons and organizations as the result of such changes.

The HyperTerminal® PC application described in this manual is a product of Microsoft®.

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1. Introduction

We thank you for your decision to purchase a quality Futek product. Please read through this Operating Manual carefully in order to make best use of the versatile features of your product.

This product is an IBT100 Supply and Evaluation Instrument for Torque and Force Sensors.

Torque sensors with speed and angle of rotation outputs as well as force sensors can be connected directly to this tabletop unit. Sensors based on the strain gage measurement method without their own amplifier as well as sensors with normalized voltage or frequency outputs have direct connections on the IBT100 instrument.

The supply and evaluation instrument provides passive strain gage sensors with a unipolar voltage of 5V. The 6-conductor technique is used to compensate voltage drops over the supply lines as a result of so-called Sense connections. This means the IBT100 instrument is able to record and to evaluate measured values more precisely. As well as bipolar, analog measurement signals in the ±5V or ±10V range, a torque-equivalent frequency with definable offset and frequency deviation can also be recorded.

For better evaluation of units such as electrical or combustion engines, gearboxes, compressors, fans, crank assemblies, etc., the input torque and the speed of the mechanical power must be specified. The IBT100 instrument accomplishes this by calculating the performance from the measured parameters and displaying the result.

The functionality of the supply and evaluation instrument extends from monitoring functions, through trigger options, assignable analog outputs, digital input and outputs, up to serial interfaces such as the RS-232C and the USB port.

1.1 Features

- Supply of the torque or force sensor
- Determination of the torque or force signal as an analog voltage (mV/V, V) or frequency
- Determination of the speed and angle of rotation (quadrature)
- Measured value conversion between input and output (functionality as a measured value amplifier)
- Simultaneous display of torque/force, speed/angle of rotation, revolution counter reading and mechanical power
- Software and hardware trigger functions for saving a measurement graph
- Limit value monitoring of 3 measurement parameters
- Min./max. memory for each measured and calculated parameter
- Data transfer via RS-232C interface (USB port in preparation

2. Important Notes

You must heed the following notes; these are provided for your personal safety when working with the Supply and Evaluation Instrument, IBT100 and ensure long, trouble free operation.

2.1 For Your Safety

The unit left the factory in a safe and perfect condition. To maintain this condition and to ensure hazard-free operation, the notes and warning comments in this operation manual and on the unit must be heeded.

Also adhere to the local safety regulations which govern the handling of electrical and electronic devices.

If it can be assumed that hazard-free operation of the instrument is no longer possible, it must be taken out of operation and secured against accidental operation.

Hazard-free operation is no longer possible:

- if the instrument shows any signs of damage
- if the instrument does not work correctly
- after prolonged storage under unfavorable conditions
- following severe shipping conditions.

If hazard-free operation is no longer guaranteed as a result of the above-mentioned points, the instrument must be sent immediately to the responsible Futek Sales Company or representative for repair.

2.2 Electromagnetic Compatibility (EMC)

The Supply and Evaluation Instrument, IBT100 is designed to be CE-compliant. This instrument fulfills safety engineering requirements with respect to electromagnetic compatibility in accordance with EN 61000-6-2 (noise immunity) and EN 61000-6-4 (noise immunity in the industrial sector).

2.3 Tips for Using the Operation Manual

We recommend that you read the entire operation manual thoroughly.

Keep this operation manual in a secure location where it is available at all times. If the manual is lost, please contact the responsible Futek Sales Company or representative and ask for a replacement.

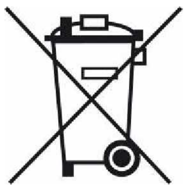
Instrument modifications (rebuilds, retrofits, etc.) normally also result in changes to the operation manual. In this event, inquire into the updating options for your documentation from the responsible Futek Sales Company or representative.

2.4 Nomenclature Used

Here you will find explanations of the nomenclature and abbreviations used in this operation manual:

Active sensor	Torque sensor with active electronics
Passive sensor	Torque or force sensor without active electronics. Strain gauge signal is fed out directly
Control signal	This signal is used to test active or passive torque sensors (controlled self-test)
Condition 0	Logic condition of a digital input. The voltage level range for this is < 0.8 V.
Condition 1	Logic condition of a digital input. The voltage level range for this is < 3.5 V.
Condition z	Open (electronic) switch of a digital output without electrical level or reference.

2.5 Disposal Instructions for Electronic Devices



Obsolete electronic devices must not be disposed of in household refuse/waste. Please give the obsolete device to the nearest electronic disposal location for disposal or contact your Futek sales office.

3. Basic Information About the Instrument

3.1 Unpacking

Check all instrument packaging for damage in transit. Notify the shipping company and the responsible Futek Sales Company or representative of any such damage.

Please check the shipment before beginning with the setup of the instrument system. If any part is missing, please contact the responsible Futek Sales Company or representative.

3.2 Storage

If the instrument is to be stored for a prolonged period, take the following safety precautions:

- The temperature should be in the range between -10 °C and 60 °C.
- The sensor connections must be covered with a dust cap.
- The environment should be as dry as possible.
- If possible, the instrument should be stored in its original packaging when not in use.

3.3 Instrument Versions

There are two versions of the IBT100 listed below:

	Item#
▪ 105-125V Power	FSH02121
▪ 210-250V Power	FSH02426

3.4 Accessories Supplied

The Supply and Evaluation Instrument, IBT100 is supplied with:

	Item#
▪ AC Cord for Power Supply	GOD00682
▪ Male DB9 connector with housing	FSH01075
▪ Female DB9 connector with housing	FSH01076
▪ 25 pin D-sub connector	GOD02072
▪ DB25 metal shell connector housing	GOD02073
▪ USB cable	GOD00672
▪ IBT100 software	FSH02917

4. Basics

4.1 Torque Sensors

In practice, torque sensors measure the torque with the aid of strain gages. The strain gages are applied to the torsion section and undergo a change in impedance that depends on the torque.

This causes a voltage change that is proportional to the change in impedance and that either reaches the Evaluation Instrument, IBT100, directly or is conditioned with the aid of an internal amplifier in the torque sensor.

TRD300

Commutator ring torque sensor (passive sensor)
TRD300

Torque sensors of Type TRD300 work according to the strain gage principle and provide an analog output signal in mV/V. Optionally, there is an integrated angle/speed measurement available. The TRD300 Series is optimized for usage in screw technology. The versions with square shaft or hexagonal shaft fit directly onto the outputs of the assembly tools for screws and nuts.

Typical applications are the testing of stationary screw spindles or torque measurement with hand-guided assembly tools for screws and nuts.

The versions with round shaft ends can be used wherever torque is to be measured sporadically or at low speed.

TRH600

Mini-Smart torque sensor (active sensor)
TRH600

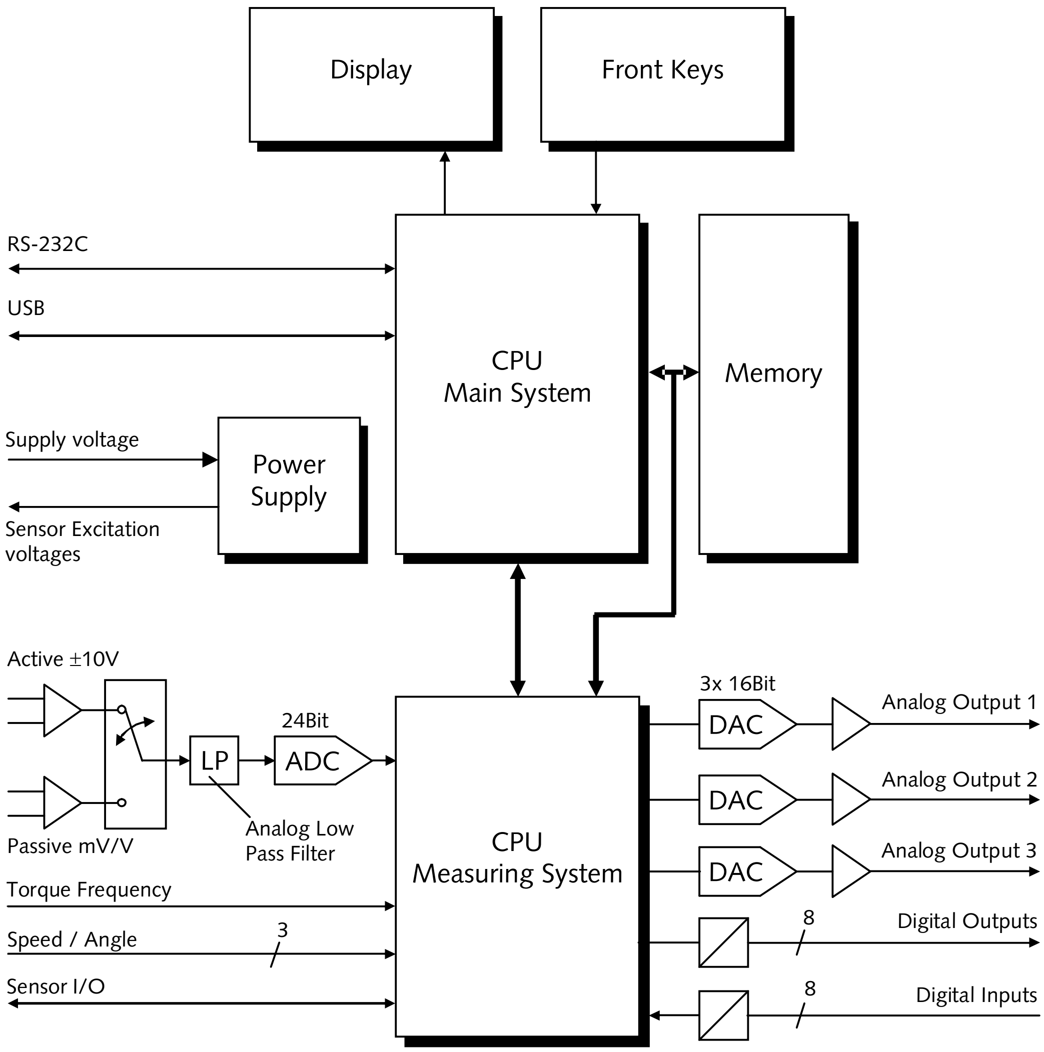
Torque sensors of Type TRH600 work according to the DMS principle. The torque signal is transferred without physical contact from the rotating shaft using frequency modulation and is conditioned as a 0 ... ±5 VDC analog signal. Optionally, there is an integrated angle/ speed measurement available.

The TRH600 Series with rotating measurement shaft is not only suitable for the dynamic determination of tightening and release torques in screw fitting and assembly technology, but also for quality control in production and in the laboratory.

5. Instrument Description

5.1 Architecture

In the following the most important internal components of device architecture:



5.2 Internal Measured Value Buffer

The internal measured value buffer serves to store the recorded measured values of an initiated measurement. This is particularly useful if an adequately high sampling rate seems necessary (up to 10 kHz, e.g. for recording the tightening torque of a power screwdriver or the bending torque of a torque wrench).

Up to 5,000 successive measured value packets can be stored in the measured value buffer. It is then possible to transfer the recorded contents to the target system (e.g. PC).

NOTICE

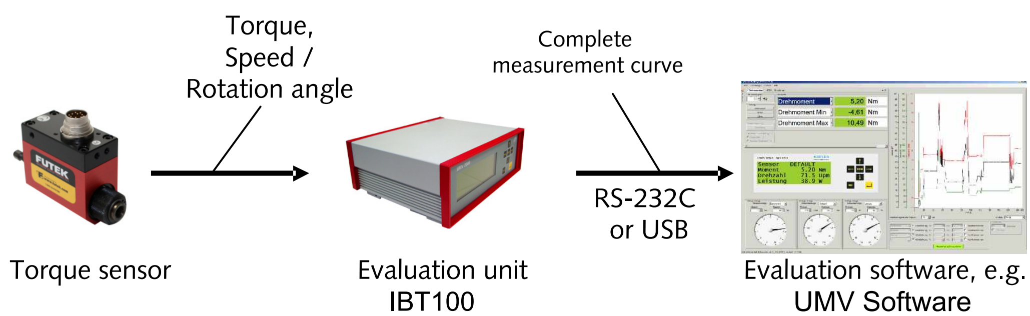
Individual measured value packet

An individual measured value packet always contains the following measured value variables:

1. Torque
2. Speed
3. Rotation angle
4. Rotation counter reading
5. Mechanical power

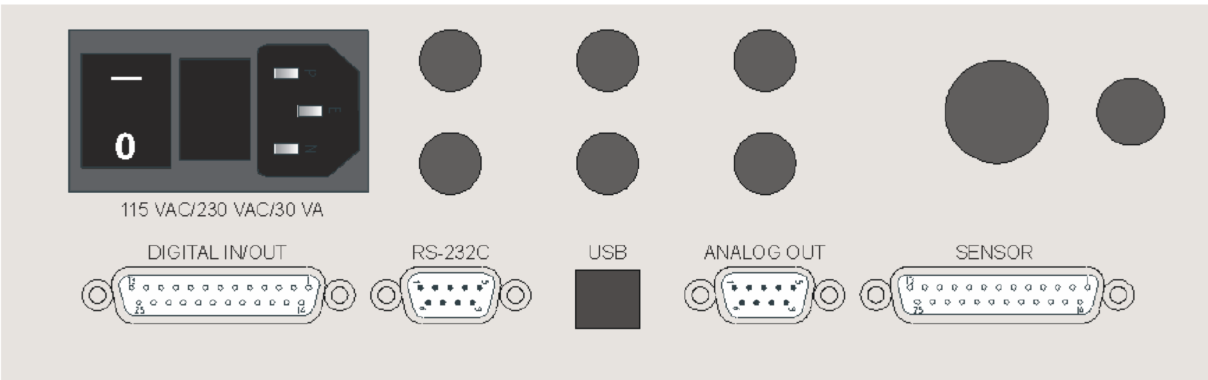
A trigger condition must be met to store successive measured value packets (measurement curve). The trigger condition is dependent on a threshold being reached, the defined condition of a digital input or manual triggering with a key. These conditions can be set in the menu system.

A new measured value storage operation overwrites the previously saved values. It is therefore only possible for a continuous measurement curve to be saved in the measured value buffer.



5.3 Front and Rear View

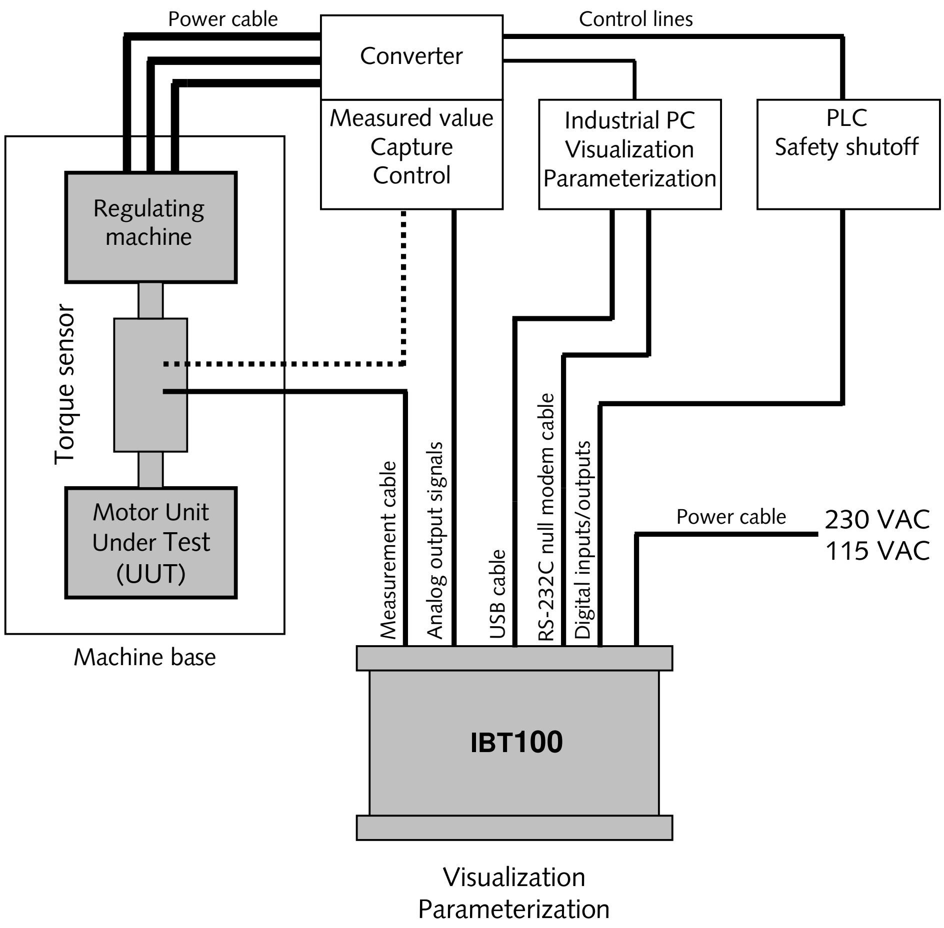
The operating keys and the backlit 4x20 character display of the Supply and Evaluation Instrument, IBT100 are on the front panel. All connection plugs and socket are mounted on the rear.



5.4 Connection Description

5.4.1 Cabling

The Supply and Evaluation Instrument, IBT100 is suitable for integration in existing systems. The following figure shows a typical application of motor testing:



Electrically isolated sensor supply

The torque sensor can be supplied by the IBT100 instrument. This results in electrical isolation between the digital inputs and outputs that are often connected with the operating ground of the programmable logic controller (PLC).

Measured value conversion for passive sensors

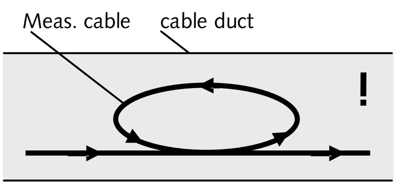
If the torque signal is to be used for control or regulation purposes, this can be carried out with the analog outputs of the Supply and Evaluation Instrument, IBT100. This can be particularly advantageous with a passive sensor (mV/V signals) (works as a measured value amplifier).

