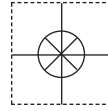




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# User's Guide



230 VAC Model Only

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# BB703 Blackbody Calibrator



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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.

**WARNING:** These products are not designed for use in, and should not be used for, patient-connected applications.

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## Section 1 - Introduction

Your BB700 Series Blackbody Calibration Source has been designed for ease of use and reliability whenever you have the need to test or calibrate non-contact infrared temperature instruments. It is important that you read this manual completely and follow all safety precautions before operating this instrument.

### 1.1 Precautions

- Follow all safety precautions and operating instructions outlined in this manual.
- Never leave your calibrator unattended when in use.
- Keep out of reach of all children.
- Never touch the target plate when hot.
- Never place any object within 3 inches of the cavity opening when hot.
- Do not operate in flammable or explosive environments.
- Never operate with a power cord other than the one provided with your unit.
- Remove and or disconnect main power cord before attempting any maintenance or fuse replacement.
- Do not connect this unit to a non-grounded, non-polarized outlet or power source.
- This unit is intended for indoor use only. Avoid exposure to moisture.



There are no user serviceable parts inside your unit. Attempting to repair or service your unit may void your warranty.

### 1.2 Safety Warnings and IEC Symbols

This device is marked with international safety and hazard symbols in accordance with IEC 1010. It is important to read and follow all precautions and instructions in this manual before operating or commissioning this device as it contains important information relating to safety and EMC. Failure to follow all safety precautions may result in injury and or damage to your calibrator. Use of this device in a manner not specified by the manufacturer may impair protection provided within the unit.

IEC symbols

Description



Caution, risk of electric shock



Caution, refer to accompanying documents



Caution, hot surface



230 VAC @50Hz (European Models)  
115 VAC @60Hz (Domestic Models)

Figure 1. IEC symbols

### 1.3 Statement on $\text{C}$ $\text{E}$ Marking

It is the policy of OMEGA to comply with all world-wide safety and EMI/EMC regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

### 1.4 General Description

The Model BB703 is a portable, rugged, bench-top, hot blackbody calibration source with a built-in precision PID digital controller. The calibrator is used to test and calibrate infrared pyrometers. The 1.125" diameter target plate has an emissivity of .97 and can be set to any temperature between ambient +20 to 752°F (ambient +11 to 398°C).

## Section 2 - Installation

### 2.1 Unpacking

Remove the packing list and verify that you have received all your equipment. If you have any questions about the shipment, please call our Customer Service Department at

1-800-622-2378 or 203-359-1660. We can also be reached on the Internet at [www.omega.com](http://www.omega.com)  
e-mail: [info@omega.com](mailto:info@omega.com)

When you receive the shipment, inspect the container and equipment for any signs of damage. Note any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

#### NOTE:

The carrier will not honor any damage claims unless all shipping material is saved for inspection. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

The following items are supplied in the box:

Item:	OMEGA Part Number:
BB703 Blackbody Calibration Source	BB703 or BB703-230
User Manual	M-3265
Calibration Certificate	CAL-3 (3 DATA POINTS)
Power Cord	200-0028 (Domestic), 200-0107 (International)
Soft Storage Case	IR-0019

### 2.2 Mounting

Mount the unit on a bench, table top or shelf in a horizontal position and operate at least ten inches from any air obstructions to the front, rear, or side panel. Operate the unit in an ambient environment between the specified 32 to 104°F (0 to 40°C).

