NONCONTACT POSITION MEASURING SYSTEM

KμDA™ SERIES

Kaman's micro **digital** advantage

DesignFax
Product of the Month
August 1999

Complete process control made simple and economical

FEATURES AND BENEFITS

- Measures in minutes; quick set-up.
- Push-button calibration, easy-to-use.
- Data acquisition is easy: no A/D card.
- Mix sensors with same electronics.
- Custom configurations.
- Software upgrades free on Internet.
- Digital filtering.
- Microinch resolution.
- Fast sampling, up to 10,000/second.
- Powerful new signal conditioning and error correction.
- Ideal for process control.
- Rugged sensors operate up to 200°C.
- Active temperature compensation: less than 0.01%/°C.
- Analog voltage and current output.
- RS-232 and RS-485 multidrop for sensor networking.
- Unmatched precision and reliability.

www.kamansensors.com
800-552-6267

KAMAN

WHY DIGITAL

KμDA is a high-precision, eddy current system. Microprocessor-based sensing systems offer many benefits over analog systems, especially in applications that have many variables. Kaman's KμDA, a smart digital system, has the ability to implement many control features that in the past required a PLC or other microprocessor-based controller.

STAND ALONE OPERATION

KμDA incorporates a 32-bit microprocessor, advanced signal conditioning electronics, and flash memory. Configuration, set-up, and calibration are accomplished either by pushing the buttons on the front panel, or by connecting KμDA to a PC and running KμDAView™, Kaman's proprietary software that is included with every system. All operating parameters are stored internally, so you can disconnect KμDA from the PC and retain all programming.

CONFIGURABLE

You can configure a KμDA system to operate with any of eight standard KμDA sensors, which offer ranges from .020" to 1.00". Custom sensors, as well as those used with other Kaman products, are also compatible with the KμDA electronics. You can save your configurations to a PC and then reload them into KμDA at a future date. If you decide to change sensors later, you simply set up KμDA to that new configuration.

KμDA is available as a single or dual-channel system. With a dual-channel KμDA, you can configure each channel for different sensors and for different target materials.

3-POINT LINEARITY CALIBRATION

You perform basic linearity calibration via push buttons. Because KμDA is digital, you do not need to turn potentiometers or use a voltmeter. Calibration is as easy as pushing these buttons on the front panel:

1. Select "Calibrate"
2. Select "Sensor 1" or "Sensor 2"
3. Set "Min" point
4. Set "Mid" point
5. Set "Max" point
6. Select "Run"

Standard system output is both +/-10 Vdc and 4-20 mA. By using KμDAView software, you can adjust the output voltage to anything that includes zero, such as 0 to 1 Vdc, +/-2.5 Vdc, -3.5 to 0 Vdc, or -2.5 to +3.5 Vdc.

21-POINT LINEARITY CALIBRATION

For applications requiring improved linearity, you can calibrate KμDA using 21 discrete, equidistant points over the standard or extended range of the sensor. This is a significant improvement over the 3-point linearity specification, depending on sensor size and target material. To calibrate to 21-point linearity, you follow the step-by-step instructions in KμDAView software.

TEMPERATURE COMPENSATION

The output of all eddy current-type displacement sensors is affected by changes in sensor temperature. Because KμDA is a digital system, it can actively monitor for changes in sensor temperature. If you perform a temperature compensated calibration in KμDAView, KμDA will actively compensate for both zero and slope shift of the analog output with changes in sensor temperature.

ANALOG OUTPUTS

Three outputs are standard with KμDA, each providing a separate analog voltage and 4-20 mA current output. The standard configuration is sensor 1 to output 1, sensor 2 to output 2. Output 3 is available for user-defined functions.

In many applications, you may not need to monitor the actual sensor outputs. In these cases, you can map the programmable functions and analysis results to any number of the outputs, providing useful information based on the sensor output. Examples of these outputs include:

1. Peak hold
2. Valley hold
3. Amplitude
4. Thickness
5. Centerline running position
6. Inside diameter
7. Outside diameter

All configurations of KμDA, including the outputs that you set via KμDAView, are stored in flash memory and retained even when disconnected from the PC or in the event of a power loss.

