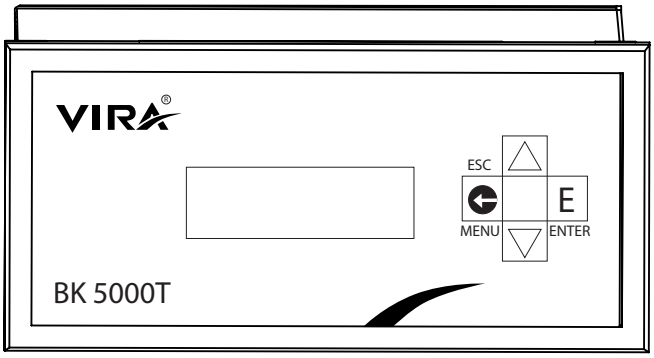
BK 5000-T

Conductivity Controller

Installation, Operating and Maintenance Instructions



Safety Information

General Information

Typical Applications

Mechanical Installation

Electrical Installation

Functions and Configurations

Technical Information

Commissioning

Troubleshooting

Technical Assistance

EN
ENGLISH

1. Safety Information

The equipment may only be installed, electrically connected and commissioned by suitable persons with the relevant instruction/training.
Maintenance and modification may only be performed by authorised staff who have undergone specific instruction/training.

The terminal blocks of the equipment are live during operation!
There is a risk of serious injury due to electrical shock!
Always cut off the power supply to the equipment before installing, remove blocks!

The name plate specifies the features of the equipment. Do not comission or operate any item of equipment that does not have its own specific name plate.

1.2 Directives and Standards

The conductivity controller BK 5000-T, in combination with conductivity probes BD 5400, BD 5600-T and BD 5300-T is type approved to the TUV. The TUV “EN 12952 and EN 12953” describes the requirement for water monitoring and limiting equipment.

LV (Low Voltage) Directive and EMC (Electromagnetic Compability)
The equipment conforms to the requirements of the Low Voltage Directive 2014/35/EU, the EMC Directive 2014/30/EU.

ATEX (Atmosphere Explosible)
The equipment must not be used in potentially explosive atmospheres, in accordance with European Directive 2014/34/EU.

2. General Information

2.1. Intended Use

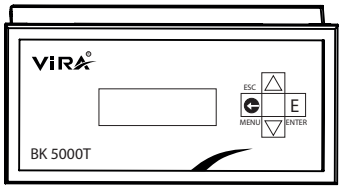
The Vira BK 5000-T conductivity controller in conjunction with conductivity probes BD 5600-T, BD 5400 and BD 5300-T is used for blowdown control and limit in steam boilers, pressurized hot water installations as as well as condensate and feedwater tanks.

Note : BD 5600-T and BD 5300-T has internal type temperature sensors.

The blowdown controller indicates when the preset MAX TDS/Conductivity is reached and opens or closes a blowdown valve. The controller can provide a MAX alarm.

2.2 Function

Note: Conductivity is measured in micro Siemens per centimeter (µS/cm).



Users can incorporate an hysteresis set to enhance damping effects, preventing overly frequent valve operation and contributing to system stability. The system provides an actual value output in the form of a 4-20 mA signal, facilitating easy monitoring and integration with other control systems. Password protection ensures the security of system settings, adding an extra layer of control and preventing unauthorized access.

2.3 Inputs

The BK 5000-T conductivity controller measure and limits the Conductivity using conductivity probes BD 5400, BD 5600-T and BD 5300-T.
BD 5600-T and BD 5300-T are equipped with an integrated temperature sensor for automatic temperature compensation.

2.4 Continuous Output

The probe can continuously monitor conductivity from the tip of the probe to the boiler shell.