### 2.3 Ambient Temperature

The target plate of the BB703 can achieve any temperature within the specified temperature range of ambient +20 to 752°F (ambient +10 to 40°C) when being operated in ambient temperatures up to 76.4°F (24.7°C). **When operating the unit at higher ambient temperatures, the user must not exceed the "Maximum Allowable Target Plate Temperature" shown along the y-axis in Figure 2. Failure to adhere to these guidelines may cause a safety switch inside the unit to open the heater circuit. If the PID light is blinking or continuously on but there is no increase in target plate temperature, then the thermal safety switch has tripped. In this case refer to Section 3-3.**

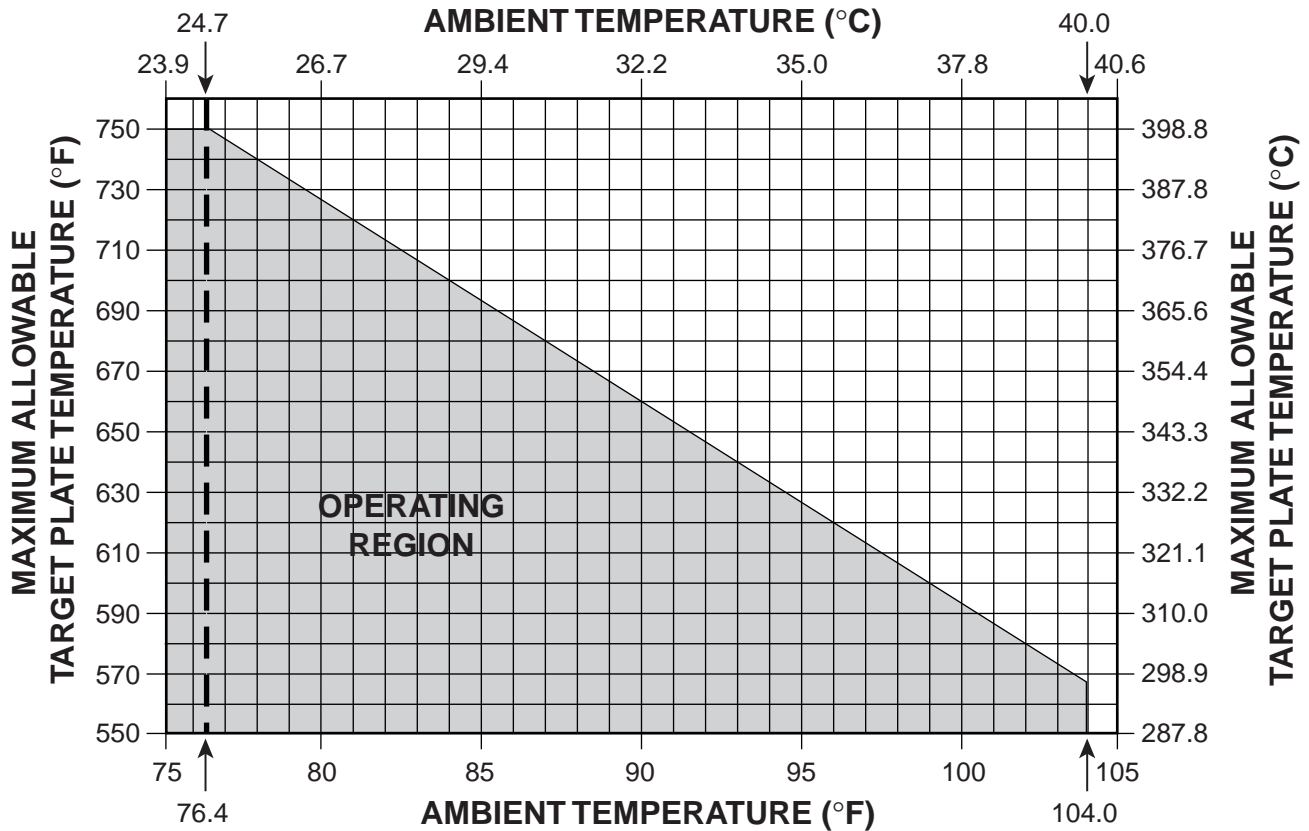


Figure 2. Limitation of Maximum Setpoint Temperature at Elevated Ambient Temperatures

An increase in ambient temperature of 1°F reduces the maximum allowable target plate temperature by 6.7°F. (An increase of 1°C is accompanied by an decrease in minimum target plate temperature of 3.7°C).