DIGITAL INPUTS

You can remotely trigger KμDA's programmable functions via three digital inputs on the terminal block or through three user-function push buttons on the front panel. This flexibility allows easy interface to PLC or PC-controlled process functions and identical functionality locally via the front panel.

KμDA can run as a stand-alone system, or system features can be enhanced via PC interface.

DIGITAL OUTPUTS (LIMITS)

KμDA is equipped with four discrete opto-isolated outputs. Each output can be individually configured to a variety of limit sources or inputs. Using a PC and KμDAView, you can set for each output level or window mode, high and low settings, active high or active low, and enabled or disabled. Once you have completed the configuration, you can disconnect the PC, and all settings are permanently stored in flash memory in KμDA.

PROGRAMMABLE FUNCTIONS

You can configure KμDA to be as "smart" as you need it to be. You have available four independent programmable functions capable of calculating such measurements as thickness, inside diameter (ID), outside diameter (OD), total indicated run out (TIR), vibration amplitude, and centerline running position. In addition, KμDA features two analysis functions with the ability to sample and buffer data and then process it to derive the peak, valley, average, or standard deviation of the sensor signal. Other programmable parameters related to the analysis include: threshold, hysteresis, sampling interval, maximum samples, and percent from start.

DATA COLLECTION

KμDA is an extremely powerful process control tool. When you connect KμDA to a PC or any process controller with serial communication capability, you can set it up to automatically write the collected data to a file on the PC's hard drive or floppy drive and automatically time and date stamp it. Based on how you wish to configure it, this can be done as often as each second, or once an hour, once a day, once a week. This makes KμDA ideal for SPC data collection. You can also query KμDA via the serial interface for information on a variety of condition parameters and output states.

KμDAVIEW™ SOFTWARE

Kaman includes the latest revision of KμDAView software with every KμDA. Loaded onto a PC running Windows95 or later, KμDAView configures and customizes KμDA for any application. In addition, KμDAView monitors individual outputs along with the limits and digital input and output conditions. KμDAView also allows you to open and configure any number of strip chart windows to monitor and log sensor or function outputs. KμDAView can support multiple KμDA installations via RS-485 communication.

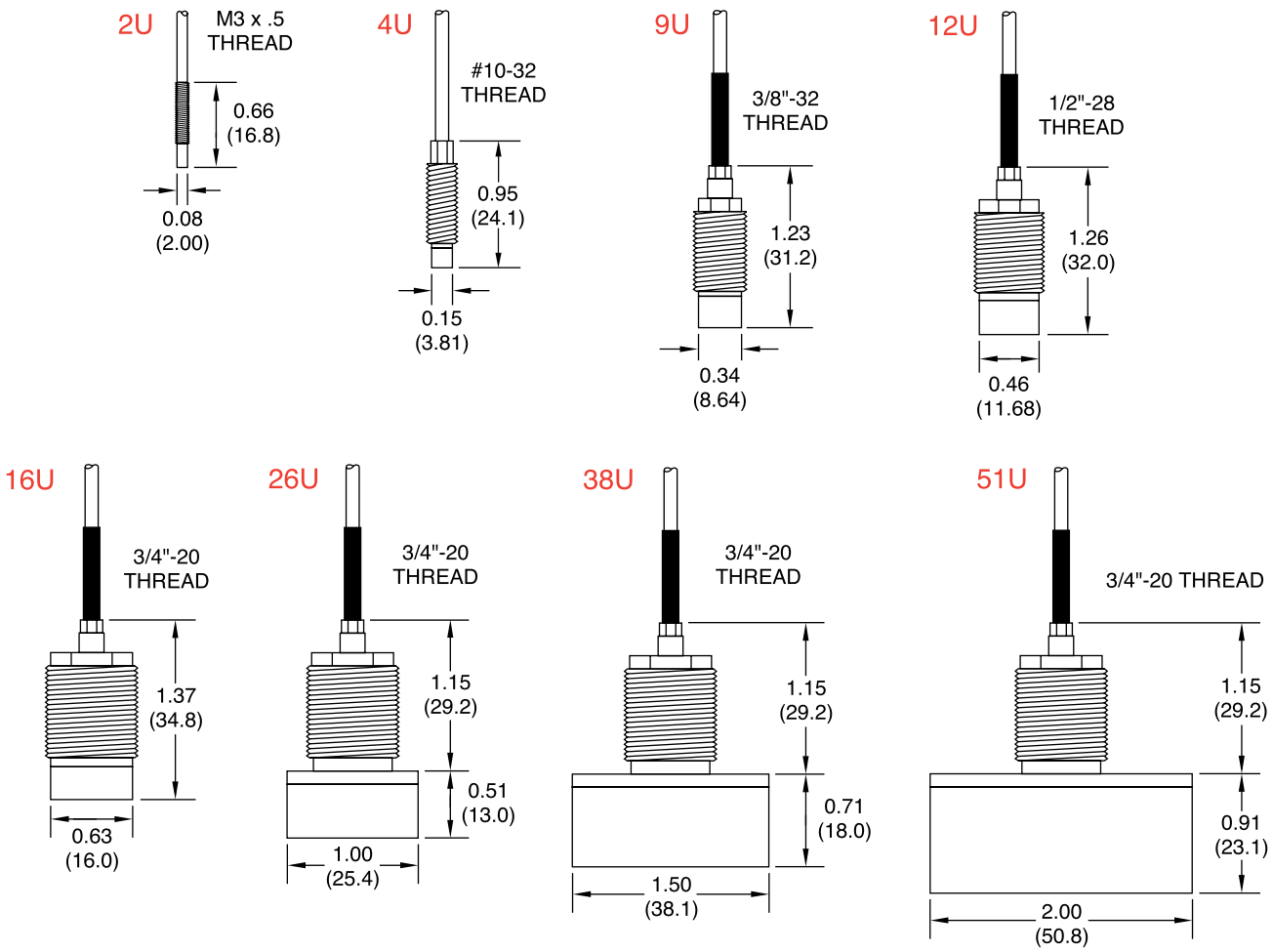
Engineering support from Kaman is always available if you desire to interface with a plant-wide control and data collection network.

