USER GUIDE

SERIES 545

DIGITAL MASS FLOWMETER

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INTRODUCTION

The Kurz Series 545 Digital Mass Flowmeter is a rugged industrial grade mass flowmeter with several outstanding features. Pressure drops are extremely low, typically 2" of water or about 1/15th of 1 PSI, resulting in a very energy efficient design. The Kurz sensor responds to true mass flow. Previously complex measurements are now simple. There is no need for seperate flow, temperature, and pressure sensors, or for the complicated flow computers required to integrate their signals. Using state of the art Kurz sensor technology, the 545 measures true mass flow, not volumetric flow. This means the 545 automatically corrects for variations in ambient temperature and barometric pressure, eliminating the need for tedious manual corrections to arrive at standard conditions. Your measurement is expressed in standard liters per minute (SLPM), on a large easy to read LCD Display. All models of the 545 have dual ranges allowing an extremely wide rangeability (100 to 1), that makes the 545 a truly versatile Mass Flowmeter. The 545 utilizes our new digital E-PROM linearizer for both ranges, providing outstanding response and accuracy. The series 545 comes in a rugged all-metal bench cabinet enclosure, with convenient output jacks for use with chart recorders, data loggers and computers. A durable high-impact plastic, foam-padded carrying case is included.

DESCRIPTION

In order to understand the technology of Kurz mass flowmeters, a brief explanation of our sensor and how it works is in order. Each probe is constructed of reference grade Platinum 385, wound on a ceramic mandrel and then glass, epoxy or teflon coated. (A new version featuring all stainless steel construction is now available). There are two seperate platinum windings. These serve as platinum resistance temperature detectors and consequently exhibit the exceptional stability and linear resistance change vs. temperature that Platinum RTD's are so well known for. One winding serves as an ambient temperature detector, the other winding is heated to a constant temperature above that of the ambient or surrounding gas. A measure of the power required to maintain this differential overheat is a measure of the heat transfer from the heated flow sensor winding. This heat transfer off a well defined heat element is a measure of the gas flow moving past the sensor. The sensor circuitry is designed to measure the conditions at the center of the heated velocity winding, therefore the Kurz sensor makes a point measurement of mass flow rate per unit area at the location of the probe. Within a Kurz mass flowmeter a uniform flow is ensured thru use of ten pipe diameters upstream pipe length and thru acceleration of the flow thru a nozzle. Because our sensor always operates at a constant temperature above that of the surrounding gas, it may be thought of as temperature compensating. This is one of the requirements for measuring mass flow. Secondly, because a measure of heat transfer capacity is a direct measure of mass, heat carried away from our sensor is a direct indication of the amount of mass (true number of molecules) that has flowed past our heated sensor. Thus our sensor measures mass flow. The effect of density is automatically incorporated during sensing. Calibration is accomplished thru use of Meriam laminar flow standards that are plus or minus 1/2% accurate and are directly traceable to NBS equipment. Calibration systems are available from Kurz Instruments for larger users. Specialty gas calibrations are done at an outside facility equiped for safe handling of various toxic and corrosive gases. Normally, calibration is accomplished with NBS traceable Bell Provers.

LINEARIZATION

While the resistance of our Platinum RTD sensors is linear with respect to temperature change, heat transfer vs. flow is a non-linear function. Thus to provide the convenience of a linear output signal we provide an onboard digital linearizer with the Series 545 Mass Flowmeters.