## 2.4 Power Connection

### Standard (120 VAC~, 50/60 Hz models)

The BB703 comes with a standard North American 3-prong AC power cord. Do not use any other power cord other than the one provided. This cord provides the proper grounding and has been safety tested by the proper safety agencies.

### International (230 VAC~, 50/60 Hz models)

On 230 VAC~, 50/60Hz models an International style power cord with the proper color code and approvals is provided with stripped wire ends for connection to the proper connector used in your country or local area, this connector is not provided.

**CAUTION:**

Electrical connections and wiring should be performed only by suitably trained personnel.

Be sure that the line voltage powering your unit does not go above or below 10% of the rated voltages specified above.



## Section 3 - Operation

### 3.1 Front Panel Controls and Indicators

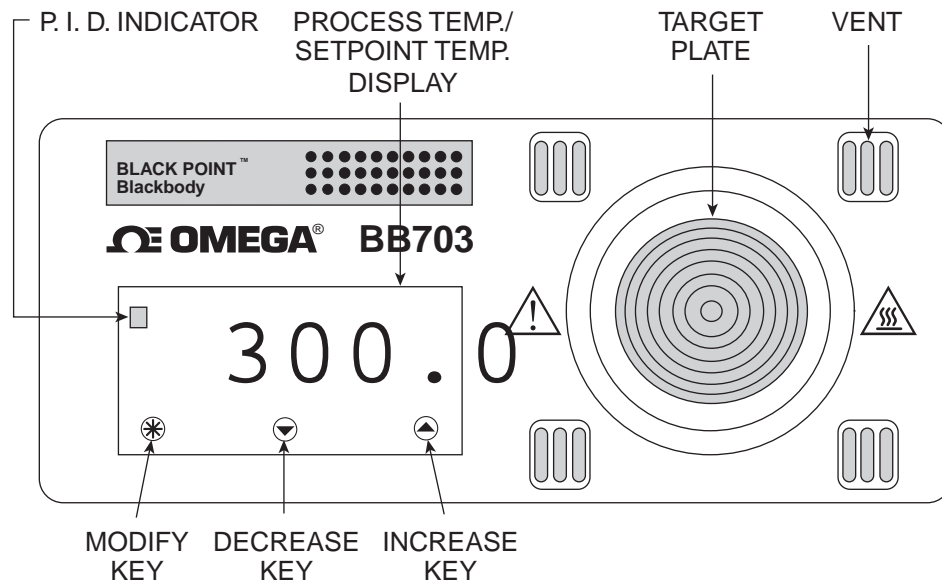


Figure 3. Front Panel

#### Process Temperature/Setpoint Temperature Display:

In the default mode, the display will show the process temperature, i.e. the target plate temperature. When the modify key is held down, the setpoint temperature is displayed.

#### Target Plate:

The 1.125" target plate is a near ideal blackbody source. The emissivity of the plate is .97. When calibrating an IR pyrometer, hold the pyrometer perpendicular to the target plate for optimal performance. The proper distance between the IR pyrometer and the target plate depends on the field of view of the pyrometer. If the pyrometer is too far away it will scan unwanted surfaces outside of the perimeter of the target plate. Holding the pyrometer too close could introduce undesirable heat to the IR detector of the pyrometer.

#### WARNING:

- The BB703's target plate can be set to very high temperatures. Exercise extreme caution when operating the unit. Keep hands and fingers away from the target plate area. Keep flammable products such as paper, plastics and clothing far from the BB703.
- The BB703 is a Class II instrument. It is intended to be operated in laboratory environment only. Never operate the unit outside or around children.
- Nothing should come in contact with the target plate. Even when the unit is off.
- Never unplug the unit while it is on or during "Cool Down."

#### P.I.D. Indicator:

When this light is illuminated, the unit is heating up the target plate.

