

# Digivider™ Voltage Dividers and Digidecade™ Resistance Decades

Digividers™ and Digidecades™ are thumbwheel switch modules that have been specially modified to provide the highest possible precision and repeatability of voltage or resistance settings.

They are more accurate than precision 10-turn potentiometers, and are smaller, yet they cost less to buy and to operate.

Digitran's Digivider™ and Digidecade™ offer a unique, error-free, digital-setting wheel that provides absolute reset ability as well as positive detent action. They also are designed with parallel entry, for high-speed setting, and with an in-line readout, to minimize reading and setting errors.

They are available in standard or miniaturized sizes; front- or rear-mounted; sealed or unsealed; and with an almost unlimited choice of electrical characteristics. They embody the high reliability, stability and long life that are universally associated with Digitran thumbwheel switches.

The Digivider and Digidecade are derived from any one of six Digitran Thumbwheel switches. These switches include the Series 300 and Series 9000 Digiswitches,® Series 700, 8000 and 29000 Miniswitches® and Series 23000 Slimswitch.®

Module width of these switches range from 15.24 (.600") down to 8.00 (.315") and cut-out height is from 50.8 (2.00") down to 24.40 (.961").

The many options that are available with these switches are, of course, available with the Digividers and Digidecades.

The Digivider and Digidecade may be ordered from Digitran Technical Representatives or directly from the factory.

## APPLICATIONS

Digividers and Digidecades have been proven to be ideal design solutions for hundreds of applications requiring precise selection of resistance or voltage levels. Among these are:

- Programmable power supplies
- Temperature controls
- Special-purpose airborne computers
- Surface analyzer tables

- Null balancing circuits
- Substitution boxes
- Wheatstone bridge circuits
- Machine tool controls
- Broadband frequency generators
- Alarm systems
- Rate tables and motion simulators
- Typeset programming tables
- Analog analytical computers
- Automatic test equipment
- Industrial process controls
- Automatic sorting machines

For advice on whether a Digivider or Digidecade can fit your particular need, please contact a Digitran technical representative or the factory.

## Digivider (Kelvin-Varley)

The Kelvin-Varley circuit uses a cascade arrangement of resistors to subdivide voltages. Figure 1 depicts the four decades required to divide 100 volts into increments of 10 millivolts. Input impedance of Kelvin-Varley circuits remains constant throughout the full range of incremental voltage setting. Input impedance of the particular circuit pictured in Figure 1 is 10,000 ohms. Dial setting is 38.55. The total voltage output is the sum of voltages contributed by all decks.

### ELECTRICAL STABILITY

The maximum contact resistance change throughout the rated switch life will not exceed 5 milliohms. For the circuit outlined in Figure 1, maximum output variation would be 0.0005%  $E_{IN}$  to the most significant digit. A positive detent feature ensures complete repeatability of voltage setting.

### TEMPERATURE COEFFICIENT

The resistors in any matched group of each deck will track closely to each other throughout the operating temperature range. (A typical Digivider has less than .02% maximum change in ohms per 100°C change in temperature.)

## ACCURACY

The accuracy of the Digivider is expressed as a percent of input voltage, not as a percent of setting. A prime advantage of the Kelvin-Varley Digivider is that, in order to achieve 0.025% linearity, the resistors need not have an absolute accuracy of 0.025%. Resistor matching during manufacture ensures the accuracy of Kelvin-Varley Digividers. Linearity of the Digivider is adversely affected by  $R_L$ . As  $R_L$  approaches  $Z_{IN}$ , the linearity error increases. Therefore, it is desirable to operate the Kelvin-Varley divider into as high an impedance as possible. Typically,  $R_L$  should be at least 200 times greater than  $Z_{IN}$  for a full scale accuracy of 0.1% of  $E_{IN}$ . See Figure 2.

Voltage Divider (Kelvin-Varley) with Provision for 11 Resistors — 10 Positions.