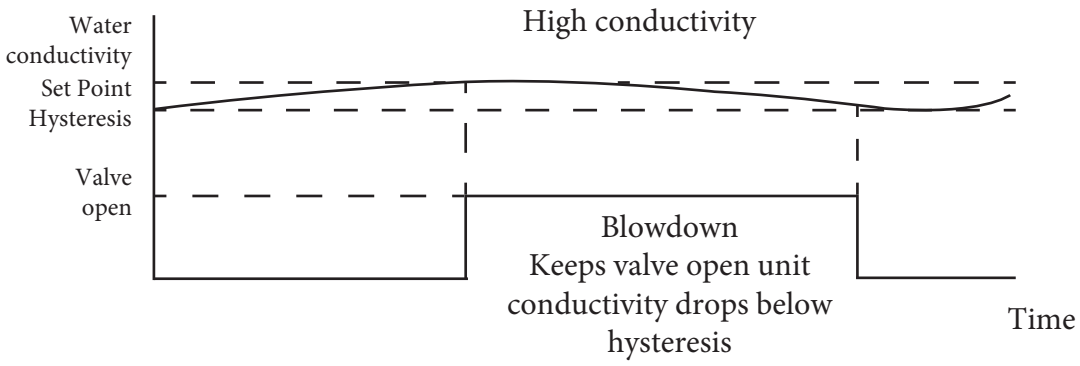


Figure 1 : Automatic Blowdown vs Time

3. Typical Applications

3.1 Boiler Control Systems

3.1.1 BS1-T Blowdown Control System for Steam Generators

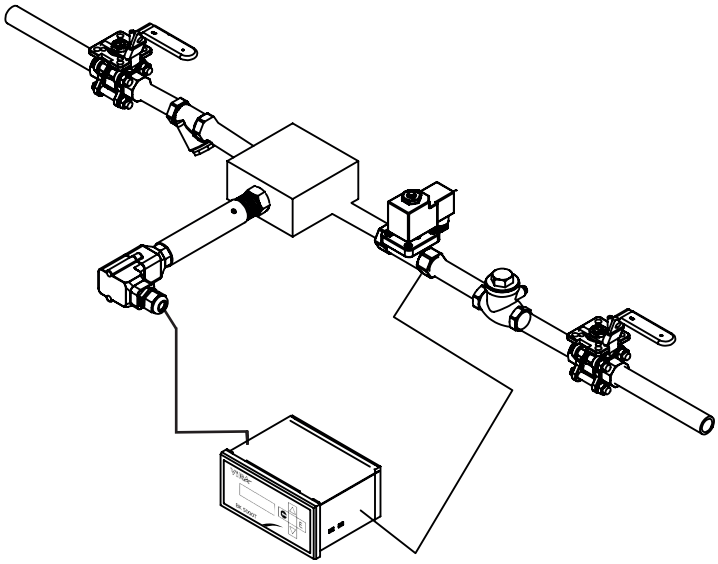


Figure 2 : BS1-T System Application

3.1.2 BS2-T Pipeline Mounted Probe

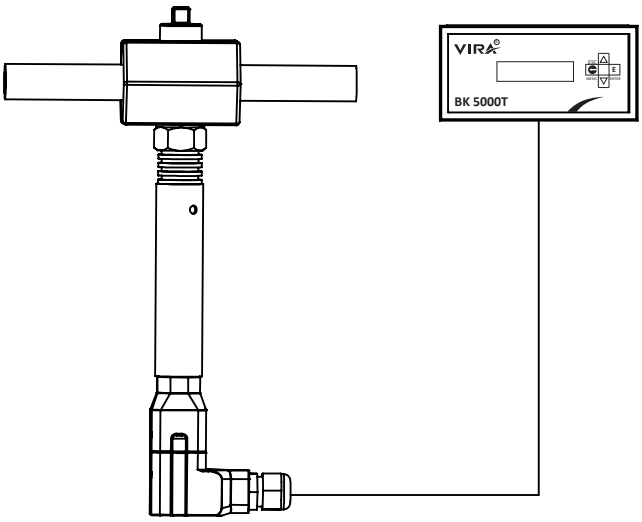


Figure 3 : BS2-T System Application

3.1.3 BS4 Blowdown Control System

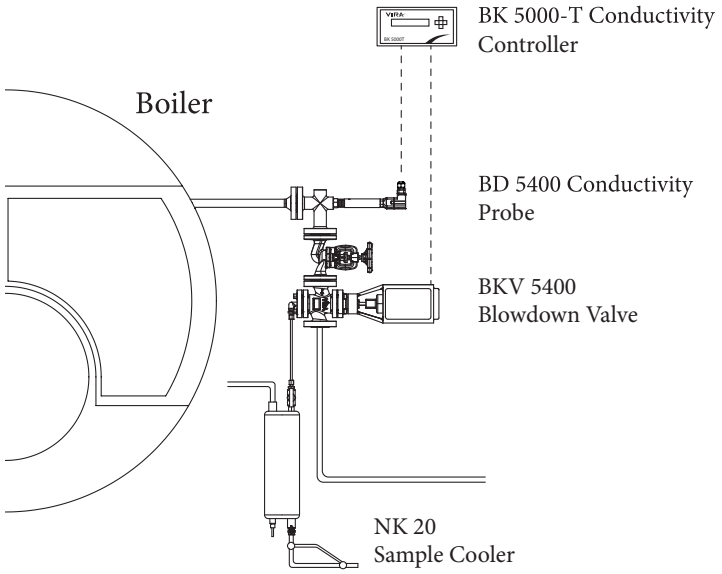


Figure 4 : BS4 System Application

3.1.4 BS4-T Blowdown Control System

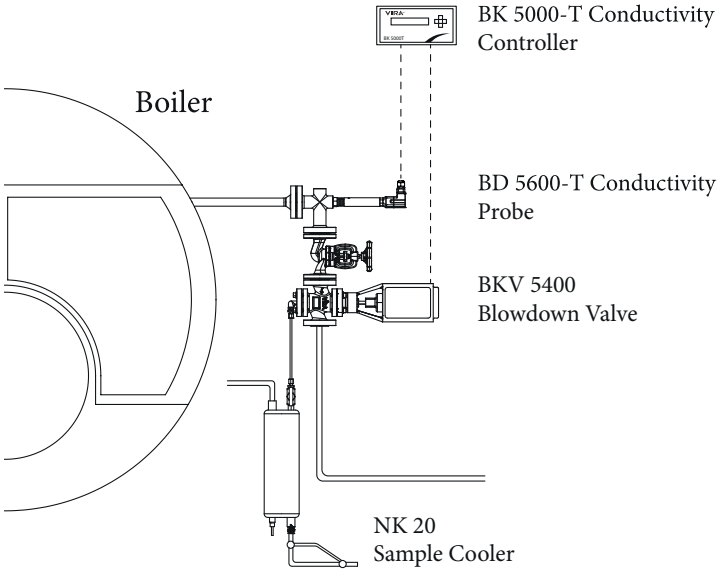


Figure 5 : BS4-T System Application

3.1.5 BS5-T Blowdown Control System

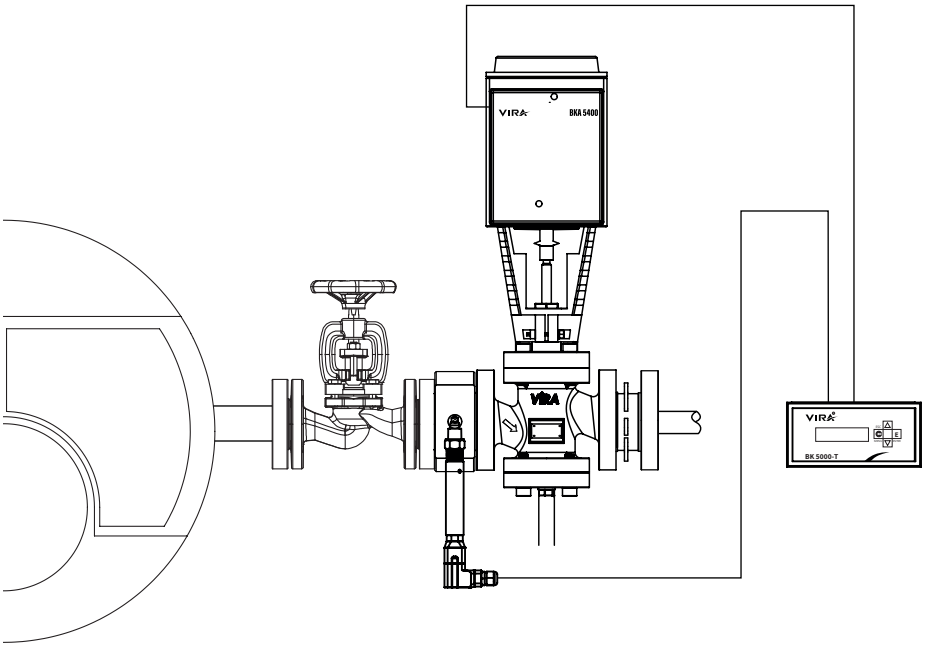


Figure 6 : BS5-T System Application

3.2 Condensate Conductivity Control System (BS3-T)

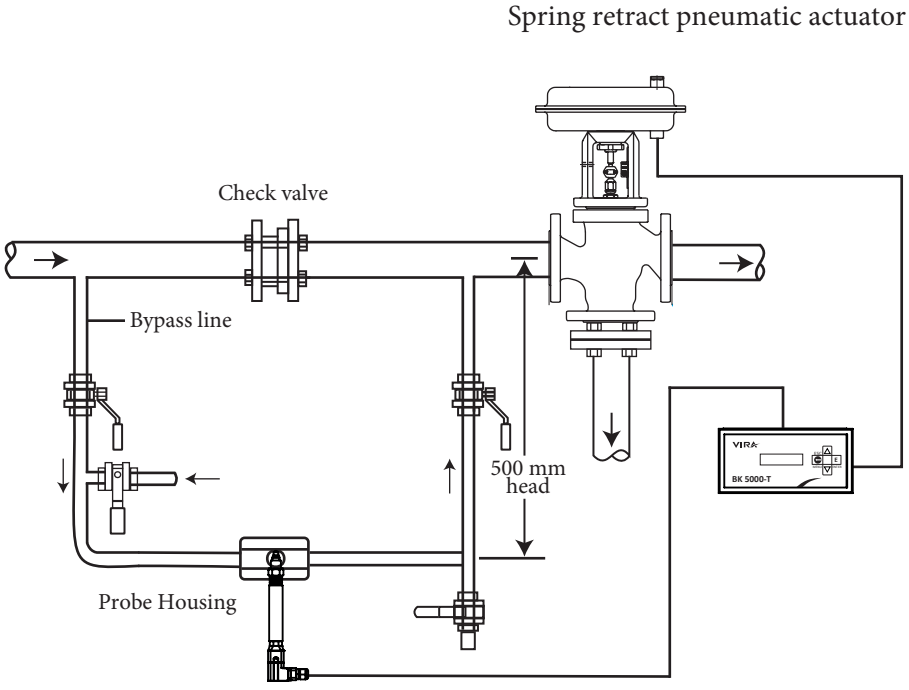


Figure 7 : BS3-T System Application

The Vira Condensate Conductivity Control system actively monitors and displays the conductivity of condensate return. In the event that the conductivity surpasses a predetermined level, the system redirects the flow to the drain. This preventive measure is implemented to avoid the return of contaminated water to the boiler feedtank. It's important to note that the system may not identify contaminants that do not alter conductivity, such as oils, fats, or sugars.

To achieve this monitoring capability, a conductivity sensor including temperature sensor (e.g BD 5300-T) are installed in a bypass line, as illustrated in Figure 7. A check valve within the main line ensures a continuous flow past the sensor, particularly under low-flow conditions. The incorporation of a 500 mm head serves to impede flash steam flow in the bypass line. We recommend the use of a 3-port diverter valve. Typically, a spring retract pneumatic actuator is employed to ensure valve diversion in case of air supply failure.

