

Case	<input type="checkbox"/> 'B', <input type="checkbox"/> 'H', <input type="checkbox"/> 'V', <input type="checkbox"/> 'Q', <input type="checkbox"/> 'S', <input type="checkbox"/> 'L', <input type="checkbox"/> 'R1', <input type="checkbox"/> 'R2'
Input	programmable
Outputs:	up to 2
Electromechanical relay	5A/250VAC with NO/NC or NO contact
SSR	<input type="checkbox"/> 1A/250VAC, <input type="checkbox"/> 0.2A/250VAC
MOS gate	0.1A/60V, optically isolated
Output for external SSR	5...24 VDC, 30 mA
- K1	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
- K2	<input type="checkbox"/> relay, <input type="checkbox"/> SSR, <input type="checkbox"/> MOS gate, <input type="checkbox"/> for ext. SSR
Serial Interface	<input type="checkbox"/> RS485, isolated, <input type="checkbox"/> RS485 for "PolyMonitor", isolated
Power Supply	<input type="checkbox"/> 230 VAC, <input type="checkbox"/> 90...250 V, <input type="checkbox"/> 24 VDC, <input type="checkbox"/> 12...24 V, <input type="checkbox"/>
Excitation Voltage (Vaux)	<input type="checkbox"/> 10...30 V, 30 mA, <input type="checkbox"/>
Consumption	less than 3 VA
Measurement Error	≤ ± 0.3% from span
Temperature Drift	≤ 0.02% from span for 1 °C
RTD Line Error	≤ ± 0.001%/Ω at R _{lin} ≤ 50 Ω
Cold-junction Error	≤ ± 1 °C at air temperature -10...80 °C
Ambient Temperature / Humidity	-10...65 °C / 0...85% RH, non-condensing
Protection Class: front / terminals	<input type="checkbox"/> IP65, <input type="checkbox"/> IP54 / IP20



PROGRAMMABLE CONTROLLER

BTC284U
with keyboard

OPERATION MANUAL



Please read this Operation Manual before mounting and operating.
Save the Manual for future references.

Warranty and Support

Warranty

BASI Instrument AB warrants this product to be free from defects in materials and workmanship for 2 years. If your unit is found to be defective within that time, we will promptly repair or replace it. This warranty does not cover accidental damage, wear or tear, or consequential or incidental loss. This warranty does not cover any defects caused by wrong transportation, storage, installation, or operating (see 'Specifications').

Technical support

In the unlikely event that you encounter a problem with your BASI device, please call your local dealer or contact directly our support team.

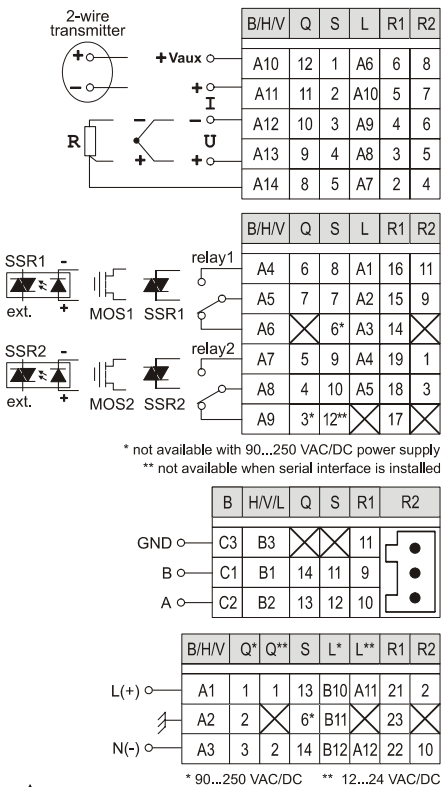
.....
serial number

.....
manufacturing date

QC check mark(passed)
(stamp)

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Wiring



Input signal wiring

Connect the input with regard to its type through the respective and depending on the case type (see 'Specifications') terminals on the device back.

⚠ Voltage transmitters should be powered ONLY by external source.

Output wiring

Connect the outputs with regard to their types (see 'Specifications') via the respective terminals.

RS485 wiring

Connect the unit to RS485 network line via the respective terminals (connector).

Power supply wiring

Connect the right power supply voltage for your device (see 'Specifications').

⚠ Important notes:

- ◆ Strictly observe the requirements for RS485 network building!
- ◆ With DC power supply, the polarity does not matter.
- ◆ In case of 90...250 V power supply, grounding the device via separate wire is mandatory for covering safety standards.