**A NOTE:** on P.I.D. control:

Proportional, integral, derivative control ( P.I.D.) is a temperature control algorithm used in high end temperature controllers. The controller causes the process to attain the desired temperature by turning the process on or off. The process may be a heater or refrigerator. As the process temperature approaches the setpoint temperature the hot or cold process will be pulsed to reduce the corrective measures and minimize overshooting. The controller provides a visual representation of the process status through LED indicators. An indicator may be lit continuously, blink or shut off entirely to indicate that the process is on, being pulsed, or off, respectively.



**Modify Key:** Press to view and change setpoint.



**Decrease Key:** Press in conjunction with Modify Key in order to decrease setpoint.



**Increase Key:** Press in conjunction with Modify Key in order to increase setpoint.

## 3.2 Back Panel Connections

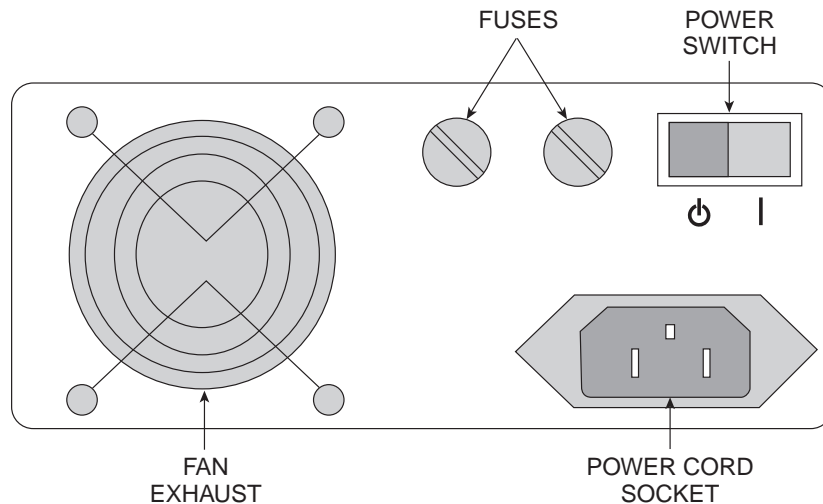


Figure 4. Back Panel

### AC Power Input:

The customer connects the power cord to the AC Power Input. As a safety precaution, the power cord cannot be connected if the fuse compartment is open. Refer to Section 3.5 for information on fuse replacement.

### Power Switch

The power switch has two positions, "ON" and "STANDBY."



In the ON mode, the entire unit is powered up. The fan will only activate when the target plate is been brought up to a high temperature for a period of about five minutes.

In the STANDBY mode, the unit is powered down except for the fan and fan thermostat. If the unit has been operated at high temperature and is then put into standby mode, the fan will still run until the target plate has cooled down to room temperature.

### 3.3 Overheat Reset Switch

If the unit is operated at high temperatures in elevated ambient temperatures, an overheat condition may occur. In an overheat situation a mechanical reset switch on the right side panel will pop and open the heater circuit. The controller will still have power. While the controller will be demanding heat from the heater, the process temperature will fall continuously until it equalizes with the room temperature. If an overheat condition occurs, let the unit cool off for one hour (leave the unit on), then press the reset button, firmly.