4. Mechanical Installation

4.1 Dimensions

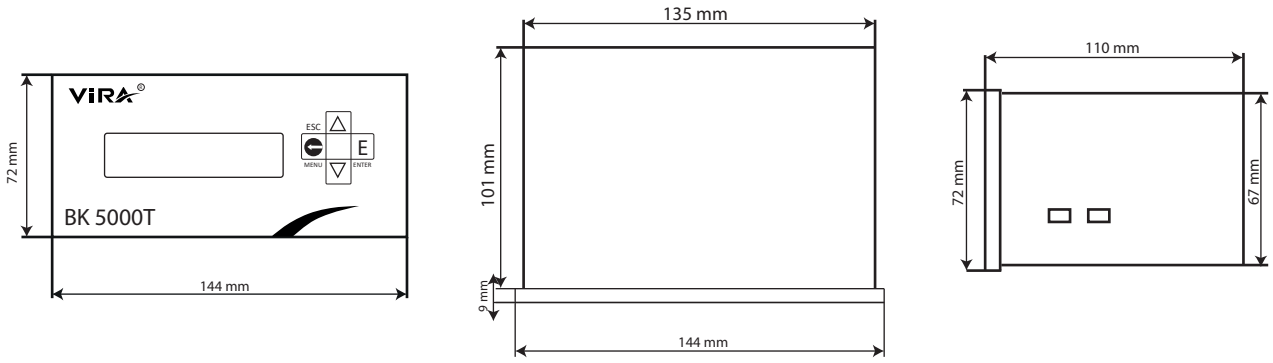


Figure 8 : Conductivity Controller Dimensions

4.2 Installation in a Control Cabinet Door

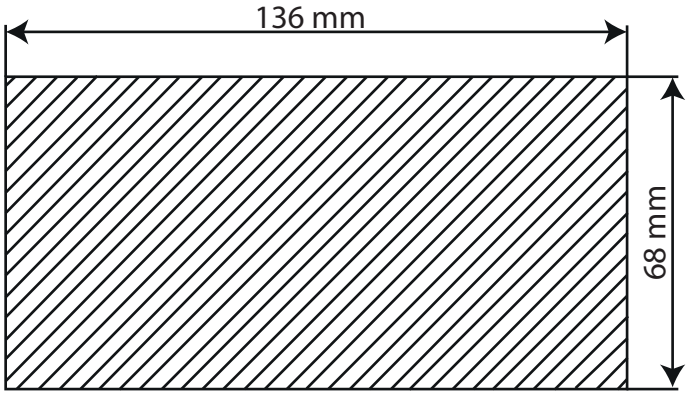


Figure 9 : Panel cut out dimensions of Conductivity controller BK 5000-T

4.3 Nameplate

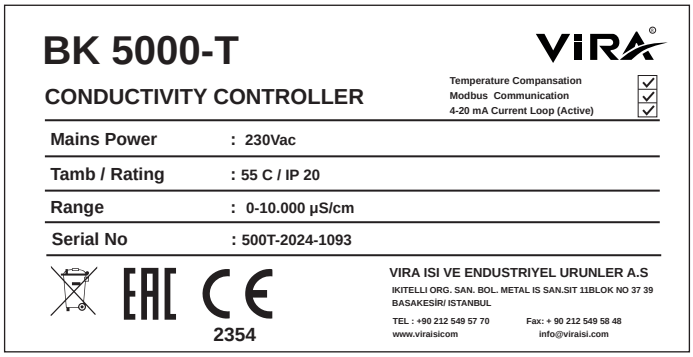


Figure 10 : BK 5000-T Nameplate

5. Electrical Installation

4.1 Wiring Diagram of Different Applications

4.1.1. Wiring Diagram of BK 5000-T and BD 5600-T/BD 5300-T

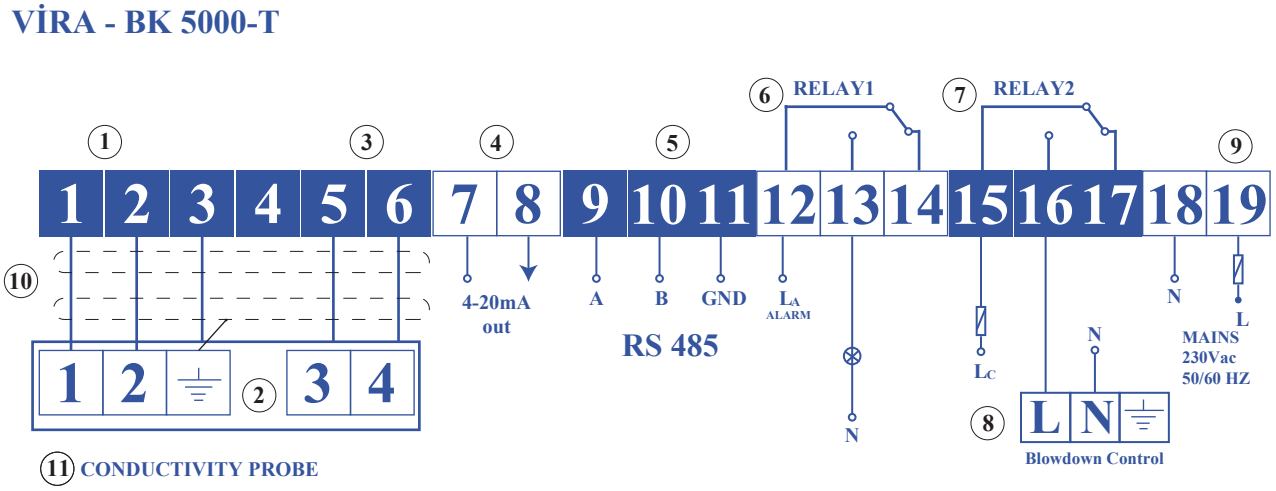


Figure 11 : BK 5000-T Wiring Diagram with BD 5600-T & BD 5300-T

Item	Description
1	Conductivity probe input.
2	Earthing point at the conductivity probe.
3	Conductivity Probe PT 100 Input.
4	Actual value output 4- 20 mA.
5	RS 485 Communication Output.
6	Max. Conductivity Alarm
7	Relay contacts to activate the control valve.
8	Control valve actuator connections.
9	Supply voltage connection 230 Vac with semidelay fuse M 3A provided on site.
10	Cable shield, wired only in probe side.
11	Conductivity Probe

Table 1 : Wiring Diagram Descriptions of Figure 11

4.1.2 Wiring Diagram of BK 5000-T and BD 5400

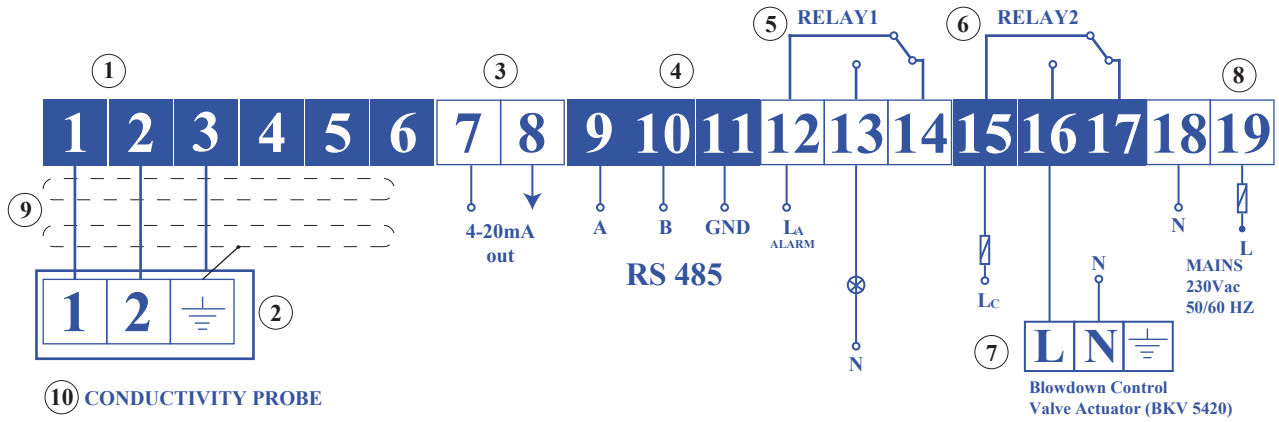


Figure 12 : BK 5000-T Wiring Diagram with BD 5400

Item	Description
1	Conductivity probe input
2	Earthing point at the conductivity probe.
3	Actual value output 4-20 mA
4	RS 485 CommunicationOutput
5	Max. Conductivity Alarm
6	Relay contacts for activating the control valve
7	Control valve actuator connections
8	Supply voltage connection 220VAC with semi-delay fuse M 3A provided on site
9	Cable shield, wired only in probe side.
10	Conductivity Probe