Generating a tacho signal from the speed

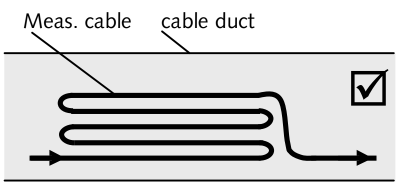
The speed recorded and measured by the IBT100 instrument can be converted into a voltage parameter with an analog output. This output voltage is proportional to the speed/angle of rotation (tacho signal).

Cable shield, laying the measurement cable

- Use shielded cables if possible. Do not lay them parallel to power lines or control lines.
- Do not lay them close to strong electromagnetic fields, e.g. transformers, welders, magnetic switches, motors, etc.
- If this is unavoidable, lay the measurement cable in a grounded, armored steel tube.
- Avoid excess cable lengths. If this is not possible, do not wind excess lengths as a closed cable loop in order to keep induction surfaces as small as possible!



Danger of induction on the measurement signal as a result of electromagnetic fields

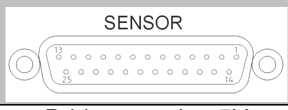


Effective inductive surfaces are reduced by bifilar laying

External control signals

Digital signal states can be generated via the digital input and output signals of the Supply and Evaluation Instrument, IBT100 (e.g. if limit values are exceeded). It is also possible to detect digital input signals of a PLC via the serial interface of the IBT100 instrument.

5.4.2 Sensor Connector

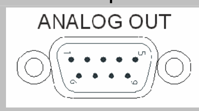
IBT100 25-pin female D-SUB	Description 
1	Bridge supply +5V
2	Sense +
3	Bridge signal +
4	Torque + (active sensor)
5	–12V
6	Counter 1 (zero pulse)
7	+5V
8	GND (+5V)
9	TXD *
10	RXD *
11	+12V
12	Active control signal (TTL output for active sensors)
13	+24V
14	Bridge supply 0V
15	Sense –
16	Bridge signal –
17	Torque – (active sensor)
18	Counter 2 (leading angle/speed)
19	Counter 3 (lagging angle)
20	Counter 4 (torque active sensor with frequency)
21	GND (± 12V)
22	GND TTL output
23	Passive control signal (output for passive sensors)
24	GND (counter)
25	GND (+24V)

NOTICE

* **Torque sensor with voltage or frequency output:**

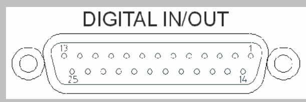
A torque sensor with voltage output is connected to connection pins $C^{(U)}$ and $D^{(U)}$. A torque sensor with frequency output is connected to pins $C^{(f)}$ and $D^{(f)}$.

5.4.3 Voltage Outputs

IBT100 9-pin female D-SUB	Description  			
	1st channel 	2nd channel 	3rd channel 	Non assigned connections
1	U_{A1}			
2				n.a.
3				n.a.
4				n.a.
5		U_{A2}		
6	GND_{A1}			
7			U_{A3}	
8			GND_{A3}	
9		GND_{A2}		

n.a.: Not assigned, do not connect.

5.4.4 Digital Inputs and Outputs

IBT100 25-pin female D-SUB	Description 	
	Digital inputs	Digital outputs
1		GND_{OUT}
2		Output 1
3		Output 3
4		Output 5
5		Output 7
6		GND_{OUT}
7	+24 V (80 mA)*	
8	GND_{INP}	
9	Input 2	
10	Input 4	
11	Input 6	
12	Input 8	
13	GND_{INP}	
14		GND_{OUT}
15		Output 2
16		Output 4
17		Output 6
18		Output 8
19		GND_{OUT}
20	GND_{INP}	
21	Input 1	
22	Input 3	
23	Input 5	
24	Input 7	
25	GND_{INP}	

NOTICE

* **Internal +24V voltage source:**

An electrically isolated 24 V voltage source is provided for the digital inputs (PIN 7, max. 80 mA). The relevant ground potential is GND_{INP} (PINS 8, 13, 20 and 25).

Digital input states, optocoupler

An optocoupler is present on each digital input. The inputs are electrically isolated from the other parts of the circuits of the IBT100, Supply and Evaluation Instrument.

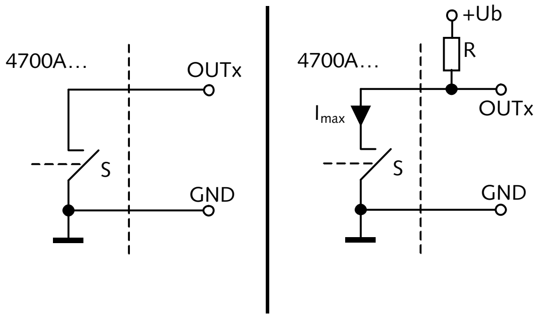
Logic state 1 or *High*:	3.5 V … 30 V.
Logic state 0 or *Low*:	≤ 0.8 V.

Digital output states, electronic relay

An electronic semiconductor relay is available for each digital output. These are electrically isolated from the other parts of the circuits of the IBT100 instrument.

Logic state z or high-impedance:	Relay opened.
Logic state 0 or Low:	Relay closed.

An open semiconductor relay does not have any unique logic level (state z for this reason). By connecting an external pull-up resistor R, the logic state 1 or *High* is created. The pull-up resistor is not part of the IBT100 instrument.



With R, state z becomes state 1.

The pull-up resistor R is connected to a voltage source; this connection can be made on Pin 7 of the internal 24V voltage source of the IBT100, Supply and Evaluation Instrument.

The maximum current consumption I_{max} of each digital output is 100 mA. The resistor must be dimensioned accordingly:

$$R_{\min} = \frac{U_b}{I_{\max}}.$$

Calculation example:

U_b = +24 V (e.g. Pin 7 on IBT100), $I_{\max}$ = 100 mA,
this results in a good approximation:

$$R_{\min} = \frac{U_b}{I_{\max}} = \frac{24V}{100mA} = 240\Omega_{\min}$$ with open output.

On $R_{\min}$ there is a maximum power loss $P_{\max}$ of:

$$P_{\max} = I^2_{\max} \cdot R_{\min} = (100mA)^2 \cdot 240\Omega = 2{,}4W$$!

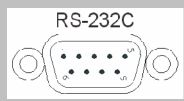
Limitation of the power loss on the pull-up resistor

A resistor value of, for example, 1 kΩ should be selected; this mainly depends, however, on the input resistance of the external evaluation circuit (e.g. digital PLC input).

5.4.5 RS-232C Interface

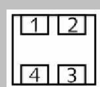
A null modem RS-232C cable (crossed cable) is used between the PC and the IBT100 instrument. The interface works according to the following conditions:

1 start bit
8 data bits
1 stop bit
No parity

IBT100 9-pin male D-SUB	Description  	Non assigned connections
1		n.a.
2	RXD	
3	TXD	
4		n.a.
5	GND	
6		n.a.
7		n.a.
8		n.a.
9		n.a.

n.a.: not assigned.

5.4.6 USB Interface

IBT100 USB 2.0 Standard, Type B	Description 
1	U_{USB}*
2	DATA -
3	DATA +
4	GND_{USB}

* **USB Interface:**

The IBT100 instrument is not supplied via the U_{USB} connection of the USB port. The PC detects whether the Evaluation Instrument, IBT100 is connected via this line.

6. Menu Guidance

6.1 Operating the Instrument

The Supply and Evaluation Instrument, IBT100 is operated from a menu. A total of 7 keys are provided for navigation.

The main menu can always be selected with the MENU key. The Enter key ↵ is used to call up the submenu selected with the four arrow keys as well to confirm a change to a parameter.

The ESC key is used to discard a change to the parameter or to exit the menu item again. The individual menu items and the menu structure are explained in more detail in the following section.

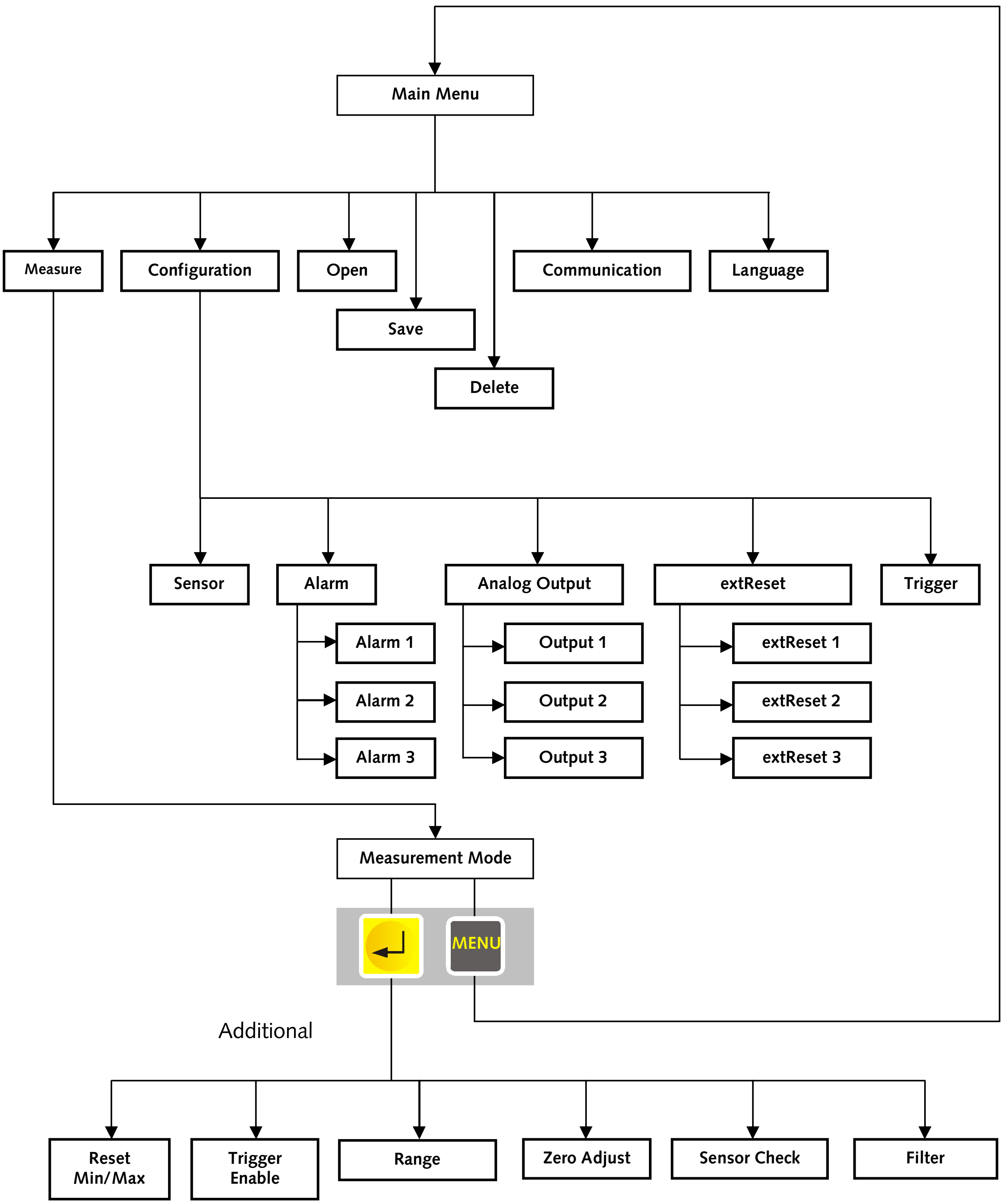
6.2 Welcome Screen

UMV 3000
Firmware V.4.89

When the Supply and Evaluation Instrument, IBT100 is switched on, the model identification and the firmware version number are displayed for a few seconds.

The display then switches into measurement mode.

6.3 Menu Structure



6.4 Main Menu

▸	Measure	↓
	Configuration	↓
	Open	↓
	Save	↓
	Delete	
	Communication	
	Language	
	Password	

The main menu consists of a number of entries. Only four lines are visible on the display. Arrows on the right side of the menu show whether it is possible to navigate further in the menu by scrolling downwards, downwards and upwards, or just upwards. The selected menu item is indicated by an arrow ▸ on the left side.

6.5 Measurement Mode

The '**Measure**' menu is not a submenu in the real sense, but rather the measurement mode for the parameters:

Sensor	TRD305
Torque	0.0000 N·m
Speed	0 1/min
Power	0.0 W

- Torque/Force
- Speed/Angle
- Revolution counter
- Mechanical power

In this mode, the correct values of the current measurements with the desired units are shown on the display.

6.6 Configuration Menu

All significant settings for the evaluation device type IBT100 are made in the '**Configuration**' menu:

▸	Sensor
	Alarm
	Analog output
	ExtReset
	Trigger

- Sensor configuration
- Threshold observations (alarms)
- Signal conversions (analog output)
- External reset options of Min./Max. buffer (ExtReset)
- Trigger conditions for the internal measured value buffer

6.6.1 Sensor Submenu

The IBT100 instrument is parameterized in the '**Sensor**' menu using a connected torque or force sensor. Assignments between the output voltage/frequency and applied rated torque or rated force of a sensor are configured in this menu.

When connecting a dual-range sensor, it is possible to define two nominal ranges of use (1st and 2nd range).

The number of pulses of speed sensors as well as other settings for the display in measurement mode (number of decimal places, additional measurement parameters, etc.) are also specified in this menu. The various setting options are shown and explained in detail in the following section:

▸	**Sign.Kind**	**+/-10V**
	Unit	N·m

In '**Sign.Kind**', a choice can be made between '**Bridge**' , '**+/-10V**' and '**Freq.**'.

In this menu item the user chooses a passive or active sensor. An active sensor with voltage output (0…±10V) is selected with '**+/-10V**'. Sensors with a torque-equivalent frequency output are selected with '**Freq.**'. A passive sensor contains a strain gage bridge without its own measured value amplifier. This is selected with '**Bridge**'.

Depending on which function is activated, the diagram and the subsequent setting options change to the present display.

	Sign.Kind	+/-10V
▸	**Unit**	**N·m**

A choice can be made between the following units for the signal type in '**Unit**':

Metric units:

'**kN·m**' '**N·m**' **N·cm**' '**N·mm**' ⇒ torque sensor
'**kN**' '**N**' ⇒ force sensor

Imperial units:

'**lbft**' (*pound force feet*) ⇒ torque sensor
'**lbin**' (*pound force inches*) ⇒ torque sensor
'**ozin**' (*ounce-force inches*) ⇒ torque sensor
'**lbf**' (*pound force*) ⇒ force sensor

It is possible to differentiate between a torque and a force sensor by the units. The factors for calculating the mechanical power are automatically taken into account.

Setting example: **Passive sensor**

Measurement range: 200 N·m
Sensitivity: ± 1 mV/V

▸	**Sign.Kind**	**Bridge**
	Unit	N·m
	Range	200.0 N·m
	Sens.	1.000 mV/V
	Dec. Pt.	###.###

If the '**Bridge**' measurement type is activated, the sensitivity of the strain gage bridge of a passive sensor appears behind the abbreviation '**Sens.**'.

In conjunction with the selected '**Range**', the conversion of mV/V into the selected '**Unit**' of the sensor is carried out automatically.

The number or decimal places after the decimal point for displaying the torque or force signal can be defined in '**Dec.Pt.**'. A definition of '**##.####**', for example, means that 4 decimal points are displayed for the respective display range.

Setting example: **Active dual-range sensor with voltage output**

1st meas. range: 200 N·m, ± 10.004 V
2nd meas. range: 20 N·m, ± 9.997 V

▸	**Sign.Kind**	**+/-10V**
	Unit	Nm
	1. Range	200.0 Nm
	Nominal	10.004V
	Dec. Pt.	####.##
	2. Range	20 Nm
	Nominal	9.997V
	Dec. Pt.	###.###
	Selection	Button
	Output	---

An active sensor with normalized torque-equivalent voltage output is selected with '**+/-10V**'. In this case, the '**Nominal**' abbreviation appears for the 1st and 2nd measurement range ('**1.Range**' and '**2.Range**').

This means sensors with an output voltage of 0 … ± 10V can be connected.

Switch-over of the measuring range by key actuation or digital input

The measuring range can be switched over in the additional 'Measuring range' menu (1st range to the 2nd range or vice versa). To this purpose the '**Button**' option is defined for '**Selection**'.

	2. Range	20 N·m
	Nominal	9.997 V
	Dec.Pt.	###.###
▸	**Selection**	**IN1**
	LogicIn	0→1
	Output	---

If the measuring range is to be selected via a digital input, this is possible by definition of the options '**IN1**' to '**IN8**' in '**Selection**'.

The necessary digital change in status for the selected input is defined with '**LogicIn**'. The options '**0→1**' or '**1→0**' are available to this purpose.

Switchover of the measuring range with a digital input and the key in the additional 'Measuring range' menu is not permissible.

Signalling of the measuring range with digital output

The selected measuring range can be displayed with a digital output. This is possible by selection of '**OUT1**' to '**OUT8**' in '**Output**'. If the parameter '**---**' is set, no digital output is defined for signalling.

	2. Range	20 N·m
	Nominal	9.997 V
	Dec.Pt.	###.###
	Selection	IN1
	LogicIn	0→1
▸	**Output**	**OUT1**
	LogicOut	z→0

The original status of the digital output depending on the active measuring range is defined in '**LogicOut**'. The following options are possible:

'0→z'

1st measuring range (nominal range)	status 0 (closed)
2nd measuring range (smaller range)	status z (open)

'z→0'

1st measuring range (nominal range)	status z (open)
2nd measuring range (smaller range)	status 0 (closed)

Setting example: **Active dual-range sensor with frequency output**

1st meas. range: 200 N·m, 100 kHz ± 40 kHz
2nd meas. range: 20 N·m, 100 kHz ± 39.99 kHz

▸	**Sign.Kind**	**Freq.**
	Unit	N·m
	1. Range	200.0 N·m
	FreqOffs	100.00 kHz
	Nominal	40.00 kHz
	Dec. Pt.	####.##
	2. Range	20 N·m
	FreqOffs	100.00 kHz
	Nominal	39.99 kHz
	Dec. Pt.	###.###
	Selection	Button
	Output	---

If, however, the '**Freq.**' measurement type is selected as the '**Sign.Kind**', the '**FreqOffs**' line is inserted which can be used to define a frequency offset.

