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Manual abstract:

No. @@@@ · Monitor the control loop by LBA (Loop Break Alarm) · Use the communications function · Calibrate input or transfer output · It also features a watertight construction (NEMA4: equivalent to IP66) This User's Manual describes how to use the E5AK compact, high-function digital controller.

Before using your E5AK, thoroughly read and understand this manual in order to ensure correct use. About this manual E OMRON, 1996 (1) All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of OMRON. (2) No patent liability is assumed with respect to the use of the information contained herein. (3) Moreover, because OMRON is constantly striving to improve its high-quality products, the information in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

I Conventions Used in This Manual J Meanings of Abbreviations Sometimes the following abbreviations are used in parameter names, figures and in text explanations. These abbreviations mean the following. Abbreviation PV SP RSP LSP LBA HB AT ST Process value Set point Remote set point Local set point Loop break alarm Heater burnout Auto-tuning Self-tuning Term J How to Read Display Symbols The following tables show the correspondence between the symbols displayed on the displays and alphabet characters. ABCDEFGH I J KLM NOPQR S T UVWXYZ J "Reference" mark This mark indicates that extra, useful information follows, such as supplementary explanations and how to apply functions. II J Notice: OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product. ! DANGER Indicates information that, if not heeded, is likely to result in loss of life or serious injury. Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation. ! WARNING ! Caution III J How this Manual is Organized Purpose Title Chapter 1 Introduction Description This chapter describes the features of the E5AK, names of parts, and typical functions. D Learning about the general features of the E5AK D Setting up the E5AK Chapter 2 Preparations This chapter describes the operations that you must carry out (e.g. installation, wiring and switch settings) before you can use the E5AK. These chapters describe how to use the front panel keys and how to view the display when setting the parameters of the major functions for the E5AK. These chapters describe the important functions of the E5AK and how to use the parameters for making full use of the E5AK. This chapter describes the functions related specifically to position-proportional type controllers. This chapter mainly describes the communications commands, and gives program examples. D Basic E5AK operations Chapter 3 Basic Operation Chapter 5 Parameters D Applied E5AK operations Chapter 4 Applied Operation Chapter 5 Parameters D Using a Position-proportional Type Controller Chapter 4 Applied Operation/4.

I Selecting the Control Method D Communications with a host computer Chapter 6 Using the Communications Function D Calibration Chapter 7 Calibration This chapter describes how the user should calibrate the E5AK. This chapter describes what to do if any problems occur. D Troubleshooting Chapter 8 Troubleshooting IV Pay Attention to the Following when Installing this Controller F If you remove the controller from its case, never touch nor apply shock to the electronic parts inside. F Do not cover the area around the E5AK. (Ensure sufficient space around the controller to allow heat radiation.) F Use a voltage (AC100-240V or AC/DC24V at 50 to 60 Hz). At power ON, the prescribed voltage level must be attained within two seconds. F When wiring input or output lines to your controller, keep the following points in mind to reduce the influence from inductive noise: · Allow adequate space between the high voltage/current power lines and the input/output lines. · Avoid parallel or common wiring with high voltage sources and power lines carrying large currents. · Using separating pipes, duct, and shielded line is also useful in protecting the controller, and its lines from inductive noise.

F Allow as much space as possible between the controller and devices that generate a powerful, high frequency (high-frequency welders, high-frequency sewing machines, and so forth) or surge. These devices may cause malfunctions. F If there is a large power-generating peripheral device and any of its lines, attach a surge suppressor or noise filter to the device to stop the noise affecting the controller system. In particular, motors, transformers, solenoids and magnetic coils have an inductance component, and therefore can generate very strong noises. F When mounting a noise filter, be sure to first check the filter's voltage and current capacity, then mount the filter as close as possible to the controller.

F Do not use the controller in places where icing, condensation, dust, corrosive gas (especially sulfurized gas or ammonia gas), shock, vibration, splashing liquid, or oil atmosphere occur. Also, avoid places where the controller can be subjected to intense heat radiation (like from a furnace) or sudden temperature changes. F Ambient temperature must be kept between -10_C to 55_C. Ambient humidity must be kept between 35%RH to 85%RH (with no icing or condensation). If the controller is installed inside a control board, the ambient temperature must be kept under 55_C, including the temperature around the controller.

If the controller is subjected to heat radiation, use a fan to cool the surface of the controller to under 55_C. F Store the controller at an ambient temperature between -25_C to 65_C. The ambient humidity must be between 35%RH to 85%RH (with no icing or condensation). F Never place heavy objects on, or apply pressure to the controller that may cause it to deform and deterioration during use or storage. F Avoid using the controller in places near a radio, television set, or wireless installation. These devices can cause radio disturbances which adversely affect the performance of the controller. V Table of Contents Preface



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: Lit when operation has stopped. : Lit during remote operation. : Flashes during auto-tuning. · MANU : Lit in the manual operation mode. · STOP · RMT · RSP · AT F Bar graph On a standard type controller (E5AK-AA2), this bar graph indicates the manipulated variable (heat) in 10% increments per single segment. On a position-proportional type controller (E5AK-PRR2), this bar graph indicates the valve opening in 10% increments per single segment. J How to use keys F A/M The following describes basic key operations. Each press of this key switches between the auto and manual operations. The functions of this key change according to how long it is pressed.