Table 2 : Wiring Diagram Descriptions of Figure 12

4.2 Blowdown Valve Wiring Notes

4.2.1 Wiring with BKV 5420

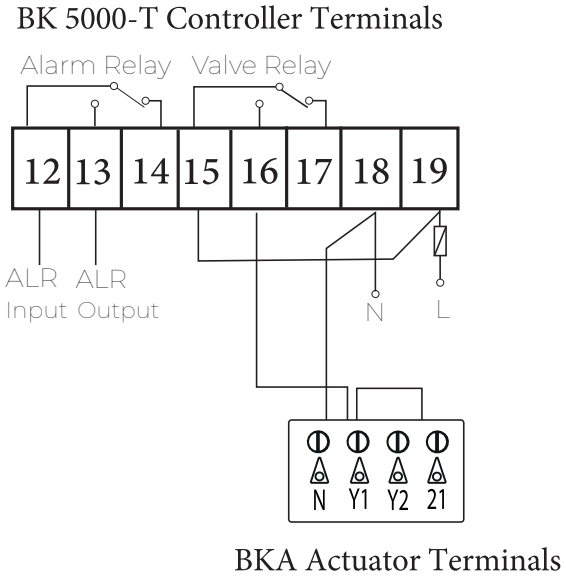


Figure 13 : Wiring between BK 5000-T and BKA Actuator

4.2.2 Wiring with BKV 5440

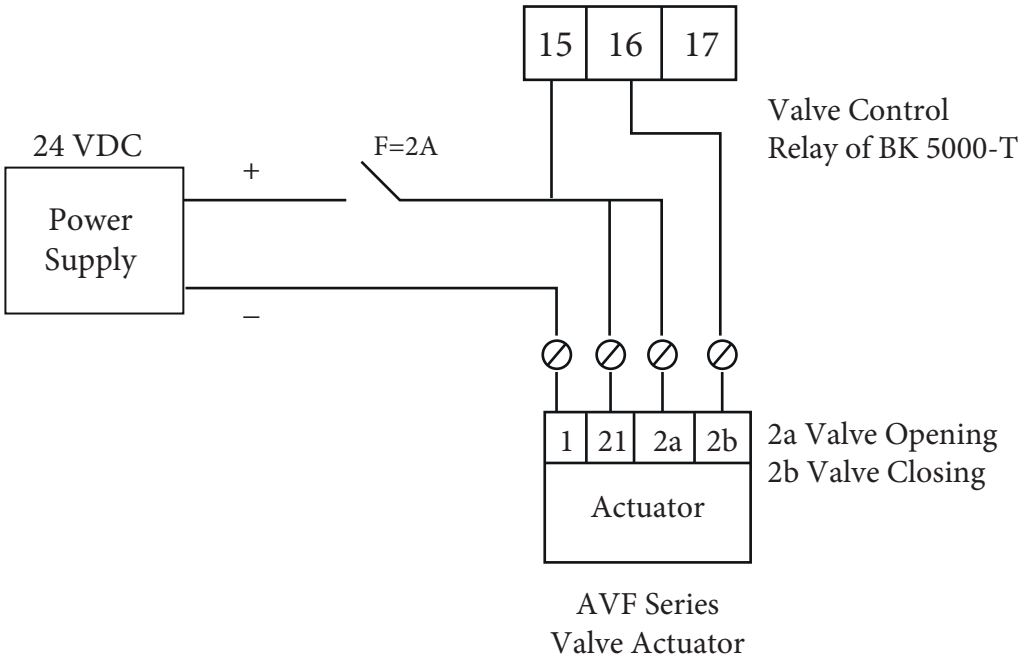


Figure 14 : Wiring between BK 5000-T and AVF Actuator

4.3 Supply Voltage Connection

The equipment must be supplied with 230Vac from a power supply. An external 3A semi-delay fuse must also be fitted.
This power supply unit must be electrically isolated from dangerous live voltages and meet the requirements for double or reinforced insulation in accordance with one of the following standards:
EN 50178, EN 61010-1, EN 60730-1, EN60950-1 or EN 62368-1.

4.4 Connection of Output Contacts

Wire the terminals between 6-14, (Fig. 11 and 12) according to the desired switching functions.
Provide an external slow-blow 2.5 A fuse for the output contacts.

4.5 Connecting the Conductivity Probes

The BK 5000-T Conductivity controller can be combined with the BD 5400, BD 5600-T and BD 5300-T conductivity probes.For equipment connections, utilize a screened multi-core cable with a minimum conductor size of 0.5 mm^2.
Route the connecting cable between probe and equipment separately from power lines.
Due to the 2 wire connection of the temperature sensor, the temperature reading is not very accurate.
This does not effect the functionality because the temperature is used for compensation purpose only.


Do not use unused terminals as support point terminals.

4.6 Connecting the 4-20 mA Output

For equipment connections, use a multi-core cable with a minimum conductor size of 2*0.5 mm^2 with a maximum length of 100 meters.
Follow the wiring diagram in Figure 11 and 12 to wire the terminals.
Ensure that the connecting cables are kept separate and routed away from power cables.

Note: Unless otherwise stated, the 4-20 mA connection type is an active connection. There is no need for an additional external 24V power supply.

BK5000T has 4-20mA current loop transmit capability for remote monitoring. With the two values of 4 & 20 mA representing 0–10.000 µS/cm (for boiler application) of the range of measurement.

Note : Conductivity range can be customized according to application.

4.7 Tools

Screwdriver size 3 x 100 mm.

5. Functions and Configurations

5.1 Display Definitions and Button Functions

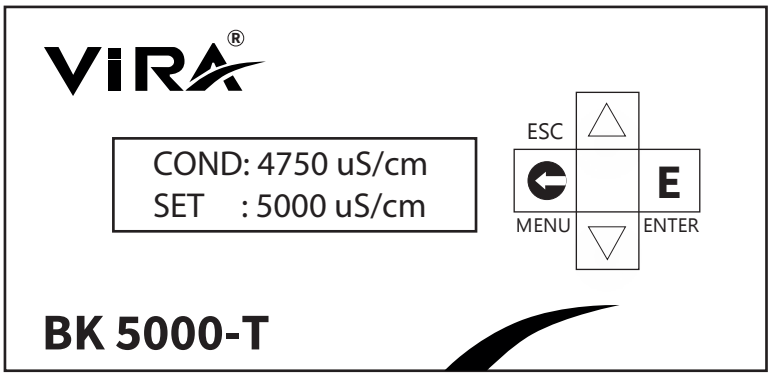


Figure 15 : Front Panel and Button Functions

5.2 Changing Functions and Settings

Figure 16 : Main Screen

Upon powering up the device, the display will present the main screen of the BK 5000T, as depicted in the accompanying figure. On the display, the upper row provides real-time conductivity values, while the lower row displays the pre-set conductivity values.

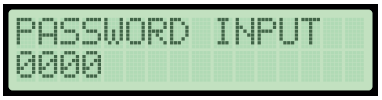


Figure 17 : Password Screen

To enter the main menu, press the menu button once. Use the up and down buttons to enter the password, then press the enter button. If the password entered is correct, the controller will switch to the setting mode. The default password for this process is '0000'.

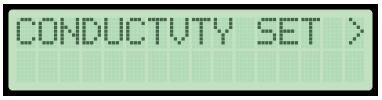


Figure 18 : First Menu Screen

The subsequent screen is labeled 'CONDUCTIVITY SETTING.' Pressing the UP/DOWN buttons will either reveal the next parameter on the screen, or by pressing the ENTER button, allow modification of the 'CONDUCTIVITY SET' parameter.

Figure 19 : Parameter Changing Screen

Adjust the parameter value using the UP and DOWN buttons, and subsequently, press the ENTER button to confirm and save the updated parameter value. To exit without saving the new value, press the ESC button.

5.5.1 Conductivity Set

Figure 20 : Parameter Changing Screen

The set value for the boiler water conductivity. When the water conductivity reaches this level, a relay is activated, causing the valve to open

5.5.2 Conductivity Hysteresis Set

Figure 21 : Hysteresis Set Screen

This function is employed to minimize fluctuations in the valve during opening and closing. It is advisable to choose a value between 4-5% of the set conductivity value for optimal performance.

5.5.3 Alarm Set

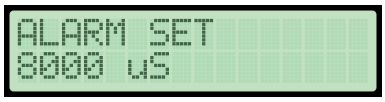


Figure 22 : 8 Alarm Set Screen

The BK 5000-T is equipped with an alarm relay, which is activated when the conductivity level exceeds the value adjusted using this function.

5.5.4 Alarm Hysteresis Set

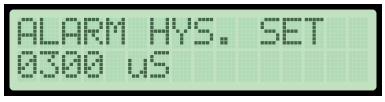


Figure 23 : Alarm Hysteresis Set Screen

This value is utilized to minimize frequent switching on/off of the alarm relay. It is recommended to choose a value between 4-5% of the set alarm set value for optimal performance.

5.5.5 Conductivity Calibration

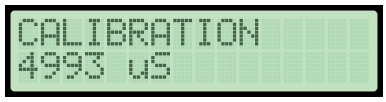


Figure 24 : Calibration Screen

This function is employed to establish the proper conductivity value of water extracted directly from the boiler. When obtaining a water sample for controller calibration, it is crucial that the boiler is at its operational pressure and temperature. For more accurate sampling and calibration, it is recommended to use the ViRA NK-20 Sample Cooler.