The value entered for '**FreqOffs**' and '**Nominal**' (frequency deviation) is always made in kHz.

▸	**Type**	**Speed**
	Puls/rot	60
	Direction	cw
	Dec. Pt.	#####.#

The options of '**Speed**', '**Angle**' or '**---**' are available under '**Type**'. In this case, the speed or angle parameter is added to the measurement mode. The number of pulses per revolution/rotation (0 … +9999) can be specified under '**Puls/Rot**'.

The direction of rotation of the sensor can be defined in '**Direction**'. Here, a signed evaluation of the speed/angle/ counter and the mechanical power is carried out (considered as positively signed with the selection '**cw**' (clockwise) and negatively signed with the selection '**ccw**' (counter clockwise)).

NOTICE

Maximum speed:

The maximum input frequency that can be evaluated for recording the speed parameter is 300 kHz. The maximum permitted input speed based on the pulses per revolution can be calculated as follows:

$$n_{max} = \frac{f_{max}}{z} \cdot 60 \quad [n_{max}] = \min^{-1}$$

here
n_{max} is the maximum speed searched for in $\min^{-1}$, f_{max} = 300 kHz and z is the user-defined pulses per revolution.

Example:

360 pulses per revolution are defined. The maximum permitted input speed n_{max} is:

$$n_{max} = \frac{300000 Hz}{360} \cdot 60 = 50000 \quad \min^{-1}.$$

▸	Type	Angle
	Puls/rot	360
	Direction	cw
	Dec. Pt.	####.##

Angular resolution in ¼ degrees:

If the sensor has two tracks, each displaced by 90 °, for the angle recording, the instrument evaluates the angle with the quadrature process. If 2 decimal places are defined for displaying the '**Dec.Pt.**' angle ('####.##'), an angle display is made in ¼ (0,25) degree steps in the measurement mode.

Simultaneous measurement of speed and angle

In the IBT100 instrument , the speed and angle parameters as well as the counter reading are always recorded simultaneously and permanently, independently of the selection in '**Type**'.

Displaying the counter reading and its tare

The counter reading is proportional to the angle. For every 360° degrees, the counter reading changes by a value of 1. This results in the following relationship:

$$z = \frac{\alpha}{360°} \text{ where}$$

z is the counter reading and α is the angle.

Examples:

Angle	Counter reading
0 °	0.0
180 °	0.5
360 °	1.0
720 °	2.0
…	…

The counter reading can be tared separately from the angle, see the '**Zero Adjust**' or **'Reset Min/Max**" submenu for this.

	Add. Displ.	Power
	Unit	W
	Dec. Pt.	####.##

For the 4th line in the measurement mode, an additional parameter can be displayed next to the torque/force signal and the speed or the angle.

This is carried out in '**Add.Displ.**' depending on the previous settings. The following options can be selected:

'**---**'	no additional parameters
'**To.Min**'	minimum torque
'**To.Max**'	maximum torque
'**Fo.Min**'	minimum force
'**Fo.Max**'	maximum force
'**Sp.Min**'	minimum speed
'**Sp.Max**'	maximum speed
'**An.Min**'	minimum angle
'**An.Max**'	maximum angle
'**Counter**'	revolution counter
'**C.Min**'	minimum counter reading
'**C.Max**'	maximum counter reading
'**Pow.**'	mechanical power
'**P.Min**'	minimum power
'**P.Max**'	maximum power
'**LPF**'	cutoff frequency of the lowpass filter

With the '...Min ' and '...Max ' options, the continuous Min./Max. memory is read and displayed for the selected parameter. The cutoff frequency of a low pass filter can be defined in the '**Filter**' submenu in the measurement mode.

The power is calculated in the IBT100 instrument with the following formula:

$$P_{mech} = M \cdot \omega = M \cdot 2 \cdot \pi \cdot \frac{n}{60} \text{ , where}$$

P_{mech} is the mechanical power in W,

M is the torque in N·m and n is the speed in min^{-1}.

NOTICE

Calculating the mech. power in HP (horse power):

If the '**lbft**', '**lbin**' or '**ozin**' units have been defined, the mechanical power is automatically calculated in HP.

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6.6.2 Alarm Submenu

Up to three different parameters can be monitored at the same time in the IBT100 instrument. Alarm states are generated when freely-definable thresholds are undercut or exceeded. These are indicated by the measured value display flashing in the measurement mode and by a defined logical status change of the digital outputs.

▸	**Type**	**Norm**

The '**Norm**' (Normal), '**Hold**' (saving alarm status) and '**---**' (no monitoring) options are available under '**Type**'.
Normal monitoring means that the alarm state is only triggered as long as the threshold is undercut or exceeded. In the case of hold monitoring, a triggered alarm can only be reset by a freely-defined digital input.

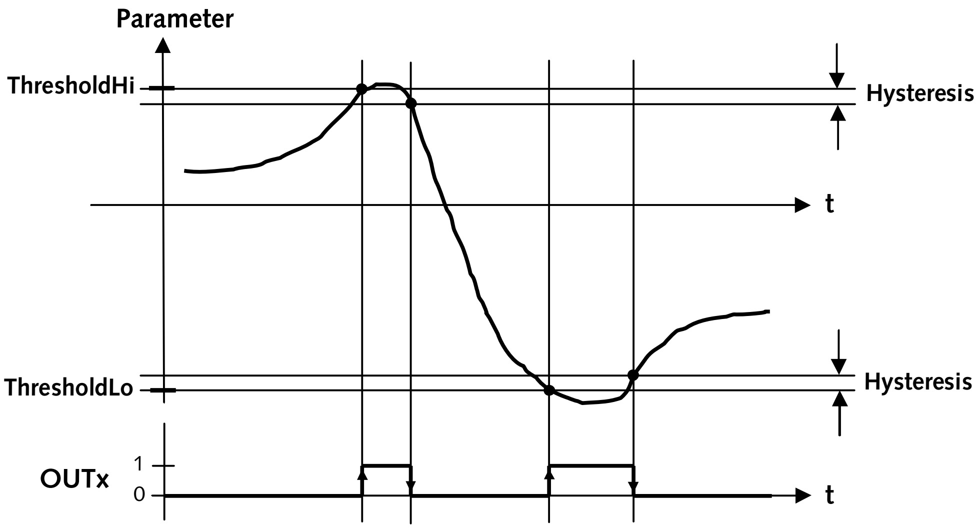
▸	**Source**	**Torque**

The parameters to be monitored can be defined with '**Source**':

'**Torque**'	torque
'**Force**'	force
'**Speed**'	speed
'**Angle**'	angle
'**Counter**'	counter reading
'**Power**'	mechanical power

▸	**Thr. Lo.**	**-10.000 N·m**
	Thr. Hi.	10.000 N·m
	Hyst.	0.010 N·m

The lower threshold value is parameterized with '**Thr.Lo.**' and the upper threshold value can be specified with '**Thr.Hi.**'. Optionally, a hysteresis can be defined for each threshold by selecting the '**Hyst.**' menu option.



▸	**Enable**	**In1**
	LogicIn	0→1

With '**Enable**', a digital input '**In1**'... ' **In8**' is selected and can be used to specifically activate or deactivate the monitoring in order to drive to a valid range first (from 0 to target value), for example. A triggered and saved alarm state (through '**Type**' → ' **Hold**') can also be reset again here.

The '**Button**' can also be selected with '**Enable**'. A triggered and saved alarm state can then be reset in the measurement mode by pressing the left arrow key.

If the Enable function is not desired, select the '**---**' option under '**Enable**'.

The digital switch state is defined in '**LogicIn**' to specify whether the monitoring should be enabled or the triggered and saved alarm state should be reset when the state changes from '**0→1**' or '**1→0**'.

Targeted enable of alarm function monitoring

For example, the definition '**0→1**' in '**LogicIn**' means that alarm function monitoring is enabled or reset in the digital switch state '**1**'.

A digital output '**OUT1**'... ' **OUT8**' that switches to the desired direction when an alarm state is triggered in accordance with '**LogicOut**' is defined in the '**Output**' menu item. If the alarm process is not to influence any digital output, select the '**---**' option in '**Output**'.

The following settings are possible in '**LogicOut**':

'**z→0**' from high-impedance state to state 0
'**0→z**' from state 0 to high-impedance state

6.6.3 Analog Output Submenu

Every recorded or calculated parameter can be reproduced in a scaled form on an analog output. The IBT100 instrument acts as a measured value amplifier as a result.

▸	**Output 1**
	Output 2
	Output 3

The structure of the '**Analog Output**' submenu is divided into the '**Output 1**', '**Output 2**' and '**Output 3**' submenu items. For each analog output, there is an option to independently set up different configurations.

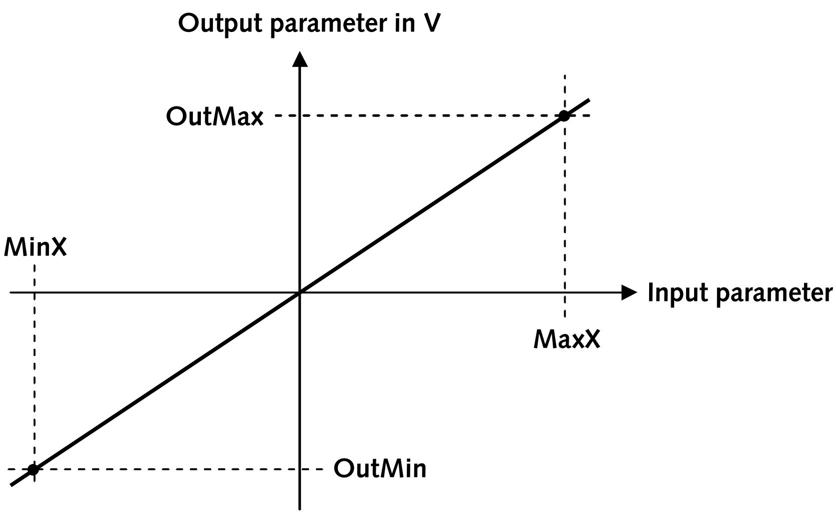
▸	**Source**	**Torque**
	MinX	-5.000 N·m
	MaxX	5.000 N·m
	OutMin	-10.000V
	OutMax	10.000V

The parameter to be converted is defined in the '**Source**' menu item:

'**---**'	analog output deactivated
'**Torque**'	torque
'**Speed**'	speed
'**Angle**'	angle
'**Counter**'	counter reading
'**Power**'	mechanical power

The input value is scaled in '**MinX**' and '**MaxX**'. The assignments of the output voltage values are defined in '**OutMin**' and '**OutMax**'.

The following schematic diagram shows the linear relationship between the input and output parameters for each analog output.



The maximum definable output voltage value is +10 V and the minimum value is –10 V.

Dual-range sensor

	1. MinX	-5.000 N·m
	1. MaxX	5.000 N·m
▸	**2. MinX**	**-0.500 N·m**
	2. MaxX	0.500 N·m
	OutMin	-10.000 V
	OutMax	10.000 V

If there is an extended (i.e. smaller) measuring range, an additional pair of values can be added for scaling the input values. This is performed in "**2.MinX**" and "**2.MaxX**". The output voltage values in '**OutMin**' and '**OutMax**' are equally valid for the nominal and extended measuring range.

Value range transgression

If the value range is exceeded during the measurement, the output voltages remain at their maximum (+11 V) or minimum values (–11 V) until the input parameters return to the defined value range again.

Detection of the direction of rotation

If the speed parameter is portrayed by an analog output, the detection of the direction of rotation can be realized by a change in sign of the output voltage. Prerequisite for detection of the direction of rotation is that the speed is fed by means of 2 tracks shifted with respect to one another.

Configuration example:

'**MinX**' = 0 min^{-1} with '**OutMin**' = 0 V
'**MaxX**' = 20 000 min^{-1} with '**OutMax**' = 10 V

During the measurement –10 V would appear on the analog output at –20 000 min^{-1} (opposite direction of rotation).

6.6.4 External Reset Submenu (Value Memory Reset via Dig. Inputs)

The Evaluation Instrument, IBT100, contains minimum and maximum memory for each recorded parameter and calculated value (e.g. mechanical power).

These are continuously updated during operation while the measurement is taking place. These memories as well as the measured value of the current angle and counter reading can be reset in the additional '**Reset Min/Max**' menu or via external digital input states.

▸	**ExtReset 1**
	ExtReset 2
	ExtReset 3

Three configurations, '**ExtReset 1**', '**ExtReset 2**' and '**ExtReset 3**', are available for this in the '**ExtReset**' submenu. This means that a maximum of three different parameters can be reset by external input states.

▸	**ExtReset**	**To.Min**

The corresponding measured value memory is defined under '**ExtReset**':

'**---**'	no measured value memory
'**All**'	all measured value memories
'**To.Min**'	minimum torque
'**To.Max**'	maximum torque
'**Sp.Min**'	minimum speed
'**Sp.Max**'	maximum speed
'**Angle**'	angle
'**An.Min**'	minimum angle
'**An.Max**'	maximum angle
'**Counter**'	actual counter reading
'**C.Min**'	minimum counter reading
'**C.Max**'	maximum counter reading
'**P.Min**'	minimum mechanical power
'**P.Max**'	maximum mechanical power

▸	**Input**	**In1**
	LogicIn	0→1

An external digital input '**In1**'.. ' **In8**' is defined in '**Input**'. The logic state change on which a memory reset is carried out is selected under '**LogicIn**'.

Example:

'**0→1**' means that a reset should be carried out when the state changes from '**0**' to '**1**'.

6.6.5 Trigger submenu (trigger condition for measured value storage)

Before the internal measured value buffer of the evaluation device IBT100 can be used, the trigger condition parameters must be set.

▸	**Mode**	**on**
	Source	Torque
	Threshold	3,000 N·m
	Direction	over
	Time	3.0S
	Measured values	5000

If the trigger condition is met, measured value storage is triggered. The created measured value packets can then be communicated to the outside via the port.

The general function of the measured value buffer is activated or deactivated with **'Mode'**. The following options can be selected:

'**on**' The measured value storage function is enabled
'**---**' The measured value storage function is disabled

Disabling of the measured value storage function

If the function of the measured value buffer is not used, in '**Mode**' select the '**---**' option (disabled). As a result other functions of the device are not negatively affected if a trigger condition is accidentally initiated.

Measured value storage and restrictions

During trigger monitoring activity and measured value storage, the following functions are temporarily **not** available:

Analog outputs
Alarm monitoring and digital outputs
Average value filter
Measurement range switchover

The function of the measured value buffer remains inactive with a torque sensor with **torque-equivalent frequency output**.

	Mode	on
▸	**Source**	**Torque**
	Threshold	3,000 N·m
	Direction	over
	Time	3.0S
	Measured values	5000

'**Source**' defines on which input variable the trigger condition should depend.

The following options can be selected:

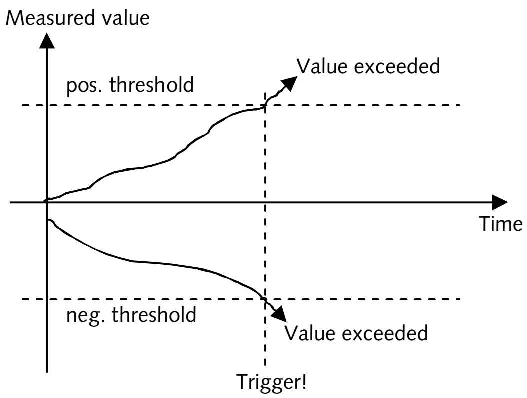
'**Torque**'	Torque
'**Speed**'	Speed
'**Angle**'	Angle
'**Counter**'	Rotation counter reading
'**Power**'	Mechanical power
'**IN1**' … '**IN8**'	digital input 1 … 8
'**Key**'	Key actuation in the additional functions menu

	Mode	on
	Source	Torque
▸	**Threshold**	**3,000 N·m**
	Direction	over
	Time	3.0S
	Measured values	5000

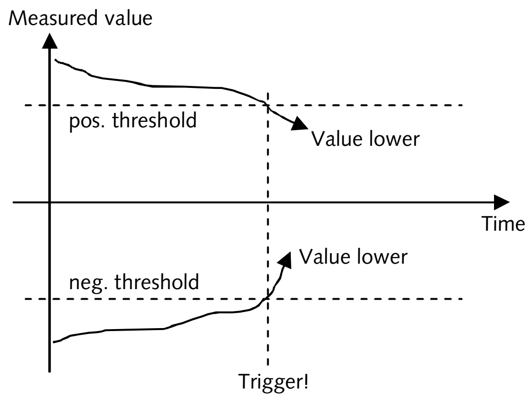
When a measurement variable is defined, trigger monitoring is initiated depending on a programmable threshold. This value is defined with the '**Threshold**' option. The unit is automatically added and depends on the defined measurement variable and the sensor settings.

The direction of threshold passage is defined with '**Direction**' and is shown in the diagram below.

Higher than threshold (direction: '**over**')



Lower than threshold (direction '**below**')



Example:

If the torque measured value exceeds a value of 0.5 N·m, the trigger condition should be met and therefore measured value storage initiated. Therefore the option '**Torque**' should be selected as '**Source**', the value 0.5 for '**Threshold**' and the option '**over**' for '**Direction**'.

	Mode	on
	Source	Torque
	Threshold	3,000 N·m
	Direction	over
▸	**Time**	**3.0S**
	Measured values	5000

The storage time when measured value storage is triggered is defined with the '**Time**' option. The number of measured value packets in measured value storage can be set with '**Measured values**'.