If the key is pressed for less than one second, the parameters are switched. If the key is pressed for one second or more, the menu display appears. In key operations from here on, "press the key" refers to pressing the key for less than one second. For details on parameter switching and menu display items, see page 1-8. Each press of the key increments or advances the values or settings on the No.2 display, while each press of the key decrements or returns the values or settings on the No.2 display. key key F F key Functions vary, for example, when the A/M key is held down simultaneously with the display key, or a key is held down continuously. For details, see page 1-8. Also, chapters 3 and 4 describe examples using various key combinations.

1--3 CHAPTER 1 INTRODUCTION 1.2 Input and Output Temperature input Voltage input Current input Controller Control output (heat) Control output (cool) Alarm 1 Control output 1 Control output 2 CT input Potentiometer Alarm 2 Alarm 3 Auxiliary output 1 Remote SP input HBA LBA Auxiliary output 2 Event input Error 1 Error 2 Error 3 Transfer output J Input The E5AK supports following inputs: temperature input, current input, voltage input, CT input/Potentiometer, remote SP input and event input. F Temperature input/Voltage input/Current input · Only one of temperature input, voltage input and current input can be selected and connected to the controller. The above figure shows temperature input connected to the controller. · The following input sensors can be connected for temperature input: Thermocouple: K, J, T, E, L, U, N, R, S, B, W, PLII Platinum resistance thermometer: JPt100, Pt100 · The following currents can be connected for current input: 4 to 20 mA, 0 to 20 mA · The following voltages can be connected for voltage input: 1 to 5 VDC, 0 to 5 VDC, 0 to 10 VDC F CT input/Potentiometer · Connect CT input when using the HBA (heater burnout alarm) function on a standard type controller (E5AK-AA2).

· Connect the potentiometer when monitoring the valve opening on a position-proportional type controller (E5AK-PRR2). When the remote SP function is enabled, inputs within the range 4 to 20 mA are used as the remote SP.



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F Remote SP input 1--4 1.1 Names of parts F Event input When using event input, add on the input unit (E53-CKB). You can select from the following five event inputs: Multi-SP Run/Stop Remote/Local Auto/Manual SP mode J Output The E5AK supports the following five outputs.

Control output 1 Control output 2 Auxiliary output 1 Auxiliary output2 Transfer output When using control outputs 1 and 2, set the output unit (sold separately). Nine output units are available to suit the output circuit configuration. When using transfer output, add on the communication unit (E53-AKF). Note: The output functions of the E5AK do not operate for five seconds after the E5AK is turned ON. F Output assignments The E5AK supports the following ten output functions. Control output (heat) Control output (cool) Alarms 1 to 3 HBA LBA Error 1 (input error) Error 2 (A/D converter error) Error 3 (RSP input error) Assign these output functions to control output 1, control output 2, auxiliary output1, and auxiliary output2. However, note that as control output 1 is used as the open output and control output 2 is used as close output on a position-proportional type controller (E5AK-PRR2), control outputs 1 and 2 cannot be used as assignment destinations. Also, of the output functions, control output (heat), control output (cool), HBA and LBA are disabled. On a standard type controller, there are restrictions on how assignment destinations (control output 1, control output2, auxiliary output1, and auxiliary output2) can be used. For details, see 3.

3 Setting Output Specifications. In the example on the previous page, "control output (heat)" is assigned to "control output 1", "alarm 1" is assigned to "control output 2", and "alarm 2" is assigned to "auxiliary output 1". Accordingly, the configuration is such that heating control output is connected to control output 1, and alarm output is connected to control output 2 and auxiliary output 1. 1--5 CHAPTER 1 INTRODUCTION Control outputs 1 and 2 are used depending on the differences in control method as follows. Control Method Standard control Heating and cooling control Position-proportional control Model E5AK-AA2 AC100-240 E5AK-AA2 AC/DC24 E5AK-AA2 AC100-240 E5AK-AA2 AC/DC24 Control Output 1/ Control Output 2 Control output (heat) / Alarm, etc., Control output (heat) / Control output (cool) E5AK-PRR2 AC100-240 Open/Close E5AK-PRR2 AC/DC24 F Transfer output The E5AK supports the following six transfer outputs. Set point Set point during SP ramp Process value Heating side manipulated variable Cooling side manipulated variable Valve opening However, note that heating/cooling side manipulated variables can be output only standard type controllers, and valve opening can be output on position-proportional type controllers These transfer outputs can be output after being scaled. Setting of an upper limit value smaller than the lower limit value is allowed, so reverse scaling can also be carried out. 1--6 1.1 Names of parts 1.

3 Parameters and Menus J Parameter types E5AK parameters are distributed between the following nine modes. Protect mode Manual mode Level 0 mode Level 1 mode Level 2 mode Setup mode Expansion mode Option mode Calibration mode The settings of parameters in each of seven modes (excluding the protect mode and manual mode) can be checked and modified by selection on the menu display. F Protect mode This mode is used to limit use of the menu and A/M keys. The protect function is for preventing unwanted modification of parameters and switching between the auto and manual operation. In this mode, the controller can be switched manual operation.

The manipulated variable can be manipulated manually only in this mode. Set the controller to this mode during normal operation. In this mode, you may change the set point during operation, and stop and start operation. You can also monitor (not change) the process value, ramp SP and manipulated variable. This is the main mode for adjusting control.

