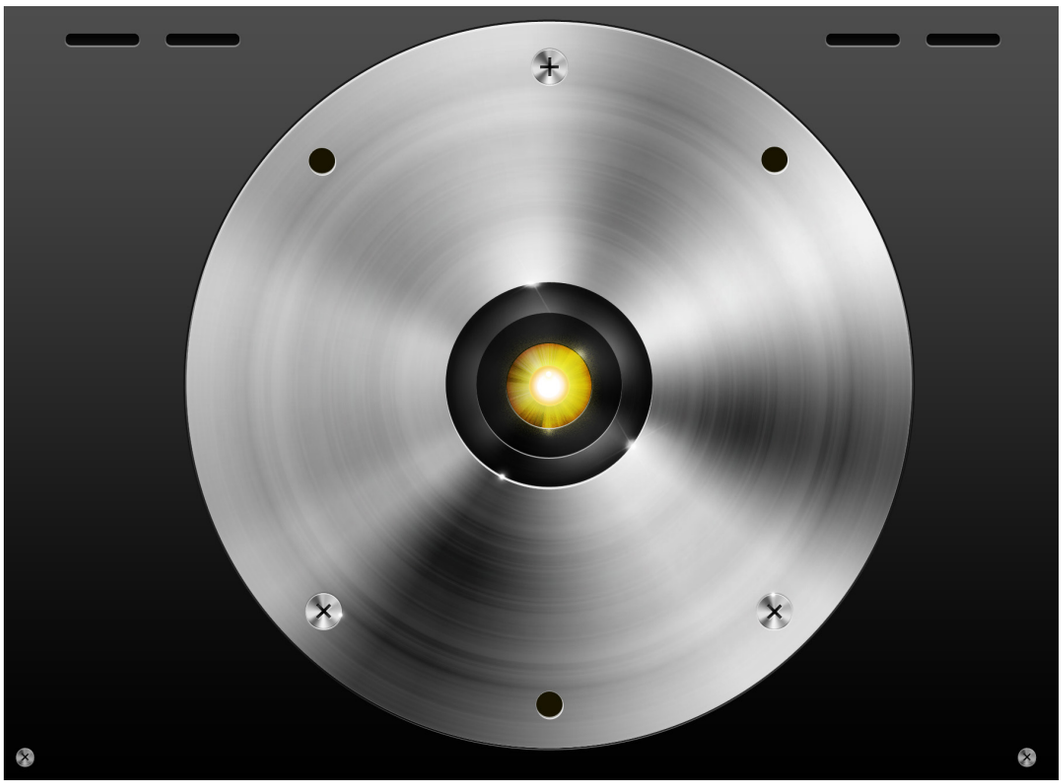


TEMPERATURE CALIBRATION SOURCES

Highly accurate calibration equipment for pyrometers, thermal imaging cameras, radiometers, heatflux and spectrographic measurement sytems.

Calibration sources are infrared radiators with fixed or adjustable temperatures, which are used for the calibration or verification of the correct temperature indication of pyrometers, thermal imaging systems, heatflux measurement systems or spectrographic analysis systems. Depending on the model of the calibration source, single temperature points or temperature curves of an infrared measurement device can be monitored and recorded.

Advanced Energy supplies a unique selection of very precise calibration sources that are traceable to national standards. Mikron® blackbodies are superior because of the emissivity values, homogeneous emission areas and a wide range of different sized apertures to adapt to the desired target area. In addition, fast heat up times and high temperature stability are guaranteed.

The quality of our calibration sources is guaranteed by tests, burn-in times, and pyrometric calibrations. A certificate is provided to document the traceability to the international temperature scale ITS90.

