

**64 Series**

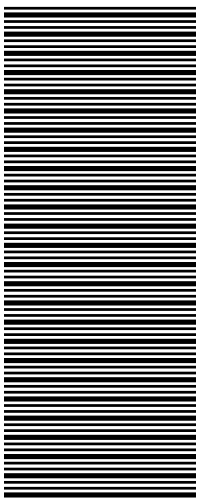
**MEDTHERM  
CORPORATION**

# **HEAT FLUX TRANSDUCERS and INFRARED RADIOMETERS**

**for the DIRECT MEASUREMENT  
OF HEAT TRANSFER RATES**

**MEDTHERM 64 SERIES** heat flux transducers and infrared radiometers have been proven in thousands of applications for over thirty years - in ground and flight aerospace testing, fire testing, heat flux standards for flammability testing, heat transfer research, materials development, and furnace development.

**NIST traceable comparison calibrations to ISO/IEC 17025** are referenced both to blackbodies as standard sources and **MEDTHERM Kendall Absolute Cavity (ECR) Radiometers** as standard detectors.



- **LINEAR OUTPUT**
- **OUTPUT DIRECTLY PROPORTIONAL TO HEAT TRANSFER RATE**
- **ACCURATE, RUGGED, RELIABLE**
- **UNCOOLED MODELS, WATER COOLED MODELS, GAS PURGED MODELS**
- **RADIOMETER AND LIMITED VIEW ACCESSORIES**
- **MEASURE TOTAL HEAT FLUX**
- **MEASURE RADIANT HEAT FLUX**

# 64 SERIES HEAT FLUX TRANSDUCERS

## DESCRIPTION

MEDTHERM 64 Series Heat Flux Transducers offer dependable direct measurement of heat transfer rates in a variety of applications due to careful design, rugged quality construction and versatile mounting configurations. Each transducer will provide a self-generated 10-millivolts (nominal) output at the design heat flux level. Continuous readings from zero to 150% design heat flux are made with infinite resolution. The linear transducer output is directly proportional to the net heat transfer rate absorbed by the sensor.

64 Series transducers have for almost forty years met thousands of application challenges in ground and flight aerospace testing, fire testing, flammability heat flux standards, heat transfer research, materials development, and furnace development.

## CALIBRATION

Each transducer is provided with a certified comparison calibration per written procedures to ANSI/NCSS Z540-1, ISO 10012-1, and ISO/IEC 17025. Calibrations are traceable through temperature standards and electrical standards to the National Institute of Standards and Technology (NIST). Calibrations are radiant calibrations, referenced both to blackbody simulators as source standards and to a set of MEDTHERM Kendall Absolute Cavity (ECR) Radiometers as detector standards. Special calibrations are also available.

## FEATURES

- \* LINEAR OUTPUT
- \* OUTPUT PROPORTIONAL TO HEAT TRANSFER RATE
- \* ACCURATE, RUGGED, RELIABLE
- \* CONVENIENT MOUNTING
- \* UNCOOLED, WATER COOLED, GAS PURGED MODELS
- \* RADIOMETER AND LIMITED VIEW ACCESSORIES
- \* MEASURE TOTAL HEAT FLUX
- \* MEASURE RADIANT HEAT FLUX

## CONSTRUCTION

ACCURACY, RUGGEDNESS AND RELIABILITY are provided by the thoroughly proven Gardon and Schmidt-Boelter sensors.

LONG TRANSDUCER LIFE AND SIGNAL STABILITY are enhanced by the massive body of OFHC copper.

PROTECTION AGAINST ROUGH HANDLING in mounting is provided by a stainless steel flange when specified.

SIGNAL INTEGRITY is protected by the use of welded connections, stranded lead wire with braided copper shielding and Teflon insulation firmly secured in the transducer body with strain relief to ensure resistance to rough handling and stray signals.

## ACCESSORIES

REMOVABLE WINDOW ATTACHMENTS, with the standard sapphire or optional window materials, are available to limit the basic transducer to measurement of radiation heat flux only.

VIEW RESTRICTOR ATTACHMENTS are available to limit the angle of view for the basic transducer to 150°, 120°, 90°, 60°, 30°, 15°, or 7° for narrow view angle measurements.

DIRECT READING HEAT FLUX INDICATORS Models H-201, H-203, and H-204 are available for direct digital readout in any heat flux units from any linear heat flux transducer input. An amplified analog output is provided on some. Ask for Bulletin.