In this mode, you can execute AT (auto-tuning), and set alarm values, the control period and PID parameters. This is the auxiliary mode for adjusting control. In this mode, you can set the parameters for limiting the manipulated variable, switch between the remote and local modes, switch between the SP modes, and set the loop break alarm (LBA), alarm hysteresis and the digital filter value of inputs. This is the mode for setting the basic specifications. In this mode, you can set parameters that must be checked or set before operation such as the input type, scaling, output assignments and direct/reverse operation. This is the mode for setting expanded functions. In this mode, you can set ST (self-tuning), SP setting limiter, selection of advanced PID or ON/OFF control, specification of the standby sequence resetting method, time for automatic return to the monitoring display. This is the mode for setting option functions. You can select this mode only when the option unit is set in the controller. In this mode, you can 1--7 F Manual mode F Level 0 mode F Level 1 mode F Level 2 mode F Setup mode F Expansion mode F Option mode CHAPTER 1 INTRODUCTION set the communications conditions, transfer output and event input parameters to match the type of option unit set in the controller.

Heater burnout latch function, position-proportional travel time and remote SP scaling parameters are also located in this mode. F Calibration mode This mode is provided so that the user can calibrate inputs and transfer output. When calibrating input, the selected input type is calibrated. Whereas, transfer output can be calibrated only when the communications unit (E53-AKF) is set in the controller. J Selecting modes The following diagram shows the order in which modes are selected. Power ON A/M 1 second min. 1 second min. Level 0 mode 1 second min. Manual mode A/M 1 second min. Level 1 mode 1 second min.

Level 2 mode 1 second min. A/M + A/M + 1 second min. 1 second min. Setup mode 1 second min. Protect mode Expansion mode 1 second min. A/M + 1 second min. Option mode 1 second min. Calibration mode F Menu display · To select the menu display in any of the above modes (excluding the key for 1 second miniprotect mode and manual mode), press the or keys and mum. If you select the desired mode using the key, the top parameter in the specified mode is dispres the played. · When you have selected the menu display, the previous mode is selected.

For example, if you selected the menu display while in the level 0 mode, the No.2 display changes to [] as shown on the left. · Protected modes cannot be selected. Also, the menu display does not appear when modes are protected up to the level 1 mode. F Level 0 to 2 modes · If you select [][] or [] in the menu display, the level 0, level 1 and level 2 modes, respectively, are selected.



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· These modes are selected with control still continuing. 1--8 1.1 Names of parts F Setup mode F Expansion mode F Option mode F Calibration mode][][] or [] in the menu display, · If you select [the setup, expansion, option and calibration modes, respectively, are selected. · When these modes are selected, the control is reset. So, control outputs and auxiliary output are turned OFF.

When another mode is selected while in these modes, reset is canceled. · To set the controller to the protect mode or to return to the level 0 key for 1 second from the protect mode, press the A/M key and cond minimum simultaneously. · To set the controller to the manual mode, press the A/M key for 1 second minimum in the level 0 to 2 mode. To return to the level 0 mode from the manual mode, press the A/M key for 1 second minimum. · When not in the manual mode, each press of the parameter. key switches the F Protect mode F Manual mode J Selecting parameters key when at the final parameter, the display re- If you press the turns to the first parameter. Parameter 1 Parameter 2 Parameter 3 Parameter n J Fixing settings · When you have changed a parameter setting, specify the parameter or keys, and either leave the setting for at least two using the key. This fixes the setting. seconds or press the · When another mode is selected, the content of the parameters before the mode was selected is fixed. · When turning the power OFF, you must first fix the settings and key or selecting another parameter contents (by pressing the mode).

The settings and parameter contents are sometimes not or keys. changed by merely pressing the 1--9 CHAPTER 1 INTRODUCTION 1.4 About the Communications Function The E5AK can be provided with a communications function that allows you to check and set controller parameters from a host computer. If the communications function is required, add on the communications unit. For details on the communications function, refer to Chapter 6. F RS-232C When using the communications function on the RS-232C interface, add on the communications unit (E53-AK01). When using the communications function on the RS-422 interface, add on the communications unit (E53-AK02). When using the communications function on the RS-485 interface, add on the communications unit (E53-AK03). F RS-422 F RS-485 1--10 1.1 Names of parts 1.

5 About Calibration The E5AK controller is calibrated before shipment from the factory. So, the user need not calibrate the E5AK controller during regular use. However, if the E5AK controller must be calibrated by the user, use the parameters provided for user to calibrate temperature input, analog input (voltage, current) and transfer output. Also, note that calibration data is updated to the latest value each time the E5AK controller is calibrated. Calibration data set before shipment from the factory cannot be returned to after calibration by the user. F Calibrating inputs The input type selected in the parameter is the item to be calibrated. The E5AK is provided with the following four calibration parameters. · Thermocouple · Platinum resistance thermometer · Current input · Voltage input Two parameters are provided for thermocouple and voltage input. F Calibrating transfer output F Registering calibration data Transfer output can be calibrated when the communications unit (E53-AKF) is added on. When calibrating each item, the calibration data is temporarily registered.