The 545 uses our new EPROM board for signal linearization. The EPROM board consists fundamentally of three components: a 10 bit A/D, a 2K 8 bit EPROM, and an 8 bit D/A. The 10 bit analog to digital converter uses the non-linear voltage output of the sensor as its input and converts the voltage into a 10 bit binary value. This 10 bit binary value represents numbers up to 1,024. These numbers are used as an address for 1 Kilobyte of EPROM memory. At each of these 1,024 addresses is stored a 8 bit word or byte. This 8 bit word represents a number between 0 and 255. The 8 bit value or number is converted back to an analog voltage (now your linear output signal) by a digital-to-analog converter. The linearizing takes place in the EPROM. A calibration technician takes voltage vs. flow data at a number of data points (500, 1000, 1500, 2000, 2500, 3000 sccm for instance) and plugs this data into a software program that runs on an Eagle PC-XL computer. The software performs a curve fit and derives the numbers to get a linear curve. The software then graphically plots the data on the screen so the technician can make a quick visual check that the curve fit data results in an approximately linear curve plot. The software then automatically programs and verifies an EPROM. The EPROM is a 2K 2716 so it can hold two curves, one for each of the two ranges of the 545. The 10 bit A/D is used so that there is more accurate addressing of the EPROM. There will be 256 steps in the output curve, but those 256 steps will be selected by 1024 addresses. For the output to be off 1 bit, the 10 bit A/D would have to be in error 4 bits.

OPERATION

Operation of Kurz Series 545 Mass Flowmeters is very straightforward. Install the flow transducer in-line, with the longer portion towards the flow. (With block-type flowbodies use the provided flow straightener on the inlet). Mounting attitude is unimportant. Connect the flow transducer to the Switchcraft jack on the rear panel of bench cabinet using the 15' cable provided. (For Current-Mode meters up to 1,000' of cable may be substituted, refer to the chart for proper impedences. Voltage-Mode cables should not be modified as it could adversly affect meter accuracy). Connect the power cord to the jack on the rear panel and plug the cord into an appropriate AC Outlet. Turn the switch on the front panel once or twice to the right (depending on range desired). The meter should now be functional and the LCD readout should indicate any flow present. If nothing happens, unplug the power cord and check the fuse located on the rear panel.

TWO-WIRE SIGNAL TRANSMISSION

Kurz Series 545 Mass Flowmeters utilize two-wire signal transmission circuitry that allows the flow transducer to be over 1,000 feet from the signal conditioning and power supply electronics. No additional power supply is needed at the physical location of the flow transducer. In Kurz two-wire systems (also known as Current-Mode), the entire Wheatstone bridge circuit is contained in a explosion-proof conduit junction box mounted to the flowbody. This design allows signal transmission through a simple 2 wire cable, and because of inherent line noise immunity no shielding is needed. Any two conductor cable can be used but the total loop resistance of the two wires should be 4 ohms or less. Refer to the Wire gauge resistance chart below.

APPROXIMATE RESISTANCE OF STRANDED COPPER WIRE AT +65 DEGREES C.

AWG Size	Ohms/Ft.	AWG Size	Ohms/Ft.
4	.0003	16	.005
6	.0005	18	.008
8	.0008	20	.012
10	.0012	22	.019
12	.002	24	.030
14	.003	28	.077

CALIBRATION

All Kurz Meters are calibrated at the factory at ambient temperature and atmospheric pressure, referenced to 25°C. and 760mm Hg. Special Gas and high pressure or high temperature calibrations are available as Options. All calibration related test equipment is NBS Certified or Traceable. An NBS traceability certificate and flow Data are provided with each meter. We recommend an annual recalibration under normal usage. Consult our Service Department for more information.

PROBE INTERCHANGEABILITY

Kurz probes or sensors are not interchangeable. They should be used only with the matching signal conditioning/power supply unit with which they were delivered. Temperature compensation resistors matched to your individual sensor and linearizer calibration for your individual sensor preclude probe interchangeability.

MAINTENANCE

Although the relatively large size of the mass flow sensor renders it resistant to particulate contamination in most applications, continuous use in dirty flows may necessitate periodic cleaning of the sensor and internal parts of the flowbody. For small flowbodies we recommend the use of a small camel-hair brush and water followed by an alcohol rinse. In the case of the larger transducers, the insertion probe can be removed from the flowbody for cleaning. Be very careful when cleaning the sensor as the ceramic portion can be damaged if mishandled. The optional Metal-Clad sensors can be cleaned with any commercial stainless steel cleaner or by a fine grade of steel wool.

SPECIFICATIONS

ACCURACY

±(2% of Reading + ½% Full Scale), over a temperature range of 0° to 50°C. & a pressure range of .25 to 2 atmospheres.