Communication Protocol

Table 2

Parameter	Symbol	Value
Input Type	inp	pt100, pt1000,
		ptc1, ptc2,
		r.0.1k,
		t.c.b, t.c.j,
		t.c.k, t.c.r,
		t.c.s, t.c.t,
		u, u.0.10,
		i.0.20, i.4.20
Unit	unit	c, f
Point Position	pnt	0, 1, 2, 3
Input Low	i.lo	-1999...9999
Input High	i.hi	-1999...9999
Input Correction	i.cor	-1999...9999
Address	addr	1...254
Baud Rate	baud	1200, 2400, 4800, 9600
Gradient	grad	0...9999
Filter Time	f.t	0...9999
Filter Band	f.b	0...M
Input Value	p.v	*
Error Info	error	**

* Input Value (read-only)

- numerical value with ISU - measured input value
- sat.lo - ADC under-range
- sat.hi - ADC over-range
- inp.br - sensor break
- break - device failure
- noise - noisy measurement

** Error Info

- 0 - initializes non-volatile memory
- 1 - error FR, L (read-only)
- 1...29 - errors Er0 1...Er29 (read-only)

Protocol architecture

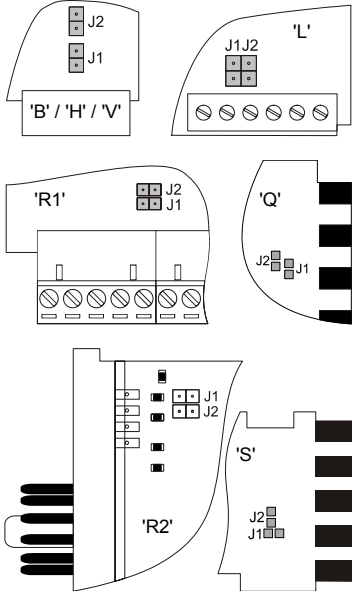
- ◆ The protocol is based on UART protocol with:
 - Baud Rate - as defined by parameter Baud Rate;
 - Data bits - 8;
 - Parity Control - Even;
 - Stop bit - 1.
- ◆ ASCII protocol is used for communicating, and the information is exchanged in frames.
- ◆ Each frame consists of 1, or 2 words separated by byte 32 (SPACE), and ends with bytes 13 (CR) and 10 (LF). The first word in the frame denotes a parameter 'Symbol' as taken from Table 2 and the second word (if needed) is the parameter 'Value', both spelled with only small Latin letters, digits, dots, and/or the '-' sign.

Device activating

- ◆ To respond to commands, the device should be active.
- ◆ For a device to be activated, it must receive a Ux command, where 'x' is the value of the parameter Address or the value '255' (if device address is unknown), and respond to it with ok...
- ◆ If a device does not respond even to U255, check the UART protocol settings, chiefly Baud Rate value.

BTC284U is a low-cost multifunctional programmable controller. Its universal input accepts the most common RTDs, thermocouples, and linear signals. The device can be equipped with up to 2 relay outputs, which can control various actuators using ON/OFF control algorithm, and an optional RS485 interface enables networking. BTC284U allows adjusting of the built-in digital filters and the programmable output delay, resulting in increased operation reliability in case of industrial interferences.

Input Setting



- ◆ Open the case.
- ◆ Follow the diagrams on the left to find the configuration jumpers J1 and J2, located on the main board (cases 'B', 'H', 'V', 'L', 'R1') and on the outer side of the right board (cases 'Q' and 'S').
- ◆ To set input 0...10 V, short out J2.
- ◆ To set any of the other possible input types, short out J1.

Waste Disposal



Do not dispose of electronic devices together with household waste material!

If disposed of within European Union, this product should be treated and recycled in accordance with the laws of your jurisdiction implementing Directive 2012/19/EU on waste electrical and electronic equipment (WEEE).

Communication Protocol



Notes:

- ◆ BTC284U adds 3 spaces in the beginning of the response.
- ◆ BTC284U returns decimal point even when the value is integer.
- ◆ #13 (CR) is byte 0x0D; #10 (LF) is byte 0x0A.
- ◆ The U255 command should be used only in case just one slave is presented.



Protocol examples:

PC or other device: BTC284U response:

activating device number 10
 U10#13#10 ok.#13#10

reading filter time
 f.t#13#10 f.t 0015.#13#10

writing filter time of 30
 f.t 30#13#10 f.t 0030.#13#10

reading input value of 27.5
 p.v#13#10 p.v 027.5#13#10

invalid command.	command not recognized
parity error.	parity error detected
not a number.	attempt to write symbols for numerical parameter
point error.	value resolution greater than parameter's one
out of range.	value out of range
unit is busy.	writing is allowed only to device at Basic level
read only.	parameter is read-only
can't save.	problem with writing in non-volatile memory

- ◆ The device remains active until it receives another Ux command, but with different device address, a FR, L error, or with reset.
- ◆ Any Baud Rate value change through the communication interface also deactivates the device.