EASY AND FLEXIBLE

KμDA is the most powerful position sensing system in the world. KμDAView software was written for ease of use and maximum flexibility. However, Kaman will configure KμDA for you at the factory if you desire. You provide Kaman with the specifications of your application, and Kaman will provide a KμDA that is fully operational right out of the box.

Kaman Instrumentation also offers you the option of downloading the latest version of KμDAView software directly from our web site. This allows you to keep your KμDA up-to-date with all the latest features and performance enhancements. Kaman also offers Application and Technical Notes on configuring KμDA to calculate target parameters such as ID, OD, thickness, and TIR. Our web site is updated often with additional Application and Technical Notes from actual case histories in many industries of how KμDA solved a tough measurement and control application.

Kaman Instrumentation's measuring systems products have been applied in nearly every industry imaginable from biomedical to metal forming, from aerospace to textile manufacturing, from power generation to semiconductor manufacturing. No matter what your application, chances are Kaman has a proven solution.



Sensors shown at 70% *Note: All dimensions shown in inches (mm).*

KµDA 19-inch rack mount

FEATURES AND BENEFITS

- Holds up to four dual-channel modules for a total of eight individual channels.
- Maximum of 12 analog outputs (three per module).
- RS-232 or RS-485 communication.
- Standard 19-inch Euro-rack includes power supply with built-in loss of power detection.