BODY TEMPERATURE THERMOCOUPLE measurement can be provided by an optional copper/constantan 24 AWG solid conductor thermocouple, with TIG welded junction and Teflon insulated duplex wire.

## OPERATING PRINCIPLES

The 64 Series transducers are of two basic sensor types, the Gardon type sensor, standard in the ranges from 5 to 4000 Btu/(ft<sup>2</sup>·s), and the MEDTHERM Schmidt-Boelter thermopile type sensor, standard in the 0.2 to 4 Btu/(ft<sup>2</sup>·s) ranges. In both type sensors heat flux is absorbed at the sensor surface and is transferred to an integral heat sink that remains at a different temperature than the sensor surface. The difference in temperature between two selected points along the path of the heat flow from the sensor to the sink is a function of the heat being transferred, and a function of the net absorbed heat flux. At two such points, MEDTHERM transducers have thermocouples or thermopiles to form a differential thermoelectric circuit, thus providing a self-generated emf at the output leads that is directly proportional to the heat transfer rate. No power supply or thermoelectric reference junction is needed.

Gardon gages absorb heat in a thin metallic circular foil and transfer the heat radially (parallel to the absorbing surface) to the heat sink welded around the periphery of the foil. The emf output is generated by a single differential thermocouple between the foil center temperature and foil edge temperature.

MEDTHERM Schmidt-Boelter gages absorb the heat at one surface and transfer the heat in a direction normal to the absorbing surface. The emf output is generated by a multi-junction thermopile responding to the difference in temperature between the surface and a plane beneath the surface. The Schmidt-Boelter thermopile sensor is always used below 5 Btu/(ft<sup>2</sup>·s). It can be optionally specified up to 100 Btu/(ft<sup>2</sup>·s).

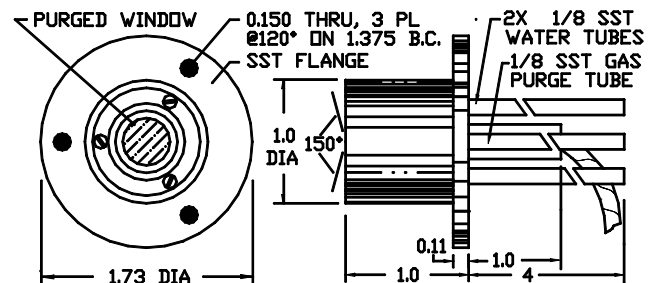
OPTIONAL FEATURES include four mounting configurations, window attachments, water cooling provisions, or thermocouples for body temperature measurement. Water-cooling should be specified if the uncooled transducer is expected to reach above 400°F.

The gas purging provision should be included on radiation transducers that are to be used in a sooty environment. The MEDTHERM purge is designed to pass rigid NASA performance tests with fuel-rich oxy-acetylene flames directed towards the window at close range.

## STANDARD CONFIGURATIONS

The basic transducer may be selected with either of four mounting configurations and with or without provisions for water cooling of the transducer body. The listed radiometers are provided with gas purging to keep the radiation-transmitting window clean. When the purge provision is included, the window is installed internally at MEDTHERM and is not an accessory. Basic transducers can be converted to unpurged radiometers by addition of a window attachment, but the standard purged radiometers can not be converted to basic transducers. (Inquire about other models with this feature.)

### FLANGED RADIOMETER WITH GAS PURGING PROVISIONS



All listed gas purged models are provided with water cooling provisions. Call MEDTHERM for uncooled purged radiometers.

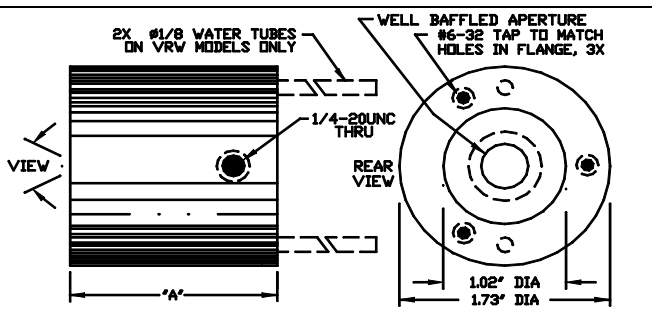
**STANDARD MOUNTING CONFIGURATIONS ARE ILLUSTRATED BELOW.** There is the smooth body with flange, the threaded body with flange, the smooth body without flange, and the threaded body without flange. All mounting flanges are 1.73" dia. with 0.150" dia. mounting holes equally spaced on a 1.375" dia. bolt circle. Water-cooling tubes (when specified) and gas purge tubes are 1/8" dia. SST. All tubes are 4" long. (Other tube diameters, lengths, and fittings are available.) All threaded bodies have 1-12UNF-2A threads.