Reading from a device

- ◆ If the frame consists of only one word, it is recognized as a command for reading.
- ◆ The device responds to it by returning the same word and its value, according to Table 2.

Writing in a device

- ◆ If the frame consists of two words, it is recognized as a command for writing.
- ◆ With writing, transferred are the same two words that would have been received at the respective command for reading from the device.
- ◆ After successful writing, the device responds with the respective command for reading, except for the baud command.

Other device responses

- ◆ When Error Info value is -1, the device substitutes any command for error reading.
- ◆ BTC284U responses in case of incorrect protocol use are given on the left.

Reset

To reset the device, send command reset.

Mounting

Panel mounting ('B' / 'H' / 'V' / 'Q' / 'S' / 'L')

- ◆ Place BTC284U into an appropriate panel cut-out.
- ◆ Tighten it into place using the enclosed mounting bracket(s).

Rail mounting ('R1')

- ◆ Insert the upper rail edge into the upper plastic groove of the rail-installing mechanism on the back side of the unit.
- ◆ Press the unit towards the lower rail edge until the moving part of the installing mechanism clicks.

Rail mounting ('R2')

The device can be easily mounted on every 35 mm rail conforming to EN50022 by the means of a standard UNDECAL socket base.

Electro-Magnetic Interference (EMI) Issues



Important note:

A built-in RC noise suppression circuit is connected in parallel with relay contacts. Full AC voltage isolation is NOT provided when relay contacts are open. Small AC current (≈ 1.5 mA at 230 VAC) still flows through the RC circuit!

- ◆ All signal wires must be shielded. They must not be packaged together with power cables!
- ◆ Never lay the signal wires close to inductive or capacitive noise sources, such as relays, contactors, motors, etc.!
- ◆ All shields have to be grounded ONLY at one end, as closer as possible to the controller terminals!
- ◆ Avoid sharing supply lines with powerful consumers, especially with inductive loads, switched on and off.
- ◆ To stop unwelcome interference signals entering through the power supply lines, use shielded 1:1 isolation transformer!
- ◆ Shunt all switched (not only those switched by the controller) inductive consumers with special suppression networks: RC group and varistor - for AC loads, or diode - for DC loads.
- ◆ If the controller operates in a very powerful EMI area, it has to be mounted inside a grounded metal shielding box!
- ◆ To protect the interface from electro-magnetic disturbances, follow the RS485 standard guidelines.

Parameter	Symbol	Description
Configuration Parameters (These parameters are part of Configuration level)		
Input Type	i_nP	Type of signal that can be connected to the device input
Unit	uni_t	Temperature measurement unit
Point Position	Pnt	Display decimal point position
Input Low	iLo	Display value at low limit of the linear input range
Input High	iHi	Display value at high limit of the linear input range
Input Correction	$iCor$	Constant to be added to the measured input value
Address	$Addr$	Device address
Baud Rate	$bAud$	Serial interface rate
Gradient	$GrAd$	Maximum input signal change during the sampling period (120 ms)
Filter Time	Ft	Relative time constant of the input filter
Filter Band	Fb	Zone around the measured value, within which the filter is active
SP limit Low	SP_L	Set-point Low limit
SP limit High	SP_H	Set-point High limit
Direction 1	$d1r1$	Control action direction of output K1
Direction 2	$d1r2$	Control action direction of output K2
Parameters of the control algorithm (These parameters are part of Parametric level)		
+ Differential 1	$Pd1$	Positive Differential of output K1
- Differential 1	$nd1$	Negative Differential of output K1
Time On 1	$tOn1$	ON duration of output K1
Time Off 1	$tF1$	OFF duration of output K1
Hold 1	$HLd1$	Holds the output reaction of output K1
The same 5 parameters, but with index 2 - for output K2		
Parameters of Basic (operating) level		
Set Point 1	$SP1$	Set-point value of output K1
Set Point 2	$SP2$	Set-point value of output K2

Peak filter

This filter is intended for eliminating pulse spikes (peaks), which can appear in the input signal, in the following way:

- ◆ BTC284U measures the input signal value every 120 ms (sample time).
- ◆ The measured values are compared subsequently. The filter checks the difference between the last two samples. If it does not exceed **Gradient** value, the device accepts the signal as *normal*.
- ◆ If the last measured value differs from the previous one by more than the **Gradient** value, the filter output is held until the device determines a presence of a *normal* signal. It is possible only if the input signal has not been changed with more than the **Gradient** value for four subsequent samples.
- ◆ If the device has not determined a *normal* signal for 20 subsequent samples, $n0,5$ appears on the display (see 'Basic level').