Storage time

The storage time cannot be below 0.5 s and not exceed 7,200 s (i.e. 2 hours).

Number of measured value packets

A minimum of 10 and a maximum of 5,000 measured value packets can be recorded during measured value storage in the evaluation device IBT100. When the evaluation device is switched off, the stored measured values are lost.

Sampling rate during measured value storage

The sampling rate is automatically calculated by the evaluation device IBT100 on the basis of the set storage time and the number of the measured value packets.

$$f_{Sample} = \frac{n_{packets}}{t_{Storage}}$$ whereby

f_{Sample} is the sampling rate,

$n_{packets}$ is the measured value packets,

$t_{Storage}$ is the storage time.

Example:

The storage time is set to 0.5 s, and 5,000 measured value packets should be stored. The sampling rate in the equation above is therefore 10 kHz.

Time interval during measured value storage

The time interval (time stamp) as well as the sampling rate are automatically calculated by the evaluation device IBT100 .

$t_{Slice} = \dfrac{1}{f_{Sample}}$, whereby t_{Slice} is the time interval.

Example:

At a sampling rate of 10 kHz the interval between each measuring point is 100 µs.
If the option '**IN1**' … '**IN8**' is selected as '**Source**', another option is available instead of the threshold.

	Mode	on
	Source	In1
▸	**Logic**	**0→1**
	Time	3.0S
	Measured values	5000

The necessary change in condition for initiation of measured value storage is defined with '**Logic**'. The following options can be selected:

'**0→1**' Measured value storage with logic condition 1
'**1→0**' Measured value storage with logic condition 0

	Mode	on
▸	**Source**	**Key**
	Time	3.0s
	Measured values	5000

If measured value storage should be triggered manually, it is possible to define the option '**Key**' as '**Source**'.

Initiation of trigger monitoring / measured value storage

Trigger monitoring depends on the set '**Source**' option.

Additional functions menu

	Reset Min/Max	|
▸	**Trigger release**	|
	Measurement range	|
	Zero point	↓

Measurement mode

Sensor	4700A	**TA**
Torque	0.0000 N·m	
Speed	0 rev/min	
Power	0.0 W	

'**Torque**'
'**Speed**'
'**Angle**'
'**Counter**'
'**Power**'

Selection of the '**Trigger release**' option in the additional functions. The symbol '**TA**' *(trigger armed)* then appears at the top left of the display for trigger monitoring. If the trigger condition is met (e.g. threshold value exceeded), measured value storage then starts immediately. Trigger monitoring must then be performed again manually ('**Trigger release**').

'**IN1**'…'**IN8**'

If a digital input is defined, measured value storage can be started immediately by the corresponding change in condition of the digital input.

'**Key**'

In this option, trigger monitoring of a measured variable or of a digital input is not available. Measured value storage is initiated immediately with selection of the '**Start trigger**' option in the additional functions.

6.7 Open Menu (Load Parameter Set)

▸	**Open**

An existing parameter set (all configurations) from the internal memory of the Evaluation Instrument, IBT100 can be opened with the '**Open**' menu function.

▸	**DEFAULT**
	TRD300

The '**DEFAULT**' parameter set in which the factory settings are stored is used as the default setting. The identification of the loaded parameter set is shown on the first line of the measurement mode.

6.8 Save Menu (to Save a Parameter Set)

▸	**Save**

In the '**Save**' menu function, a parameter set is saved to the nonvolatile internal memory of the I instrument; this parameter set is defined with a name (all available characters allowed). A maximum of 20 parameter sets can be stored.

▸	<New>
	DEFAULT
	TRD300

A new parameter set is created by selecting '**<New>**'. The name must then be defined.

TRD300
Overwrite?
▸ Yes ◂

If the desired name of the parameter set already exists, a confirmation prompt appears before the overwrite ('**Yes**' or '**No**').

The identification of the saved parameter set is shown on the first line of the measurement mode.

6.9 Delete Menu (to Delete a Parameter Set)

▸	**Delete**

An existing parameter set is deleted from the internal memory of the IBT100 instrument with the '**Delete**' menu function.

TRD300
Delete?
▸ no ◂

A confirmation is requested for this ('**yes**' or '**no**'). The delete is irrevocable and cannot be undone.

6.10 Communication Menu

The '**Communication**' menu contains the settings of the RS-232C and USB port.

▸	**Port**	**RS232**

The type of port is defined with the '**Port**' option. The following options can be selected:

'**RS232**'	RS-232C port
'**USB**'	USB port

▸	**Baudrate**	**115200**

The transmission speed is defined in bits/second; the following settings are available in '**Baudrate**':

4800
'9600'
'19200'
'38400'
'57600'
'115200'
'230400'

▸	**Termination**	**CRLF**

Each ASCII command over the serial interface ends with a so-called "end" character (a termination). This termination is used to correctly interpret the end of a command character string. The following termination options are available with the **'Termination'** option:

		ASCII code
'**;**'	semicolon	59_{dec}
'**CRLF**'	*carriage return & line feed*	13_{dec} & 10_{dec}
'**LFCR**'	*line feed & carriage return*	10_{dec} & 13_{dec}
'**CR**'	*carriage return*	13_{dec}
'**LF**'	*line feed*	10_{dec}.

The communication settings are immediately saved as nonvolatile in the IBT100 instrument on exiting the '**Communication**' submenu.

NOTICE

FUTEK UMV Software PC application

A baud rate range of '**38400**' to '**115200**' bits/second must be set for communicating with the FUTEK UMV Software PC application. The required termination is '**CRLF**'.

6.10.1 Automatic Sending

With the '**Auto Send**' option the RS-232C communication is able to send measured values automatically. The following settings are available:

▸	Auto Send	Yes

'**Yes**'	automatic sending activated,
'**No**'	measured values are only sent when the respective command is activated.

▸	Format	Torque

The data content can be defined with '**Format**':

'**Torque**'	torque,
'**To.Min**'	minimum torque,
'**To.Max**'	maximum torque,
'**Speed**'	speed,
'**Sp.Min**'	minimum speed,
'**Sp.Max**'	maximum speed,
'**Angle**'	angle,
'**An.Min**'	minimum angle,
'**An.Max**'	maximum angle,
'**Counter**'	counter reading,
'**C.Min**'	minimum counter reading,
'**C.Max**'	maximum counter reading,
'**Output**'	mechanical output,
'**P.Min**'	minimum power,
'**P.Max**'	maximum power,
'**M+n+P**'	Torque, speed and mechanical output, separated by the vertical separating character '**|**' ($7C_{Hex}$, 124_{10}), example: <M>**|**<n>**|**<P><CR><LF>
'**4703A**'	Protocol as for the electric force measuring instrument type 4703A... (formerly model STM 702), whereby the following table applies:

Byte	ASCII-Character	Meaning
1	B N	Meas. value without taring Tared measured value
2	<Space> –	positive measured value negative measured value
3…8*	<Meas. value>	Measured value
9..10*	<Termination>	The terminating characters depend on the '**Termination**' menu item, e.g. '**CRLF**'

* The number of bytes for the measured value or termination is variable.

As an example, a measured value 5.000856 N·m with tared zero point and the setting '**4703A**':

N 5.000856<CR><LF>

▸	**Index**	**Yes**

If necessary, an index can be added before each automatically sent measured value package. To this purpose the counter reading is incremented from zero to 1, 2 etc.
The highest counter reading is 2^{32}-1 (4294967295), followed by an overflow after which the index starts again at 0. The index and the corresponding measured value are separated by a vertical separating character '**|**' ($7C_{Hex}$, 124_{10}).

Indexing is controlled with '**Index**' with the settings '**Yes**' (activated) and '**No**' (deactivated).

Example for automatic sending of torque values with the termination '**CRLF**', but without indexing:

1st measured value: 5.005787<CR><LF>
2nd measured value: 5.006022<CR><LF>
3rd measured value: 5.007122<CR><LF>

and with indexing:

1st measured value: 0|5.005787<CR><LF>
2nd measured value: 1|5.006022<CR><LF>
3rd measured value: 2|5.007122<CR><LF>
…

▸	Interval	100ms

The time between each sent measured value package is defined with '**Interval**'.
The following settings are available to this purpose:

'**10s**'	10 seconds,
'**5s**'	5 seconds,
'**1s**'	1 second,
'**500ms**'	500 milliseconds,
'**100ms**'	100 milliseconds,
'**50ms**'	50 milliseconds,
'**10ms**'	10 milliseconds,

The communication settings are immediately saved as nonvolatile in the IBT100 instrument on exiting the '**Communication**' submenu.

NOTICE

PC Application FUTEK UMV Software

Automatic sending of measured values must be deactivated for use of the UMV Software PC Application. (Option '**Auto Send**' to'**No**').

6.11 Language Menu

▸	**English**
	German
	Francais

This menu provides the option of defining the display language of the IBT100 instrument.

The following languages are supported:

'**English**' English
'**Deutsch**' German
'**Francais**' Francais

After selecting the language, the instrument automatically returns to the main menu. The language selection is immediately saved as nonvolatile in the IBT100 instrument.

6.12 Additional Functions

6.12.1 Reset Min/Max Submenu (to Delete Value Memory)

▸	**Reset All**	
	To.Min	-9.998 N·m
	To.Max	11.623 N·m
	Sp.Min	-1002.67 1/min
	Sp.Max	980.78 1/min
	An.Min	-6766.25 °
	An.Max	1290.75 °
	Angle	230.00 °
	C.Min	-67.5
	C.Max	80.9
	Counter	31.2
	P.Min	1049.78 W
	P.Max	1183.76 W

The option to manually delete the value memory is available in the '**Reset Min/Max**' submenu. The following memories can be reset:

'**Reset All**' all value memories
'**To.Min**' minimum torque
'**To.Max**' maximum torque
'**Sp.Min**' minimum speed
'**Sp.Max**' maximum speed
'**An.Min**' minimum angle
'**An.Max**' maximum angle
'**Angle**' angle
'**C.Min**' minimum counter reading
'**C.Max**' maximum counter reading
'**Counter**' actual counter reading
'**P.Min**' minimum mechanical power
'**P.Max**' maximum mechanical power

Select the respective position with the arrow keys and confirm the reset with the Enter key ↵.

6.12.2 Zero Adjust Submenu

▸	**Torque**	**0.002 N·m**
	Angle	0.00 °
	Counter	0.00 rev

The '**Zero Adjust**' submenu is used to set current measured values, such as torque/force, the measured angle value or the counter reading, to the value of zero.

For this, the respective measured value is selected with the arrow keys and the renewed zero point shift (taring) is confirmed with the Enter key ↵.

The zero point shift of the angle measured value or the counter reading has the same effect as the reset in the '**Reset Min/Max**' submenu.

The ESC key is used to exit the '**Zero Adjust**' submenu when the user is returned to the additional functions.

Saving the zero point shift (taring)

The zero point shift is lost when the IBT100 instrument is switched off and on again. If this taring is to remain saved as nonvolatile, however, this can be achieved by saving the parameter set (Main menu → ' **Save**' submenu).

6.12.3 Sensor Check Submenu

Sensor Check	
--	
Torque	10.00 N·m
Signal	5.000 V

The '**Sensor Check**' submenu is used to put the sensor into a defined state. By pressing the Enter key ↵, an active or passive sensor causes the strain gage bridge to become unbalanced in order to test the sensor.

This test mode remains active until the Enter key ↵ is released again. The display shows both the normalized torque value and the tared voltage/frequency value.

FUTEK torque sensors with sensor check functionality

The following sensors contain the sensor check function:

TRx30x	passive sensor
TRx60x/705	active sensor

Sensor check voltage level on the sensor connector

Activation of the sensor check affects the output pins of the sensor connector as follows:

Active sensors (PIN 12, ground reference PIN 22)

Control signal inactive (normal operating condition)	active control signal (↵ pressed)
0 V	+5 V

Passive sensors (PIN 23, ground reference PIN 14)

Control signal inactive (normal operating condition)	active control signal (↵ pressed)
+2,5 V (bridge supply middle)	0 V

6.12.4 Filter Submenu

In the submenu '**Filter**' there are filter functions available for torque/force and speed measurement values. Following filter functions are available:

Analog low pass filter 2nd order

This low pass filter can be used by analog input values (passive or active sensors). This filter is not usable for sensors with frequency outputs based on torque.

Moving average filter for torque/force

Instead of low pass filter, this moving average filter can be used for analog and sensors with frequency outputs based on torque.

Moving average filter for speed

Speed measured values can be damped with the moving average function (e.g. for minimization of speed fluctuations).

Filtering of mechanical power

The mechanical power can also be affected by the filter functions because the power calculation depends on torque and speed.

►	**Torque**
	Speed

In the '**Torque**' submenu low pass filter or moving average filter for torque/force can be defined.

►	**Low-pass**	**50 Hz**
	Averaging	**off**

The following cutoff frequencies (-6 dB) are available for the torque signal:

'**1Hz**'	1 Hz
'**2Hz**'	2 Hz
'**5Hz**'	5 Hz
'**10Hz**'	10 Hz
'**20Hz**'	20 Hz
'**50Hz**'	50 Hz
'**60Hz**'	60 Hz
'**100Hz**'	100 Hz
'**120Hz**'	120 Hz
'**200Hz**'	200 Hz
'**500Hz**'	500 Hz
'**1kHz**'	1 kHz
'**2kHz**'	2 kHz
'**3kHz**'	3 kHz
'**5kHz**'	5 kHz
'**off**'	no low pass active (cutoff frequency 10 kHz)

Instead of analog low pass filter, a moving average filter can be defined in following depths:

2	depth 2
4	depth 4
8 '	depth 8
'16'	depth 16
'32'	depth 32
'64'	depth 64
'128'	depth 128
'256'	depth 256
'512'	depth 512
'1024'	depth 1024
'off'	moving average filter deactivated

Low pass filter/moving averaging

If activating moving average filter, the analog low pass filter will be deactivated automatically.

	Torque
▸	**Speed**

With the submenu '**Speed**' moving average filter can be defined for speed measured values.

▸	**Averaging**	**16**

Following depths are available:

'2'	depth 2
'4'	depth 4
'8'	depth 8
'16'	depth 16
'32'	depth 32
'64'	depth 64
'128'	depth 128
'256'	depth 256
'512'	depth 512
'off'	moving average filter deactivated

NOTICE

Effects of the filter functions

The measured value display and the analog outputs are directly affected by the filter functions.

7. Interface Commands

Communication between the IBT100 instrument and an operating PC is possible over the RS-232C interface. The ASCII commands to be used are based on the SCPI standard (**s***tandard* **c***ommands for* **p***rogrammable* **i***nstruments*) in order to achieve the most straightforward and easy to understand method of communication.

An **RS-232C null modem cable** is used for the connection between the IBT100 instrument and operating PC. The RS-232C interface works in accordance with the following conditions:

4800 … 230 400 bits/second (adjustable)
8 data bits
1 stop bit
no parity
no flow control

Each ASCII command contains an ASCII character string followed by a termination. See also the chapter on "**Communication menu**". The following chapters list and describe commands where the terminating character strings are omitted for purposes of clarity.

7.1 Conventions and Syntax

The Evaluation Instrument, IBT100 only responds over the RS-232C interface when it receives a command from the requester (i.e. PC: *Master* IBT100: *Slave*).

A response (acknowledgment) is always sent by the IBT100 instrument even if only configurations are transmitted by the requester.

Only ASCII commands are sent by the requester. Terminating characters must always be appended at the end of these commands. The IBT100 instrument communicates the same termination to the requester. Terminating characters can be defined in the '**Communication**' submenu of the IBT100 instrument.

Syntax example for determining the torque with the termination '**CRLF**':

Requester:	**MEAS:TORQ?***<CR><LF>*
IBT100 responds:	**120.089***<CR><LF>*

Upper and lower case are not differentiated. The command interpreter of the IBT100 instrument also ignores any leading spaces and spaces within the commands.

Examples:

Typical	**MEAS:TORQ?***<CR><LF>*
Identical to	**MEAS :torq ?** *<CR><LF>*
Identical to	**MeaS :Torq?***<CR><LF>*

Syntax and conventions

The end of a command chain must always be made with a termination (e.g. *<CR><LF>*).

A command for a request ends with a question mark ("**?**"), e.g. MEAS:TORQ**?***<CR><LF>*.

The numerical value of zero ("**0**") is sent back as a confirmation following successful transfer of a configuration.

Example:

Requester:	**ROUT:TORQ:ACTI***<CR><LF>*
IBT100 responds:	**0***<CR><LF>*

Commas in floating-point numbers are defined in decimal point form (e.g. 9**.**998).

If a command is not accepted for various reasons, the Evaluation Instrument, IBT100 returns a negative error value.

Example of an incorrectly written command:

Requester:	**MEA:TORQ?***<CR><LF>*
IBT100 responds:	**ERR-100***<CR><LF>*

Error values and their meanings can be found in the chapter on “**Error messages**“.

For reasons of clarity, the terminating characters are omitted in the following *(e.g. <CR><LF>*).