Figure 25 : Calibration Countdown Screen

During the calibration process, once the new value is entered, it is imperative to wait for a duration of 30 seconds to complete the calibration. Throughout this period, the following screen will be displayed.

5.5.6 Change Password

Figure 26 : Change Password Screen

To prevent unauthorized interference, the BK 5000T is equipped with password protection. This function is utilized to modify the device's password.

Figure 27 : Valve Relay Test Screen

This function is employed to assess the proper functioning of the valve relay. Pressing the ENTER button will keep the valve open for 15 seconds, and the subsequent screen will be displayed during this period.

Figure 28 : Valve Relay Test Countdown Screen

5.5.8 Alarm Relay Test

Figure 29 : Alarm Relay Test Screen

This function is designed to evaluate the proper functioning of the Alarm Relay . Upon pressing the enter button, the relay will be activated for a duration of 5 seconds. The subsequent screen will be displayed during this interval before the relay is switched off.

Figure 30 : Alarm Relay Test Countdown Screen

5.5.9 Language

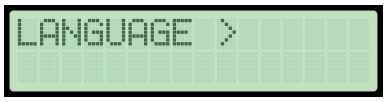


Figure 31 : Language Screen

This function is employed for language selection. The language can be chosen by utilizing the up and down buttons, and the selected option is saved by pressing the enter button. Two language options are available: Turkish and English.

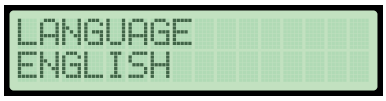


Figure 32 : English Language Screen

5.5.10 Temperature

Figure 33 : Temperature Screen

This function displays the water temperature. Pressing the ENTER button will reveal the following screen.

5.5.11 Probe Data

Figure 34 : Probe Data Screen

This menu displays the signal received from the probe. The function is utilized to verify the normal operation of the probe. Pressing the enter key will prompt the appearance of the following screen. Values may fluctuate based on water temperature and conductivity

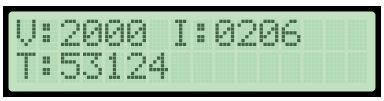


Figure 35 : Probe Data Screen 2

Note : V, I and T values must be as following;

V = ~ 2000
I = 40 - 4000
T = 3000 - 70.000

5.5.12 Version

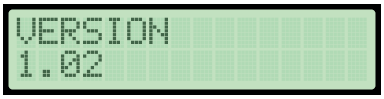


Figure 36 : Version Screen

This function displays the version of the current software. Pressing the enter button will reveal the following screen.

5.5.13 Service Sets

Figure 37 : Service Set Screen

This menu is only used by the factory.

5 .5.14 Modbus Slave Address Settings

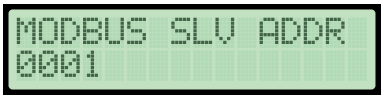


Figure 38 : Modbus Slave Address Screen

To integrate the controller with an external automation system, a slave address must be assigned. Each slave, including the BK5000T or other devices, within the network is allocated a distinct unit address ranging from 1 to 247.

5.5.15 Modbus Baudrate Settings

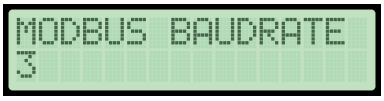


Figure 39 : Modbus Baudrate Screen

This function is employed to configure the communication speed. The Modbus baud rate can be set within the range from 1 to 4.

6. Technical Information

Supply Voltage	230 Vac (+5% /- 10%), 50/60 Hz
Fuse	external 0.5 A (semi-delay)
Power Consumption	2,5 W
Probe Tip Voltages	200 mV
Range	0 - 200 µS / cm 0 - 1000 µS / cm 0 - 10.000 µS / cm
Outputs	1 floating changeover contacts, 12A, 250VAC, cosφ=1, 85°C. **Valve Control** 1 floating changeover contacts, 12A, 250VAC, cosφ=1, 85°C. **Alarm** 1 real time process value 4-20 mA **Analogue ouput.**
Displays and Controls	2*16 LCD Display 4 * button
Containment	Housing material, base: black polycarbonate Terminal strips can be removed separately
Electrical Safety	Degree of contamination 2 for installation in control cabinet with degree of protection IP 54, fully insulated. Overvoltage category III.
Degree of Protection	Housing: IP 20 to EN 60529
Weight	approx. 0.7 kg
Ambient Temperature	0 °... 55 °C
Transport Temperature	–20 ... +80 °C
Storage Temperature	–20 ... +70 °C
Relative Humidity	max. 95%, no moisture condensation
Approvals	CE type approval, EMC and LVD, Machine Directive

Table 3 : Technical Informations

Scope of Supply

- 1* Conductivity Controller
- 1* Installation and Maintenance Instructions
- 2* Panel Mounted Enclosure Fixing Clamp

7. Commissioning

7.1 Calibration Steps

7.1.1 - Take proper sample (Vira recommend to use NK 20 Sample Cooler during sample-taking process)

7.1.2 - If the external meter does not have temperature compensation, wait to cool it down until 24 C

7.1.3 - Measure with an external meter

7.1.4 - Set calibration value to the controller (see figure 24)

7.1.5 - Wait for countdown

7.1.5 - Calibration completed

7.2.1. Calibration in General

When calibrating the system, it is imperative that the boiler is at its operational temperature, especially if a it is being used a conductivity sensor without integrated temperature sensor. For optimal accuracy, calibrate the controller with the conductivity as close as possible to the Set Point. In some instances, it may be necessary to run the boiler for a period to allow the TDS to accumulate before calibration. Re-calibrate the /Conductivity at the Set Point once the boiler has stabilized, typically after a few days.To maintain peak performance, check the calibration (as close to the Set Point as practical) on a weekly basis. Take a sample of the boiler water and measure its conductivity (in µS/cm) using an external conductivity meter.

7.2.2. Calibration in Condensate Conductivity Control System

We strongly advise consulting a qualified water treatment company to determine the most suitable conductivity level for individual plants. Conditions and chemical properties, as well as the conductivity of contaminants, can vary significantly.In many instances, the typical measured value of 'clean' condensate may be very low, perhaps only 5 or 10 µS/cm, while the set point could be much higher, reaching 70 or 80 µS/cm. To calibrate a condensate contamination control system, introduce a liquid with conductivity close to the maximum allowable level into the system. Use a mixture of tap water and condensate to simulate condensate at approximately the maximum allowable conductivity level (the set point). Typically, 5 liters is sufficient for most systems. Use a reliable external conductivity meter to verify the conductivity. Close both stop valves, open the drain valve, and the 'water for flushing and calibration' valve. Pour in the prepared water and let it run through the system until free of bubbles. Close the drain valve and allow the display to settle for two minutes. Calibrate the controller as outlined in the main text. It is recommended to check calibration after the system has been running for a few days and periodically thereafter, depending on the specific conditions of the individual plant. If there are any uncertainties, consult with your water treatment specialist.