CALIBRATION SOURCE OVERVIEW

Portable Versions		
Type	**M316**	**Mobile Calibration Unit**
		
Temperature Ranges	($T_{ambient}$+5°C) to 300°C (+9 to 572°F)	250 to 1300°C[1] (+482 to 2372°F) 550 to 1300°C[1] (+1022 to 2372°F)
Benefits	Ultra-portable, two-piece low temperature blackbody calibration source available for sale in the US only.	Extremely fast, mobile calibration unit with control pyrometer and laptop /calibration software.
Heated Emitter Shape	Thermally uniform plate	Thermally uniform plate
Standard Calibration Method	Pyrometric	Pyrometric
Emissivity (ε_{eff}=effective / ε=real)[2] in Calibration Spectral Range[3]	ε_{eff} = 1.00 8 to 14 µm	ε_{eff} = 1.00 0.78 - 1.1 µm / 1.45 - 1.7 µm
Aperture Diameter/ Surface Area	57 mm (2.25”)	10 mm
Temperature Uncertainty	±0.5% of reading ±1°C	0.3°C
Average Warm-up Time	~10 minutes from room temperature to 200°C	< 5 s (1300°C)
Dimensions (H x W x D)	Blackbody: 203 mm x 89 mm x 98 mm Controller: 102 mm x 178 mm x 127mm	Calibration unit: 368 mm x 443 mm x 634 mm Control pyrometer: 135.5 mm x 78.5 mm x 255 mm
Weight:	Blackbody: 0.9 kg (2 lb) Controller: 0.70 kg (1.5 lb)	Calibration unit: 40 kg

Low Temperature Versions up to 150°C (302°F)				
Type	**IRC 45 to IRC 150**			**M340**
				
Temperature Ranges	45°C (IRC 45) 70°C (IRC 70) 75°C (IRC 75)	95°C (IRC 95) 100°C (IRC 100) 110°C (IRC 110)	120°C (IRC 120) 140°C (IRC 140) 150°C (IRC 150)	-20 to 150°C (-4 to 302°F)
Benefits	Small, easy to use. Large surface area and fixed temperature. Ideal for benches and multiple, calibration fix temperature setpoints. Min. temperature deviation.			Portable, sub-zero temperature blackbody calibration source. Compact, high resolution, and high temperature stability for low temperatures.
Heated Emitter Shape	Thermally uniform plate			Thermally uniform plate
Standard Calibration Method	Contact-thermometric			Pyrometric
Emissivity (ε_{eff}=effective / ε=real)[1] in Calibration Spectral Range[2]	ε= 0.98 ± 0.004 2 to 5.4 µm; 8 to 14 µm			ε_{eff} = 1.00 8 to 14 µm
Aperture Diameter / Surface Area	50.8 mm (2”)			51 mm (2”)
Temperature Uncertainty	0.4°C (IRC 45-120); 0.5°C (IRC 140,150)			±1°C @ 8 to 14 µm
Average Warm-up Time	max 5 (IRC 45) up to 30 min. (IRC 150)			~6 min from ambient to -15°C or 100°C
Dimensions (HxWxD)	64.5 mm x 81 mm x 133.5 mm			167 mm x 280 mm x 280 mm
Weight:	0.9 kg (1.98 lb)			7.1 kg (15.6 lb)

1 If used with IGA-12-C Control Pyrometer

2 For radiometric calibrated sources, the emissivity tolerances are included in the temperature uncertainty value.

3 For emissivities of other wavelength temperature correction tables are available for some models, see “Technical Specifications”.

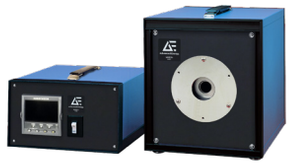
Low Temperature Versions up to 450°C (842°F)		
Type	**M310-HT**	**M315-HT**
		
Temperature Ranges	($T_{ambient}$+5°C) to 450°C (+9 to 842°F)	($T_{ambient}$+5°C) to 450°C (+9 to 842°F)
Benefits	Portable, compact low temperature blackbody calibration source with a large surface area.	Portable, two-piece low temperature blackbody calibration source with a large surface area.
Heated Emitter Shape	Thermally uniform plate	Thermally uniform plate
Standard Calibration Method	Pyrometric	Pyrometric
Emissivity (ε_{eff}=effective / ε=real)[1] in Calibration Spectral Range[2]	ε_{eff} = 1.00 8 to 14 µm	ε_{eff} = 1.00 8 to 14 µm
Aperture Diameter/ Surface Area	76 mm (3”)	76 mm (3”)
Temperature Uncertainty	0.25% of reading ±1°C	0.25% of reading ±1°C
Average Warm-up Time	< 30 min to 400°C	< 30 min ambient to 300°C
Dimensions (HxWxD)	207.3 mm x 280.4 mm x 266 mm	Calibration source: 207.3 mm x 280.4 mm x 266 mm Controller: 207.3 mm x 280.4 mm x 266 mm
Weight:	5.6 kg (12.4 lb)	Calibration source: 4.9 kg (10.8 lb) Controller: 3.2 kg (7 lb)