7.2 Command Glossary

The command strings follow the structure of an instrument and are separated by separators (":"). Each command string has a maximum of four ASCII characters. The most important command strings are listed and assigned with their meaning in the following table:

Code	Meaning	Translation
ACTI	ACTIve	Active branch
ADD	ADDitional	Additional
ALER	ALERt	Alarming
ALL	ALL	All
ANA	ANAlog	Analog branch
ANG	ANGle	Angle
ARM	ARMing	Arming
ASR	AlertStatusRegister	alert event register
AUTO	AUTOmatic	Automatic
AVER	AVERage	(moving) average
BRID	BRIDge	Bridge branch
BUFF	BUFFer	Memory range
CALC	CALCulate	Calculation unit
CCW	Counter Clock Wise	Counterclockwise
CENT	CENTer	Center
CLE	CLEar	Delete
CLSE	CLoSE	Close
CONT	CONTrol	Control signal
COUN	COUNter	Counter (status)
CW	Clock Wise	Clockwise
DEL	DELete	Delete file
DIG	DIGital	Digital
DIR	DIRectory / DIRection	File directory/direction
DISP	DISPlay	Display
DOWN	DOWN	Down
DPT	Decimal PoinT	Decimal point
ENA	ENAble	Activated
ENG	ENGlish	English
ENTR	ENTeR	Enter key
ERST	External ReSeT	External reset
ESC	ESCape	Cancel
ESR	EventStatusRegister	Event register
EXT	EXTended	Extended
FILE	FILE	File
FILT	FILTer	Filter
FOFF	Frequency OFFset	Frequency offset
FRA	FRAncais	French
FREQ	FREQuency	Frequency measurement branch
GER	GERman	German
HIGH	HIGH	Logic state 1
HOLD	HOLD	Saved mode
HYST	HYSTeresis	Hysteresis

Code	Meaning	Translation
IDN	IDeNtification	Identification
INP	INPut	Input
KEY	KEY	Key on the front panel
LANG	LANGuage	Language
LEFT	LEFT	Left
LOAD	LOAD	Load
LOW	LOW	Logic state 2
LPFT	Low Pass FilTer	Low pass filter
MAX	MAXimum	Maximum
MaxX	X MAXimum	X maximum
MAXY	Y MAXimum	Y maximum
MEAS	MEASure	Measure
MEM	MEMory	Memory
MENU	MENU	Menu
MIN	MINimum	Minimum
MinX	X MINimum	X minimum
MINY	Y MINimum	Y minimum
MODE	MODE	Mode
MULT	MULTiplicate	Range multiplicator
NOM	NOMinal	nominal
NONE	NONE	None
Norm	NORM	Normal mode
OFF	OFF	Off
ON	ON	On
OPEN	OPEN	Open
OUTP	OUTPut	Output
POST	POST	After
POW	POWer	Mechanical power
PRE	PRE	Before
PULS	PULSe	Pulse
RANG	RANGe	Range
RFRH	ReFResH	Refresh
RGHT	RiGHT	Right
ROUT	ROUTe	Measurement routing
SAVE	SAVE	Save
SECN	SECoNd	Second
SENS	SENSe	Sensing unit
SOUR	SOURce	Source
SPE	SPEed	Speed
STAT	STATus	Status
TARE	TARE	Zero point shift
TARG	TARGet	Target
TEMP	TEMPerature	Temperature
THR	THReshold	Threshold
TIME	TIME	Time
TORQ	TORQue	Torque
TRAC	TRACe	Volatile memory
TRIG	TRIGger	Trigger
UNIT	UNIT	Unit
UP	UP	Up

7.3 Error Messages

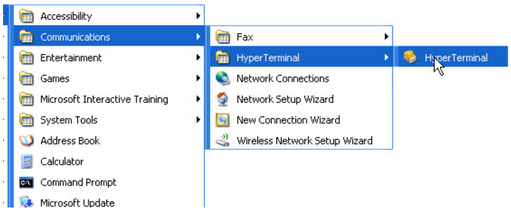
The Evaluation Instrument, IBT100 transfers a negative error value ("**ERR-xxx**") over the RS-232C interface if a command has not been accepted for various reasons (see the following table).

Error value of the Type IBT100 instrument	**Error description**	**Remedy**
ERR-100	Command not understood.	Check command syntax. Send the command again as IBT100 instrument may be busy.
ERR-101	"**?**" has not been appended to a request.	Add "**?**" to the request.
ERR-104	Calculation steps led to an overflow.	Check calculation variables (company-internal use).
ERR-105	Error when accessing the nonvolatile memory.	Rewrite the memory, Notify FUTEK
ERR-106	Access to protected memory.	Remove memory protection (company-internal use).
ERR-108	Transferred character string too long.	Shorten character string (company-internal use).
ERR-109	Transferred numerical value invalid.	Check numerical value (company-internal use).

7.4 HyperTerminal®

Basic communication over the RS-232C interface is possible with the HyperTerminal® from Microsoft®. The commands are entered manually, sent to the IBT100 instrument and output again on the PC screen as acknowledged.

With the aid of the HyperTerminal®, it is possible to set up a simple means of communication for the initial installation or for service functions.



The configuration in the IBT100 instrument and of the HyperTerminal® is explained in more detail in the following example.

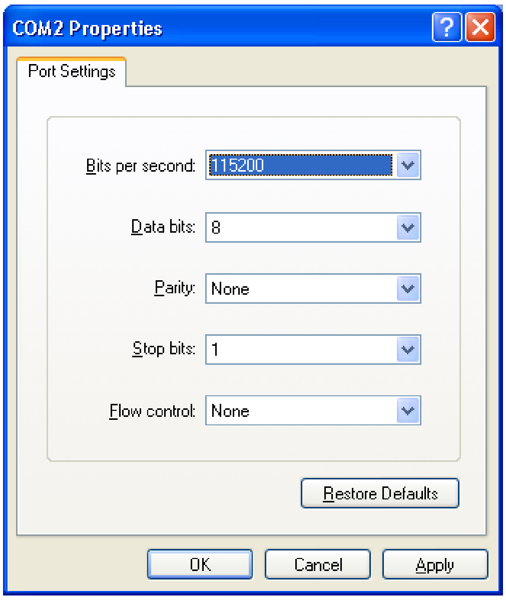
The HyperTerminal® is started from the start group of the Windows® PC.

HyperTerminal® recommends a new connection. The name must be defined, e.g. "**4700A**", in order to identify the connection. The HyperTerminal® setting can be saved later on the desktop; any icon can be selected for this.

The entry is confirmed with the “**OK**“ button.

The connection to the serial RS-232C interface is then defined, e.g. "**COM1**".

The configurations are confirmed with the "**OK**" button.



The properties of the COM port are defined as follows:

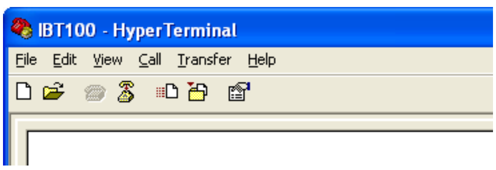
115 200 bits per second
8 data bits
no parity
1 stop bit
no flow control

The following configurations should be selected in the IBT100 instrument ('**Communication**' submenu):

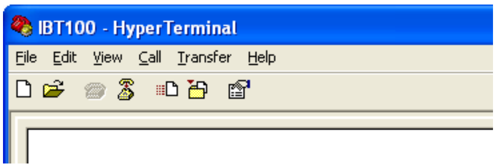
"**Baud rate**"	=	"**115200**" bits/second
"**Termination**"	=	"**CRLF**" (*carriage return & line feed*)

RS-232C cable and transmission speed

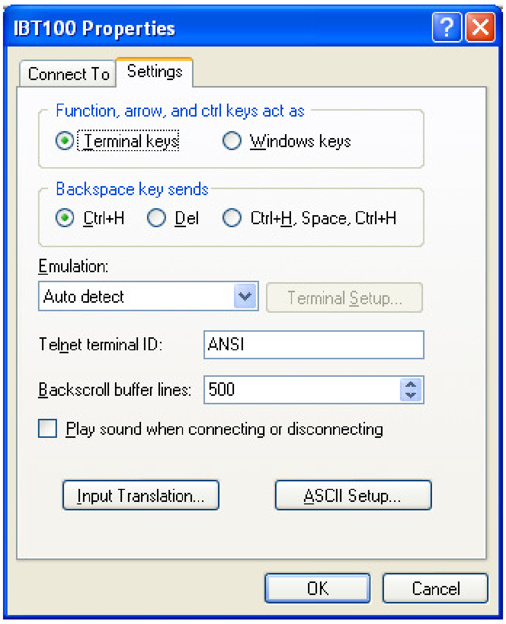
The definition of the transmission speed (baud rate) depends on the length and quality of the RS-232C cable. In an emergency, the transmission speed in the IBT100 instrument and operating PC must be decreased.



The connection between the HyperTerminal and IBT100 instrument is disconnected by pressing the "**Hangup**" symbol  as the terminal settings need to be made first (alternatively with menu item "**Call**" → "**Disconnect**").

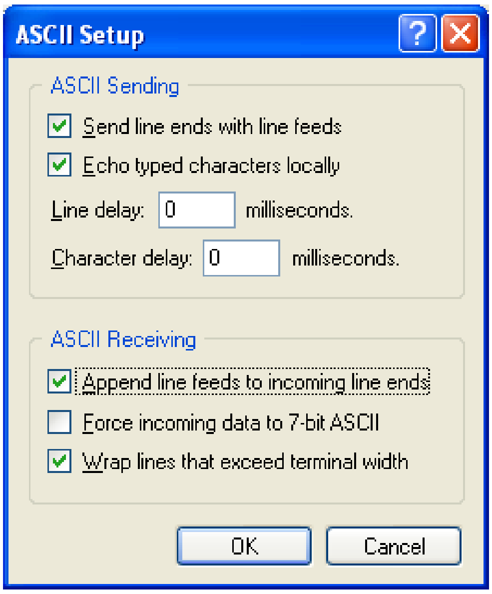


The window with the COM port and terminal settings is opened with the "**Properties**" symbol  (alternatively with menu item "**File**" → "**Properties**").



Then click the "**Settings**" tab in the "**Properties**" window. The following settings must be made and mostly correspond to the default settings:

Allocation of function keys…:	Terminal
Back key sends:	CTRL+H
Emulation:	Auto-Detect.
Telnet terminal detection:	ANSI
Lines in image buffer:	500

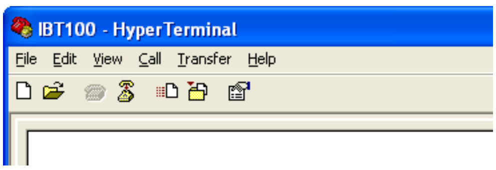


The window for defining the sent and received ASCII characters is opened by pressing the "**ASCII configuration**" button. The following settings should be made:

Sent lines end with line feed
Output entered characters locally (local echo)
Append line feed at line end when received
Wrap excessive lines in the terminal window

The settings are confirmed with the "**OK**" button.

The "**Properties**" window is also closed by pressing the "**OK**" button.



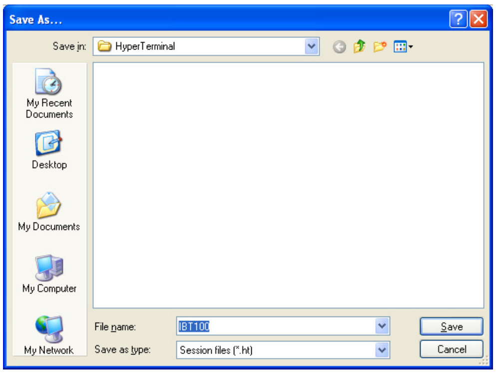
The connection to the IBT100 instrument can now be established by pressing the "**Call**" symbol  (or, alternatively, menu item "**Call**" → "**Call**").

Command conventions and useful entry aids

Upper and lower case are not differentiated, i.e. case insensitive. Spaces are also ignored. Star symbols ("*") that also need to be entered for special commands in the SCPI standard can be omitted.

The backspace key can be used for deleting individual characters in order to correct incorrectly entered commands.

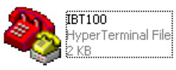
The last command sent from the IBT100 instrument is displayed again on the HyperTerminal® by entering the exclamation mark ("**!**", key Shift+1).



The settings of the HyperTerminal® can be saved on the desktop of the PC. This means the HyperTerminal® can be accessed quickly and easily in the future.

To do this, open the Save window in the HyperTerminal® with the menu item "**File**" → "**Save under…**".

To do this, select the "**Desktop**" save location and save the "**4700A.ht**" file by pressing the "**Save**" button.



The corresponding icon then appears on the desktop; click on this at any time to start the HyperTerminal® again with the previously saved settings.

7.5 System

7.5.1 Event Status Register (*ESR?)

***ESR?**

The *event status register* is read with this command. The contents show the internal states of the IBT100 instrument.

Empty bit fields of the ESR register are not allocated and have the value 0. When the IBT100 instrument is in the switched on state, the ESR register is deleted and then the PON bit (*power on*) is set.

	ESR register							
Bit	D7	D6	D5	D4	D3	D2	D1	D0
Event	**PON**	**NSE**	**CME**	**EXE**	**SC**	**ALE**	**RNG**	**OPC**
Weighting	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Assignment:

0 Event bit is not set
1 Event bit is set

Event bits:

PON **Switched on state (power on)**
This bit is set as soon as the IBT100 instrument is in measurement mode.

NSE **Changed configuration data (new settings)**
This bit is set as soon as configurations are made in the IBT100 instrument in a menu or over an interface (e.g. another sensor type, etc.).

EXE **Execution error**
This bit is set if an inadmissible command has been transferred to the IBT100 instrument.

SC **Sensor check**
This bit is set if a sensor check functionality to a connected sensor was switched on (colloquial: calibration signal).

ALE **Alert occurred**
This bit is set if a user defined threshold was exceeded, e.g. torque or speed.

RNG **Measurement range**
This bit is set if extended (smaller) measurement range was activated.

OPC **Operation complete**
This bit is set when a command has been successfully completed or the trigger process ends.

The output of the ESR register is made in decimal format (0_{dec} … 255_{dec}). The set bits are deleted based on the determination of the ESR register.

Syntax example:

***ESR?**
129 (PON and OPC bit set)

7.5.2 Alert Status Register (ASR?)

ASR?

The *alert status register* is read with this command. The contents show the internal affected threshold states of the IBT100 instrument.

Empty bit fields of the ASR register are not allocated and have the value 0. When the IBT100 instrument is in the switched on state, the ASR register is deleted.

	ASR register							
Bit	D7	D6	D5	D4	D3	D2	D1	D0
Event	**M**	**N**	**A**	**C**	**P**	---	---	---
Weighting	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Assignment:

0 Event bit is not set
1 Event bit is set

Event bits:

M **Torque/Force**
This bit is set if torque or force threshold was exceeded.

N **Speed**
This bit is set if speed threshold was exceeded.

A **Angle**
This bit is set if angle threshold was exceeded.

C **Counter**
This bit is set if counter value threshold was exceeded.

P **Mechanical power**
This bit is set if calculated mechanical power threshold was exceeded.

The output of the ASR register is made in decimal format (0_{dec} … 255_{dec}). The set bits are deleted based on the determination of the ASR register.

Syntax example:

ASR?
136 (M and P bit set)

7.5.3 Trigger status register (TSR?)

TSR?

This command is used to output the (*trigger status register*). The displayed content includes internal conditions regarding the measured value buffer and trigger conditions of the IBT100.

Empty bit fields of the TSR register are not assigned and contain the value 0. When the IBT100 is switched on, the content of the TSR register is deleted.

	TSR register							
Bit	D7	D6	D5	D4	D3	D2	D1	D0
Event	**A**	**E**	**F**	**C**	---	---	---	---
Weighting	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 :H^{Y}ST)	4 (2^2)	2 (2^1)	1 (2^0)
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Assignment:

0 Event bit is not set
1 Event bit is set

Event bits:

A **Trigger monitoring** (*armed*)
As soon as trigger monitoring is armed, this bit is set. If the bit is set, measured value storage can be initiated when the trigger condition (e.g. exceeded threshold value) is met.

E **Measured value storage initiated?**
(established)
This bit is set as soon as measured value storage is initiated when a trigger condition is met.

F **Measured value storage finished?**
(finished)
If the measured value storage is finished (time elapsed), this bit is set.

C **Measured value contents available?**
(contents)
If measured value packets are available in the buffer which can be transferred externally through the port, this bit is set.

7.6 Measuring

7.6.1 Determining Measured Values (MEAS)

MEAS:<function>?
MEAS:ALL?

Individual measured values can be determined with the MEAS command group. The following parameters are available:

<Function> =

TORQ	torque (or force)
TORQ:MIN	minimum torque
TORQ:MAX	maximum torque
SPE	speed
SPE:MIN	minimum speed
SPE:MAX	maximum speed
ANG	angle
ANG:MIN	minimum angle
ANG:MAX	maximum angle
COUN	counter reading
COUN:MIN	minimum counter reading
COUN:MAX	maximum counter reading
POW	mechanical power
POW:MIN	minimum mechanical power
POW:MAX	maximum mechanical power

The measured value is transferred as a decimal floating-point number. The associated unit for the torque can be determined with **SENS:UNIT?**. The unit for the mechanical power is determined with **CALC:POW:UNIT?**. The speed parameter is always assigned the unit 'rev/min' and angle is always assigned the unit 'degree'.

Syntax examples:
MEAS:TORQ?
56.556
MEAS:ANG?
100.25

With **MEAS:ALL?**, all relevant parameters can be transferred in one go. The sequence is made up as follows:

<torque>|<speed>|<angle>|<counter>|<power>

<torque> torque/force
<speed> speed
<angle> angle
<counter> counter reading
<power> mechanical power

The vertical separator or pipe ("**|**") represents ASCII code 124_{dec} ($7C_{Hex}$).

Syntax example:

MEAS:ALL?
10.554|890.67|334.25|1901.34|984.379

7.6.2 Determining Digital Input States (INP:DIG)

INP:DIG?

The digital input states can be determined with the **INP:DIG?** command. The return value is output as a decimal number (0 … 255).

	Digital input port							
Bit	In8	In7	In6	In5	In4	In3	In2	In1
Weighting	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Syntax example:

INP:DIG?
144 (In8 and In5: state 1, remaining: state 0)

7.6.3 Determining Digital Output States (OUTP:DIG)

OUTP:DIG?

The digital output states can be determined with the **OUTP:DIG?** command. The return value is output as a decimal number (0 … 255).

