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Page 1 Model: 8600, 8601, 8602, 8610, 8612, 8614, 8616, 8620, 8622, 8624, and 8625 Programmable DC Electronic Loads USER MANUAL... Safety Summary The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument. Before applying power to this instrument: Read and understand the safety and operational information in this manual. ... Page 4 Category IV (CAT IV): Measurement instruments whose measurement inputs are meant to be connected to the primary power entering a building or other outdoor wiring. Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument. Page 5 Do not operate in an explosive or flammable atmosphere Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates. The instrument is designed to be used in office-type indoor environments. Do not operate the instrument ... Page 6 cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument. Clean the instrument only as instructed Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Page 7 Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists. Fuse replacement Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Page 8 Do not short-circuit batteries When using a DC load to discharge a battery, do not exceed the battery manufacturer's specified maximum rate of discharge. Use correctly sized wires To connect the load to the power supply, use a wire diameter large enough to handle the maximum continuous output short-circuit current of the power supply without the wire overheating. Compliance Statements Disposal of Old Electrical & Electronic Equipment (Applicable in the European Union and other European countries with separate collection systems) This product is subject to Directive 2002/96/EC of the European Parliament and the Council of the European Union on waste electrical and electronic equipment (WEEE), and in jurisdictions adopting that Directive, is marked as being put on the market after August 13, 2005, and should not be. ... CE Declaration of Conformity The instrument meets the requirements of 2006/95/EC Low Voltage Directive and 2004/108/EC Electromagnetic Compatibility Directive with the following standards. Low Voltage Directive EN61010-1: 2001 EMC Directive EN 61000-3-2: 2006 EN 61000-3-3: 1995+A1: 2001+A2: 2005 EN 61000-4-2 / -3 / -4 / -5 / -6 / -11 EN 61326-1: 2006 viii... Safety Symbols CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. Chassis (earth ground) symbol. On (Power) Off (Power) On (Power). Table of Contents Safety Summary Compliance Statements vii CE Declaration of Conformity viii General Information 1 Product Overview 1 Package Contents 2 Product Dimensions 2 Rackmount Installation 6 Front Panel Overview 7 Front Panel Description Page 13 Constant Current (CC) Mode 20 Constant Voltage (CV) Mode 23 Constant Resistance (CR) Mode 24 Constant Power (CW) Mode 25 Setting CC, CV, CR, CW Mode 27 SYSTEM Menu 27 Restore Factory Default Settings 28 Configure Power-On State Page 14 OPP Test Function 74 3.10 Key Lock 77 Remote Operation 78 Interface Connection 78 RS-232 78 GPIB 79 USBTMC 79 Remote Commands 79 Troubleshooting Guide 80 General 80 Remote Control 80 Specifications 1 General Information 1.1 Product Overview The 8600 Series DC Electronic Loads are versatile instruments used for static and dynamic testing of DC power supplies, batteries, DC-to-DC converters, and battery chargers. Other applications include fuel-cell and photovoltaic cell test. The DC load can be used in one of the following operation modes: constant voltage (CV), constant current (CC), constant resistance (CR), or constant power (CW). Report any damage to the shipping agent immediately. Save the original packing carton for possible future reshipment. Every instrument is shipped with the following contents: 1x 8600 series DC Electronic load, 1x User Manual, 1x AC Power Cord ... Page 17 Figure 1 – Front and Side View (Half-rack models) Figure 2 - Front and Side View (Full-rack 3U models) Page 18 Figure 3 Front and Side View (Full-rack 6U models) Page 19 Figure 4 - Rear View (Half-Rack models) Figure 5 - Rear View (Full-rack 3U models) Figure 6Rear View (Full-rack 6U models) 1.4 Rackmount Installation The instrument can be installed in a standard 19 inch rack. For half-rack models, the optional rackmount kit IT-E151 is required (No rackmount kit required for full-rack models). Below is an image of a half-rack model installed with the IT-E151 rackmount kit. This rackmount kit will allow up to two half-rack models installed side by side, as shown below. 