<b>SMOOTH BODY WITH FLANGE</b> DESCRIPTION :      MODEL NO. BASIC, UNCOOLED      64-xx-16 WATER COOLED      64-xx-20 RADIOMETER, GAS PURGED, COOLED      64P-xx-24		<b>THREADED BODY WITH FLANGE</b> DESCRIPTION :      MODEL NO. BASIC, UNCOOLED      64-xx-17 WATER COOLED      64-xx-21 RADIOMETER, GAS PURGED, COOLED      64P-xx-25		<b>SMOOTH BODY, NO FLANGE</b> DESCRIPTION :      MODEL NO. BASIC, UNCOOLED      64-xx-14 WATER COOLED      64-xx-18 RADIOMETER, GAS PURGED, COOLED      64P-xx-22		<b>THREADED BODY, NO FLANGE</b> DESCRIPTION :      MODEL NO. BASIC, UNCOOLED      64-xx-15 WATER COOLED      64-xx-19 RADIOMETER, GAS PURGED, COOLED      64P-xx-23	

**WINDOW ATTACHMENTS** may be added for elimination of convective heat transfer, thus making the transducer a radiometer or radiation heat flux transducer. Sapphire is the standard window material. A broad selection of other materials is available per the list on page 4. Standard view angles available are: 90°, 120°, and 150°. Window attachments are removable and replaceable by the user. When the window is used the sensitivity of the basic transducer is reduced to a nominal fraction of the original as follows: 90°, 43%; 120°, 64%; and 150°, 79%. Thickness of the attachment varies with view angle and sensor type from 1/16" to 3/8".

	<b>BODY TYPE "D"</b>	<b>CALIB?</b>	<b>MODEL</b>
	SMOOTH 1.0	NO	SW-1-YY
	THREADED 0.84	NO	SW-2-YY
	SMOOTH 1.0	YES	SW-1C-YY
	THREADED 0.84	YES	SW-2C-YY

**VIEW RESTRICTOR ATTACHMENTS** for limiting the area viewed or seen by the sensor are available for making spot radiation or remote temperature measurements. Attachments may be ordered with or without water-cooling and with or without an additional calibration with the attachment in place. Flanged transducers attach to the back. A 1/4"-20UNC set screw holds unflanged transducers and provides tripod mount access.



VIEW ANGLE	"A"	NOMINAL % BASIC SENSITIVITY	MODEL NO.	
			UNCOOLED	COOLED
7°	3.9"	0.4%	VR-7	VRW-7
15°	2.3"	1.7%	VR-15	VRW-15
30°	1.6"	6.6%	VR-30	VRW-30
60°	1.2"	25.0%	VR-60	VRW-60

**SPECIFICATIONS**

**STANDARD RANGES AVAILABLE:** Full scale design heat flux level: 4000, 3000, 2500, 2000, 1500, 1000, 500, 250, 200, 100, 50, 30, 25, 20, 15, 10, 5, 2, 1, 0.5, 0.2 Btu/(ft<sup>2</sup>-s). (Custom ranges available.)

**OUTPUT SIGNAL:** linear output, 10 millivolts nominal at full range.

**MAXIMUM ALLOWABLE OPERATING BODY TEMPERATURE:** 400 °F.

**OVERRANGE CAPABILITY:** to 150% range for 2-1000 Btu/(ft<sup>2</sup>-s) ranges.

**MAXIMUM NON-LINEARITY:** ± 2% of full range.

**REPEATABILITY:** ± 1/2%

**CALIBRATION EXPANDED UNCERTAINTY:** ± 3% for ranges to 250 Btu/(ft<sup>2</sup>-s), coverage factor k=2, for approximate 95% confidence level.

**CALIBRATION:** Each transducer is provided with a certified radiant heat flux comparison calibration to ANSI/NCSL Z540-1, and ISO/IEC 17025. Calibrations are traceable through temperature standards and electrical standards to the National Institute of Standards and Technology (NIST). Radiant comparisons are made to working standard heat flux transducers of similar type. The working standards are regularly calibrated versus both blackbody simulators as standard sources and versus a set of MEDTHERM Kendall Absolute Cavity (ECR) Radiometers as standard detectors. (The ECR is an electrical substitution calibrated cavity radiometer, an absolute detector in that it requires only NIST-traceable electrical standards of the volt and ohm to determine irradiance.) Special calibrations, including a direct comparison to a MEDTHERM absolute ECR, are available at additional cost.