This data can be registered as final calibration data only when all items have been newly calibrated. So, all items must be temporarily registered when calibrating the E5AK controller. When registering data, information regarding whether or not calibration has been carried out is also registered. To calibrate these items, the user must prepare separate measuring devices and equipment. For details on handling these measuring devices and equipment, refer to the respective manuals. For details, see Chapter 7 Calibration. 1--11 CHAPTER 1 INTRODUCTION 1--12 CHAPTER 2 PREPARATIONS CHAPTER2 CHAPTER 2 PREPARATIONS This chapter describes the operations you should carry out before turning the E5AK ON. 2.1 Setting up . .

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(Do not replace with other output units.) · When setting up the output units, draw out the internal mechanism from the housing and insert the output units into the sockets for control outputs 1 and 2. J Draw-out When drawing out the internal mechanism from the housing, prepare a phillips screwdriver matched to the size of the screw on the lower part of the front panel. (1) Press down on the hook on the top of the front panel and turn the phillips screwdriver to the left to loosen the screw on the lower part of the front panel. (2) Draw out the internal mechanism towards you holding both sides of the front panel. Fixing Screw for

Front Panel Tighten this screw by a torque of 0.3 to 0.5 Nm, or approx. 3 to 5 kgfcm. 2--2 2.

1 Setting up J Setting up the output unit F Before setup · Check the type of the output unit you are about to set up. · For details on types of output unit and main specifications, see page 2-9. F Procedure (1) Check the positions of the sockets you are about to insert the output units into as shown in the following diagram. OUT1 OUT2 Bracket (2) Insert the output unit for control output 1 into the socket "OUT1" and the output unit for control output 2 into the socket "OUT2". (3) Fasten the output units with the bracket (accessory).

2--3 CHAPTER 2 PREPARATIONS J Setting up the option unit F Before setup · Check the type of the option unit you are about to set up. · For details on types of option unit and main specifications, see Appendix, Model List (page A-11) and Appendix, Option Unit Ratings and Characteristics (page A-4). · For details on the relationship between units and terminals, see page 2-8. F Procedure (1) Remove the power board and option boards in the order shown in the following diagram. 2 1 (2) Insert the option units into the sockets for options 1 to 3.



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The following diagram shows the relationship between option units and mounting positions. Option 1 E53--AKB: Event inputs 1/2 E53--AK01: RS--232C E53--AK02: RS--422 E53--AK03: RS--485 Option 3 E53--AKB: Event inputs 3/4 Option 2 E53--AKF: Transfer output (3) Mount the option boards and the power board in the order shown. 2--4 2.2 Installation 2.2 Installation J Dimensions 96j 13.5 100 PV SV RMT OUT1 RSP OUT2 MANU STOP SUB1 AT SUB2 E5AK J Panel cutout Unit (mm) 110 mm min 120 mm min 92 +0.8 0 · Recommended panel thickness is 1 to 8 mm. +0.8 0 92 · Maintain the specified vertical and horizontal mounting space between each controller. Controllers must not be closely mounted vertically or horizontally.

112 j 91 2--5 CHAPTER 2 PREPARATIONS J Mounting (1) Insert the E5AK controller into the mounting hole in the panel. (2) Fit the mounting bracket (accessory) into the fixing slots on the top and bottom of the rear case. (3) Tighten the mounting bracket screws alternately a little at a time until the ratchet start to slide. 2--6 2.2 Installation F Setting up the terminal covers · Fasten the terminal covers (E53-COV0809) to protect terminals. · E5AK-VV2-500 controller is provided with terminal covers. · Use E53-COV09 for terminals 1 to 10, and E53-COV08 for terminals 11 to 33. · Fasten the terminal covers as follows by using the snap pins. E5AK E53-COV0809 · To remove the terminal covers, pull the edges of the snap pins. 2--7 CHAPTER 2 PREPARATIONS 2.3 Wiring Terminals J Terminal arrangement AC100-240V ~ (AC/DC24V) SOURCE 10 9 8 7 6 5 4 3 2 1 TRSF 30 31 32 20 19 29 28 27 26 18 17 16 15 14 13 12 11 EV1/2 RS232C RS422 RS485 OUT1 OUT2 SUB1 SUB2 CT PTMR TC Pt I V EV3/4 25 24 23 RSP 22 21 33 TRSF : Transfer output EV1 to 4 : Event inputs PTMR : Potentiometer J Precautions when wiring · Use ducts to separate input leads and power lines in order to protect the controller and its lines from external noise. · We recommend using solderless terminals when wiring the controller. · Tighten the terminal screws using a torque no greater than 0.78

N·m, or 8 kgf·cm max. Take care not to tighten the terminal screws too tightly.
· Use the following type of solderless terminals for M3.5 screws. 7.2mm max. 7.

2mm max. J Wiring F Power supply 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 In the following wiring diagrams, the left side of the terminal Nos. indicates the inside of the controller · Input power to terminal Nos. 9 and 10. Power specifications are as follows: AC100-240V, 50/60Hz, 16VA (AC/DC24V, 50/60Hz, 12VA, 8W) 2--8 2.3 Wiring Terminals F Sensor input 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 · Connect the sensor input to terminal Nos. 11 to 14 and 33 as follows according to the input type. 14 13 12 11 33 -- + 14 13 12 11 33 Platinum resistance thermometer 14 13 12 11 33 + V -- 14 13 12 -11 mA Current input Thermocouple Voltage input 33 + F Control output 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 · Terminal Nos. 7 and 8 are for control output 1 (OUT1), and terminal Nos. 5 and 6 are for control output 2 (OUT2).