8. Troubleshooting

8.1 Fault Finding

Fault There is no power on the screen	**Remedy** Check 230V supply. Check the fuse inside the device.
Fault There is power on the screen but no text or unknown characters appear.	**Remedy** Return the product to the VİRA service department.
Fault Once the device is calibrated, it either remains constant or changes very rapidly in the range of 0-10,000 (range can be different acc. to application)	**Remedy** Check the probe connections for correctness Check if the probe is touching the water.
Fault Process conductivity value changes suddenly.	**Remedy** Check that the probe cable shield is connected to ground (on the probe side).

Verifying Probe Connection to the Controller

To ensure the correct connection of the probe to the controller, please follow the steps outlined below:

1. Access the menu by pressing the Menu button.
2. Navigate through the menu using the arrow keys and locate the "Probe Data" menu.
3. Select the "Probe Data" menu to view the relevant values.
- The V value should be approximately 2000.
- The I value should range between 30 and 4000.
- The T value should range between 30,000 and 70,000.

If these three values fall within the specified ranges, the probe is properly connected.

Table 4 : Fault finding table

Note: The probe must be in contact with water when checking these settings

8.2 High-frequency interference

High-frequency interference can be caused by out-of-phase switching operations. If such interference occurs and results in sporadic failure, we recommend taking the following action to suppress interference:

- Route the connecting cable to the level probe separately from power lines.
- Increase the distance from sources of interference.
- Suppress HF interference using hinged-shell ferrite rings.

8.3 Replacement of a " Out of Service" Unit

- Switch off the power supply and cut off power to the equipment.
- Remove terminal blocks from the back of the product.

8.4 Disposal

The equipment must be disposed of in accordance with statutory waste disposal provisions.

In the event of faults that cannot be remedied with the aid of this manual, please contact our

9. Technical Assistance

For technical assistance or service requests, please directly contact Vira service center by making a phone call or sending an e-mail to **servis@viraisi.com.**

Return faulty or service items to Vira itself or authorized agency in your area. Ensure all items are suitably packed for transit (preferably in the original cartons).

Please provide the following information with any equipment being returned:

- Your name, company name, address and telephone number, order number and invoice and return delivery address.
- Description and the serial number of equipment.
- Full description of the fault or repair required.
- If the equipment is being returned under warranty, please indicate the date of purchase.

The manufacturer reserves the right to make change without prior notification.

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ANNEX A

BK 5000-T MODBUS COMMUNICATION USER GUIDE

What is RS485?

RS485 or EIA (Electronic Industries Association) RS485 is a balanced line, half-duplex transmission system allowing transmission distances of up to 1.2 km.

What is half duplex?

Half duplex is a system in which one or more transmitters (talkers) can communicate with one or more receivers (listeners) with only one transmitter being active at any one time. For example, a "conversation" is started by asking a question, the person who has asked the question will then listen until he gets an answer or until he decides that the individual who was asked the question is not going to reply. In a 485 network the "master" will start the "conversation" with a "Query" addressed to a specific "slave", the "master" will then listen for the "slave's" response. If the "slave" does not respond within a pre-defined period, (set by control software in the "master"), the "master" will abandon the "conversation".

Connecting the Instruments

Screened twisted pair cable should be used. All "A" connections should be connected together using one conductor of the twisted pair cable, all "B" connections should be connected together using the other conductor in the pair. The cable screen should be connected to the "Gnd" terminal.

A Belden 9841 (Single pair) or 9842 (Two pair) cable with a characteristic impedance of 120 ohms is recommended, the cable should be terminated at each end with a 120 ohm, quarter watt (or greater) resistor.

There must be no more than two wires connected to each terminal, this ensures that a "Daisy Chain or "straight line" configuration is used. A "Star" or a network with "Stubs (Tees)" is not recommended as reflections within the cable may result in data corruption.

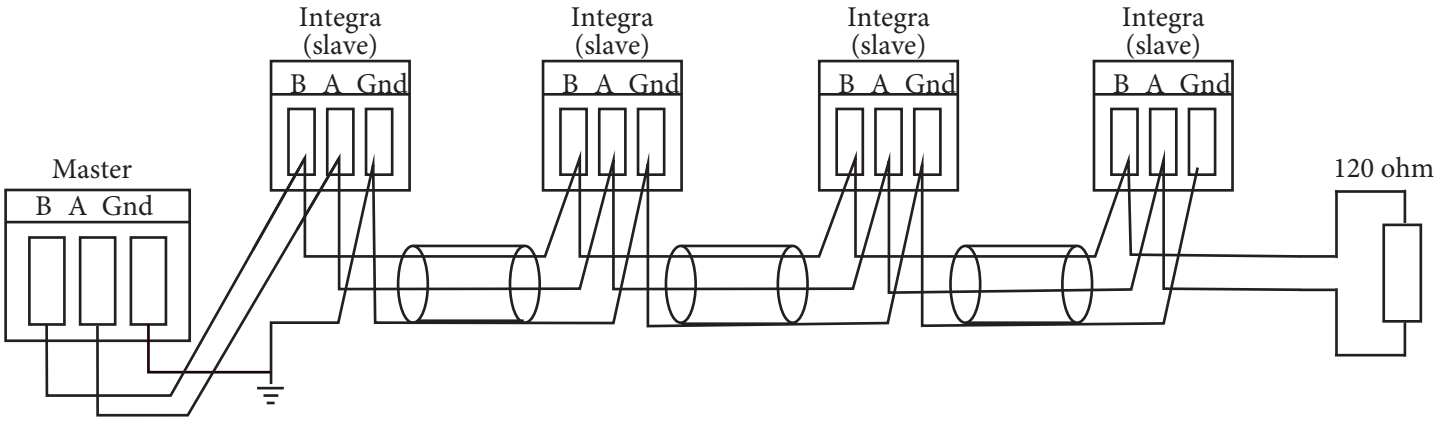


Figure 40 : Wiring Topology

Which is A and Which is B?