1.5 Front Panel Overview Figure 7 – Front Panel (Half-rack models) Figure 8 - Front Panel (Full-rack models) Front Panel Description Power On/Off switch Local button Shift button Numeric keypad CC/OCP button CW/OPP button Enter/Recall settings button Input On/Off and key lock button CR button CV/Setup button Navigation arrow keys Input terminal Rotary knob VFD display ESC button... Trans button (Full-rack models) List button (Full-rack models) 1.6 Rear Panel Overview Figure 9 - Rear Panel (Half-rack models) Figure 10 - Rear Panel (Full-rack models) Rear Panel Description Cooling fan Vent Remote control port (not used) RS232 Interface Current Monitor BNC output USB Interface GPIB Interface AC input receptacle Fuse box Line voltage selector Voltage fault (VF) output terminal Input On/Off (ON) control terminal External trigger input terminals External programming input terminals Remote sense terminals Input Terminal (Full-rack models) Display Description Measured input voltage Measured input power Settings Display Displays parameter settings such as CC, CV, CR, CW Measured input current Indicates input is disabled Indicates constant current (CC) operation Indicates constant voltage (CV) operation Indicates constant resistance (CR) operation Indicates constant power (CW) operation Indicates remote mode Addr... 2 Getting Started Before connecting and powering up the instrument, please review and go through the instructions in this chapter. 2.1 Input Power and Fuse Requirements Input Power The load has a selectable AC input that accepts line voltage input within: Voltage: 115 V (+/-10%) or 230 V (+/- 10 %) Frequency: 47 Hz... 110 VAC or 220 VAC input. Table 1 - Fuse Requirements Model Fuse Specification (110 VAC) Fuse Specification (220 VAC) 8600 T 1.25 A, 250 V T 500 mA, 250 V 8601 T 1.25 A, 250 V... Fuse box slit Fuse Check/Remove Fuse Figure 13 - Fuse Box 2.2 Input Connections The main DC input terminal is a screw type binding post terminal located in the front panel. To loosen, turn the terminal cap counter-clockwise. Note: The screws on the terminals can be completely removed to allow for ring type adapters (must be greater than 6mm in diameter). 2.3 Preliminary Check Complete the following steps to verify that the load is ready for use. Verify AC Input Voltage Verify and check to make sure proper AC voltages are available to power the instrument. The AC voltage range must meet the acceptable specification as explained in "2.1 Input Power and Fuse Requirements". Table 2 - Self-Test Messages Error Message on Display Description EEPROM FAILURE The internal EEPROM is corrupted or damaged. Config Data Lost The last operation data within the EEPROM is lost. Calibration Data Lost Calibration data within the EEPROM is lost. FactoryCal.Data Lost Factory calibration data is lost. 2. The display will show the following: 0.000V 0.000A 8600 Ver : 1.29 - 1.36 3. The model is shown above as 8600, and the firmware version is shown as 1.29-1.36. 4. Press once to return to the normal display. 3 Front Panel Operation 3.1 Menu Options Most settings and parameters can be configured from the built-in menu systems of the instrument. There are two main menus: System and Config. System Menu To access the system menu, press 1 then The system menu will have the following options: Initialize Reset load settings to factory default values. How to Navigate the Menu Before using the instrument, it is important to be familiarized with its menu structure and learn how to view or change settings and parameters. Follow the steps below to guide you in selecting menu options. 1. 3.2 Configure Operation Modes (CC/CV/CR/CW) The electronic load can work in the following modes: 1) Constant current (CC) operation mode 2) Constant voltage (CV) operation mode 3) Constant resistance (CR) operation mode 4) Constant power (CW) operation mode Constant Current (CC) Mode In this mode, the electronic load will sink a current in accordance with the programmed value regardless of the input voltage. Page 35 The setup parameters are: Range, High (Voltage limit), Low (Voltage limit), and Rise/Fall time. Use the key to select each parameter, and use the numeric keypad to change the value. Press to confirm the change. Range Use the numeric keypad to change the range. This value will also act as a limit to how much current the load can be configured to. Page 36 Slow Rate Measurement and Actual Transition time Current slow rate is defined as the change in current over time. A programmable slow rate allows a controlled transition from one load setting to another. The actual transition time is defined as the time for the input to