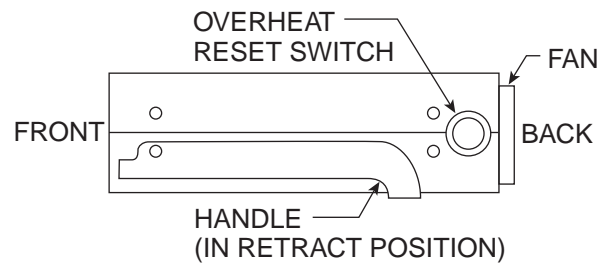


Figure 5. Overheat Reset Switch

### 3.4 Changing the Temperature Setpoint

The layout of the front panel is shown in Figure 3. The BB703 incorporates a PID digital setpoint controller. In the default mode the digital display indicates the blackbody target plate temperature known as (PV) Process Variable. Holding down the modify key causes the display to show the programmed setpoint known as (SV) Setpoint Variable. Making changes to the setpoint, units of measure and communication settings are made by pressing the MODIFY key in conjunction with the INCREASE or DECREASE key. Holding the MODIFY key and INCREASE/DECREASE key for an extended period will cause the setpoint temperature to advance more quickly to a desired value. Three scanning speeds are provided: slow, medium and fast. The minimum and maximum setpoints are locked at 32 and 752°F (0 and 398°C), respectively. **While these max. and min. settings are changeable (see "Changing the Internal Parameters," Section 3.4), it is strongly advised not to adjust these parameters.**

### 3.5 Changing the Controller Parameter Settings

The BB703 operates at its optimum performance when left with the factory parameter settings. The only internal parameter that the operator may need to change is the

NOTE: An "A" or a "\*" next to parameter means that this parameter is custom calibrated for each unit at the factory. The values for these parameters in the figure are arbitrarily chosen.

Menu 1		Menu 2		Menu 3	
TUNE	OFF	SP1.P	0	SP1.d	SSd1
BAND	A 58	hAnd	OFF	SP2.d	SSd2
int.t	A 1.2	PL.1	100	burn	uP.SC
der.t	A 8	PL.2	100	rEU.d	1r.2d
daC	A 2.0	sp2.A	none	rEU.L	1n.2n
CyC.t	A 5	sp2.b	none	SPAn	* 10
oFSt	0.0	diSp	0.1°	Zero	* -2.5
SP.LK	OFF	hi.SC	752	ChEK	OFF
SP.rr	0	Lo.SC	32	rEAd	Uar°
SPrn	OFF	ipPt	rtd	tECh	Ct A
SOAK	- -	unit	°F	Uer	392
SEt.2	0.0			rSEt	nonE
bnd.2	3.6				
CyC.2	on.oF				

Figure 6. Menu Hierarchy Showing Factory Default Settings

engineering units (°F or °C) or display resolution (XXX, XXX.X or X.XX). Following are two diagrams: a) menu hierarchy with factory default settings b) programming procedure.














1. To enter programming menu hold down the  and  keys, simultaneously, for 3 seconds. Upon entering the menu, the user is always located at the "tUnE" parameter. This is the first parameter of MENU1.
2. Use the  and  keys to scan through the various parameters on a given menu level.
3. Use the  key together with the  key or the  key to change a given parameter.
4. To change menu levels, scan to the first parameter on a given menu level, using the  key. Next, hold down the  key in addition to the  key or the  key to go to a different menu level.
5. To leave the programming menu and return to the normal operation mode, hold down the  and  keys, simultaneously.
6. All parameters are saved, even when power is removed from the unit.

Figure 7. Programming Procedures

### 3.6 Approximate Target Plate Temperature Transition Graph

The BB703 heat-up and cool-down characteristics are illustrated in the following graph. The graph illustrates the approximate time required to make a transition from one plate temperature to another. First determine the current plate temperature and go to the corresponding row. Now decide the new target plate temperature and go to the appropriate column. Note that there are X's along the diagonal where original and target temperatures are the same.

FROM: TO:	150°F	300°F	450°F	600°F	750°F	
150°F	X	13 min.	15 min.	16 min.	16 min.	65.6°C
300°F	17 min.	X	6 min.	15 min.	16 min.	148.9°C
450°F	18 min.	8 min.	X	12 min.	16 min.	232.2°C
600°F	35 min.	19 min.	18 min.	X	15 min.	315.6°C
750°F	40 min.	24 min.	20 min.	16 min.	X	398.9°C
	65.6°C	148.9°C	232.2°C	315.6°C	398.9°C	TO: FROM:

Figure 8. Approximate Target Plate Temperature Transition Times

## Section 4 - Maintenance

### 4.1 Calibration

This unit has been fine tuned at the factory and calibrated to give optimum performance of its full temperature range. It is recommended that the unit be returned annually for re-calibration.