Large Area Versions			
Type	**M315X** (X4, X6), **-HT** (X4,X6,X8,X12)	**M345X** (X4, X4D, X6, X8, X12)	**M345X-LC** (X6)
			
Temperature Ranges	($T_{ambient}$+5°C) to 400°C (M315X4, X6) ($T_{ambient}$+5°C) to 600°C (M315X-HT)	0 to 170°C (X4, X4D, X6, X8) 0 to 150°C (X12)	-40 to 100°C (-40 to 212°F)
Benefits	Two-piece, high temperature blackbody calibration source with a large surface area.	Large area blackbody source for low temperatures cooled and heated by precision thermoelectric modules.	Liquid cooled version of M345X for very low temperatures.
Heated Emitter Shape	Thermally uniform plate	Thermally uniform plate	Thermally uniform plate
Standard Calibration Method	Pyrometric	Pyrometric	Thermometric only
Emissivity (ε_{eff}=effective / ε=real)[1] in calibration spectral range[2]	ε_{eff} = ~1.00 8 to 14 µm	ε_{eff} = 1.00 8 to 14 µm	0.9756 ± 0.0039 @ 8 to 15 µm 0.9713 ± 0.0049 @ 3 to 5 µm
Aperture Diameter/ Surface Area (in mm)	X4: 101 x 101; X6: 152 x 152; X8: 203 x 203; X12: 305 x 305	X4/X4D: 101 x 101; X6: 152 x 152; X8: 203 x 203; X12: 305 x 305	X4: 101 x 101; X6: 152 x 152; X8: 203 x 203
Temperature Uncertainty	±1°C (<100°C) to ±1.3°C (@ 400°C); HT: ±1°C (<100°C) to ±2°C (@ 600°C)	±1°C @ 8 to 14 µm	±1°C @ 8 to 14 µm
Average Warm-up Time	~30 min ambient to 300°C HT: ~ 30 min ambient to 500°C	~15 min from ambient to 100°C	15 min maximum with chiller set at 0°C to -40°C
Dimensions (H x W x D)	X4: 269 mm x 285 mm x 267 mm to X12: 646.4 mm x 490.2 mm x 602 mm Controller: 195 mm x 432 mm x 576 mm	X4/X4D: 153 mm x 153 mm x 153 mm to X12: 400 mm x 400 mm x 356 mm Controller: 195 mm x 432 mm x 576 mm	197 mm x 190 mm x 165 mm Controller: 178 mm x 483 mm x 593 mm

1 For radiometric calibrated sources, the emissivity tolerances are included in the temperature uncertainty value.

2 For emissivities of other wavelength temperature correction tables are available for some models, see “Technical Specifications”.

CALIBRATION SOURCE OVERVIEW

Mid Temperature Versions up to 1150°C (2102°F)			
Type	**M300**	**M305**	**M360**
			