change from 10% to 90%, or 90% to 100% of the programmed current values. Constant Voltage (CV) Mode In this mode, the electronic load will attempt to sink enough current to control the source voltage to the programmed value. Configure CV Parameters There are several parameters that should be set up prior to operating in CV mode. Press so that it lights up, then press and to access Setup for CV mode. The setup menu will be shown; Constant Power Range = 250.0 0 W The setup parameters are: Range, High (Voltage limit), and Low (Voltage limit). Press to PASS upon completion. If the DUT operates above the configured value, the test will FAIL upon completion. Constant Resistance Range = 7500. 0Ω The setup parameters are: Range, High (Voltage limit), and Low (Voltage limit). Use the key to select each parameter, and use the numeric keypad to change the value. Press to confirm the change. Range Use the numeric keypad to change the range. Page 40 Configure CW Parameters There are several parameters that should be set up prior to operating in CW mode. Press so that it lights up, then press and to access Setup for CW mode. The setup menu will be shown; Constant Power Range = 250.0 0 W The setup parameters are: Range, High (Voltage limit), and Low (Voltage limit). Press to PASS upon completion. If the DUT operates above the configured value, the test will FAIL upon completion. Note: This parameter is used for Automatic test Function ONLY. This parameter refers to the voltage low limit for the automatic test mode. During automatic test mode, the DUT must be operating above the configured value for the test to PASS upon completion. SYSTEM MENU In it i al ze Po w r - O N B u z z e r Restore Factory Default Settings All instrument settings can be reset back to their factory default values by doing the following: Note: Restoring the instrument to factory default will change all current instrument settings and parameters back to their default values. Memory Group 0 Power-On Buzzer Load On Knob Update On Timer Voltage Auto Range Averaging Filter 2~14 Remote Sense External Program Configure Power-On State The initial Power-On state of the load can be configured by following the steps below: 1. From the SYSTEM menu, select Power-On and press 2. Configure Trigger Source The trigger function is used to initiate the start of a program in list mode and also as a toggle for transient mode. The trigger source can be set so that users can send a trigger from the front panel, through a remote command via remote interface or through the external trigger input in the rear panel. 4. To exit the menu at any time, press twice. Save/Recall Instrument Settings The instrument can save up to 100 instrument settings in non-volatile memory. Memory is allocated in 10 different storage groups (group 0 to 9), and each group has 10 memory locations to store settings (0 to 9). Page 46 Example: Settings are saved to memory location 60. To recall those settings, set storage group to 5 from the menu, then press recall and the number Select Storage Group 1. From the SYSTEM menu, browse and select Memory and press . Page 47 12.000A 80.000V 0.0 0 W S ave 3. Use the current adjust knob or the numeric keypad to enter the memory location to which to store current instrument settings. Select between 0 – 100. Press save to the selection location. NOTE: The "0"... Display Input On Timer The instrument has an internal timer that counts how long the input has been enabled (ON). Follow the steps below to enable the timer display. 1. From the SYSTEM menu, browse and select Displ and press . Page 49 Note: The RMT indicator will appear on display when the instrument is successfully connected to a PC remotely through any remote interface. Keys on the front panel will be locked until the instrument is in LOCAL mode. To return to LOCAL mode from the front panel, press and then . Page 50 Parity: N (None), E (Even), O (Odd) Stop bit: 1 Flow control: NONE, CTS/RTS, XON/XOFF Note: The default is 4800, 8, N, 1, NONE. *Setting the baud rate to 115200 may provide unstable results during remote communication. Select a lower baud rate if communication errors occur. 5. 