SENSOR SPECIFICATIONS FOR NON-MAGNETIC TARGETS *Characterized on aluminum*

Standard KμDA Sensor Type		2U	4U	9U	12U	16U	26U	38U	51U
Offset	inch (mm)	0.002 (0.05)	0.005 (0.125)	0.010 (0.25)	0.016 (0.4)	0.020 (0.5)	0.032 (0.8)	0.050 (1.2)	0.100 (1.5)
Full scale output voltage for testing	Volts dc	10	10	10	10	10	10	10	10
Sensor thermal sensitivity shift with active temp. compensation	%/°C maximum	±0.01 (standard range, 10 °C - 50 °C)							
Standard measuring range	inch (mm)	0.020 (0.5)	0.050 (1.25)	0.100 (2.5)	0.160 (4.0)	0.200 (5.0)	0.320 (8.0)	0.500 (12)	0.600 (15)
Nonlinearity with 3 point calibration (+/-%FS)	typical maximum	0.3 0.4	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.4 0.4	0.4 0.4
Nonlinearity with 21 point calibration (+/-%FS)	typical maximum	0.2 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2
Resolution (P-P %FS) 100 Hz mid scale 100 Hz full scale	typical typical	0.04 0.08		0.03 0.08					
Resolution (P-P %FS) 1000 Hz mid scale 1000 Hz full scale	typical typical	0.10 0.30		0.10 0.30					
Extended measuring range	inch (mm)	0.030 (0.75)	0.070 (1.75)	0.150 (3.75)	0.240 (6.0)	0.320 (8.0)	0.500 (12.5)	0.800 (20.25)	1.000 (25.5)
Nonlinearity with 3 point calibration (+/-%FS)	typical maximum	0.8 1.0	0.7 1.0	0.7 1.0	0.7 1.0	0.7 1.0	0.7 1.0	0.7 1.0	0.7 1.0
Nonlinearity with 21 point calibration (+/-%FS)	typical maximum	0.3 0.4	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3
Resolution (P-P %FS) 100 Hz mid scale 100 Hz full scale	typical typical	0.04 0.15		0.03 0.15					
Resolution (P-P %FS) 1000 Hz mid scale 1000 Hz full scale	typical typical	0.10 0.30		0.10 0.30					

SENSOR SPECIFICATIONS FOR MAGNETIC TARGETS *Characterized on 4130 steel*

Standard KμDA Sensor Type		2U**	4U**	9U**	12U**	16U	26U	38U	51U
Offset	inch (mm)	0.002 (0.05)	0.005 (0.125)	0.015 (0.375)	0.016 (0.4)	0.020 (0.5)	0.032 (0.8)	0.050 (1.2)	0.100 (1.5)
Full scale output voltage for testing	Volts dc	±10	±10	10	10	10	10	10	10
Sensor thermal sensitivity shift with active temp. compensation*	%/°C maximum	±0.03	±0.01	±0.01					
Standard measuring range	inch (mm)	0.010 (0.25)	0.020 (0.50)	0.100 (2.5)	0.160 (4.0)	0.200 (5.0)	0.320 (8.0)	0.500 (12)	0.600 (15)
Nonlinearity with 3 point calibration (+/-%FS)	typical maximum	0.3 0.5	0.3 0.5	0.8 1.0	0.8 1.0	0.8 1.0	0.3 0.5	0.3 0.5	0.3 0.5
Nonlinearity with 21 point calibration (+/-%FS)	typical maximum	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2	0.1 0.2
Resolution (P-P %FS) 100 Hz mid scale 100 Hz full scale	typical typical	0.06 0.12		0.03 0.09					
Resolution (P-P %FS) 1000 Hz mid scale 1000 Hz full scale	typical typical	0.10 0.30		0.10 0.30					
Extended measuring range	inch (mm)	0.015 (0.375)	0.025 (0.625)	0.150 (3.75)	0.240 (6.0)	0.320 (8.0)	0.500 (12.5)	0.800 (20.25)	1.000 (25.5)
Nonlinearity with 3 point calibration (+/-%FS)	typical maximum	0.8 1.0	0.8 1.0	0.8 1.0	0.8 1.0	0.8 1.0	0.8 1.0	0.8 1.0	0.8 1.0
Nonlinearity with 21 point calibration (+/-%FS)	typical maximum	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3	0.2 0.3
Resolution (P-P %FS) 100 Hz mid scale 100 Hz full scale	typical typical	0.06 0.15		0.04 0.15					
Resolution (P-P %FS) 1000 Hz mid scale 1000 Hz full scale	typical typical	0.10 0.30		0.10 0.30					

**Standard range, 25°C - 100°C.*
***Sensors not available with extension cable for steel.*

EXAMPLES OF CURRENT APPLICATIONS

DRIVE SHAFT BALANCING

GOAL

- Automate the QC testing of drive shafts on the balancing machine.
- Take data and derive TIR within two seconds.
- Must be integrated with existing PLC.