	Digital output port							
Bit	In8	In7	In6	In5	In4	In3	In2	In1
Weighting	128 (2^7)	64 (2^6)	32 (2^5)	16 (2^4)	8 (2^3)	4 (2^2)	2 (2^1)	1 (2^0)
Value	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Syntax example:

OUTP:DIG?
5 (In3 and In1: state 1, remaining: state 0)

7.6.4 Deleting Peak Value Memory (TRAC)

TRAC:<Function>:CLE

The internal min./max. memory can be reset (deleted) with this command group. The following memories are available:

<Function> =

ALL	all min./max. memories
TORQ:MIN	minimum torque
TORQ:MAX	maximum torque
SPE:MIN	minimum torque
SPE:MAX	maximum torque
ANG:MIN	minimum angle
ANG:MAX	maximum angle
COUN:MIN	minimum counter reading
COUN:MAX	maximum counter reading
POW:MIN	minimum mechanical power
POW:MAX	maximum mechanical power

Syntax examples:

TRAC:ALL:CLE
0 (all min./max. memories deleted)

TRAC:TORQ:MIN:CLE
0 (minimum torque only deleted)

7.6.5 Control Signal (INP:CONT)

INP:CONT:ON
INP:CONT:OFF
INP:CONT:STAT?

The control signal (for the functional test of the connected sensor) is activated with **INP:CONT:ON**. The control signal is deactivated again by **INP:CONT:OFF**.

INP:CONT:STAT? is used to determine whether the control signal is currently active (response '**ON**'). If the control signal is deactivated, the IBT100 instrument responds with the '**OFF**' character string.

NOTICE

Control signal

The sensor must be equipped for this. The following torque sensors have this functionality:

TRD Series
TRH Series

7.6.6 Torque/Force Zero Point Shift (CALC:TARE:TORQ)

CALC:TARE:TORQ:AUTO
CALC:TARE:TORQ:ON
CALC:TARE:TORQ:OFF
CALC:TARE:TORQ:STAT?

A zero point shift (taring) is possible for the torque or force parameter.

The torque signal is tared (set to zero) with **CALC:TARE:TORQ:AUTO**. The taring is activated with **CALC:TARE:TORQ:ON** and deactivated with **CALC:TARE:TORQ:OFF**.

CALC:TARE:TORQ:STAT? is used to determine whether the zero point shift is currently active (response '**ON**'). If the zero point shift is deactivated, the IBT100 instrument responds with the '**OFF**' character string.

Syntax examples:

CALC:TARE:TORQ:AUTO	(torque tared)
0	
CALC:TARE:TORQ:ON	(activates taring)
0	
CALC:TARE:TORQ:STAT?	
ON	

7.6.7 Angular Zero Point Shift (CALC:TARE:ANG)

CALC:TARE:ANG:AUTO
CALC:TARE:ANG:ON
CALC:TARE:ANG:OFF
CALC:TARE:ANG:STAT?

A zero point shift (taring) is possible for the angle parameter.

The angle signal is tared with **CALC:TARE:ANG:AUTO** (set to zero). The taring is activated with **CALC:TARE:ANG:ON** and deactivated by **CALC:TARE:ANG:OFF**.

CALC:TARE:ANG:STAT? is used to determine whether the zero point shift is currently active (response '**ON**'). If the zero point shift is deactivated, the IBT100 instrument responds with the '**OFF**' character string.

Syntax examples:

CALC:TARE:TORQ:AUTO	(torque tared)
0	
CALC:TARE:TORQ:ON	(activates taring)
0	
CALC:TARE:TORQ:STAT?	
ON	

7.6.8 Torque/Force Low Pass Filter (INP:FILT)

INP:FILT<cutOffFreq>
INP:FILT:ON
INP:FILT:OFF
INP:FILT:STAT?

The analog torque/force measurement branch has a 2nd order, analog low pass input filter. This can be selected in **INP:FILT<cutOffFreq>**.

The low pass filter is activated with **INP:FILT:ON**. The low pass filter is deactivated with **INP:FILT:OFF**.

INP:FILT:STAT? is used to determine whether the low pass filter is currently active (response '**ON**'). If the low pass filter is deactivated, the IBT100 instrument responds with the character string '**OFF**'.

<cutOffFreq> =

1	1 Hz
2	2 Hz
5	5 Hz
10	10 Hz
20	20 Hz
50	50 Hz
60	60 Hz
100	100 Hz
120	120 Hz
200	200 Hz
500	5 kHz
1000	1 kHz
2000	2 kHz
3000	3 kHz
4000	4 kHz
5000	5 kHz

Syntax examples:

INP:FILT10	(filter frequency 10 Hz)
0	
INP:FILT?	
10	
INP:FILT:ON	(filter activated)
0	
INP:FILT:STAT?	
ON	

NOTICE

Sensors with frequency output

The analog low pass filter will be deactivated if a sensor with frequency output is connected.

7.6.9 Torque/Force Averaging Filter (INP:AVER:TORQ)

INP:AVER:TORQ<averageDepth>
INP:AVER:TORQ:ON
INP:AVER:TORQ:OFF
INP:AVER:TORQ:STAT?

The moving average filter can be defined for torque or force measurements. The depth can be selected in **INP:AVER:TORQ<averageDepth>**.

The moving average filter is activated with **INP:AVER:TORQ:ON**. The moving average filter is deactivated with **INP:AVER:TORQ:OFF**.

INP:AVER:TORQ:STAT? is used to determine whether the moving average filter is currently active (response '**ON**'). If the moving average filter is deactivated, the IBT100 instrument responds with the character string '**OFF**'.

<averageDepth> =

2
4
8
16
32
64
128
256
512
1024

Syntax examples:

INP:AVER:TORQ32	(Moving average depth to 32)
0	
INP:AVER:TORQ?	
32	
INP:AVER:TORQ:ON	(Moving average activated)
0	
INP:AVER:TORQ:STAT?	
ON	

NOTICE

Moving average and low pass filter function

The analog low pass filter will be deactivated, if moving average filter for torque or force is parameterized and activated.

7.6.10 Speed Averaging Filter (INP:AVER:SPE)

INP:AVER:SPE<averageDepth>
INP:AVER:SPE:ON
INP:AVER:SPE:OFF
INP:AVER:SPE:STAT?

The moving average filter can be defined for speed measurements. The depth can be selected in **INP:AVER:SPE<averageDepth>**.

The moving average filter is activated with **INP:AVER:SPE:ON**. The moving average filter is deactivated with **INP:AVER:SPE:OFF**.

INP:AVER:SPE:STAT? is used to determine whether the moving average filter is currently active (response '**ON**'). If the moving average filter is deactivated, the IBT100 instrument responds with the character string '**OFF**'.

<averageDepth> =

2
4
8
16
32
64
128
256
512

Syntax examples:

INP:AVER:SPE64	(Moving average depth to 64)
0	
INP:AVER:SPE?	
64	
INP:AVER:SPE:ON	(Moving average activated)
0	
INP:AVER:SPE:STAT?	
ON	

7.7 Sensor Configuration

It is possible to remotely control the Evaluation Instrument, IBT100 fully over the RS-232C interface. All configurations in the menus can also be set up via this interface.

7.7.1 Torque Measurement Channel (ROUT:TORQ)

ROUT:TORQ:ACTI
ROUT:TORQ:BRID
ROUT:TORQ:FREQ
ROUT:TORQ:ICAM
ROUT:TORQ?
ROUT:TORQ<route>

The physical measurement channel of the torque measurement can be defined with this command group. **ROUT:TORQ:ACTI** switches to the ±10 V measurement mode (active sensor). **ROUT:TORQ:FREQ** is used for a torque sensor with frequency output. A passive sensor with DMS output is connected to the IBT100 instrument when **ROUT:TORQ:BRID** is specified.

Is an ICAM – Indutrial Charge Amplifier Type 5073A… connected, then **ROUT:TORQ:ICAM** should be used.

The measurement channel can also be defined in the form of a number:

<route> =

0	±10 V measurement mode (active sensor)
1	passive sensor with strain gage output
2	torque sensor with frequency output
3	ICAM – Charge Amplifier Type 5073A…

ROUT:TORQ? can be used to determine the corresponding number which represents the measurement channel.

Syntax examples:

ROUT:TORQ1	(sensor with strain gage output)
0	
ROUT:TORQ?	
1	(strain gage channel determined)

7.7.2 Unit of the Force/Torque Parameter (SENS:UNIT)

SENS:UNIT:<unit>
SENS:UNIT?

The force or torque parameter unit can be defined with **SENS:UNIT:<unit>**. The following units are available:

<unit> =

N	N
KN	kN
LBF	lbf (*pound force*)
NMM	N·mm
NCM	N·cm
NM	N·m
KNM	kN·m
LBFT	lbf-ft (*pound force feet*)
LBIN	lbf-in (*pound force inches*)
OZIN	oz-in (*ounce-force inches*)

The **SENS:UNIT?** command is used to determine the unit defined in the IBT100 instrument. The unit is transferred as a character string (e.g. **NM**).

Syntax examples:

SENS:UNIT:NCM
0
SENS:UNIT?
Ncm

NOTICE

Imperial units and mechanical power

The mechanical power unit depends on the units used for the torque. If the units '**LBFT**', '**LBIN**' and '**OZIN**' are used, '**HP**' (*horse power*) is automatically assigned to the mechanical power.

NOTICE

Dual-range sensor

The defined unit is applicable for both measurement ranges.

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7.7.3 Nominal Measurement Range (SENS:RANG)

SENS:RANG<range>
SENS:RANG?

The nominal measurement range of the torque parameter is defined with this command. **SENS:RANG?** can be used to determine the defined value in the IBT100 instrument.

<range> = floating-point number.

Syntax examples:

SENS:UNIT:NM
0
SENS:RANG100.00 (nominal meas. range 100 N·m)
0
SENS:RANG?
100

7.7.4 Nominal Characteristic Value of Force/Torque (SENS:NOM)

SENS:NOM<nominal>
SENS:NOM?

The characteristic value of an active sensor or the sensitivity of a passive sensor is defined with **SENS:NOM<nominal>**.

The characteristic value of a sensor with analog output is normalized in Volts. The normalization is in kHz for the frequency parameter. The sensitivity of a passive sensor is specified in mV/V.

<nominal> = floating-point number in V, kHz or mV/V

Syntax examples:

ROUT:ACTI (active sensor voltage)
0
SENS:NOM9.998 (characteristic voltage 9.998 V)
0
SENS:NOM?
9.998

ROUT:FREQ (active sensor frequency)
0
SENS:NOM40.005 (characteristic freq. 40.005 kHz)
0

ROUT:BRID (DMS passive sensor)
0
SENS:NOM1.999 (sensitivity 1.999 mV/V)
0

7.7.5 Frequency Offset of Force/Torque (SENS:FOFF)

SENS:FOFF<freqOffset>
SENS:FOFF?

The frequency offset of a torque sensor with frequency output is defined with **SENS:FOFF<freqOffset>**. The output frequency at zero torque corresponds to the frequency offset in kHz.

SENS:FOFF? determines the frequency offset.

Example on Type 4503A… (0260DM) or Type 4504A… (0325DF) with frequency output:

0 N·m: 100 kHz

<freqOffset> = floating-point number in kHz.

Syntax examples:

SENS:FOFF100.003 (frequency offset 100.003 kHz)
0
SENS:FOFF?
100.003

7.7.6 Measurement Range Selection (SENS:EXT:ENA…)

SENS:EXT:ENA<selection>
SENS:EXT:ENA?
SENS:EXT:ENA:DIR<direction>
SENS:EXT:ENA:DIR?

It is possible to switch between the nominal and the extended measuring range from the 'Measuring range' additional menu or via a digital input. This is defined with **SENS:EXT:ENA<selection>**.

The following options are possible to this purpose:

<selection> =

0 ENTER key in the 'Measuring range' additional menu,
{1,2,…,8} digital input 1…8.

With **SENS:EXT:ENA?** it is possible to determine the type of measuring range selection.

The logical digital input status for changing the measuring range is defined with **SENS:EXT:ENA:DIR<direction>**:

<direction> =

0	Extended measuring range with status 0 (1→0)
1	Extended measuring range with status 1 (0→1)

With **SENS:EXT:ENA:DIR?** the digital input status is determined for switching the measuring range.

Syntax examples:

SENS:EXT:ENA0	(button)
0	
SENS:EXT:ENA3	(digital input 3)
0	
SENS:EXT:ENA?	
3	(Response: digital input 3)
SENS:EXT:ENA:DIR1	(extended measuring range with status from 0 to 1)
0	
SENS:EXT:ENA:DIR?	
1	(Response: state 1)

7.7.7 Measurement Range at Digital Output (SENS:EXT:OUTP…)

SENS:EXT:OUTP<digOutput>
SENS:EXT:OUTP?
SENS:EXT:OUTP:DIR<direction>
SENS:EXT:OUTP:DIR?

The active measuring range can be displayed as a logical status on a digital output. The command **SENS:EXT:OUTP<digOutput>** is available to this purpose:

<digOutput> =

0	no digital output
{1,2,…,8}	digital output 1…8

With **SENS:EXT:OUTP?** it is possible to determine whether a digital output is assigned to the measuring range status, and if yes, which output.

The type of digital output status can be defined with **SENS:EXT:OUTP:DIR<direction>**. The following options are available to this purpose:

<direction> =

0	Nominal measuring range:	Status 1
	Extended measuring range:	Status 0
1	Nominal measuring range:	Status 0
	Extended measuring range:	Status 1

With **SENS:EXT:OUTP:DIR?** it is determined which output status was defined for the extended measuring range.

Syntax examples:

SENS:EXT:OUTP0	(no digital output defined)
0	
SENS:EXT:OUTP5	(digital output 5)
0	
SENS:EXT:OUTP?	
5	
SENS:EXT:OUTP:DIR1	(output status 0 for nominal measuring range and status 1 for the extended range)
0	
SENS:EXT:OUTP:DIR?	
1	(Response: Status 1 in the extended measuring range)

7.7.8 Number of Speed Sensor Pulses (SENS:PULS)

SENS:PULS<pulsesPerRev>
SENS:PULS?

The number of speed sensor pulses per revolution is defined with the **SENS:PULS<pulsesPerRev**> command. This parameter is used in the IBT100 instrument to calculate the speed or angle or the counter reading.

SENS:PULS? can be used to determine the defined pulses.

<pulsesPerRev> = {1|2|…|4095}.

Syntax examples:

SENS:PULS720	(720 pulses per revolution)
0	
SENS:PULS?	
720	

7.7.9 Direction of Rotation of a Speed Sensor (SENS:DIR)

SENS:DIR:CW
SENS:DIR:CCW
SENS:DIR<direction>
SENS:DIR?

The direction of rotation of a speed sensor is defined with **SENS:DIR:CW** (right-rotating, i.e. clockwise) or **SENS:DIR:CCW** (left-rotating, i.e. counterclockwise). This defines the preferential direction (positive reading).

It is also possible to configure the direction of rotation in the form of a number. **SENS:DIR?** can be used to determine the selected direction of rotation of the IBT100 instrument.

<direction> =

0 right-rotating (*clockwise*)
1 left-rotating (*counter clockwise*)

Syntax examples:

SENS:DIR:CW (right-rotating)
0
SENS:DIR?
0

SENS:DIR:CCW (left-rotating)
0
SENS:DIR?
1

SENS:DIR0 (0 → right-rotating)
0
SENS:DIR?
0

NOTICE

Reversal of the direction of rotation

The sign of the speed and angle parameter as well as the counting of the counter reading can be determined with **SENS:DIR:CW** and **SENS:DIR:CCW**.

7.7.10 Mechanical Power Unit (CALC:POW:UNIT)

CALC:POW:UNIT:<unit>
CALC:POW:UNIT?

The unit of mechanical power can be defined with **CALC:POW:UNIT:<unit>**. The following units are available:

<unit> =

W	W
KW	kW
MW	MW

The unit can be determined with **CALC:POW:UNIT?**. The return is made in the form of a character string.

NOTICE

HP imperial unit (horsepower)

For the '**LBFT**', '**LBIN**' and '**OZIN**' torque units, '**HP**' is automatically defined for the mechanical power.

Syntax examples:

CALC:POW:UNIT:W	(power in W)
0	
CALC:POW:UNIT?	
W	
SENS:UNIT:LBFT	(torque in lb-ft)
0	
CALC:POW:UNIT?	
HP	(power autom. in HP)

7.8 Alarm

Every parameter in the IBT100 instrument can be monitored. It is possible to generate alarm states when limit values are undercut or exceeded.

7.8.1 Alert Mode (ALER:MODE)

ALER:MODE:NORM<ch>
ALER:MODE:HOLD<ch>
ALER:MODE:OFF<ch>
ALER:MODE"<ch>;<mode>"
ALER:MODE<ch>?

The parameter monitoring of the alarm channel can be explicitly activated with **ALER:MODE:NORM<ch>**.

If a limit value is exceeded, the alarm state can remain triggered until a digital input releases it again. In this case, the **ALER:MODE:HOLD<ch>** command is used for the configuration.

The monitoring for the respective channel is deactivated with **ALER:MODE:OFF<ch>**.

<ch> = {1|2|3} alarm channel number.

The alert mode can also be configured in numerical form, the **ALER:MODE"<ch>;<mode>"** command is used for this.

<mode> =

0 parameter monitoring deactivated (**NONE**),
1 monitoring activated (**NORM**),
2 monitoring with saved mode activated (**HOLD**).

ALER:MODE<ch>? is used to determine the configuration of the respective alert channel.

Syntax examples:

ALER:MODE:NORM1 (active, normal mode)
0
ALER:MODE1?
1

7.8.2 Parameters to Be Monitored (ALER:SOUR)

ALER:SOUR:<source><ch>
ALER:SOUR"<ch>;<sourceNo>"
ALER:SOUR<ch>?

The **ALER:SOUR:<source><ch>** command is used to define the parameter to be monitored.