Low-pass filter

This first-order filter acts ONLY within a certain band around filter output value. This has been designed to cut periodic noises outside the communication signal spectrum.

- ◆ Filter operation is defined by two parameters: **Filter Time** (defines filter time constant) and **Filter Band** (defines filter active band around filter output value).
- ◆ If the newly measured value differs from the filter output by more than **Filter Band**, the filter resets with a new initial output value (newly measured value).

Output Control

Control output operation

- ◆ The control outputs operate according to the control algorithm parameters.
- ◆ The outputs deactivate with the value change of one of the following configuration parameters - **Point Position, Input Low, Input High, and Input Correction** - and remain inactive till Basic level is entered.
- ◆ The outputs deactivate also when an error has been detected (see 'Error messaging').

ON/OFF control algorithm

The static characteristic of a relay controlled by an ON/OFF algorithm is shown on the left drawing.

Output hold

For eliminating undesirable switches of the relay output, additional parameter (**Hold**) is assigned to hold the output reaction for certain period of time.

Output pulse mode

When a relay is forced to ON by the control algorithm, it can either stay ON or pulse depending on **Time On** and **Time Off** parameter values. Setting any of these parameters to '0' disables the Pulse mode.

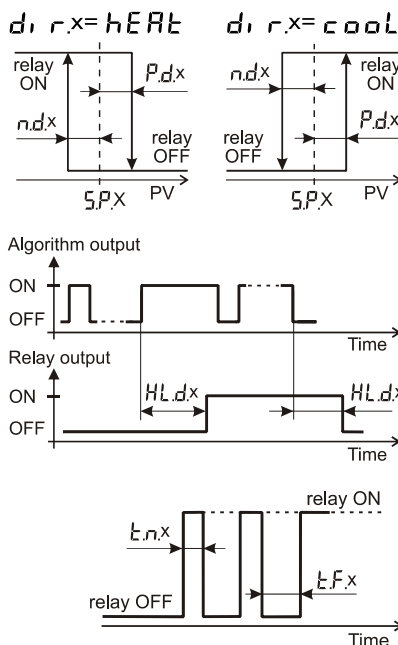


Table 1

Value	Unit	Notes
Pt_{100} or Pt_{1000}	-	Pt100: -100...850 °C or Pt1000: -100...600 °C
$Ptc1$ or $Ptc2$	-	PTC 1k or 2k: -50...150 °C
$r01$	-	resistive linear: 0...1 kΩ
$tC-b$	-	T/C "B": 200...1800 °C
$tC-J$	-	T/C "J": -20...1000 °C
$tC-K$	-	T/C "K": -20...1300 °C
$tC-R$	-	T/C "R": 0...1700 °C
$tC-S$	-	T/C "S": 0...1700 °C
$tC-T$	-	T/C "T": -40...400 °C
v	-	voltage linear: 0...100 mV
$i020$ or $i420$	-	current linear: 0...20 mA or 4...20 mA
$v010$	-	voltage linear: 0...10 V
oC or oF	-	°C or °F
x1, x0.1, x0.01, x0.001	-	when indicating values with the input-signal measurement unit (ISU)
-1999 ... 9999	ISU	These parameters make sense ONLY in case of a linear input signal!
-1999 ... 9999	ISU	OFFSET
1...254	-	
$12, 24, 48, 96$	bps	1200, 2400, 4800 (factory-set), or 9600 bps
0 ... 9999	ISU	used for input peak filtration; Value '0' cancels the filtration.
0 ... 9999	-	This parameter and the following one define a low-pass input filter.
0 ... M	ISU	temperature: whole part of $M \leq 100$; linear: $M = 25\%$ of input range
within input range	ISU	These parameters keep the Set point in safe limits, preserving it from random changes.
$cool, heat$	-	('cooling', 'heating')
These parameters are accessible in the presence of the corresponding relay.		
0 ... 9999	ISU	lower than (High input range - Set Point 1)!
0 ... 9999	ISU	lower than (Set Point 1 - Low input range)!
0 ... 9999	sec.	Value '0' disables Pulse mode.
0 ... 9999	sec.	
These parameters are accessible in the presence of the corresponding relay.		
within input range	ISU	