SOLUTION

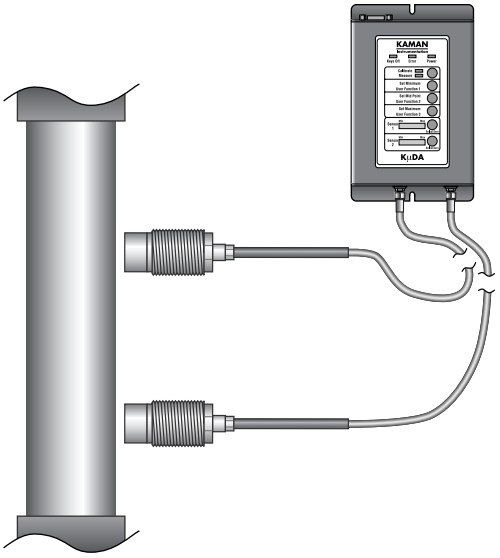
A two-channel KμDA system was installed with the sensors mounted to monitor each end of the rotating drive shaft. The PLC provided an output wired to one of the three digital inputs on KμDA which was configured to trigger two (one for each end of the drive shaft) of the KμDA programmable functions.

KμDA performed these functions on each sensor:

- Captured two seconds worth of data.
- Derived the peak and valley values, then subtract them.
- Sent this value to one of the three analog outputs.
- Triggered one of the digital outputs if the analog value exceeded the acceptance specification.

BENEFITS OF USING KμDA

- KμDA configurations are stored on board.
- KμDA takes on many of the tasks of PLC s.



- KμDA operates with all the benefits of digital circuitry, without a PC.
- With the use of a local enunciator wired to the KμDA digital output, the indication of pass or fail resided at the balancing with the technician.

DISK THICKNESS IN READ/WRITE HEAD MANUFACTURING

GOAL

- Implement a fast and accurate method to measure aluminum substrate thickness after lapping for sorting requirements.
- Must measure immediately after lapping. Discs will be wet and coated with residue. Cannot touch the disc.
- Must integrate with future process automation plans.

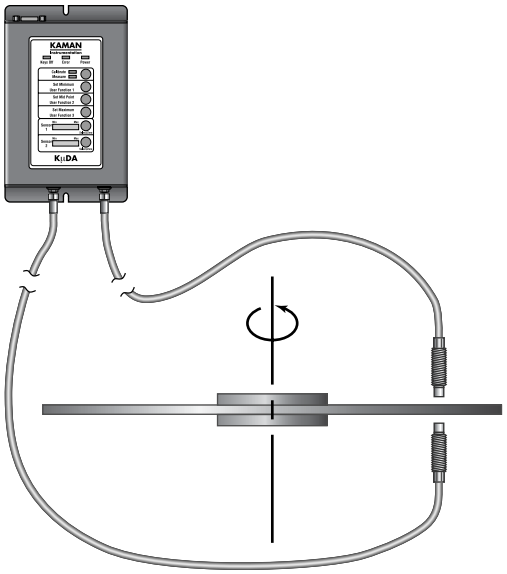
SOLUTION

A two-channel KμDA was integrated into a NEMA 4 rated tabletop system, with the sensors mounted a fixed distance apart on opposite sides of the disc. Using a disc of known thickness, the spacing between the sensors is derived and stored in KμDA.

The thickness of each disc placed in between the sensors is calculated by subtracting the sum of the output of both sensors from the stored sensor spacing value. KμDA is configured to provide the thickness as an analog output, which is displayed locally to the operator in engineering units.

BENEFITS OF USING KμDA

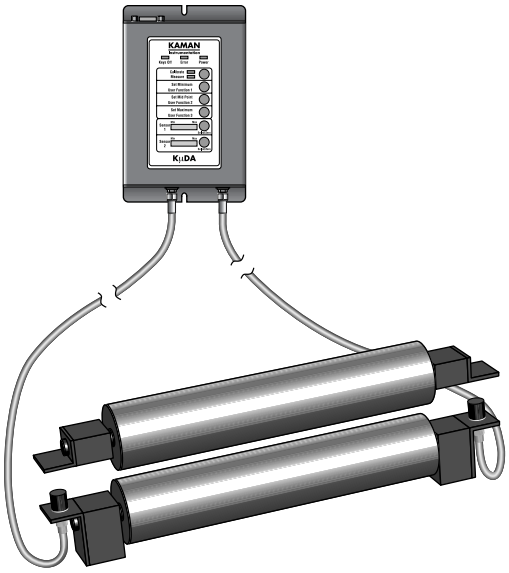
- KμDA configurations are stored on board. Once the configuration is set, KμDA operates without a PC.
- Performance can be verified as often as needed by checking the thickness of the known disc.