REPEATABILITY

± .25%

TURNDOWN

Maintains accuracy over 10:1 turndown ratio. Derate accuracy 1% below 10% of Full Scale. Derate accuracy 2% below 5% of Full Scale.

RESPONSE TIME

1 Sec typical, down to 35mSec available.

PRESSURE RATING OF FLOW TRANSDUCER

150 PSI Standard, 1,000 PSI Optional.

MAXIMUM PRESSURE DROP

4.5cm H_2O (1.8" H_2O).

SENSOR OPERATING TEMP. RANGE

Standard: 0-125°C., High Temperature Option: 0-250°C., Very High Temperature Option: 0-500°C.

FLOW BODY TEMP. RANGE

-55° to 500°C.

ELECTRONIC CIRCUITS TEMP. RANGE

-20° to 60°C.

CONSTRUCTION, SENSOR

Proprietary Kurz "*DuraFlo*" Sensor constructed of reference grade 385 platinum RTD's wound on a high grade ceramic mandrel and glass coated. Sensors may also be optionally Teflon 850PTFE coated or Stainless Steel sheathed for corrosive applications.

CONSTRUCTION, FLOW BODY

316 Stainless Steel, includes 10 diameters upstream straight section, 2 diameters downstream. MNPT fittings.

CALIBRATION

Calibrated at ambient temperature and atmospheric pressure, referenced to 25°C. and 760mm Hg. NBS Traceable, Certificate and Data included.

LINEARIZATION

Dual range EPROM linearizer featuring 10-bit analog to digital conversion.

OUTPUT

Linear 0-5VDC, 20mADC maximum, available at female mini-banana jacks on rear panel of Meter.

POWER

115VAC/60Hz, 6' 3 conductor power cord furnished. 220VAC/50Hz optional.

HOOKUP

15' cable between Flow transducer and bench cabinet is standard. Cable lengths of up to 1,000' is available as an Option.

DISPLAY

4½ digit LCD display driven by a 3½ digit IC. Dimensions: 1" x 2.5" with 5/8" numerals. Readout is in engineering units. The least significant digit is a static zero.

DIMENSIONS

Bench cabinet: 4.0" height x 7" width x 10" length. Flowbodies: 545-0; ¼"MNPT x 6" length x 7.5"height. 545-1; 3/8"MNPT x 7" length x 7.5" height. 545-2; 3/4"MNPT x 10" length x 9¼" height.