Temperature Ranges	200 to 1150°C (392 to 2102°F)	100 to 1000°C (212 to 1832°F)	50 to 1100°C (122 to 2012°F)
Benefits	Medium calibration source with high emissivity for calibration indipendent of the wavelength.	Compact design of the M300 with smaller cavity shape and temperature range.	Medium temp. blackbody calibration source with two separate portable modules and a wide temperature range.
Heated Emitter Shape	Spherical	Spherical	Spherical
Standard Calibration Method	Pyrometric	Pyrometric	Pyrometric
Emissivity (ε_{eff}=effective / ε=real)[1] in Calibration Spectral Range[2]	ε_{eff} = 1.00 0.65 to 15 µm	ε_{eff} = 1.00 8 to 14 µm (<230°C); 0.7 to 1.8 µm (>230°C)	ε_{eff} = 1.00 8 to 14 µm (< 230°C); 0.7 to 1.8 µm (> 230°C)
Aperture Diameter	51 mm (2”)	25.4 mm (1.0”)	25 mm (1”)
Temperature Uncertainty	0.25% of reading ±1°C	±0.2% of reading ±1°C	±0.2% of reading ±1°C
Average Warm-up Time	60 min from ambient to 1000°C	~60 min from ambient to 700°C	60 min from ambient to 700°C
Dimensions (H x W x D)	640 mm x 500 mm x 572 mm	270 mm x 430 mm x 370 mm	Cal. Source: 345 mm x 277 mm x 425 mm Controller: 168 mm x 280 mm x 280 mm
Weight	80 kg (175 lb)	25 kg (55 lb)	Cal. source: 17.8 kg (39.3 lb) Controller: 5 kg (10.7 lb)

High Temperature Versions				
Type	**M330-US / M330-EU**	**M335**	**M390**	
				
Temperature Ranges	300 to 1700°C (572 to 3092°F)	300 to 1500°C (570 to 2730°F)	600 to 2300°C (A2) 600 to 2600°C (B2) 600 to 3000°C (C2)	300 to 2000°C (L1) 600 to 3000°C (S; 2 piece)
Benefits	High temperature calibration source with specially manufactured heating elements.	High temperature, very quick heat-up time.	Calibration source for extremely high temperatures at very quick heat-up time.	
Heated Emitter Shape	Closed end tube	Closed end tube	Closed end tube	
Standard Calibration Method	Pyrometric	Pyrometric	Pyrometric	
Emissivity (ε_{eff}=effective / ε=real)[1] in Calibration Spectral Range[2]	ε_{eff} = 1.00 0.65 to 1.8 µm	ε_{eff} = 1.00 0.65 to 1.8 µm	ε_{eff} = 1.00 0.6 to 1.8 µm	ε_{eff} = ~0.96 3 to 15 µm
Aperture Diameter	25 mm (1”)	16.5 mm (0.65”)	25 mm (1”)	
Temperature Uncertainty	±0.25% of reading ±1°C	±0.4% of reading ±1°C	±0.25% of reading ±1°C	
Average Warm-up Time	45 to 50 min from ambient to 300°C 65 to 80 min from 300 to 1600°C	30 min from ambient to 1200°C	5 min (to 2300°C)	
Dimensions (H x W x D)	648 mm x 500 mm x 551 mm	290 mm x 495 mm x 550 mm	1710 mm x 560 mm x 820 mm	
Weight	80 kg (175 lb)	28 kg (62 lb)	182 kg (400 lb)	

1 For radiometric calibrated sources, the emissivity tolerances are included in the temperature uncertainty value.

2 For emissivities of other wavelength temperature correction tables are available for some models, see “Technical Specifications”.

TECHNICAL SPECIFICATIONS

Temperature Range
Calibration sources are available for temperature ranges from -40 to 3000°C.

Emissivity
The emissivity is stated depending on the calibration method used for the radiation source. Using pyrometric calibration, the effective emissivity (ε_{eff}) normally equals 1. Using thermometric contact calibration, the actual emissivity (ε) given is always below 1.

Calibration Spectral Range
The stated emissivity is only valid in the specified spectral range. To calibrate measurement devices in a different spectral range, a temperature correction table may have to be applied (model specific).

Radiation-Calibration Method
Pyrometric calibration of a radiation source: The emitted radiated temperature of a calibration source is measured with a highly accurate non-contact transfer-standard-pyrometer using $\varepsilon = 1$. The temperature indication of the calibration source is then adjusted to the measured temperature of this pyrometer. This results in an effective emissivity of the calibration source in a defined spectral range of $\varepsilon_{eff} = 1$ (as an exception in 2 cases the emissivity of the transfer-standard-pyrometer is set to a value smaller than 1, so that this value is also the effective emissivity (ε_{eff}) of the blackbody calibration source).