- KμDA is based on eddy current technology, so lapping residue, water, dirt, and grime are invisible.
- With built in digital I/O and RS-232/485, KμDA is ideal as a standalone system or easily integrated into any future automation process control platforms.

EXAMPLES OF CURRENT APPLICATIONS

ROLL GAP CONTROL AND WEB THICKNESS



GOAL

- Measure/display the gap at each end of a roller pair.
- Provide local digital display for technicians making routine adjustments to the roll gap.
- Provide for implementation of a plant-wide data acquisition system to monitor system performance.

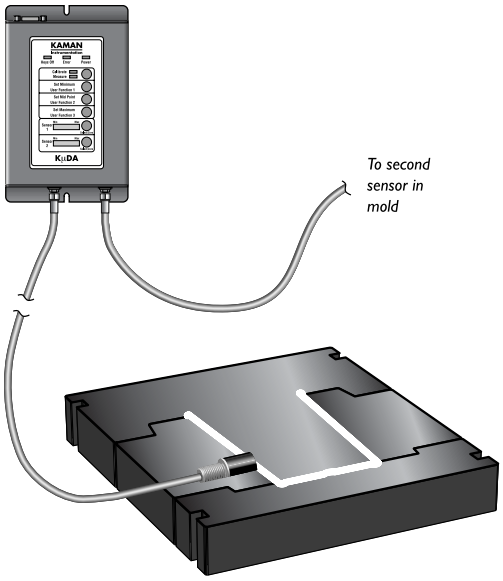
SOLUTION

A two-channel KμDA is integrated into a NEMA 4 rated enclosure with digital displays. A sensor is mounted to a lower roller bearing block and an aluminum target, to an upper block. With a known gap between the rollers, the sensor output is adjusted. Each sensor provides an analog voltage output proportional to the gap. KμDA calculates the difference between the sensor outputs and provides the difference between the gaps at each end of the roller. A limit output is triggered when this value exceeds a prescribed threshold, indicating a need for maintenance.

BENEFITS OF USING KμDA

- KμDA configurations are stored on board. Once the configuration is set, KμDA operates without a PC.
- KμDA is an eddy current system and unaffected by the cleanliness of the material being measured.
- RS-485 drop allows future integration into SPC/PM systems.

PLASTIC INJECTION MOLDING WALL THICKNESS



GOAL

- Monitor core movement in-situ during the injection molding process.
- Integrate into a plant-wide data acquisition and control system.
- Survive the high temperature and pressure of the mold environment.

SOLUTION

Kaman designed a custom sensor to meet the pressure (20,000 psi) and temperature (500° F) requirements. This sensor is characterized with KμDA electronics and embedded into the wall of the mold used for making medical waste buckets with stringent wall thickness specifications. The sensor face forms part of the mold wall and senses any movement of the core. The system alarms if movement is detected that exceeds the specified limit, triggering the material handler to discard any out-of-spec bucket. Via RS-232/485 interface, the data from each part is captured by the plant wide data acquisition system.

BENEFITS OF USING KμDA

- KμDA configurations can be stored and loaded as required by the plant wide data acquisition and control program. This allows an individual sensor to remain with the mold. When mold change is required to run different parts, the sensor in the new mold is attached to the KμDA and the control program loads the configuration for that sensor. All configuration data, calibration parameters, alarms, and functions are downloaded.
- KμDA is an eddy current system and unaffected by the presence of plastic in either liquid or solid form.
- Active temperature compensation allows for accurate readings regardless of the variation in temperature of the mold.