**SENSOR ABSORPTANCE (Hemispherical):** Gardon gages, .92, nominal, from 0.6 to 15.0 μm. Thermopiles, .95, nominal, from 0.6 to 15.0 μm.

**SPECTRUM TRANSMITTED BY SAPPHIRE WINDOW (When used):** 85% nominal from 0.15 to 5.0 μm. Other window materials are optional.

**LEAD WIRE:** 24 AWG stranded copper twisted pair, Teflon insulation over each, braided copper shield, Teflon jacket overall, 36" standard length with stripped ends. (The optional body thermocouple wire is 24 AWG Teflon/Teflon insulated duplex solid conductor.)

**TIME CONSTANT:** (63.2% response to a step radiant heat Input)

250 to 4000 Btu/(ft<sup>2</sup>-s): less than 50 ms.

50 to 200 Btu/(ft<sup>2</sup>-s): less than 100 ms.

2 to 30 Btu/(ft<sup>2</sup>-s): less than 250 ms.

**SENSOR TYPE:** (Standard, options available)

5 to 4000 Btu/(ft<sup>2</sup>-s): Gardon Gage (Except S-B for 64P-5 models)

0.2 to 4 Btu/(ft<sup>2</sup>-s): Schmidt-Boelter (Schmidt-Boelter sensors are also available as an option from 5 to 100 Btu/(ft<sup>2</sup>-s) ranges.)

**NOMINAL IMPEDANCE:** (With standard leadwire)

Less than 10 ohms on Gardon Gages

Less than 250 ohms on Schmidt-Boelter Gages.

**HEAT CAPACITY OF UNCOOLED UNITS:** Energy that can be absorbed by transducer in an adiabatic installation (defined as all surfaces perfectly thermally insulated except for 1-inch diameter sensor face) before exceeding the 400 °F maximum body temperature limitation:

Model without water cooling provisions: 6.2 Btu

Models with water cooling provisions but without water: 4.2 Btu

**MAXIMUM PURGE GAS PRESSURE:** 150 psi over ambient

**ORDERING INFORMATION:**

**PRICE**

**PRICE**

**DESCRIPTION**

**MODEL NO. (P/N)**

**Schmidt-Boelter Thermopile (SB) Heat Flux Range of 0.5, 1, 2 Btu/(ft<sup>2</sup>-s) \***

**Gardon Gage (GG) Heat Flux Range of 5 Btu/(ft<sup>2</sup>-s) and up**

\*\*\*\*\* **BASIC TRANSDUCER, NO WATER COOLING PROVISIONS** \*\*\*\*\*

SMOOTH BODY, NO FLANGE	64-xx-14
THREADED BODY, NO FLANGE	64-xx-15
SMOOTH BODY, WITH FLANGE	64-xx-16
THREADED BODY, WITH FLANGE	64-xx-17

\*\*\*\*\* **BASIC TRANSDUCER WITH WATER COOLING PROVISIONS** \*\*\*\*\*

SMOOTH BODY, NO FLANGE	64-xx-18
THREADED BODY, NO FLANGE	64-xx-19
SMOOTH BODY, WITH FLANGE	64-xx-20
THREADED BODY, WITH FLANGE	64-xx-21

\*\*\*\*\* **RADIATION TRANSDUCER WITH SAPPHIRE WINDOW, GAS PURGE AND WATER COOLING PROVISIONS** \*\*\*\*\*

SMOOTH BODY, NO FLANGE	64P-xx-22
THREADED BODY, NO FLANGE	64TP-xx-23
SMOOTH BODY, WITH FLANGE	64P-xx-24
THREADED BODY, WITH FLANGE	64TP-xx-25