The A and B connections to the SPR and Integra Products can be identified by the signals present on them whilst there is activity on the RS485 bus:

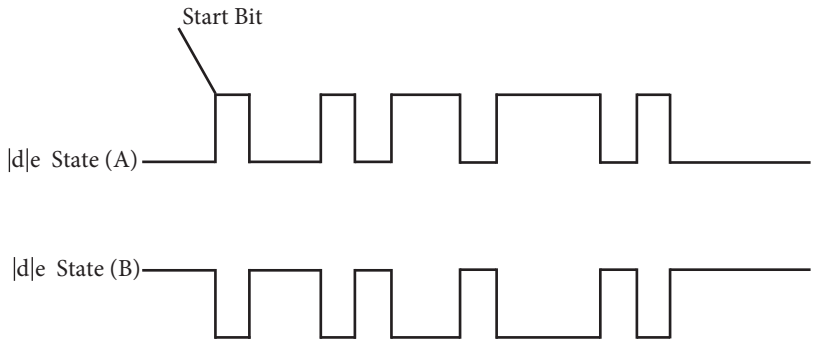


Figure 41 : A & B Connections

MODBUS Messages

Communication on a MODBUS Network is initiated (started) by a "Master" with a "query" to a "Slave". The "Slave " which is constantly monitoring the network for "Queries" will recognise only the "Queries" addressed to it and will respond either by performing an action (setting a value for example) or by returning a "response". Only the Master can initiate a query.
In the MODBUS protocol the master can address individual slaves, or, using a special "Broadcast" address, can initiate a broadcast message to all slaves. The SPR and Integra products do not support the broadcast address.

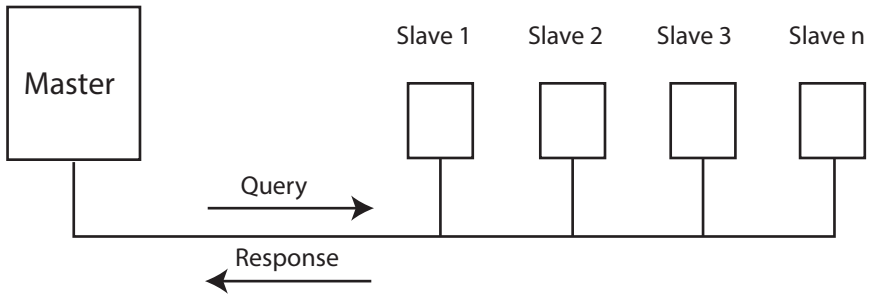


Figure 42 : Master Slave communication

EIA / TIA 485 Communication Wiring Diagram

The product can be connected as a slave to a two-wire EIA / TIA-485 multi-drop network.

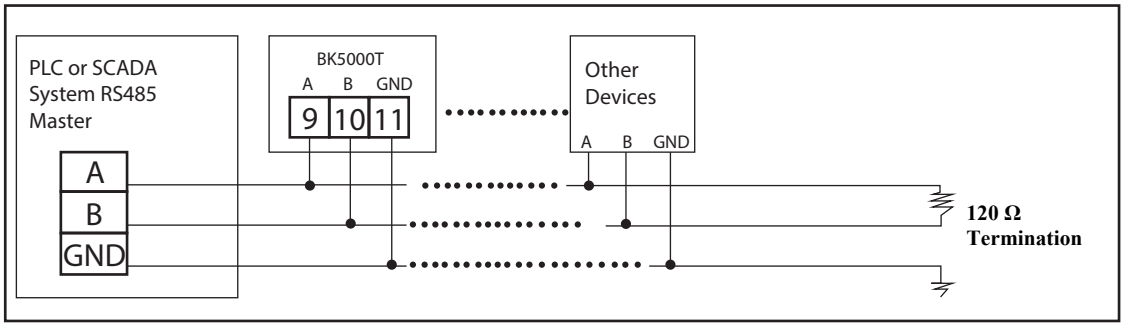


Figure 43 : RS 485 / Modbus Half Duplex Circuit

EIA / TIA 485 Wiring Notes

Twisted pair cable should not be required for short lengths of cable < 1.5 m (< 5 ft). Standard screened cable should suffice.
-For two-wire connection, connect terminal 9 and 10 together.
-The bus common must be connected directly to protective ground / earth at one point only. Generally this point is at or near the master device.
-Consider terminating the two furthest ends of the bus to match the transmission line impedance. A 150 ohm (0.5 W) resistor or a 120 ohm (0.25 W) resistor, in series with a 1 nF (10 V) capacitor is commonly used, but ideally the line impedance should be matched to each individual installation. Termination for short lengths of cable should not be necessary < 300 m (< 1 000 ft) @ 9 600 Baud.

Parameters and Register Data

Register	Parameters
40001	Process Variable (µS/cm)
40002	Conductivity Set Value
40003	Conductivity Set Value Hysteresis
40004	Conductivity Alarm Value
40005	Conductivity Alarm Value Hysteresis

Comms – Baud (Modbus Communication)

Ranges	0 - 4
Default	3

Baud Rate Table (Modbus Communication)

0	1200
1	2400
2	4800
3	9600
4	19200

(MENU->BaudRate->X)

Comms – Adress (Modbus Communication)

Ranges	1-247
Default	1

Each slave (BK 5000-T and/or other slave devices) in a network is assigned a unique unit adress from 1 to 247.

(MENU->Slave Address->XXX)

Deafult Parameters

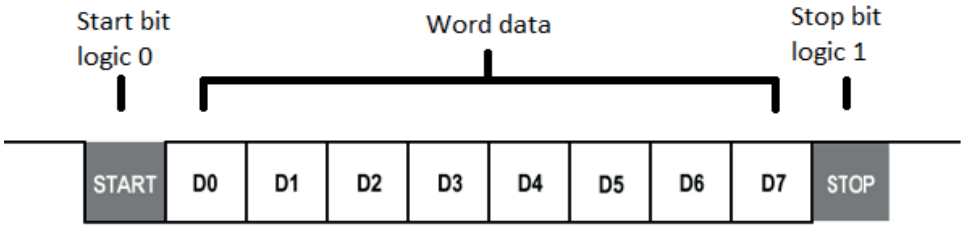
Baudrate : 9600

Data Bit : 8

Stop Bit : 1

Parity : None Parity

Summary of the Modbus Protocol



Format : Request Frame

Address	Function Code	Start address		Quantity of registers		CRC	
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

Format : Response Frame

Address	Function Code	Byte count	Register data		CRC	
1 byte	1 byte	1 byte	1 byte	1 byte	1 byte	1 byte

Format : Error Response Frame

Address	Func.Code +128	Byte count	CRC	
1 byte	1 byte	1 byte	1 byte	1 byte

Example Codes (Adress = 1, HEX Mode)

Request Frames:

01	03	00	00	00	01	crcL	crcH	Read Process Variable
01	03	00	01	00	01	crcL	crcH	Read Set Point
01	03	00	02	00	01	crcL	crcH	Read Alarm Set

Response Frame (If no error):

01	03	02	dataH	dataL	crcL	crcH	Read Data Variable.

Response Frames (In case of error):

01	83	01	crcL	crcH	The used function code is not supported.
01	83	02	crcL	crcH	The register address used is not allowed. The register address may be invalid.