WEIGHT

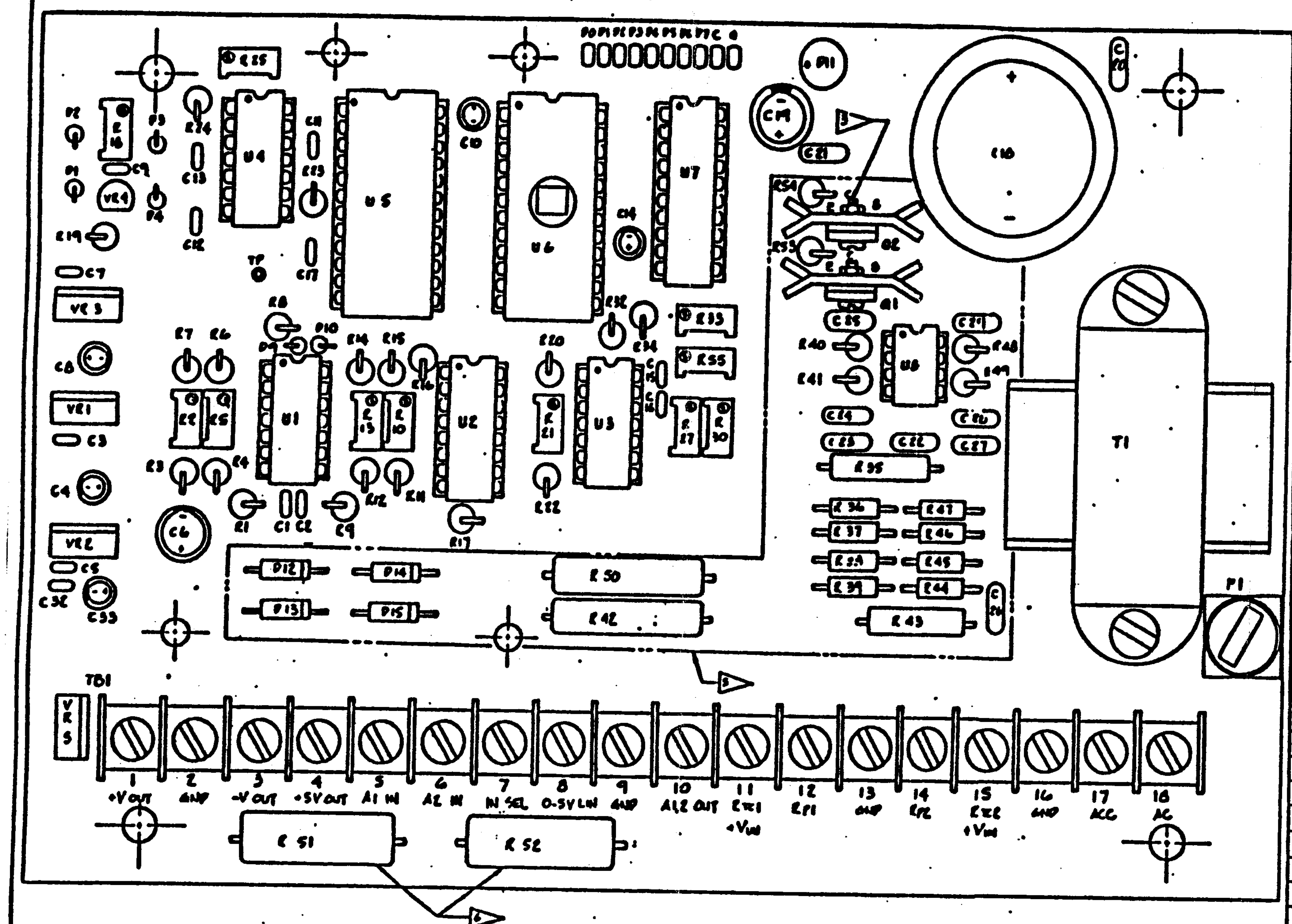
Meter, flowbody & accessories: 6 lbs. Carrying case: 5 lbs.

IMPORTANT NOTICE!

Specifications are subject to change without notice. Kurz Instruments reserves the right to make engineering changes and product improvements at any time and without prior notice. Consult your local Kurz Representative or a Factory Application Engineer for information regarding current specifications.

COMPONENT LAYOUT & PARTS LIST

The following page contains the component layout and parts list. The EPROM linearizer schematic diagram contains proprietary information and is not being released at this time.



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REFERENCE, APPED POWER SUPPLY AND BRIDGE CIRCUIT	7-12-85	AA/L.L.
B	CHANGED PER W.O. 47007	3-7-86	AA/