### 4.2 Cleaning

**CAUTION:**

Remove all electrical connections and power before attempting any maintenance or cleaning.

#### 4.2.1 Main Body

Only a damp soft rag with a mild cleaning solution should be used when cleaning the main body of this unit.

#### 4.2.2 Target Plate

Do not attempt to clean the target plate. The target plate has a special coating applied and cleaning may change the emissivity and performance of your unit.

#### 4.2.3 Fan

The fan guard should be cleaned as a minimum annually by using a compressed air source.

### 4.3 Fuse replacement

**WARNING:**

Disconnect all power from source before attempting fuse replacement.

**CAUTION:**

For continued protection against the risk of fire replace with only the same size, type and rating fuse indicated here and on the rear panel of your unit.

For model: BB703 use 1 ea. 250 VAC~, F2A (Fast-Acting, 2 A)  
VDE APPROVED (5mm dia. x 20mm long).

For model: BB703-230VAC use 2 ea. 250 VAC~, F1A (Fast-Acting, 1A)  
VDE APPROVED (5mm dia. x 20mm long).

**NOTE:**

Note that for the BB703-230VAC both fuses need to be checked if there is a suspicion that a fuse has been blown. One or both fuses may have been damaged.

## Section 5 - Specifications

<b>Target Plate Temperature Range:</b>	Ambient + 11°C to 40°C* (Ambient + 20°F to 752°F)*
<b>Ambient Environmental Conditions:</b>	
Temperature:	0 to 40°C (32 to 104°F)*
Humidity:	0 to 90% RH, non-condensing
<b>Power:</b>	
BB703	110-120 VAC~, 50/60 Hz, 175W
BB703-230VAC	208-240 VAC~, 50/60 Hz, 175W
<b>Internal Control Sensor:</b>	Platinum RTD, 100 Ω, .00385
<b>Accuracy:</b>	±1.4°C (±2.5°F)
<b>Resolution:</b>	0.1°
<b>Stability:</b>	±0.3°C (±0.5°F)
<b>Display Accuracy:</b>	±0.3°C (±0.6°F) [over entire range]
<b>RTD Accuracy:</b>	±0.38°C (± 0.75°F) [worst case]
<b>Target Plate Emissivity:</b>	0.97
<b>Heat-Up Time:</b>	10 min., 25 seconds (from 37.8°C to 398°C) (from 100°F to 752°F)
<b>Dimensions:</b>	5" W x 2.2" H x 6.1" D (127 x 56 x 155 mm)
<b>Weight:</b>	2.4 LBS. (1.09 KG.)
<b>Certifications:</b>	CE (BB703-230VAC ONLY)

\* Maximum setpoint must be reduced when operating at ambient temperatures in excess of 24.7°C (76.4°F) See Section 2.3.

## Section 6 - Troubleshooting Guide

<b>Problem</b>	<b>Solution</b>
<b>1. Unit will not turn on.</b>	<ol style="list-style-type: none"><li>Check all electrical connections.</li><li>Check rear panel fuse(s).</li><li>Unit requires service, contact our customer service department.</li></ol>
<b>2. Unit turns on but the target plate will not get hot.</b>	<ol style="list-style-type: none"><li>Check that you have entered a setpoint above the ambient temperature.</li><li>Verify that the controller is set to its factory default settings.</li><li>Unit requires service, contact our customer service department.</li><li>Unit has been operated outside of operating range. Safety cutoff switch has disabled heater. Unit should be sent back to factory for reset and safety check.</li></ol>
<b>3. Controller display shows "Error" and the target plate will not get hot or cold.</b>	<ol style="list-style-type: none"><li>Unit requires service, contact our customer service department.</li></ol>
<b>4. Target plate temperature will not stabilize to within <math>\pm .5^{\circ}\text{F}</math> of the setpoint temperature.</b>	<ol style="list-style-type: none"><li>Verify that the controller is set to its factory default settings.</li><li>Unit requires service, contact our customer service department.</li></ol>

## Section 7 - Glossary of Terms Used in This Manual

### **Blackbody**

A theoretical object that radiates the maximum amount of energy at a given temperature, and absorbs all the energy incident upon it.