<source> =

TORQ	torque
SPE	speed
ANG	angle
COUN	counter reading
POWER	mechanical power

<ch> = {1|2|3} alarm channel number

The parameter to be monitored can be defined as a numerical value with the **ALER:SOUR"<ch>;<sourceNo>"** command:

<sourceNo> =

1	torque
2	speed
3	angle
4	counter reading
5	mechanical power

ALER:SOUR<ch>? is used to determine the monitoring parameter as a numerical value.

Syntax examples:

ALER:SOUR:TORQ1 (torque)
0
ALER:SOUR1?
1

7.8.3 Limit Values (ALER:THR)

ALER:THR:HIGH"<ch>;<value>"
ALER:THR:HIGH<ch>?
ALER:THR:LOW"<ch>;<value>"
ALER:THR:LOW<ch>?

The upper limit value is defined with **ALER:THR:HIGH"<ch>;<value>"**. The lower limit value can be set with **ALER:THR:LOW"<ch>;<value>"**.

<ch> = {1|2|3} alarm channel number

<value> = floating-point number

The determination of the upper limit value is made with **ALER:THR:HIGH<ch>?** and the lower limit value with **ALER:THR:LOW<ch>?**.

Syntax example of a torque sensor with limits to be monitored of –80 N·m and +100 N·m using the alarm monitoring of the 1st channel:

ALER:THR:HIGH"1;100"
0
ALER:THR:LOW"1;-80"
0

ALER:THR:HIGH1?
100
ALER:THR:LOW1?
-80

7.8.4 Hysteresis (ALER:HYST)

ALER:HYST"<ch>;<value>"
ALER:HYST<ch>?

The hysteresis of each limit value is defined with **ALER:HYST"<ch>;<value>"**.

<ch> = {1|2|3} alarm channel number.

<value> = floating-point number.

The determination of the defined hysteresis is made with **ALER:HYST<ch>?**.

Syntax example of a torque sensor with limits to be monitored of –80 N·m and +100 N·m and a defined hysteresis of 0,1 N·m (alarm monitoring of 1st channel):

ALER:HYST"1;0.1"
0
ALER:HYST1?
0.1

7.8.5 Control Unit/Enable (ALER:ENA)

ALER:ENA"<ch>;<input>"
ALER:ENA<ch>?
ALER:ENA:DIR:LOW<ch>
ALER:ENA:DIR:HIGH<ch>
ALER:ENA:DIR"<ch>;<state>"
ALER:ENA:DIR<ch>?

The monitoring can be explicitly controlled with **ALER:ENA"<ch>;<input>"**. It is possible to enable the alarm monitoring with a digital input or to reset it again if an alarm state has been triggered and held (**HOLD** mode).

<ch> = {1|2|3} alarm channel number

<input> = {1|2|3|4|5|6|7|8} digital input

The digital input is determined with the **ALER:ENA<ch>?** command.

The required state change of a digital input for monitoring/resetting can be defined with **ALER:ENA:DIR:LOW<ch>** (change from 1 to 0) or **ALER:ENA:DIR:HIGH<ch>** (change from 0 to 1). It is also possible to define this configuration numerically (**ALER:ENA:DIR"<ch>;<state>"**):

<state> =

0	required state change from 1 to 0
1	required state change from 0 to 1

ALER:ENA:DIR<ch>? enables the required state change of a digital input to be determined. The return is made as a numerical value.

Syntax examples for alarm channel number 1:

ALER:ENA"1;5"	(digital input no. 5)
0	
ALER:ENA1?	
5	
ALER:ENA:DIR:HIGH	(state change 0→1)
0	
ALER:ENA:DIR1?	
1	

7.8.6 Digital Output (ALER:OUTP)

ALER:OUTP:NONE<ch>
ALER:OUTP"<ch>;<output>"
ALER:OUTP<ch>?
ALER:OUTP:DIR:OPEN<ch>
ALER:OUTP:DIR:CLSE<ch>
ALER:OUTP:DIR"<ch>;<state>"
ALER:OUTP:DIR<ch>?

It is possible to influence a digital output by a triggered alarm state. The digital output is specified with **ALER:OUTP"<ch>;<output>"**. If no digital output is to be assigned, the **ALER:OUTP:NONE<ch>** command is responsible.

<ch> = {1|2|3} alarm channel number

<output> = {1|2|3|4|5|6|7|8} digital output

The assigned digital output is determined with **ALER:OUTP<ch>?**. If no digital output is defined, a response of zero ('**0**') is issued.

The state change of the digital output when an alarm is triggered can be set with the command **ALER:OUTP:DIR:OPEN<ch>** (electronic relay opened, high-impedance state z) or the command **ALER:OUTP:DIR:CLSE<ch>** (electronic relay closed, state 0).

The numerical assignment of the state change is made with **ALER:OUTP:DIR"<ch>;<state>"**:

<state> =

0	electronic relay closed, state 0
1	electronic relay opened, state z

The assigned state change can be determined with **ALER:OUTP:DIR<ch>?**.

Syntax examples for alarm channel number 1:

ALER:OUTP"1;6"	(digital output no. 6)
0	
ALER:OUTP1?	
6	
ALER:OUTP:DIR:CLSE1	(alarm: relay closed)
0	
ALER:OUTP:DIR1?	
0	

7.9 Analog Output

7.9.1 Parameter Assignment (OUTP:ANA:SOUR)

OUTP:ANA:SOUR:NONE<ch>
OUTP:ANA:SOUR:<source><ch>
OUTP:ANA:SOUR<ch>?
OUTP:ANA:SOUR"<ch>;<sourceNo>"

A parameter is assigned to the analog output; this is carried out with the **OUTP:ANA:SOUR:<source><ch>** command. The following selection options are available:

<ch> = {1|2|3} channel number of the analog output

<source> =

TORQ	torque
SPE	speed
ANG	angle
COUN	counter reading
POW	mechanical power

The analog output is deactivated with **OUTP:ANA:SOUR:NONE<ch>**.

The parameters can also be determined as a numerical value (**OUTP:ANA:SOUR"<ch>;<sourceNo>"**):

<sourceNo> =

0	analog output deactivated
1	torque
2	speed
3	angle
4	counter reading
5	mechanical power

The corresponding parameters can be determined as a numerical value with **OUTP:ANA:SOUR<ch>?**.

NOTICE

Parameter assignment

The **OUTP:ANA:SOUR:TORQ1** command is identical to the numerical specification **OUTP:ANA:SOUR"1;1"** and assigns the torque parameter (numerical value 1) to the analog output 1.

Syntax examples:

OUTP:ANA:SOUR:TORQ1	(analog output 1: torque parameter)
0	
OUTP:ANA:SOUR1?	(request for output 1)
1	(response 1: torque)
OUTP:ANA:SOUR:SPE2	(analog output 2: speed parameter)
0	
OUTP:ANA:SOUR2?	(request for output 2)
2	(response 2: speed)
OUTP:ANA:SOUR:NONE3	(analog output 3: deactivated)
0	
OUTP:ANA:SOUR3?	(request for output 3)
0	(response 0: deactivated)

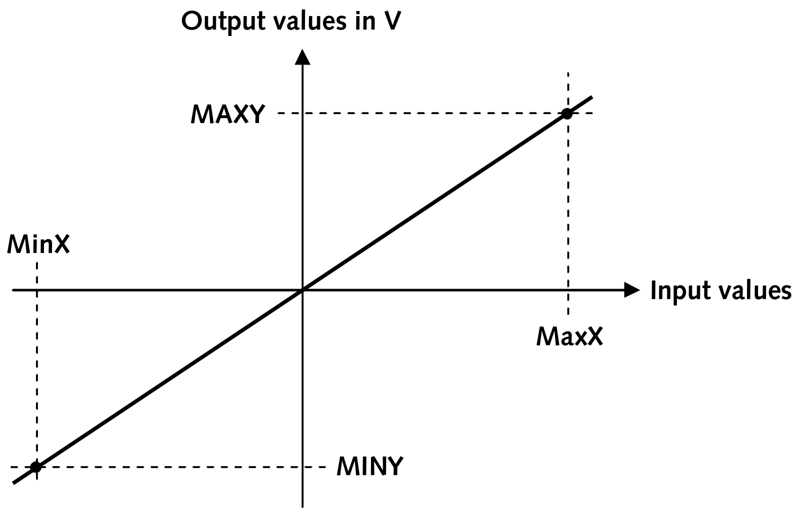
7.9.2 Scaling (OUTP:ANA:...)

OUTP:ANA:MINX"<ch>;<value>"
OUTP:ANA:MINX<ch>?
OUTP:ANA:MAXX"<ch>;<value>"
OUTP:ANA:MAXX<ch>?

OUTP:ANA:EXT:MINX"<ch>;<value>"
OUTP:ANA:EXT:MINX<ch>?
OUTP:ANA:EXT:MAXX"<ch>;<value>"
OUTP:ANA:EXT:MAXX<ch>?

OUTP:ANA:MINY"<ch>;<value>"
OUTP:ANA:MINY<ch>?
OUTP:ANA:MAXY"<ch>;<value>"
OUTP:ANA:MAXY<ch>?

The relationship between the parameter value and output voltage value is required for the linear scaling of the analog output. These are specified in the form of coordinates.



<ch> = {1|2|3} channel number of the analog output

<value> = floating-point number

Units of the input and output values

The units of the input values are based on the parameter assigned to the analog output and its defined units. The output value is always scaled in V.

7.10 External Reset

7.10.1 Parameter (TRAC:ERST:TARG)

TRAC:ERST:TARG:<target><ch>
TRAC:ERST:TARG"<ch>;<targetNo>"
TRAC:ERST:TARG<ch>?

It is possible to reset a value memory (e.g. Min./Max. memory) with a digital input. The **TRAC:ERST:TARG:<target><ch>** command defines the respective target parameter.

<ch> = {1|2|3} channel number of the external reset

<target> =

NONE	no external reset
ALL	all value memories are reset
TORQ:{MIN|MAX}	min./max. torque/force
SPE:{MIN|MAX}	min./max. speed
ANG	present angle
ANG:{MIN|MAX}	min./max. angle
COUN	present counter reading
COUN:{MIN|MAX}	min./max. counter reading
POW:{MIN|MAX}	min./max. mechanical power

The target parameters can also be defined numerically: (**TRAC:ERST:TARG"<ch>;<targetNo>"**):

<targetNo> =

0	no external reset
1	all value memories are reset
2	min. torque
3	max. torque
4	min. speed
5	max. speed
6	present angle
7	min. angle
8	max. angle
9	present counter reading
10	min. counter reading
11	max. counter reading
12	min. mechanical power
13	max. mechanical power

The **TRAC:ERST:TARG<ch>?** command is used to determine the target parameter in numerical form.

Syntax examples:

TRAC:ERST:TARG:TORQ:MIN1 (channel 1: min. torque)
0
TRAC:ERST:TARG1?
2

TRAC:ERST:TARG:SPE:MAX2 (channel 2: max. speed)
0
TRAC:ERST:TARG2?
5

TRAC:ERST:TARG:POW:MAX3 (channel 3: max. power)
0
TRAC:ERST:TARG3?
13

7.10.2 Digital Input (TRAC:ERST:INP)

TRAC:ERST:INP"<ch>;<input>"
TRAC:ERST:INP<ch>?
TRAC:ERST:INP:DIR:LOW<ch>
TRAC:ERST:INP:DIR:HIGH<ch>
TRAC:ERST:INP:DIR"<ch>;<state>"
TRAC:ERST:INP:DIR<ch>?

The digital input is defined with **TRAC:ERST:INP"<ch>;<input>"**; this can be used to trigger an external reset. The determination of the digital input is made with the **TRAC:ERST:INP<ch>?** command.

<ch> = {1|2|3} channel number of the external reset

<input> = {1|2|3|4|5|6|7|8} digital input

The required state change of the digital input can be set with **TRAC:ERST:INP:DIR:LOW<ch>** (change from 1 to 0) or with **TRAC:ERST:INP:DIR:HIGH<ch>** (change from 0 to 1).

A numerical definition is also possible (**TRAC:ERST:INP:DIR"<ch>;<state>"**):

<state> =

0 required state change from 1 to 0
1 required state change from 0 to 1

The required state change can be determined in numerical norm with **TRAC:ERST:INP:DIR<ch>?**.

Syntax examples:

TRAC:ERST:INP"1;2"	(channel 1: dig. input 2)
0	
TRAC:ERST:INP1?`	
2	
TRAC:ERST:INP:DIR:LOW1	(reset on 1→0)
0	
TRAC:ERST:INP:DIR1?	
0	
TRAC:ERST:INP"2;5"	(channel 2: dig. input 5)
0	
TRAC:ERST:INP2?	
5	
TRAC:ERST:INP:DIR:HIGH2	(reset on 0→1)
0	
TRAC:ERST:INP:DIR2?	
1	

7.11 Trigger and Measured Value Buffer

7.11.1 Number of Measured Value Packets (TRIG:VAL)

TRIG:VAL<packets>
TRIG:VAL?

The depth of the measured value buffer or the number of the measured value packets to be saved can be defined with the **TRIG:VAL<packets>** command. Each individual measured value packet contains the variables torque, speed, angle, the rotation counter reading and the mechanical power.

<packets> = {10|11|…|5000} Number of measured value packets

The defined packets are determined with the **TRIG:VAL?** command.

Syntax examples:

TRIG:VAL2000 (2000 measured value packets)
0
TRIG:VAL?
2000

7.11.2 Storage Time (TRIG:TIME)

TRIG:TIME<time>
TRIG:TIME?

The measured values are saved immediately after a trigger condition. The corresponding storage time is defined with the **TRIG:TIME<time>** command.

<time> = {0.5|…|7200.0} storage time standardized in s.

The **TRIG:TIME?** command provides information on the programmed storage time.

Syntax examples:

TRIG:TIME10 (10 s storage time)
0
TRIG:TIME?
10

7.11.3 Trigger Source (TRIG:SOUR)

TRIG:SOUR<source>
TRIG:SOUR?
TRIG:SOUR:INP<digInput>
TRIG:SOUR:INP?

To initiate storage of the measured value, triggering must take place. A trigger is initiated when a threshold value of a specific measured variable is exceeded, a key is pressed or the condition of a digital input is changed. To this purpose it is recommended to define a trigger source. This is performed with the **TRIG:SOUR<source>** command.

<source> =

:TORQ	Torque
:SPE	Speed
:ANG	Angle
:COUN	Rotation counter reading
:POW	Mechanical power
:KEY	Menu item '**Start trigger**' in the additional menu

The trigger source can also be defined as a numeric value.

<source> =

0	Torque
1	Speed
2	Angle
3	Rotation counter reading
4	Mechanical power
5	Menu item '**Start trigger**' in the additional menu
6	Digital input 1
7	Digital input 2
8	Digital input 3
9	Digital input 4
10	Digital input 5
11	Digital input 6
12	Digital input 7
13	Digital input 8

As an alternative it is also possible to use the **TRIG:SOUR:INP<digInput>** command to define a digital input as a trigger source.

<digInput> = {1|2|…|8}   digital input

The source of a trigger condition is determined with the **TRIG:SOUR?** command or **TRIG:SOUR:INP?**.

Syntax examples:

TRIG:SOUR:SPE (Trigger source speed)
0
TRIG:SOUR?
1 (Num. value for speed)

TRIG:SOUR5 (Trigger source key actuation)
0
TRIG:SOUR?
5

TRIG:SOUR:INP3 (Trigger source dig. input 3)
0
TRIG:SOUR:INP?
3 (dig. input 3)
TRIG:SOUR?
8 (Num. value for dig. input 3, determined with TRIG:SOUR?)

7.11.4 Trigger Threshold (TRIG:THR)

TRIG:THR<threshold>
TRIG:THR?

In addition to the trigger source, the trigger threshold may be required as a trigger condition if a measured variable is defined as a source. If the trigger threshold is exceeded, triggering is initiated. The trigger threshold is programmed with the **TRIG:THR<threshold>** command.

<threshold> = Floating point number standardized for the respective measured variable source

The **TRIG:THR?** command is used for determining the trigger threshold.

Syntax examples:

TRIG:SOUR:TORQ (Torque trigger source)
0
TRIG:THR155.3 (155.3 N·m trigger threshold if N·m is defined as a unit)
0
TRIG:THR?
155.3 (155.3 N·m)

7.11.5 Value Above or Below (TRIG:THR:DIR)

TRIG:THR:DIR<direction>
TRIG:THR:DIR?

If a measured variable is defined as a trigger source and a corresponding trigger threshold is defined, it is recommended to state the direction of threshold passage (value above or below threshold). The **TRIG:THR:DIR<direction>** command is used to this purpose.

<direction> =

:HIGH	Trigger if value higher than threshold
:LOW	Trigger if value lower than threshold

The information can also be given as a numeric value.

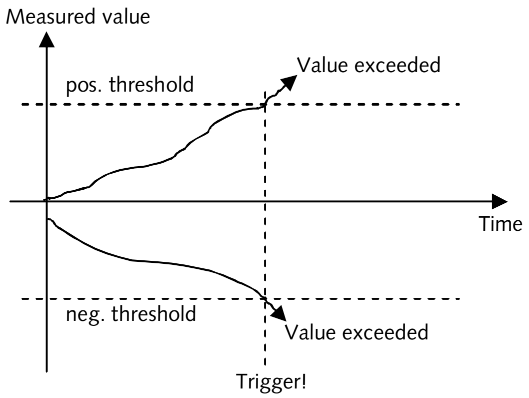
<direction> =

1	Trigger if value too high
0	Trigger if value too low

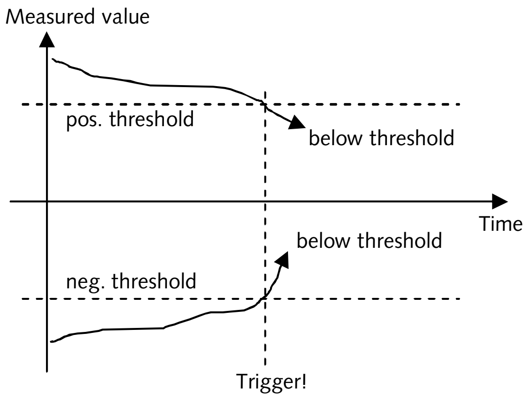
The type of threshold passage is determined with the **TRIG:THR:DIR?** command.