The following diagrams show the available output units and their internal equalizing circuits. · With E53-VVV output units, about 2 V is output for one second after the power is interrupted. · The following table shows the specifications for each output unit. Model E53-R E53-S E53-Q E53-Q3 E53-Q4 E53-C3 E53-C3D E53-V34 E53-V35 Output Type Relay SSR Voltage (NPN) Voltage (NPN) Voltage (PNP) 4 to 20 mA 0 to 20 mA 0 to 10 V 0 to 5 V 250 VAC, 5 A 75 to 250 VAC, 1 A Specifications NPN : 12 VDC, 40 mA (with short-circuit protection) NPN : 24 VDC, 20 mA (with short-circuit protection) PNP : 24 VDC, 20 mA (with short-circuit protection) 4 to 20 mA, Permissible load impedance: 600 max., Resolution: Approx. 2600 0 to 20 mA, Permissible load impedance: 600 max., Resolution: Approx. 2600 0 to 10 VDC, Permissible load impedance: 1 k min., Resolution: Approx. 2600 0 to 5 VDC, Permissible load impedance: 1 k min.

, Resolution: Approx. 2600 With E5AK-PRR2 controllers, relay output (250 VAC, 1 A) is fixed. When replacing the output unit, use the E53-R. The following diagrams show the relationship between terminals and open/close relay settings. 8 7 Open 6 5 Close 2--9 CHAPTER 2 PREPARATIONS F Auxiliary output 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 · Terminal Nos.

3 and 4 are for auxiliary output 1 (SUB1) and terminal Nos. 1 and 2 are for auxiliary output 2 (SUB2). · The internal equalizing circuits for the auxiliary outputs are as follows: 4 3 Auxiliary output 1 2 1 Auxiliary output 2 · Output specifications are as follows: SPST-NO, AC250V 3A, · When using the HBA function on the E5AK-AA2 controller, connect CT input (CT) to terminal Nos. 15 to 17. When monitoring the valve opening on the E5AK-PRR2 controller, connect the potentiometer (PTMR) to terminal Nos.

15 to 17. Connect each of these inputs as follows: 17 16 15 CT input CT 17 16 15 O W C F CT input/ Potentiometer 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 Potentiometer · For details on CT inputs, see Appendix, About Current transformer. · For details on the potentiometer, see the Instruction Manual for the valve connected to the controller. The variable resistance range is 100 to 2.5 k. F Remote SP input 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 · Connect an input (RSP) to be used as the remote SP to terminal Nos. 21 and 22. · Only 4 to 20 mA inputs can be connected. Connect the input as follows: 22 21 + 4 to 20 mA -- About the power blocks The E5AK has independent power supplies for each of the terminal blocks shown on the right. B A 10 9 8 7 6 5 4 3 2 1 B 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 C C E F D 2--10 2.

3 Wiring Terminals F Event input 10 9 8 7 6 5 4 3 2 1 30 31 32 29 28 27 26 25 24 23 22 21 33 20 19 18 17 16 15 14 13 12 11 · Connect event inputs 1 and 2 (EV1/2) to terminal Nos. 18 to 20, and event events 3 and 4 (EV3/4) to terminal Nos. 24 to 26. However, note that terminal Nos. 18 to 20 cannot be used on controllers having a communications function. · Connect the event inputs as follows: EV1 EV2 20 19 + + EV3 EV4 26 25 + + COM 18 -COM 24 -Event input 3 and 4 Event input 1 and 2 Terminals 18 and 24 (COM) are connected internally. · Use event inputs under the following conditions: Contact input No-contact input ON: 1 k max.



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, OFF: 100 k min. ON: residual voltage 1.5 V max.

, OFF: leakage current 0.1 mA max. · Polarities during no-contact input are as follows: EV1 EV2 20 19 + + EV3 EV4 26 25 + + COM 18 -Event input 1 and 2 COM 24 -Event input 3 and 4 F Transfer output · Connect transfer output (TRSF) to terminal Nos. 29 and 30. · The internal equalizing circuit for transfer output is as follows: 30 4 to 20mA 29 + L · Transfer output specifications are as follows: 4 to 20 mA, Permissible load impedance: 600 max.

, Resolution: Approx. 2600 F Communications · Terminal Nos.18 to 20, 31 and 32 can be used only on controllers having a communications units (E53-AK01/02/03). · For details on wiring, see Chapter 6, Using the Communications Function. 2--11 CHAPTER 2 PREPARATIONS 2--12 CHAPTER 3 BASIC OPERATION CHAPTER3 CHAPTER 3 BASIC OPERATION This chapter describes an actual example for understanding the basic operation of the E5AK.

3.1 Convention Used in this Chapter 3.

2 Setting Input Specifications

. . . Input type . .

.

.
. . . Scaling . . .

.

.
. 3.

3 Setting Output Specifications

. Output assignments

.

. Direct/reverse operation

.

. . Control period

.

. 3.4 Setting Alarm Type . .

.

. . . Alarm type . .

.

. Alarm value

.

. . . Alarm hysteresis . .

.

. Close in alarm/open in alarm

.

. . . 3.5 Protect Mode .