3.4 CONFIG Menu All setup procedures and settings explained in this section can be accessed from the CONFIG menu. To access this menu, press and . The following screen will show: CONFIG MENU V on P rote ct Me asu re CR, LED Von Operation The Von voltage option can be set to control the voltage turn on state for the electronic load. Page 52 Figure 15 - The Load's Operating Range with Von Latch set to ON When Von Latch is OFF, the electronic load will begin sinking current if the input voltage exceeds the Von voltage. When the input voltage drops below the Von voltage value, the electronic load will still continue sinking current and the input remains on. Page 53 Figure 16 - Von Latch OFF The Load's Operating Range with Von Latch set to OFF To set the Von modes, from the CONFIG menu, select Von and press . The following will be displayed: VON LATCH 0 ff Use the key to select between On or Off and press confirm selection. Configure Protection Settings The electronic load has the following protection functions: Overvoltage protection (OVp), overcurrent protection (OCP), overpower protection (OPP), overtemperature protection (OTP), and local and remote reverse voltage protection (LRV/RRV). The instrument will act appropriately once any of the above protections are active. You can press any button on the front panel to restore the protection function. Page 55 5. It will then prompt to enter a value for Delay. This is the protection trip delay, which is the amount of time to delay from when the input has reached the limit before triggering OCP. Use the numeric keypad or rotary knob to enter a value, then press confirm change. Page 56 Software OPP - Users can set the electronic load's software OPP value with the following steps. 1. Go to CONFIG menu and select Protect. Then press 2. Select P-limit and press 3. To enable software OPP, select On and press. Page 57 Overtemperature Protection (OTP) There is an overtemperature protection circuit, which will turn off the input if the internal temperature exceeds safe limits. When the electronic load's internal circuit temperature is over 85C, the load will enable OTP. Input will automatically be turned off and the VFD will display OTP. Configure Timed Input The load has a built-in timer function that can be configured to allow enabling (ON) the main input for a specified amount of time. To configure this time, follow the steps below: 1. Go to CONFIG menu and select Protect. Then press 2. Page 59 3. To enable voltage auto range, select On and press . To disable, select Off and press to confirm the change. Measuring Rise and Fall Time The instrument can measure the rise or fall time from a specified start and stop voltage level of the measured input. CR LED Function CR LED is a function that allows the instrument to simulate the loading behavior of typical LEDs, which can be used for testing LED drivers. When the function is enabled, the load allows the user to configure the LED's operating resistance and forward voltage along with the voltage range (same as CR operation). 5. Use the numeric keypad or rotary knob to enter the values for Range, Voltage High, Voltage Low, and Vd. Vd will be the forward voltage of the LED you want to simulate. This option will only appear after CR LED has been enabled from the CONFIG menu. 6. 7. To enable remote sense, go to CONFIG menu and select Remote-Sense and press 8. Select On to enable or Off to disable remote sense. The default is Off. 9. Once it is turned on, the Sense annunciator will appear at the top of the display. S e n s e 12.000A 80.000V... Page 63 4. Connect the external analog control pins from the rear panel of the instrument to your voltage control source as shown below: Rear Panel Terminals External Voltage Source 0 – 10 V Figure 19 - Analog Control Setup 5. Set the instrument to CC mode and enable the input to be current controlling with the external voltage source. Disable (OFF) input: Disconnect the short between the two pins. Note: The external analog control does not have to be turned ON from the menu for these pins to function as intended. To avoid accidentally turning ON the load's input, keep these pins opened with nothing connected when not in use. Page 64 6. Press 5 to select the mode. The mode will be indicated by the top of the display. Page 65 7. Press to start the test. When the test is running, Run will be indicated in place of Stop. When the test ends, either Pass or Fault will appear next to Stop. Page 89 Delay This is the delay time to hold each power step in the test. This determines how fast or slow to run through the test. End Power This is the ending power value before OPP test ends. The test will only run through in steps from Start Power to the End Power if input voltage is greater than the OPP Voltage. Page 90 Follow the same steps for Step Power and End Power. Press after each settings to continue. Enter a value for OPP Voltage and press to continue. Enter a value for Max Trip Power, and then Min Trip Power. Press