REF. DES.	DESCRIPTION	QTY.
R53,54	RESISTOR 820 Ω, 1/2 W	2
R19	RESISTOR 1.5K	1
R 3,4,11,12 35 TO 39 & 43 TO 47	RESISTOR SELECTED ▷5	14
R1,9,23, 32,34	RESISTOR 10 K	5
C20-29	CAPACITOR .02 µf ▷5	10
C19	220 µf - 25 VDC	1
C18	3300 µf - 35 VDC NIC.	1
C12,13	TEMP. COMP. (120) 200 pf, SPRAGUE	2
C11	TEMP. COMP. (100) 100 pf, SPRAGUE	1
C6	220 µf - 10 V	1
C4,8,10,14	10 µf - 25 V	4
C 1,2,3,5,7, 9,15,16,17	CAPACITOR .1 µf MONO, SPRAGUE	9
D12-15	DIODE SELECTED	4
D11	BRIDGE RECTIFIER CSC B205	1
D9-10	DIODE 1N 4734, 5.6V	2
D1-8	DIODE 1N 914	4
VR4	VOLTAGE REGULATOR LM 336-5, +5V	1
VR3	# 7912, -12V.	1
VR2	# 7805, +5V	1
VR1	VOLTAGE REGULATOR # 7815, +15V	1
Q1,2	TRANSISTOR MJE 520 + HEATSINK + HARDWARE (#4-40 × 5/16" RD. HD. SCR, NUT, WASHER) ▷3	2
U8	OP-AMP LM 358 ▷5	1
	8 PIN SOCKET	1
U7	8 BIT D/A CONVERTER, NATIONAL	1
	20 PIN SOCKET	1
U6	2K × 8 EPROM # 2716-5, INTEL	1
U5	10 BIT A/D CONVERTER, NATIONAL	1
	24 PIN SOCKET	2
U2	ANALOG SWITCH CD 4053 BC	1
	16 PIN SOCKET	1
U4	HEX SCHMITT TRIGGER CD 40106 BC	1
U1,3	OP-AMP LM 324, NATIONAL	2
	14 PIN SOCKET	3
F1	PC MOUNTED FUSE & FUSE HOLDER #19703 & #19706	1
T1	TRANSFORMER # 8435A-60 + HARDWARE (#10-32 × 1/4" SCR, NUT, WASHER (2))	1
TB1	18 PIN TERMINAL BLOCK	1
	436 PCB	1

PARTS LIST

NOTES: UNLESS OTHERWISE SPECIFIED

1. THIS DWG. TO BE USED IN CONJUNCTION W/ SCHEMATIC DIAGRAM DWG. # B30016.
2. LAST REF. DES. USED ARE: TB1, T1, F1, U8, Q2, VR5, D15, C33, R55.
3. ▷ SEE DWG. # A70003 FOR TRANSISTOR ASSY.
4. ALL DIODES TO BE ASSEMBLED W/ CATHODE TO PCB.
5. ▷ VOLTAGE MODE USE: Q1,2, U8, C22-29, R35-50, 53, 54.
6. ▷ CURRENT MODE USE: R51 & R52.
7. D11, R35, 42, 43, 50 TO BE ASSEMBLED 1/8" CLEARANCE FROM PCB.

REF. DES.	DESCRIPTION	QTY.
C33	CAPACITOR 10 µf - 25V	1
C32	CAPACITOR .1 µf MONO, SPRAGUE	1
VR5	VOLTAGE REGULATOR SELECTED	1

OPTIONAL V_{OUT} PARTS LIST

REF. DES.	DESCRIPTION	QTY.
R55	POTENTIOMETER 500 Ω	1
R33	POTENTIOMETER 1K	1
R18,25,27, 30	POTENTIOMETER 10K	4
R2,5,10, 13,21	POTENTIOMETER 2K	5
R51,52	RESISTOR 5 Ω, 5W 1% DALE ▷6	2
R42,50	15 Ω 5W	2
R40,41,48,49	1K Ω ▷5	4
R24	680K	1
R22	1M K	1
R17	4.75 K	1
R8,16	2K	2
R6,7,14, 15,20	RESISTOR 20K	5

PARTS LIST (CONT)

TOLERANCES UNLESS OTHERWISE SPECIFIED	Kurz Instruments Inc.			
FRACTIONS ± \ DEC ± \ ANGLES ± \				
APPROVALS / DATE	Model 436 Linearizer Components Layout			
DRAWN 7-12-85				
CHECKED 7-12-85	SCALE 2:1	SIZE C	DRAWING NO. C31002	REV B
APVD 7/15/85				
REV. A	DO NOT SCALE DRAWING		SHEET 1 OF 1	

WARRANTY STATEMENT

All products from Kurz Instruments Inc. are warranted against defective materials or workmanship to the original purchaser for a period of one year from the original purchase date, under normal use and service.

Defective parts will be repaired, adjusted, and/or replaced at no charge when the instrument is returned prepaid to Kurz Instruments Inc. Please call for a Return Authorization Number before returning the instrument.

The warranty is VOID if the instrument has been visibly damaged by accident, misuse, or has been serviced or modified by any person other than Kurz Instruments Inc.

This warranty contains the entire obligation of Kurz Instruments Inc. and no other warranties expressed, implied or statutory are given.