.

. Security

.

. A/M key protect

.

3.6 Starting and Stopping Operation

.... 3.
7 Adjusting Control Operation

.. Changing the set point

.... Manual operation .

.....
.. Auto-tuning (A.T.) ..

... 3-2 3-4 3-4 3-4 3-6 3-6 3-7 3-7 3-9 3-9 3-9 3-10 3-10 3-12 3-12 3-13 3-14 3-14 3-14 3-16 3--1 CHAPTER 3 BASIC OPERATION 3.1 Convention
Used in this Chapter This chapter describes basic E5AK operations such as how to set up parameters, start and stop operation, and adjusting control
operation. For more complex control examples, refer to Chapter 4 Applied Operation and Chapter 5 Parameters. F Basic Operation Flow The following
diagram shows the basic operation flow. Power ON Setup Setting input specifications Setting output specifications Setting alarm output Protecting
parameters Operation Start Adjustment Stop Power OFF 3--2 3.1 Convention Used in this Chapter F Setup This description assumes that the controller is
operated under the following conditions.

· A humidity sensor of output 4 to 20 mA is connected to the controller. The measuring range of the humidity sensor is set to 10 to 95%. · A humidifier is
controlled by pulse output to maintain humidity at a constant 60%. · An alarm is output when the humidity exceeds the upper limit value (70%) or lower limit
value (50%). · Output unit: relay type (E53-R) for OUT1.

Humidity sensor Humidifier AC100-240V ~ (AC/DC24V) SOURCE Control target 10 9 8 7 6 5 30 31 32 20 19 29 28 27 26 25 24 23 22 21 33 18 17 16 15 14
13 12 11 OUT1 Alarm 1 (deviation upper-and lower-limit) SUB1 4 3 2 1 E5AK-AA2 (OUT1 : E53-R) -4 to 20mA + 3--3 CHAPTER 3 BASIC OPERATION
3.2 Setting Input Specifications J Input type · Set the type No. (0 to 21) in the "input type" parameter. The factory setting is "2: K1 (thermocouple)." · For
details on input types and setting ranges, see page 5-26.

· When the voltage input and current input are selected, scaling matched to the control is required. · The "scaling upper limit", "scaling lower limit" and
"decimal point" parameters (setup mode) are used for scaling. · The "scaling upper limit" parameter sets the physical quantity to be expressed by the upper
limit value of input, and the "scaling lower limit" parameter sets the physical quantity to be expressed by the lower limit value of input. The "decimal point"
parameter sets the number of digits past the decimal point. · The following figure shows scaling example of 4 to 20 mA input. After scaling, the humidity can
be directly read. In this case, the "decimal point" parameter is set to "1". Readout (humidity) J Scaling Scaling upper limit value (95.0%) Scaling lower limit
value (10.0%) 0 Input (4 to 20 mA) 100%FS F Input shift · When temperature input is selected, scaling is not required.

This is because input is treated as the "temperature" as it is matched to the input type. However, note that the upper and lower limit values of the sensor can
be shifted. For example, if both the upper and lower limit values are shifted by 1.2_C, the process value (before shift) is regarded as 201.2_C after shift when
input is 200_C before shift. · To set input shift, set shift values in the "input shift upper limit" and "input shift lower limit" parameters (level 2 mode).

Temperature Input shift upper limit value Upper limit value After shift Before shift Lower limit value 0 Input shift lower limit value Input (%FS) 100 About the
temperature unit To switch the temperature unit from "_C" to "_F" for temperature unit, switch the setting of the "_C/_F selection" parameter to [] from [].
3--4 3.2 Setting Input Specifications Setting Example In this example, let's set the parameters as follows: "input type" = "17 (4 to 20 mA)" "scaling upper limit
value" = "950" "scaling lower limit value" = "100" "decimal point" = "1" 1 second min. (1) Select the menu display, and select [] (setup mode) using the or
keys.

For details on selecting the menu display, see page 1-8. key to enter the setup mode. The top parameter in (2) Press the] "input type" is displayed. The
parameter the setup mode [default is "2". (3) Press the key until the display indicates "17".
key to fix the set value. The display changes to (4) Press the] ("scaling upper limit value" parameter). The parameter [default is "100". (5) Press the key until
the display indicates "950". key to fix the set value.

The display changes to (6) Press the] ("scaling lower limit value" parameter). The parameter [default is "0". (7) Press the key until the display indicates
"100". key to fix the set value. The display changes to (8) Press the [] ("decimal point" parameter). The parameter default is "0". (9) Press the key until the
display indicates "1". 3--5 CHAPTER 3 BASIC OPERATION 3.3 Setting Output Specifications Some output specifications are different according to
controller type, standard or position-proportional.