Message	Parameters	Error type
FR.L	all	Incorrect memory
brL	-	Service required!
Er.01	GrAd	Out of range
Er.02	Ft	Out of range
Er.03	Fb	Out of range
Er.04	SP.L	Out of range
Er.05	SP.H	Out of range
Er.06	SP.L, SP.H	SP.L > SP.H
Er.11:Er.21	Ln.1, Ln.2	Out of range
Er.12:Er.22	tF.1, tF.2	Out of range
Er.13:Er.23	HLd.1, HLd.2	Out of range
Er.14:Er.24	Pd.1, Pd.2	Out of range
Er.15:Er.25	nd.1, nd.2	Out of range
Er.16:Er.26	SP.1, SP.2	Out of range (SP.L ... SP.H)
Er.17:Er.27	SP.x - nd.x	Lower than Input Low Range Limit
Er.18:Er.28	SP.x + Pd.x	Exceeds Input High Range Limit
Er.29	Rddr	Out of range

- ◆ In some cases, BTC284U finds non-conformities in parameter values that must be corrected before operating at Basic level.
- ◆ The device indicates such kind of problems by displaying error messages as given on the left.
- ◆ If FR.L appears on the display, try debugging by turning the power off/on.
- ◆ If the problem persists, press and hold or send command `error 0` via the communication interface to restore the default (factory) settings.

Some parameters are accessible only when the respective functionality is installed. (see 'Specifications').

Controller parameters

BTC284U is a programmable device whose service behavior is determined by a set of parameters. All the parameters, along with their names, symbols, and value ranges, are given in Table 1.

Setting numerical parameter value

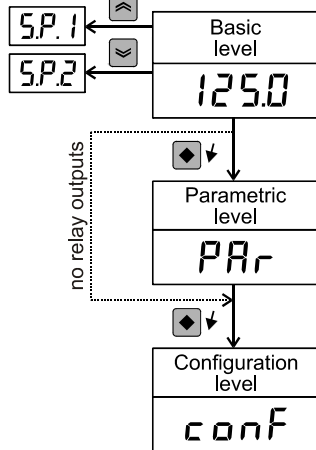
- ◆ Enter parameter value adjustment mode (see 'Program Levels').
- ◆ The whole part of the value together with the left zeroes appears on the display, and the rightmost digit blinks.
- ◆ To select another digit, press .
- ◆ The 3 rightmost digits can accept values from to , and the leftmost digit can also accept the values - and .
- ◆ To increase or decrease the blinking digit value, use respectively or .
- ◆ Confirm the adjusted value by pressing simultaneously + or + .
- ◆ If the new value has not been confirmed and no key has been pressed for a certain period of time, value adjustment automatically ceases, and the parameter retains its initial value.

- Changing Point Position value reflects the real value of all parameters with ISU.

E.g.: changing Point Position value from (0) to (0.0) would change a set-point value of 100 to 10.0.

Setting symbolic parameter value

- ◆ Enter parameter value adjustment mode (see 'Program Levels').
- ◆ Read the blinking parameter value.
- ◆ To change the value, use or , and to confirm, press + or + .
- ◆ If the new value has not been confirmed and no key has been pressed for a certain period of time, value adjustment automatically ceases, and the parameter retains its initial value.



Basic level

At Basic level, BTC284U indicates the measured input value (PV) with a resolution, according to the Point Position parameter.

- ◆ If the whole part of PV cannot be entirely displayed, the unit generates 'overflow' message (or , depending on PV sign).
- ◆ If PV is out of its operating range (the input range according to Table 1, extended by 5% on both sides), the device displays blinking symbolic message: (under-range) or (over-range).

When PV is out of physical range, the unit displays - - - - .

- ◆ Upon entering Basic level, BTC284U may display the `i n t` message, indicating that some time is necessary for filter initialization.
- ◆ The `n o f` message may appear as a result of the peak filter operation (see 'Input filtration').
- ◆ To enter parameter value adjustment mode for Set Point 1, press and hold until `SP.1` appears on the display. To view the Set-point value, release the key.
- ◆ To enter parameter value adjustment mode for Set Point 2, follow the same procedure, but start with the key.

Parametric level

This level contains the control algorithm parameters. If no relay output is installed, this level does not show up.

- ◆ Enter from Basic level by pressing and holding until `PAR` appears on the display. Release the key. If the key is not released on time, BTC284U enters Configuration level.
- ◆ Choose a parameter using and .
- ◆ To enter parameter value adjustment mode, press .
- ◆ If no key has been pressed for a while, the device automatically returns to Basic level, storing all confirmed changes.
- ◆ For quick exiting and saving, use key combination + .

Configuration level

This level contains the configuration parameters of the device.

- ◆ Enter from Basic level by pressing and holding until `CONF` appears on the display.
- ◆ To access and adjust the configuration parameters, follow the algorithm described in 'Parametric level'.