### **Calibration**

The process of adjusting an instrument or compiling a deviation chart so that its reading can be correlated to the actual value being measured.

### **Emissivity**

The ratio of energy emitted by a surface to the energy emitted by a blackbody at the same temperature.

### **IEC**

International Electrotechnical Commission

### **Infrared (IR)**

A range of the electromagnetic spectrum extending beyond red visible light from 760 nanometers to 1000 microns.

### **NIST**

National Institute of Standards and Technology

### **PID**

Proportional, Integral, Derivative. A three mode control action where the controller has time proportioning, integral (auto reset) and derivative rate action.

### **RTD**

Resistance temperature detector





## The OMEGA® Family of Blackbody Calibrators

Listed below is a selection guide of OMEGA's current line of blackbody calibration sources in addition to the one you have selected. This family of rugged, portable and accurate calibrators cover a wide range of temperatures, target plate sizes and features making them perfect for infrared pyrometer field service testing and laboratory calibrations.

---

**BB701 Hot/Cold Blackbody Calibration Source** (DOC # 1733)  
**Temperature Range:** -18 to 150°C (0 to 300°F)      **Accuracy:** ±0.8°C (±1.4 °F)  
**Emissivity:** .98      **Ambient Temp.:** 4 to 43°C (40 to 85°F)  
**Cavity Size:** 64mm (2.5 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

**BB702 2.5" Target Plate Blackbody Calibration Source** (DOC # 1733)  
**Temperature Range:** amb. 10 to 216°C (amb. 20 to 420°F)      **Accuracy:** ± 0.5°C (±.9°F, ±0.25% of rdg.)  
**Emissivity:** .96      **Ambient Temp.:** 0 to 50°C (32 to 122°F)  
**Cavity Size:** 64mm (2.5 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

**BB703 Mini Blackbody Calibration Source** (DOC # 1789)  
**Temperature Range:** amb. 10 to 400°C (amb. 20 to 752°F)      **Accuracy:** ±1.0°C (±1.8°F)  
**Emissivity:** .97      **Ambient Temp.:** 32 to 104°C (0 to 40°F)  
**Cavity Size:** 28.6mm (1.125 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

**BB704 4" Target Plate Blackbody Calibration Source** (DOC # 1788)  
**Temperature Range:** 100 to 399°C (212 to 750°F)      **Accuracy:** ±0.8°C (±1.4°F)  
**Emissivity:** .96      **Ambient Temp.:** 0 to 50°C (32 to 122°F)  
**Cavity Size:** 44.45mm (1.75 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

**BB705 Laboratory Grade Blackbody Calibration Source** (DOC # 1759)  
**Temperature Range:** 100 to 1046°C (212 to 1915°F)      **Accuracy:** ±.25% of reading ±1.0°C  
**Emissivity:** .985 or better      **Ambient Temp.:** 32 to 110°F  
**Cavity Size:** 44mm (1.75 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

**BB-4A High Temperature Blackbody Calibration Source** (DOC # 1730)  
**Temperature Range:** 100 to 982°C (212 to 1800°F)      **Accuracy:** ±0.7°C (±1.2°F)  
**Emissivity:** .98 to .99      **Ambient Temp.:** 0 to 50°C (32 to 122°F)  
**Cavity Size:** 22mm (.88 inches)      **Power:** 120 or 230 VAC 50/60 Hz

---

To receive by fax, a complete updated specification sheet and price on any of the calibrators listed here call the OMEGAFAX<sup>SM</sup> On-line Publishing Service at 1-800-848-4271 and request the DOC# shown with each unit. Please call our sales or customer service department for information and pricing on any new models available.

**Notes:**



## WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **37 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **three (3) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

**OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.**

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

## RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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