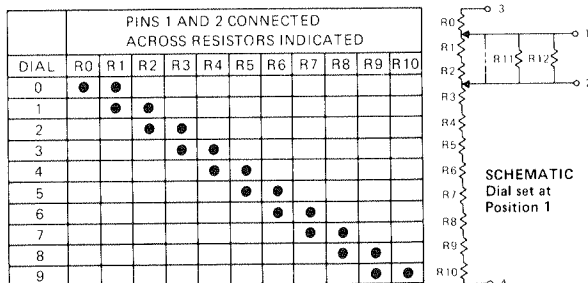


FIGURE 3

## SERIES IDENTIFICATION (KELVIN-VARLEY):

**Series K03** . . . Standard-size thumbwheel switch without sealing.

**Series K09** . . . Standard-size thumbwheel switch with environmental sealing.

**Series K08** . . . Miniature-size thumbwheel switch without sealing.

**Series K07** . . . Miniature-size thumbwheel switch with environmental sealing.

**Series K23** . . . Economy-priced, front mounted, snap-in Slimswitch® without sealing.

**Series K29** . . . Economy-priced, rear-mounted Miniswitch® without sealing.

## GENERAL SPECIFICATIONS:

**For Resolution, Accuracy of Full Scale Voltage Ratio, and Input Impedances:** See page 68.

**Type of circuit:** Kelvin-Varley.

**Maximum input voltages (Function of input impedance):** 1,000 ohm input impedance, 70 Volts at 25°C—50 Volts at 70°C, 10,000 ohm Input Impedance, 200 Volts at 25°C—150 Volts at 70°C, 100,000 ohm Input Impedance, 200 Volts at 25°C—200 Volts at 70°C.

**Operating temperature:** Refer to series.

**Storage temperature:** Refer to series.

**Switch life:** 5mΩ max. contact resistance change in 100,000 detent operations per decade.

**Switching action:** Make-before-break.

**Dielectric withstanding voltage:** 750 volts minimum.

**Resistors:** ¼ watt metal film resistor or 1 watt wire wound, depending on value or accuracy of divider.

**Output change with temperature:** 20ppm (0.00002 voltage ratio) per °C.

**Output Change with load:** Variable depending on input setting and load.

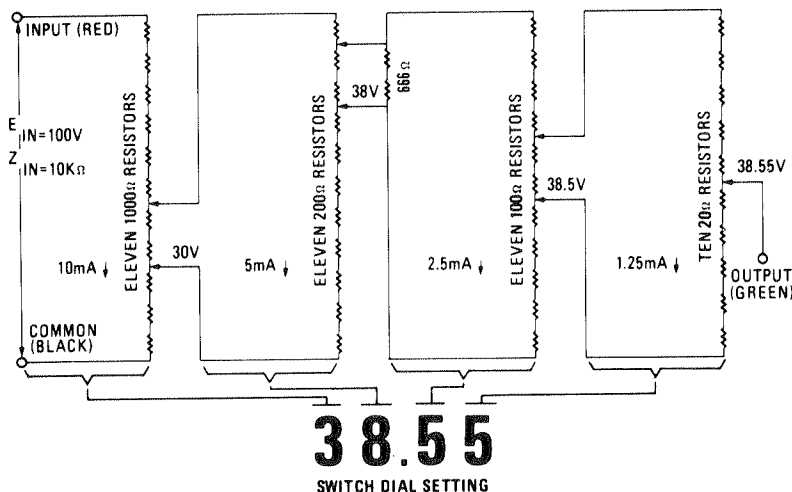


FIGURE 1—Standard Schematic for a Four-Digit Kelvin-Varley Digivider.

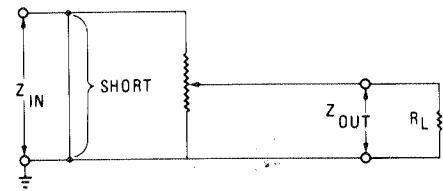


FIGURE 2—Output Impedance.

# Digidecade (Resistance Decade)

The Digidecade utilizes a weighted code of 1-2-2-2-2, using five resistors to achieve nine discrete steps of resistance from (0-9) or multiples thereof. The Digidecade has a string of five resistors mounted on its terminal board, the appropriate resistors being shorted out to provide a linear progression yielding the desired total resistance. See Table A.

