MAB

Large area THz blackbody

Fig.1. Photo of MAB-16D blackbody

BASIC INFORMATION:

Typical area blackbodies offered at international market (including TCB/MTB blackbodies offered by Inframet) are optimized to simulate perfect blackbody targets in a commonly used band of infrared radiation: from about 1μm to about 15 μm. High emissivity of emitters of such blackbodies is achieved by coating temperature controlled metal plates with a thin layer of high absorptance painting.

Typical area blackbodies cannot be used to simulate blackbody targets at THz band (0.1 mm to 1 mm) and sub-THz band (wavelengths from 1 mm to 10 mm) because emissivity of such blackbodies starts decreasing at about 0.1 mm and becomes very low at wavelengths over about 1 mm. The reason is that high emissivity paints used in typical infrared blackbodies becomes partially translucent for THz optical radiation, particularly at longer wavelengths over about 0.5 mm.

Design of area blackbodies for THz is a technological challenge due to several reasons: a)emitters of high absorptance coating in THz/short microwave spectral band are needed to assure high emissivity, b)large area blackbodies are needed due to low resolution of THz/microwave imagers; c)high temperature uniformity, temporal stability and accuracy are needed to enable accurate calibration of passive THz/microwave sensors.

MAB blackbodies are the first commercially available large area broadband blackbodies of high emissivity in complete THz and sub-THz spectral band. The blackbodies have been developed after several years of experiments carried out by Inframet research team. Design of these blackbodies is based on a special castable absorber coating optimized for THz range, large thermally uniform emitter plate and ultra precision control electronics.

MAB blackbodies are offered in form of a series of versions of different emitter area, different temperature range, and optimized for different spectral bands. Next, MAB blackbodies are characterized by good temperature resolution, temporal stability, temperature uniformity, and temperature uncertainty and high emissivity. All these features make MAB blackbodies an ideal choice for blackbodies to be used as reference sources in systems for testing/calibration THz/sub-THz imagers or other meters of such radiation.

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FEATURES:

- Broad spectral range covering both THz and sub THz bands
- Large area up to 1m x1m
- High emissivity in Thz/sub-THz
- Good thermal uniformity on large blackbody area
- Extremely good temperature resolution 1 mK and temperature stability 10mK
- High speed, easy control from PC
- Compact, reliable design (blackbody is integrated with controller)

PARAMETERS:

Parameter	Value
Aperture	from 150× 150 mm to 1000x1000mm typical model: 400x400mm
Optimal work spectral band*	Different version available: A- from 0.1 mm to 1mm (0.3-3 THz), B - from 0.5 mm to 4 mm (75GHz -0.6 THz), C - from 2 mm to 10 mm (30GHz-150GHz), D- from 0.5mm to 10 mm (30 GHz- 0.6THz), E- from 0.5mm to 30 mm (10GHz - 0.6THz) Ka- from 7.5mm to 11.1mm (26.5–40 GHz)
Absolute temperature range	+5°C to +95°C - code ST -5°C to +95°C - code EX +5°C to 150°C - code HT, ambient+10°C to 200°C - code EHT -30°C to +70°C - code LT.
Set point and resolution	1 mK
Emissivity	≥0.96 (spectral band A) ≥0.98 (spectral band B) ≥0.99 (spectral band C) ≥0.99 (spectral band D) ≥0.99 (spectral band E) ≥0.99 (spectral band Ka)
Temperature uniformity**	<0.02x(T-Tamb) or 0.2ºC where Tamb – ambient temperature
Regulation stability	±5 mK @ ΔT=10°C
Total temperature uncertainty	0.005 (T-25°C)+100 [mK] at 25°C ambient temperature
Approximate Heating Rate	+0.15ºC/sec. at 25ºC (for MAB-16D
Approximate Cooling Rate	+0.05ºC/sec. at 25ºC (for MAB 16D)
Settling Time	<120 sec
Computer control	RS-232 (USB 2.0) or RS485 (option)
Power requirements	230VAC
Max power consumption	from 300W to 12 000W depending on version
Operating temperature	5˚C to 40˚C
Storage temperature	–10°C ÷ +60 °C
Relative humidity	5% to 95%, non-condensing
Approximate mass	from 18kg to 170 kg (106kg for MAB-16D)
Approximate dimensions	From 200x200x300mm to 1250x1400x400mm (540x730x380mm)

* blackbody will emit radiation also outside specified band but emissivity can drop below specified value
** measured as temperature spatial distribution uncertainty at blackbody area

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VERSIONS

MAB blackbodies can be delivered in form of a series of versions. There are three main criterion: size of blackbody emitter, spectral band and temperature range.

Emitter size is indicated by blackbody code: MAB- XD where X is approximate size of square of the emitter in inches. The following models are typically offered: MAB-6D, MAB-12D, MAB-16D, MAB-20D, MAB-24, MAB 50. As it can be seen Inframet can deliver MAB blackbodies with emitters as big as 1000x1000mm (model MAB-50D). However, it should be noticed that there are big differences between smallest MAB-6D blackbodies and MAB-50D blackbodies. The latter blackbodies are much bigger, need more power, are slower and are much more expensive. Therefore it is recommended not to exaggerate with size of ordered blackbody.

Next, MAB blackbodies can be optimized for three different spectral ranges:

A- from 0.1 mm to 1mm (0.3-3 THz),
B - from 0.5 mm to 4 mm (75GHz -0.6THz),
C - from 2 mm to 10 mm (30GHz-150GHz),
D- from 0.5mm to 10 mm (30 GHz- 0.6THz),
E- from 0.5mm to 30 mm (10GHz - 0.6THz),
Ka- from 7.5mm to 11.1mm (26.5–40 GHz).

Generally, the longer wavelength the more difficult is to achieve at the same time high emissivity, high temperature uniformity and high accuracy of temperature measurement. Therefore it is recommended not to exaggerate with maximal work wavelength of the ordered blackbody.

Finally, MAB blackbodies in standard version offer temperature range from +5°C to 70°C at ambient temperature that equals 25 °C (code ST). However, the temperature range can be modified:

-5°C to +95°C - code EX
+5°C to 150°C - code HT,
ambient+10°C to 300°C - code EHT
-30°C to +70°C - code LT.

To summarize, version of MAB blackbody is specified using three part code: part one - size, part two - spectral band, part three temperature range.

Example: MAB-16D-B-ST means blackbody of active area 400x400mm, optimized for spectral band from 0.5 mm to 4 mm, that offers temperature range from +5°C to 70°C.

Three other options are offered:

- Temperature chamber adapted (TC),
- Fog environment (FE),
- Long cables (CAB).

TC option means that MAB blackbody can be used in extreme ambient temperatures (–20°C ÷ +60°C) met in temperature chambers. This capability is achieved by design of electronics using special components capable to withstand extreme temperatures and humidity. Such blackbodies offers range extended from low temperatures: –30°C to high temperatures (+90°C). However, it should be noted that low temperature -30°C can be achieved only when temperature in chamber is also low (not higher than -10ºC) because differential temperature range is the same as for typical blackbodies. Next, it is a warning that standard blackbodies should not be used in temperature chambers because electronics will be damaged by extreme ambient temperatures.

FE option means that blackbody is designed to withstand artificial/natural fog conditions when environment contains water droplets.

CAB option means that blackbody is optimized to be controlled using long cables. Typical maximal length is up to 50m but can be extended to 300m.

Version 2.2

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