Contact thermometric calibration of a radiation source: the emitter temperature of the calibration source is measured and indicated by a built-in high precision RTD in an additional hole in the emitter.

Aperture / Emitter Area
The aperture is defined as the maximum usable diameter of the radiation source opening for calibration. In the case of large-area radiation sources, the emitter area is usable for calibration. The size of the aperture, respectively the emitter area, has to be chosen depending on the spot size of the infrared measurement device to be calibrated. It also has to be significantly larger than the spot size.

Uncertainty of Temperature
Indication of the tolerance of the accuracy.

Average Warm-up Time
The average warm up time gives the time period needed to indicate the usability of the radiation source at the stated temperature.

Dimensions and Weight
The dimensions and the weight of the calibration source indicate the usage as a portable or stationary instrument.

TRANSFER-STANDARD-PYROMETER

The accuracy of a calibration source is likely to drift over the course of time from the defined specification. If high accuracy is needed in the long term, verification of the radiator on a regular basis is mandatory. This verification is achieved by using a special pyrometer that is built to meet the high accuracy specifications and is used to transfer temperature data from a primary infrared source to other calibration sources.

This high accuracy is achieved by the Impac® transfer standard pyrometer IS 12-TSP or IGA 12-TSP. It is specifically designed for exact verification of a blackbody source. The TSP instruments are available for temperature measurement between 200 and 2550°C. Featuring a resolution of only 0.01°C (10 mK) and the required extremely high accuracy and long term stability, this unit provides the basis for a reliable and long lasting operation of a calibration-source and guarantees the back-traceability to the international temperature scale ITS90.



IS 12-TSP with power supply and robust carrying case

CALIBRATION SOURCE OVERVIEW

ORDERING INFORMATION

Reference Numbers				
Type	**Interface**	**115 VAC**	**208 VAC**	**230 VAC**
Portable Versions				
M316	–	14499	–	14499-2
Large Area Versions				
M315X4-HT	RS232	19230-3	–	19230-1
M315X6-HT	RS232	–	–	19100-4
M315X8-HT	RS232	–	19200-4 (NA)	19200-5 (EU)
M315X12-HT	RS232	–	18769-4 (NA)	18769-3 (EU)
M315X4	RS232[3]	19180-4	–	19180-1
M315X6	RS232[3]	19100-3	–	–
M345X4	RS232[3]	17100-4	–	17100-5
M345X4D	RS232[3]	17100-4D	–	17100-5D
M345X6	RS232[3]	16770-2	–	16770-3
M345X8	RS232[3]	17435-4	–	17435-7
M345X12	RS232[3]	16700-11	–	16700-22
M345X6-LC	RS232	–	–	20214-2
Low Temperature Versions up to 150°C (302°F)				
IRC 45	–	–	–	3 891 130
IRC 70	-	-	-	3 891 140
IRC 75	–	–	–	3 891 150
IRC 95	–	–	–	3 891 160
IRC 100	–	–	–	3 891 170
IRC 110	–	–	–	3 891 180
IRC 120	–	–	–	3 890 410
IRC 140	–	–	–	3 891 190
IRC 150	–	–	–	3 891 200
M340	RS232	14750-4	–	14750-5
Low Temperature Versions up to 450°C (842°F)				
M310-HT	RS232	14760-111202	–	14760-221212
M315-HT	RS232	14960-4	–	14960-3
Mid Temperature Versions up to 1150°C (2102°F)				
M300	RS232[3]	–	–	18680-3
M305	RS232[3]	14430-1	–	14430-2
M360	RS232[3]	14920-1	–	14920-2
High Temperature Versions				
M330-US	RS232	–	–	18670-1 (NA)
M330-EU	RS232	–	–	3 801 200
M335	RS232[3]	14900-1	–	14900-2
M390-A2	RS232	–	14029-A2	14029-A2
M390-B2	RS232	–	14029-B2	14029-B2
M390-C2	RS232	–	14029-C2	14029-C2
M390-L1	RS232	–	14029-L1	14029-L1
M390-S	RS232	–	18519-1	18519-1