after each settings to continue. The load will prompt to Save OPP File. Press 1 to start the test. When the test is running, Run will be indicated in place of Stop. When the test ends, either Pass or Fault will appear next to Stop. To stop the test at any time, press 3.10 Key Lock The front panel keys can be locked to prevent unwanted changes to output settings and... 4 Remote Operation 4.1 Interface Connection RS-232 For RS-232 connectivity, refer to the diagram below for pinout information. The RS-232 is labeled in the rear panel and it is a female DB-9 interface. Table 6 - RS232 Pin Outs Description Transmit Data Receive Data A straight pin-to-pin DB9 female to DB9 male serial cable is required for using the RS-232... GPIB The load can be configured with a GPIB address from 0 – 31. To communicate via GPIB, connect a GPIB cable to the GPIB interface on the rear panel, as illustrated below. USBTMC The device is SRI, RLI, and DTL enabled. It can receive the following request: REN CONTROL GO TO LOCAL LOCAL LOCKOUT. 5 Troubleshooting Guide Below are some frequently asked questions and answers. Please check if any apply to your instrument before contacting B&K Precision. General Q: I cannot power up the instrument. Check that the power cord is securely connected to the AC input and there is live power from your electrical AC outlet. Note: All specifications apply to the unit after a temperature stabilization time of 15 minutes over an ambient temperature range of 23 °C ± 5 °C. Specifications are subject to change without notice. Model 8600 8601 8602 Input Ratings Input Voltage 0 – ... Page 96 Models 8600 8601 8602 Transient Mode (CC mode) T1 & T2 20 µs – 3600 s / Resolution: 10 µs Accuracy 5 µs + 100 ppm Slow Low Rate 0.001-2.5 A/ms 0.001-1 A/ms Rate High Rate 0.001-2.5 A/µs 0.001-1 A/µs... Page 97 Model 8610 8612 8614 8616 Input Ratings Input Voltage 0 – 120 V 0 – 500 V 0 – 120 V 0 – 500 V 0 – 12 A 0 – 3 A 0 – 24 A 0 – 6 A Input Current High... Page 98 Models 8610 8612 8614 8616 Transient Mode (CC mode) T1 & T2 20 µs – 3600 s/Resolution: 10 µs Accuracy 5 µs + 100 ppm 0.001-0.25 A/µs 0.001-0.1 A/µs Rate Slow Rate High 0.01-2.5 A/µs 0.001-1 A/µs Rate... Page 99 2) The slow rate specifications are not warranted but are descriptions of typical performance. The actual transition time is defined as the time for the input to change from 10% to 90%, or vice versa, of the programmed current values. In case of very large load changes, e.g. from no load to full load, the actual transition time will be larger than the expected time. Page 100 Models 8620 8622 8624 8625 Transient Mode (CC mode) T1 & T2 20 µs – 3600 s/Resolution: 10 µs Accuracy 5 µs + 100 ppm 0.001-0.25 A/µs 0.001-0.1 A/µs 0.001-0.25 A/µs Rate Slow Rate High 0.01-2.5 A/µs 0.01-1 A/µs 0.01-2.5 A/µs 0.01-2.5 A/µs Rate... 2) The slow rate specifications are not warranted but are descriptions of typical performance. The actual transition time is defined as the time for the input to change from 10% to 90%, or vice versa, of the programmed current values. In case of very large load changes, e.g. from no load to full load, the actual transition time will be larger than the expected time. Page 102 Dimensions and weight Dimensions (W x H x D) (excludes Model Weight front and rear rubber bezels and side handle) 8600 218 x 90 x 387 mm 4.5 kg 8601 218 x 90 x 387 mm 4.5 kg... 7 Calibration It is recommended that the instrument be returned to B&K Precision for service and periodic calibration to ensure the instrument is performing within its specifications. B&K Precision recommends calibrating the instrument once per year. Index AC input, 12 Menu, 18 Automatic Test, 21, 24, 25, 27, 32, 61 Remote sense, 47 Constant Current, 20 Restore Factory Default, 28 Constant Power, 25 Self Test, 35 Constant Resistance, 24 Self Test, 15 Constant Voltage, 23 Self-test, 15 Firmware Version, 17 Short, 50 Fuse, 13... Page 105 INFORMATION SERVICE Warranty Service: Please go to the support and service section on our website at www.bkprecision.com to obtain a RMA #. Return the product in the original packaging with proof of purchase to the address below. Clearly state on the RMA the performance problem and return any leads, probes, connectors and accessories that you are using with the device. Page 106 LIMITED THREE-YEAR WARRANTY B&K Precision Corp. warrants to the original purchaser that its products and the component parts thereof, will be free from defects in workmanship and materials for a period of three years from date of purchase. 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