1. Specify Model Number. Transducer price includes factory calibration to ANSI/NCSL Z540-1 and ISO/IEC 17025.
2. Insert desired design full-scale heat flux level in place of "xx" in the Model Number (P/N), in Btu/(ft<sup>2</sup>-s).
3. \* The 0.2 Btu/(ft<sup>2</sup>-s) range, the most sensitive sensor, is at additional cost.
4. SB sensor is optional in 5 Btu/(ft<sup>2</sup>-s) range at above SB price. Add SB after "xx" in P/N. For SB in ranges from 10 to 40 Btu/(ft<sup>2</sup>-s). Contact factory for SB price at higher range, up to 400 Btu/(ft<sup>2</sup>-s).
5. For copper/constantan body temperature thermocouple on any of the above transducers, add T to Model Number and add to the basic price. For other thermocouple materials, substitute for T the desired ANSI letter code (K, E, or J), add to the basic price. For surface thermocouple on SB only, add S before ANSI letter code, add to the SB price.
6. \* The standard sensor for the 5 Btu/(ft<sup>2</sup>-s) 64P and 64TP radiometers is a Schmidt-Boelter thermopile. Use SB price.
7. Specify calibration units desired (W/cm<sup>2</sup>, kW/m<sup>2</sup>, etc.), if not Btu/(ft<sup>2</sup>-s), at same price. (1 Btu/(ft<sup>2</sup>-s) = 1.135 W/cm<sup>2</sup>)

**ACCESSORIES**

When ordered with a transducer, if unlisted calibration with an accessory is desired, add C to the Model Number and the additional calibration price to the basic price of the accessory, i.e., VRW-7C.

<b>DESCRIPTION</b>	<b>MODEL NO. (P/N)</b>	<b>PRICE</b>
SAPPHIRE WINDOW ATTACHMENT without calibration	SW-1-YY or SW-2-YY	
SAPPHIRE WINDOW ATTACHMENT with calibration	SW-1C-YY or SW-2C-YY	
VIEW RESTRICTOR ATTACHMENTS	VR-7, VR-15, VR-30, VR-60	
VIEW RESTRICTOR ATTACHMENTS, WATER COOLED	VRW-7, VRW-15, VRW-30, VRW-60	
DIGITAL HEAT FLUX METER, with calibration certificate	H-201	
RECALIBRATION OF TRANSDUCER (when returned after use)	ALL 64 SERIES	

**TO SUBSTITUTE WINDOWS ON RADIOMETERS INSTEAD OF SAPPHIRE AT ADDITIONAL COST:**

Substitute Window, (1mm unless noted)	Symbol, Insert in P/N	(Approximate Transmittance Data, Details Available)		Additional Price
		Useful Wavelength Range, micrometers	"Flat" Wavelength Range, micrometers	
Sapphire (0.5 mm)		0.2 - 5.5	0.4 - 4.2	
Quartz (0.5 mm)	QW	0.12 - 4	0.27 - 3	
Calcium Fluoride	CaF2W	0.3 - 11.5	0.7 - 9	
KRS-5	KRS-5W	0.6 - 50	0.6 - 30	
Zinc Sulfide	ZnSW	0.5 - 14.5	0.8 - 12	
Barium Fluoride	BaF2W	0.5 - 12.5	0.3 - 10	
Zinc Selenide	ZnSeW	0.5 - 22	0.7 - 17	
Cadmium Telluride	CdTeW	0.8 - 30	1 - 20	

OTHER WINDOW AND FILTER MATERIALS, RADIOMETERS WITHOUT GAS PURGE, LARGER WATER TUBES, PRECISELY TAILORED OUTPUTS, FAST RESPONSE TIMES, RESPONSE TIME TESTS, FLIGHT SIMULATIONS, OUTPUT WIRES AND COOLING TUBES OUT THE SIDE, HIGH TEMP WIRES, ABSOLUTE CAVITY RADIOMETER STANDARDS, SETS OF TRANSFER CALIBRATION STANDARDS, AND MORE ACCESSORIES ARE AVAILABLE.

In addition to the size ranges offered in the 64 Series Heat Flux Transducers (1 inch basic diameter) MEDTHERM offers the 4 Series (1/16 inch basic diameter), 8 Series (1/8 inch basic diameter), the 16 Series (1/4 inch basic diameter), the 24 Series (3/8 inch basic diameter), the 32 Series (1/2 inch basic diameter), 40 Series (5/8 inch basic diameter), and the 48 Series (3/4 inch basic diameter), as well as flat and rectangular transducers with a variety of sensor types. We specialize in the rapid design and manufacture of custom heat flux transducers for your particular applications. Write or call the factory for recommendations and quotations for your requirements.

FLIGHT QUALIFIED HEAT FLUX TRANSDUCERS (SINCE 1970) ARE AVAILABLE IN A WIDE VARIETY OF SHAPES, SIZES, RESPONSE TIMES, AND DESIGN HEAT FLUX LEVELS. PLEASE CONTACT THE FACTORY FOR DETAILS.

BULLETIN 118  
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