Resistance values do not necessarily have to be in increments of 1, 10, 100, or 1000 ohms, but can be any desired value. As an example, if a resistance range of 0-2495 ohms with 5-ohm increments is desired, a three-digit Digidecade with dial readings 000-499 is selected. The proper resistors are then selected (i.e., one 5-ohm resistor and four 10-ohm resistors for the least significant digit, one 50-ohm resistor and four 100-ohm resistors and two 1000-ohm resistors for the most significant digit) for an overall result of 499 x 5 ohms which yields the 2495-ohm total desired.

Please note that the accuracies of Digidecades are described in accuracy of setting, not of full scale as is the case with voltage dividers.

Resistance Decade, 1-2-2-2-2- Code with Ten Levels of Resistance — 10 Postions.

DIAL	RESISTORS IN CIRCUIT				
	R1	R2	R3	R4	R5
0					
1	•				
2					•
3	•				•
4				•	•
5	•			•	•
6			•	•	•
7	•		•	•	•
8		•	•	•	•
9	•	•	•	•	•

SERIES 300, 8000, 9000, 23000, 29000

Number of Decades	Input Impedance $Z_{IN}$			
	100 Ohms	1,000 Ohms	10,000 Ohms	100,000 Ohms
2	—	0-990 ohms in 10 ohm steps	0-9900 ohms in 100 ohm steps	0-99000 ohms in 1000 ohm steps
3	—	—	0-9990 ohms in 10 ohm steps	0-99900 ohms in 100 ohm steps
4	—	—	—	0-99990 ohms in 10 ohm steps
5	—	—	—	—

All accuracies  $\pm 1\%$  of setting plus zero resistance. Special tolerances are available upon request.

TABLE A

## RESISTANCE DECADE SERIES IDENTIFICATION:

**Series R03:** Standard-size thumbwheel switch without sealing.

**Series R09:** Standard-size thumbwheel switch with environmental sealing.

**Series R08:** Miniature-size thumbwheel switch without sealing.

**Series R07:** Miniature-size thumbwheel switch with environmental sealing.

**Series R23:** Economy-priced, front-mounted snap-in Slimswitch® without sealing.

**Series R29:** Economy-priced, rear-mounted Miniswitch® without sealing.

See page 66 for dimensions.

## GENERAL SPECIFICATIONS:

**Range in ohms and step sizes:** See page 68.

**Zero resistance:** 30 milliohms maximum per decade, 25 milliohms typical per decade.

**Maximum current:** Decade with 1 ohm increments 500 milliamperes at 25°C—350 milliamperes at 70°C, Decade with 10 ohm increments 150 milliamperes at 25°C—100 milliamperes at 70°C, Decade with 100 ohm increments 50 milliamperes at 25°C—35 milliamperes at 70°C, Decade with 1,000 ohm increments 15 milliamperes at 25°C—10 milliamperes at 70°C, Decade with 10,000 ohm increments 5 milliamperes at 25°C—3.5 milliamperes at 70°C, Decade with 100,000 ohm increments 1.5 milliamperes at 25°C—1.0 milliamperes at 70°C.

**Dielectric withstanding voltage:** 1,000 volts minimum.

**Resistors:** ¼ watt metal film resistor or 1 watt wire wound, depending on value or accuracy of divider.

**Resistor temperature coefficient:**  $\pm 200$  ppm/°C maximum.  $\pm 30$  ppm/°C typical.

**Operating temperature:** Refer to series.

**Storage temperature:** Refer to series.

**Switch life:** 5mΩ max. contact resistance change in 100,000 detent operations per decade.

**Switching action:** Make-before-break.

# The Digipot<sup>®</sup>

The appropriate Digipot is determined for each application based upon specific configuration and required potentiometer specifications. Digipots are available with ranges from 10 ohms to 1 megohm and linearities from  $\pm 20\%$  E<sub>IN</sub> to  $\pm 1\%$  E<sub>IN</sub>. Digipots are available for use with either standard or miniature size thumbwheel switches, and may be equipped with or without dials reading from 0-10 or 00-100. Special dials available upon request. Digipot configurations are shown in Table B. For additional details and pricing, please contact your nearest Digitran technical representative or one of our factory applications specialist.