1 Optional with RS232 or RS485
2 Optional with RS232
3 Optional with RS485
4 With optional calibration port

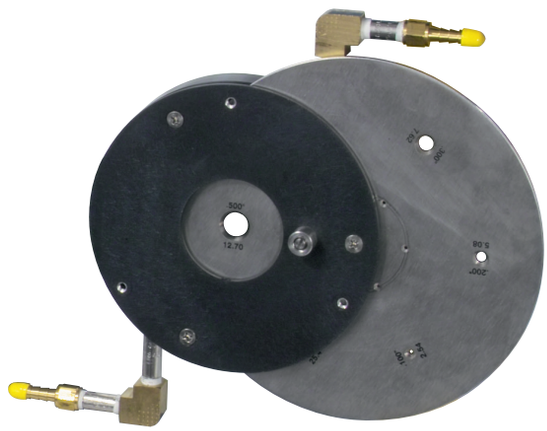
ACCESSORIES AND OPTIONS

Additional Models and Options	
PN	**Description**
3 890 420	Case for IRC calibration sources (IRC 45 to 150)
3 826 600	Infrared radiation unit for mobile calibrations, with metal band, up to 1300°C (RS232/485, 400 VAC)
3 826 610	Laptop for mobile infrared radiation unit, incl. USB-RS232-converter and InfraJust software
3 826 380	Calibration Software InfraJust
3 826 620	Replacement metal band for mobile infrared radiation unit, up to 1300°C
3 826 630	Pyrometer adjustment base for mobile infrared radiation unit
3 840 400	IS 12-C Control Pyrometer f. mobile infrared radiation unit, 550 to 1300°C, through lens sighting, laser targeting, adjustment base, connect. cable
3 840 410	IGA 12-C Control Pyrometer f. mobile infrared radiation unit, 250 to 1300°C, through lens sighting, laser targeting, adjustment base, connec. cable
3 840 710	IS 12-TSP Transfer-Standard-Pyrometer, 940 nm, 600 to 2520°C
3 840 720	IS 12-TSP Transfer-Standard-Pyrometer IS, 940 nm, 600 to 3000°C
3 840 760	IS 12-TSP Transfer-Standard-Pyrometer, 650 nm, 850 to 2520°C
3 840 810	IS 12-TSP Transfer-Standard-Pyrometer 1570 nm, 200 to 1020°C
3 840 820	IS 12-TSP Transfer-Standard-Pyrometer, 1570 nm, 250 to 1400°C
19140-485	Option: Serial communication output RS485 for M300, M305, M315X, M335, M345X, M360, M360A, M390
14002-1	Cold aperture wheel assembly, 6 apertures 25.4 - 2.54 mm, for M300, M305, M330, M335, M390
14002	Cold aperture wheel assembly, 6 apertures 50 - 1.56 mm, for M300, M305, M330, M335, M390
6 894 030	Universal mounting flange

WATER-COOLED WHEEL ASSEMBLY

To calibrate or verify the field of view of pyrometers, radiation measurement devices or thermal imagers, apertures of defined diameters are needed in the majority of cases.

With the water-cooled wheel assembly two models each with six different diameters from 2.54 mm to 25.4 mm or 2 to 50 mm are available, which can be easily attached to calibration sources. Different diameters are selectable by rotating the aperture. The wheel assembly is cooled by water or dry air to reduce the influence of the background temperature.



Mikron Infrared Blackbody Aperture Wheels							
PN	**Aperture Position (in mm)**						
	A	**B**	**C**	**D**	**E**	**F**	**G**
14002	50[1]	25	12.5	6.25	3.12	1.56	
14002-1	25.4	12.7	10.16	7.62	5.08	2.54	

1 Not useable on blackbodies that have 25.4 mm exit apertures.



ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

PRECISION | POWER | PERFORMANCE

For international contact information, visit advancedenergy.com.

sales.support@aei.com
+1 970 221 0108

Specifications are subject to change without notice. Not responsible for errors or omissions. ©2020 Advanced Energy Industries, Inc. All rights reserved. Advanced Energy®, Mikron®, and AE® are U.S. trademarks of Advanced Energy Industries, Inc.

ENG-CalibrationOverview-261-01 6.20