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Factory setting is "2: Upper-limit alarm (deviation)". J Alarm value · Alarm values are indicated by "X" in the table above. Alarm output operation differs according to whether the value of the alarm is positive or negative. · Alarm values are set independently for each alarm in the "alarm value 1 to 3" parameters (level 1 mode). Factory setting is "0". 3--9 CHAPTER 3 BASIC OPERATION J Alarm hysteresis · The hysteresis of alarm outputs when alarms are switched ON/OFF can be set as follows. Upper limit alarm Lower limit alarm Alarm hysteresis ON ON Alarm hysteresis OFF Alarm value OFF Alarm value · Alarm hysteresis is set independently for each alarm in the "alarm 1 to 3 hysteresis" parameters (level 2 mode). Factory setting is "0.02: 0.02%FS". F Standby sequence · "Standby sequence" is a function for unconditionally turning alarm output OFF when the process value has left the alarm range once and it next enters the alarm range. · For example, when the alarm type is set to "deviation lower limit," generally the process value is within the alarm range, and alarm output become ON as it is as the process value when the power is turned ON is smaller than the set point. However, if the alarm type is set to "deviation lower limit with standby sequence", alarm output first becomes ON when the process value exceeds the alarm setting value to leave the alarm range and once again falls below the alarm value. J Close in alarm/open in alarm · When the controller is set to "close in alarm," the status of the alarm output function is output as it is.

When set to "open in alarm," the status of the alarm output function is output inverted. Alarm ON OFF ON OFF Output ON OFF OFF ON Output LED Lit Not lit Lit Not lit Close in alarm Open in alarm · Alarm type and close in alarm (normally open)/open in alarm (normally close) can be set independently for each alarm. · Close in alarm/open in alarm is set in the "alarm 1 to 3 open in alarm" parameters (setup mode). Factory setting is [] "close in alarm". F Summary of alarm operations The figure below visually summarizes the above description of alarm operations (when alarm type is set to "lower limit alarm (deviation) with standby sequence"): Alarm type: lower limit alarm (deviation) with standby sequence PV Alarm value Alarm hysteresis Time Alarm output (close in alarm) Standby sequence canceled Close (ON) Open (OFF) 3--10 3.

4 Setting Alarm Type Setting Example When a set point for a temperature exceeds 10%, alarmI will be output. In this example, let's set the parameters as follows: "alarm type 1" = "1: (deviation upper-and lower-limit)" "alarm value 1" = "10" "alarm hysteresis" = "0.20" : close in alarm" "close in alarm/open in alarm" = " 1 second min. Meanings of parameters, "alarm hysteresis" and "open in alarm/close in alarm" are the same settings at the shipment, so settings for operations are omitted. (1) Select the menu display, and select [] (setup mode) using the or keys. For details on selecting the menu display, see page 1-8. key to enter the setup mode. The top parameter in (2) Press the] "input type" is displayed. In this example, the setup mode [the parameter setting is "17: 4 to 20 mA". key until [] ("alarm type 1" parameter) is displayed. (3) Press the played.

The parameter default is "2: deviation upper limit". (4) Press the it". key to return to "1: deviation upper-and lower-lim- 1 second min.] (level 1 mode) using the (5) Select the menu key, and select [or keys. For details on selecting the menu display, see page 1-8. key to enter the level 1 mode. The top parameter in (6) Press the] "AT execute/cancel" is displayed. the level 1 mode [(7) Press the played. key until [] ("alarm value 1" parameter) is displayed. (8) In this example, the parameter setting is "0.

0" so press the until "10.0" is displayed. About the Decimal Point of the Alarm Value The decimal point of the alarm value conforms to the setting of the "decimal point" parameter (setup mode). In this example, the "decimal point" parameter is set to "1". (During temperature input, the decimal point of the alarm value conforms to the set sensor.

) 3--11 CHAPTER 3 BASIC OPERATION 3.5 Protect Mode J Security · This parameter allows you to protect until start of operation parameters that do not change during operation to prevent unwanted modification. · The set value of the "security" (protect) parameter specifies the range of protected parameters. · When this parameter is set to "0", parameters are not protected. · When this parameter is set to "1" to "3", the number of modes that can be displayed on the menu display is limited.

When set to "1", level 0 to 2, setup, expansion and option modes only can be selected. When set to "2", only level 0 to 2 modes can be selected. When set to "3", only level 0 and 1 modes can be selected. · When this parameter is set to "4" to "6", operations in only the level 0 mode can be selected, and the mode is not displayed on the menu display. · When this parameter is set to "5", only the "PV/SP" parameter can be used. · When this parameter is set to "6", only the "PV/SP" parameter can be used. (The set point can not change.) · Default is "1". · This parameter disables use of the A/M key during operation. For example, if you protect use of the A/M key by the "A/M key protect" parameter (protect mode) during auto operation, the controller cannot be set to the manual mode, preventing manual operation of the controller during operation.

· Let's protect the setup, expansion, option and calibration modes. Set the parameters as follows: "security" = "2: Usable only in level 0 to 2 modes" (1) Press for 1 second minimum the A/M and keys simultaneously, the controller enters the protect mode. (2) In the protect mode, the top parameter in the protect mode "security" is displayed. The parameter default is "1". Press the key to change the parameter setting to "2". keys simultaneously, (3) Press for 1 second minimum the A/M and the display changes to the "PV/SP monitor" parameter (level 0 mode). J A/M key protect Setting Example A/M A/M 3--12 3.6 Starting and Stopping Operation 3.6 Starting and Stopping Operation · You can start and stop operation by changing the setting of the "run/ stop" parameter (level 0 mode).



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· You can switch the RUN/STOP function up to 100,000 times.

· To stop operation, set the "run/stop" parameter to [] (stop). In F Manipulated variable at stop · On a standard type controller, specify the manipulated variable (---5.0 to 105.