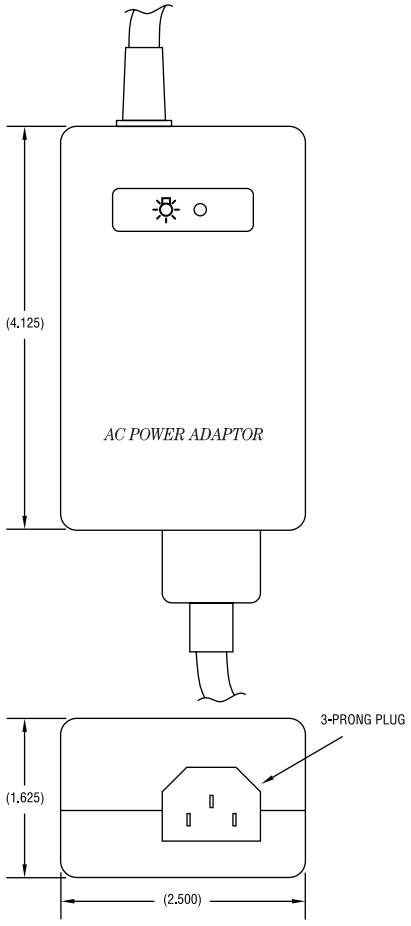
SPECIFICATIONS

Operating temperature range:
Sensors (4U through 51U): -55°C to +200°C.
Sensor (2U): -55°C to +105°C.
Electronics: -20°C to +50°C.

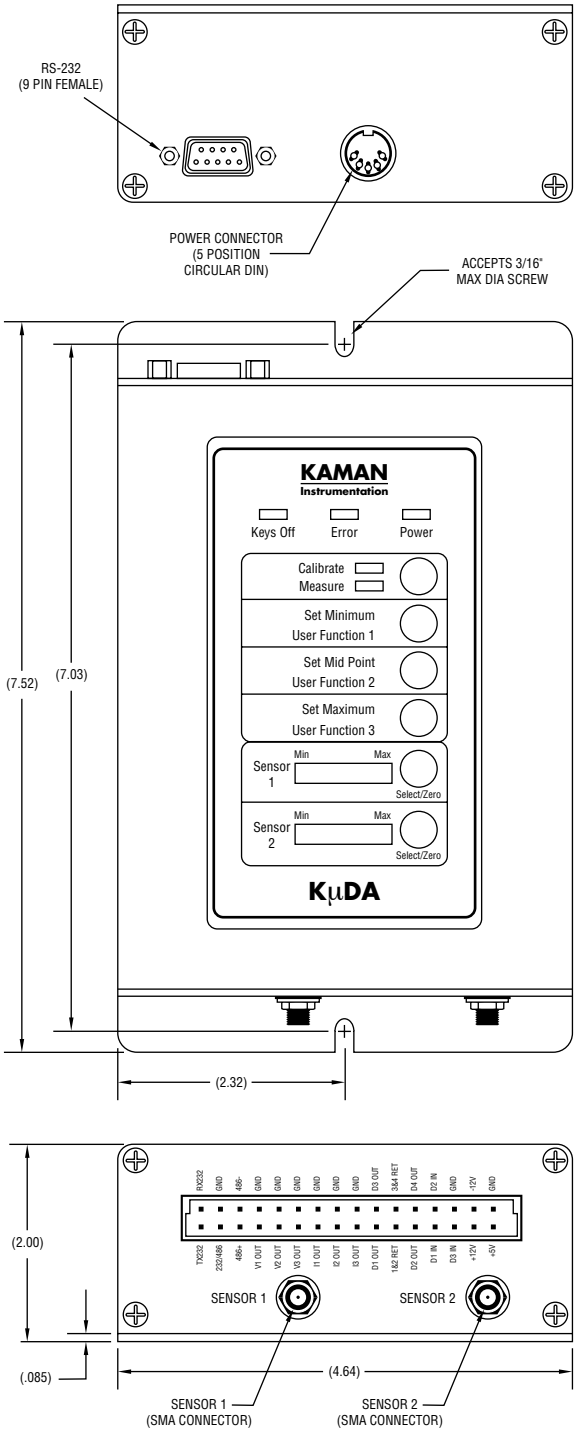
Storage temperature range:
Sensors (4U through 51U): -55°C to +200°C.
Sensor (2U): -55°C to +105°C.
Electronics: -55°C to +105°C.

Power supply: +5 VDC, ±12 VDC.

Cable length: 2m standard with optional 3m extension.



All dimensions in inches.



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