High and low value definition can be determined from the following diagrams.

Higher than threshold (TRIG:THR:DIR:HIGH)



Lower than threshold (TRIG:THR:DIR:LOW)



Syntax examples:

TRIG:THR:DIR:HIGH	(Trigger if value exceeded)
0	
TRIG:THR?	
1	(Value exceeded)

7.11.6 Change in Condition with Dig. Input (TRIG:ENA:DIR)

TRIG:ENA:DIR<direction>
TRIG:ENA:DIR?

If a digital input was defined for the trigger source, the **TRIG:ENA:DIR<direction>** command can be used to state the necessary change in condition for the trigger condition.

<direction> =

:HIGH	Trigger when change of condition 0→1
:LOW	Trigger when change of condition 1→0

The change of condition can also be stated numerically.

<direction> =

1	Trigger if change of condition 0→1
0	Trigger if change of condition 1→0

The defined change of condition can be determined with the **TRIG:ENA:DIR?** command.

Syntax examples:

TRIG:ENA:DIR:HIGH	(change of condition 0→1)
0	
TRIG:ENA:DIR?	
1	

7.11.7 Arm/Disarm Trigger Monitoring (TRIG:ARM)

TRIG:ARM<arming>
TRIG:ARM?

Trigger monitoring can be armed and disarmed with the **TRIG:ARM<arming>** command. If trigger monitoring is activated, the threshold passage, the change in condition of the digital input or the key actuation is evaluated for the trigger condition to save a measurement curve.

Repeated trigger monitoring after storage of a measured value

When a measured value is stored, trigger monitoring must be rearmed. Repeated storage of a measured value is only then possible.

<arming> =

:ON Trigger monitoring activated.

:OFF Trigger monitoring deactivated.
Measured value storage cannot be initiated.

The trigger monitoring definition can also be numeric.

<arming> =

1 Trigger monitoring activated
0 Trigger monitoring deactivated

Trigger monitoring is determined with the **TRIG:ARM?** command.

Syntax examples:

TRIG:ARM:ON (Trigger monitoring activated)
0
TRIG:ARM?
1

TRIG:ARM0 (Trigger monitoring deactivated)
0
TRIG:ARM?
0

7.11.8 Permit / Block Measured Value Storage (TRIG:MODE)

TRIG:MODE<mode>
TRIG:MODE?

Measured value storage and its trigger condition can be generally permitted or blocked with the **TRIG:MODE<mode>** command. Blocking is recommended if measured value storage is not required as a function.

<mode> =

:ON Permit measured value storage
:OFF Block measured value storage

The measured value storage definition can also be numeric.

<mode> =

1 Permit measured value storage
0 Block measured value storage

The **TRIG:MODE?** command can be used to find out if measured value storage is permitted or blocked.

Syntax examples:

TRIG:MDOE:ON (Measured value storage permitted)
0
TRIG:MODE?
1

TRIG:MODE0 (Block measured value storage as function)
0
TRIG:MODE?
0

7.11.9 Initiate Measured Value Storage Immediately (TRIG:INIT)

TRIG:INIT

Measured value storage can be directly initiated with the **TRIG:INIT** command independently of defined trigger conditions.

Syntax example:

TRIG:INIT **0**	(Triggering is initiated immediately)

7.11.10 Read out Measured Value Buffer (TRAC:BUFF)

TRAC:BUFF?
TRAC:BUFF:UNIT<measurand>?
TRAC:BUFF"<offsetAddr>;<noOfPackets>"?

The **TRAC:BUFF?** command is used to output the stored measured value variables and the number of the measured value packets. The units of the respective measured value variables are of interest for assigning the measured values. The **TRAC:BUFF:UNIT<measurand>?** command is provided to determine these.

The measured value packets themselves can be transferred with the **TRAC:BUFF"<offsetAddr>;<noOfPackets>"?** command as a continuous data chain to the PC.

<measurand> =

:TORQ	Torque unit
:POW	Unit of mechanical power

<offsetAddr> = {0|1|…|4999} Packet address

<noOfPackets> = {1|2|…|5000} Measured value packets

Content of a measured packet and number of measured value packets

The content of a measured value packet can include the following variables:

TORQ	Torque
SPE	Speed
ANG	Angle
COUN	Rotation counter reading
POW	Mechanical power

The type of measured variable, the sequence and the number of measured value packets is transferred with the **TRAC:BUFF?** command. Each information carrier is separated by a separator '**|**' (0x7C$_{Hex}$ or 124$_{10}$). An example is given below:

TORQ|SPE|ANG|COUN|POW|5000

List of the variables in a packet

Number of measured value packets in the measured

Measured value packets in the data chain

Each measured value in a measured value packet is separated by a separator '**|**' (0x7C$_{Hex}$ or 124$_{10}$). A measured value packet is terminated with '**#**' (0x23$_{Hex}$ or 35$_{10}$).

As an example, 2 measured value packets are transferred with the **TRAC:BUFF"0;2"?** command:

0.0000|-2.937935|0|0|0|0#**0.0006**|-2.937105|0|0|0|0#

Packet no. 0
(1st measured value

Packet no. 1
(2nd measured value

The time stamp (standardized in s) is always at the beginning of a measured value packet. In the example above, the difference between both subsequent time stamps of the measured value packets can be taken to calculate a sampling rate of 0.0006 s (= 600 µs). The measuring rate was therefore approx. 1.67 kHz when the value was stored.

7.12 Menu and Display

7.12.1 Keyboard Control (MENU:KEY)

The keys on the front panel of the Evaluation Instrument, IBT100 can be operated remotely over the RS-232C interface. The following commands simulate a key press:

MENU:KEY:UP	(upwards arrow key)
MENU:KEY:DOWN	(downwards arrow key)
MENU:KEY:RGHT	(arrow key to the right)
MENU:KEY:LEFT	(arrow key to the left)
MENU:KEY:ESC	(ESC key)
MENU:KEY:ENTR	(ENTER key)
MENU:KEY:ENTR:ON	(ENTER permanently pressed)
MENU:KEY:ENTR:OFF	(ENTER released again)
MENU:KEY:MENU	(MENU key)

Syntax examples:

MENU:KEY:UP	(1x upwards arrow key)
0	

NOTICE

Permanently pressing the ENTER key

The control is triggered in the '**Control signal**' menu by keeping the ENTER key pressed on the front panel of the IBT100 instrument. The control is inactive once the key is released again.

This can also take place with the **MENU:KEY:ENTR:ON** command (ENTER key permanently pressed). The key is released again with **MENU:KEY:ENTR:OFF**.

7.12.2 Defining the Menu Language (MENU:DISP:LANG)

MENU:DISP:LANG:GER
MENU:DISP:LANG:ENG
MENU:DISP:LANG:FRA
MENU:DISP:LANG<language>
MENU:DISP:LANG?

The menu language can be defined with this command group:

MENU:DISP:LANG:GER	German
MENU:DISP:LANG:ENG	English
MENU:DISP:LANG:FRA	French

It is also possible to define the language numerically with **MENU:DISP:LANG<language>**:

<language> =

0	German
1	English
2	French

The language is numerically determined with **MENU:DISP:LANG?**.

The selected language is immediately saved in the IBT100 instrument as nonvolatile.

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7.12.3 Additional Measured Value Display (MENU:DISP:ADD)

An additional parameter can be displayed on the 4th line of the measurement mode. The following commands are available for this:

MENU:DISP:ADD:NONE	(no display)
MENU:DISP:ADD:TORQ:MIN	(min. torque)
MENU:DISP:ADD:TORQ:MAX	(max. torque)
MENU:DISP:ADD:SPE:MIN	(minimum speed)
MENU:DISP:ADD:SPE:MAX	(maximum speed)
MENU:DISP:ADD:ANG:MIN	(minimum angle)
MENU:DISP:ADD:ANG:MAX	(maximum angle)
MENU:DISP:ADD:COUN	(counter reading)
MENU:DISP:ADD:COUN:MIN	(min. counter reading)
MENU:DISP:ADD:COUN:MAX	(max. counter reading)
MENU:DISP:ADD:POW	(mechanical power)
MENU:DISP:ADD:POW:MIN	(minimum power)
MENU:DISP:ADD:POW:MAX	(maximum power)
MENU:DISP:ADD:LPFT	(torque low pass filter)

It is also possible to define the additional parameter as a numeric value (**MENU:DISP:ADD<additional>**):

<additional> =

0	no display
1	min. torque
2	max. torque
3	min. speed
4	max. speed
5	min. angle
6	max. angle
7	counter reading
8	min. counter reading
9	max. counter reading
10	mechanical power
11	min. power
12	max. power
13	torque low pass filter value

MENU:DISP:ADD? can be used to determine the parameters as a numerical value.

Syntax examples:

MENU:DISP:ADD:SPE:MAX (max. speed)
0
MENU:DISP:ADD?
4
MENU:DISP:ADD10 (mechanical power)
0

7.12.4 Refreshing the Contents of the Display (MENU:DISP:RFRH)

MENU:DISP:RFRH

If configurations were made over the serial interface, these are only visible on the display when a key on the front panel is pressed or the **MENU:DISP:RFRH** command has been transferred to the IBT100 instrument.
It is enough to refresh the display just once at the end of the configuration settings.

Syntax examples:

SENS:UNIT:NM	(torque units in N·m)
0	
SENS:RANG100.0	(measurement range 100 N·m)
0	
MENU:DISP:RFRH	(display refreshed)
0	

7.12.5 Speed or Angle Parameters in Measurement Mode (MENU:DISP:SECN)

MENU:DISP:SECN:NONE
MENU:DISP:SECN:SPE
MENU:DISP:SECN:ANG
MENU:DISP:SECN<display>
MENU:DISP:SECN?

Alternatively, the speed parameter (**MENU:DISP:SECN:SPE**) or angle parameter (**MENU:DISP:SECN:ANG**) can be shown on the 2nd line of the display.

If neither of these parameter types should appear in the measurement mode, the **MENU:DISP:SECN:NONE** is responsible for this.

It is also possible to carry out the definition with **MENU:DISP:SECN<display>**:

<display> =

0	no parameter
1	speed
2	angle

MENU:DISP:SECN? can be used to determine the parameters as a numerical value.

Syntax examples:

MENU:DISP:SECN:SPE (speed in measurement mode)
0

7.12.6 Decimal Points for Torque/Force (MENU:DISP:DPT:TORQ)

MENU:DISP:DPT:TORQ<dpt>
MENU:DISP:DPT:TORQ?

The decimal points of the torque or force parameter of the nominal measurement range can be defined with **MENU:DISP:DPT:TORQ<dpt>**. The effects are visible in measurement mode.

<dpt> = {0|1|2|3|4}

No decimal places are defined for the torque or the force with **MENU:DISP:DPT:TORQ0**.

Syntax examples:

MENU:DISP:DPT:TORQ3 (3 decimal points)
0
MENU:DISP:DPT:TORQ?
3

7.12.7 Decimal Points of Speed/Angle (MENU:DISP:DPT:SECN)

MENU:DISP:DPT:SECN<dpt>
MENU:DISP:DPT:SECN?

The decimal points of the speed or angle parameters can be defined with **MENU:DISP:DPT:SECN<dpt>**. The effects are visible in measurement mode.

<dpt> = {0|1|2|3|4}

No decimal points for the speed or the angle is defined with **MENU:DISP:DPT:SECN0**.

Syntax examples:

MENU:DISP:DPT:SECN2 (2 decimal points)
0
MENU:DISP:DPT:SECN?
2

7.12.8 Decimal Points of the Additional Display (MENU:DISP:DPT:ADD)

MENU:DISP:DPT:ADD:<source><dpt>
MENU:DISP:DPT:ADD:<source>?

The decimal points of the additional parameters on the 4th line of the measurement mode can be defined with **MENU:DISP:DPT:ADD:<source><dpt>**. The following parameters are influenced with this command:

<source> =

POW	mechanical power
TORQ	torque/force
COUN	counter reading

<dpt> = {0|1|2|3|4}

No decimal places for the additional parameters is defined with **MENU:DISP:DPT:ADD:<source>0**.

NOTICE

Speed/Angle as additional parameters on the 4th line

The **MENU:DISP:DPT:SECN<dpt>** command is used for this.

Syntax examples:

MENU:DISP:DPT:ADD:POW2 (2 decimal points)
0
MENU:DISP:DPT:ADD:POW?
2

8. Technical Data

Housing

Aluminum (WxHxT)	259x100x208 mm
Weight	approx. 2 kg

Power supply

Supply voltage range	230 VAC 50 - 60 Hz (115 VAC 50 - 60 Hz)*
Power consumption	max. 30 VA
Power supply connector	
Fuses in the power supply connector socket:	2x200 mA T / 5x20 mm

NOTICE

* The switching of the supply voltage range is carried out on the power supply connector socket.

Strain gage input	**(for passive sensors)**
Accuracy class (largest single error from end value)	± 0.05 %
Strain gage connection	4 (6)-conductor technology
Supply	5 VDC
Minimum permitted bridge resistance	>85 Ω
Measurement range	0.5 - 3.5 mV/V
A/D converter resolution	19 Bit
Sampling rate	≤10 kHz

10V input	**(for active sensors)**
Accuracy class (greatest single error from end value)	±0.05 %
Internal impedance	1 MΩ
Measurement range	±11 V
A/D converter resolution	19 bit
Sampling rate	≤10 kHz

Frequency input	**(torque measurement of active sensors)**
Accuracy class (greatest single error from end value)	±0.1 %
Input impedance	10 kΩ
Frequency measurement range	max. 300 kHz
Sampling rate (at 100 kHz)	390 Hz
Sampling rate (at 1 kHz)	1,000 Hz
Logic state 1	> 3.5 V
Logic state 0	< 0.8 V

Quadrature input **(speed/angle of rotation measurement)**

Input impedance	10 kΩ
Frequency measurement range	max. 300 kHz
Count range	±2,000,000,000
Sampling rate	1,000 Hz
State 1	> 3.5 V
State 0	< 0.8 V

Sensor supply

Active sensor	+24 VDC, max. 200 mA
	±12 VDC, max. ±200 mA
	+5 VDC, max. 250 mA
Passive sensor	+5 VDC
Minimum permitted bridge resistance	>85 Ω

Analog outputs

Number	3
Accuracy class (greatest single error from end value)	±0.1 %
Analog output	+/-10 V, can be loaded with 1 mA
D/A converter resolution	16 bit
Refresh rate, output 1 (torque only)	≤10 kHz
Refresh rate, output 2 and 3	≤1 kHz

Digital outputs **(electronic relay, electrically isolated)**

Number	8
Voltage	max. 30 V
Current consumption per output	max. 100 mA
Electrical isolation	500 V
Refresh rate	≤1 kHz
Response time	≥1 ms

Digital inputs **(electrically isolated)**

Number	8
Voltage	max. 30 V
Input impedance	5 kΩ
Logic state 1 or High	3.5 - 30 V
Logic state 0 or Low	< 0.8 V
Electrical isolation	500 V
Refresh rate	≤1 kHz
Response time	≥1 ms

Internal measured value buffer

Buffer depth	10 - 5,000 measured value packets
Storage time	0.5 - 7,200 s
Measuring rate (is calculated from the buffer depth and buffer time)	≤ 10 kHz

BNC outputs **(optional)**

Number for analog outputs	3
Technical specifications see to analog outputs	
Number for speed and angle tracks	3
Voltage magnitude per speed / angle output	5 V TTL
Output current per speed / angle output	max. 100 mA
Short-circuit strength	not critical

Serial RS-232C interface

EIA standard	RS-232C
Data bits	8
Stop bits	1
Parity	none
Flow control	none
Baud rate	max. 230.4 kbps
Protocol	ASCII (based on SCPI)
Maximum cable length	5 m

Serial USB port

Standard	USB 2.0
Data rate	1 Mbits/second
Maximum cable length	5 m

Display

Illuminated LCD display	4x20 characters

Keyboard

Pressure-sensitive membrane keyboard	7 keys

Parameter sets

Number	20

Firmware

Firmware update	possible via USB 2.0

CE

Declaration of Conformity

According to EG-EMV rule 2004/108/EG, annex I,1

This is to confirm that the construction of the device, which is specified in the following

Designation:	Universal amplifier Type 4700AT100 UMV3000
Data sheet no.:	4700A_000-620d-06.07
Type:	4700A… table housing device SN 103057
Operation manual no.:	1560

in the design supplied by us, complies with the following relevant specifications:

EG-low voltage standards, 73/23/EWG, annex I
EG-EMV standards, 2004/108/EG

Applied harmonized norms and standards, especially

Inspection report from Company Baudisch EMC-Lab in Germany, date 2007-07-11

EN 61000-6-4 2002-8	IEC 61000-6-4 1997	Standard of industrial emitted interference
EN 61000-6-2 2006-3	IEC 61000-6-2 2005	Standard of industrial immunity to interference
EN 61000-4-2 2001-12	IEC 61000-4-2 2001	Immunity of discharge static electricity
EN 61000-4-3 2006-12	IEC 61000-4-3 2006	Immunity high-frequency fields
EN 61000-4-4 2005-7	IEC 61000-4-4 2004	Immunity fast transient electric disturbance / Burst
EN 61000-4-5 2001-12	IEC 61000-4-5 2000	Immunity against surge voltage
EN 61000-4-6 2001-12	IEC 61000-4-6 2000	Immunity against conducted disturbances, induced of high-frequency fields
EN 61000-4-11 2005-2	IEC 61000-4-11	Voltage drops, short-timed discontinuity and fluctuations of voltage excitation
EN 55011-Aug. 2003	IEC-CISPR 11 1997	Thresholds and measurement procedures for radio interference of ISM devices