0%) in the "MV at stop" parameter (level 2 mode) to output the manipulated variable during stop. Factory-set to "0.0:0.0%". · On a position-proportional type controller, you can select either of the open, close or hold status.

In an open status, only control output 1 is ON. In a close status, only control output 2 is ON. In a hold status, both control outputs 1 and 2 are OFF. Factory-set to "hold." Setting Example The following example describes the procedure to follow to stop control during operation of the controller. (1) Select the menu display, and select [] (level 0 mode) using the or keys. For details on selecting the menu display, see page 1-8. 1 second min. (2) Press the displayed. (3) Press the played.

key to enter the level 0 mode. The PV and SP are key until [] ("run/stop" parameter) is dis] (stop). The "STOP" LED key to select [(4) Press the lights, and operation stops. To resume operation, follow the above procedure to select [("run"). The "STOP" LED goes out and operation starts.] Using Event Input Using the E53-AKB, run/stop can be selected by event input. For details on how to use event input, see 4.3 How to Use Event Input, page 4-- 8. 3--13 CHAPTER 3 BASIC OPERATION 3.7 Adjusting Control Operation J Changing the set point · You can change the set point in the "set point" parameter (level 0 mode).

· However, note that you cannot change the set point when the "security" parameter (protect mode) is set to "6". or keys to select the · To change the set point, press the desired value. If you leave the setting for two seconds, the set point is updated to the new setting. In the following example, let's change the temperature set point from "60_C" to "50_C". (1) Select the PV/SP monitor display.

(2) Press the key to change the setting to "50.0: 50.0_C". Setting Example J Manual operation · On standard type controller, the manipulated variable is controlled, and on a position-proportional type controller, the valve opening is controlled. · To set manual operation and manually set the manipulated variable or the valve opening, press for 1 second minimum the A/M key.

The controller enters the manual mode. F Standard type Process value Manipulated variable Bar graph [MANU] LED · The process value is displayed on the No.1 display, and the manipulated variable is displayed on the No.2 display. The manipulated variable (heat) is also displayed on the bar graph in 10% increments. or keys. After · To change the manipulated variable, press the two seconds, the manipulated variable is updated to the new setting. · Other modes cannot be selected while in the manual mode. To select other modes, press for 1 second minimum the A/M key. The manual mode is quit.

· The automatic return of display function does not work while in the manual mode. · When switching between manual and auto operation, the manipulated variable is subject to balance-less, bump-less operation. Balance-less, Bump-less Operation To prevent sudden changes in the manipulated variable when switching between manual and auto operation, operation is resumed using the value that was active immediately before operation was switched, and the value is brought gradually closer to the value immediately after operation was switched. 3--14 3.7 Adjusting Control Operation · If the power is interrupted during manual operation, manual operation is resumed at the manipulated variable at power interruption when the power is reset. · You can switch the AUTO/MANUAL function up to 100,000 times. The following diagram summarizes manual operation. Manipulated variable (%) Balance-less, bump-less points 0 Manual A/M Time Manipulated variable switched OFF ON Power interruption Auto F Position-proportional type · When a potentiometer is connected to the controller, the process value is displayed on the No.1 display, and the valve opening is displayed on the No.2 display.

The valve opening is also displayed on the bar graph in 10% increments. When a potentiometer is not connected to the controller, [----] is displayed on the No.2 display, and nothing is displayed on the bar graph. Potentiometer connected Process value Valve opening Bar graph [MANU] LED Bar graph Potentiometer not connected Process value Valve opening [MANU] LED · When you press the key, the open side becomes ON. When you key, the close side becomes ON.

press the · Other modes cannot be selected while in the manual mode. To select other modes, press for 1 second minimum the A/M key. The manual mode is quit. · The automatic return of display function does not work while in the manual mode. · You can switch the AUTO/MANUAL function up to 100,000 times. 3--15 CHAPTER 3 BASIC OPERATION J Auto-tuning (A.T.) · AT (auto-tuning) cannot be executed while operation is canceled or during ON/OFF control. ·

When you execute auto-tuning, the optimum PID parameters are automatically set by forcibly changing the manipulated variable to calculate the characteristics (called the "limit cycle method") of the control target. During auto-tuning, the AT LED flashes. · 40%AT or 100%AT can be selected by the limit cycle of MV change] or [], respectively, in the "AT execute/width. Specify [cancel" parameter (level 1 mode). · During heating and cooling control and with position-proportional type, only 100%AT can be executed. (So, [] (40%AT) will not be displayed.) · To cancel AT execution, specify [] ("AT cancel").

In order to set the limit cycle of MV change width to 40%, select 40%AT to execute auto-tuning with fluctuations in the process value kept to a minimum. However, note that auto-tuning takes longer to execute compared with 100%AT. The timing by which limit cycles are generated varies according to whether or not the deviation (DV) at the start of AT execution is 10% full-scale or less. F 40%AT Deviation at start of AT execution 10% full-scale Deviation at start of AT execution < 10% full-scale Limit cycle of MV change width 40% Set point Set point Limit cycle of MV change width 40% Deviation 10% full-scale Deviation 10% full-scale Start of AT execution End of AT Time Start of AT execution End of AT Time F 100%AT In order to set the limit cycle of MV change width to 100%, select 100% AT to shorten the AT execution time without worrying about fluctuations in the process value.



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