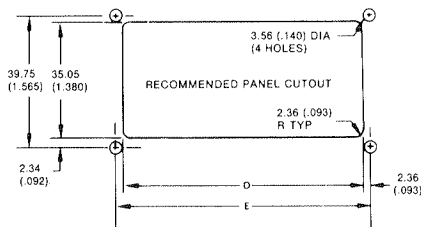
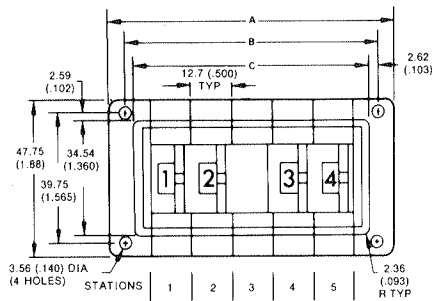
Switch Size	Series	Digipot Mounted On End Bracket*	Digipot Mounted On Adjacent Spacer
Standard Digiswitch	K03, R03	Available: Dial Reading (0-10) or (00-100)	Available: Dial Reading (0-10) or (00-100)
Miniature Miniswitch	K07, R07	Available: No Dial Reading Special DIGIPOT Module, Dial Reading (0-10) Available Upon Request	Not Available
Miniature Miniswitch	K08, R08	Available: No Dial Reading	Not Available
Standard Digiswitch	K09, R09	Special Requests Only	Special Requests Only

\*Least significant digit.

TABLE B—DIGIPOT CONFIGURATIONS AVAILABLE

## Digivider and Digidecade Installation Data

Series KO3, and RO3



(Prime dimensions are metric)

**Important Notice:** When soldering terminals, do not allow flux or cleaning agent to enter switch. Use Isopropyl alcohols for cleaning agents. For other satisfactory cleaning agents, consult the Digitran Company.

For recommended installation dimensions refer to appropriate series.

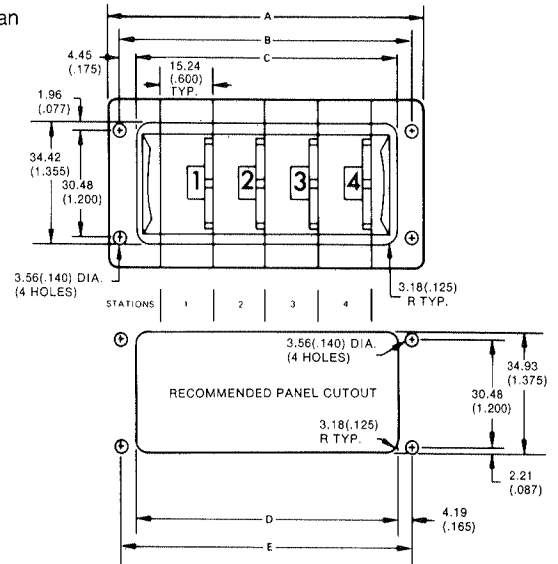
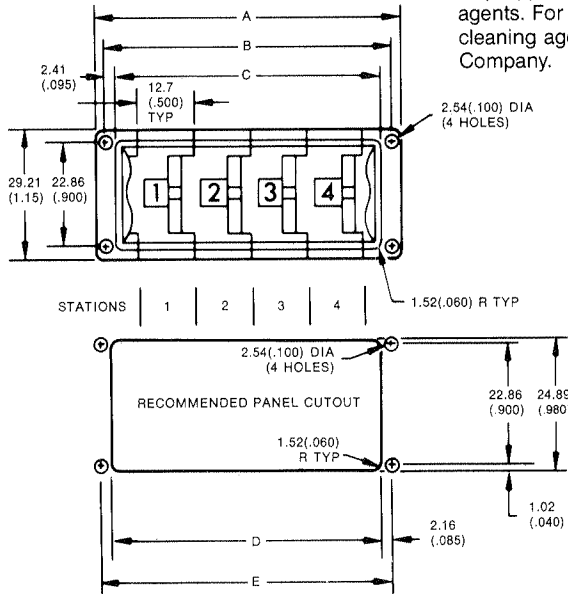
Series K07, K08, R07, and R08.

Series 8000 configuration shown;  
dimensions are the same.

Series K09 and R09

(Prime dimensions are metric)

**Important Notice:** When soldering terminals, do not allow flux or cleaning agent to enter switch. Use Isopropyl alcohols for cleaning agents. For other satisfactory cleaning agents, consult the Digitran Company.



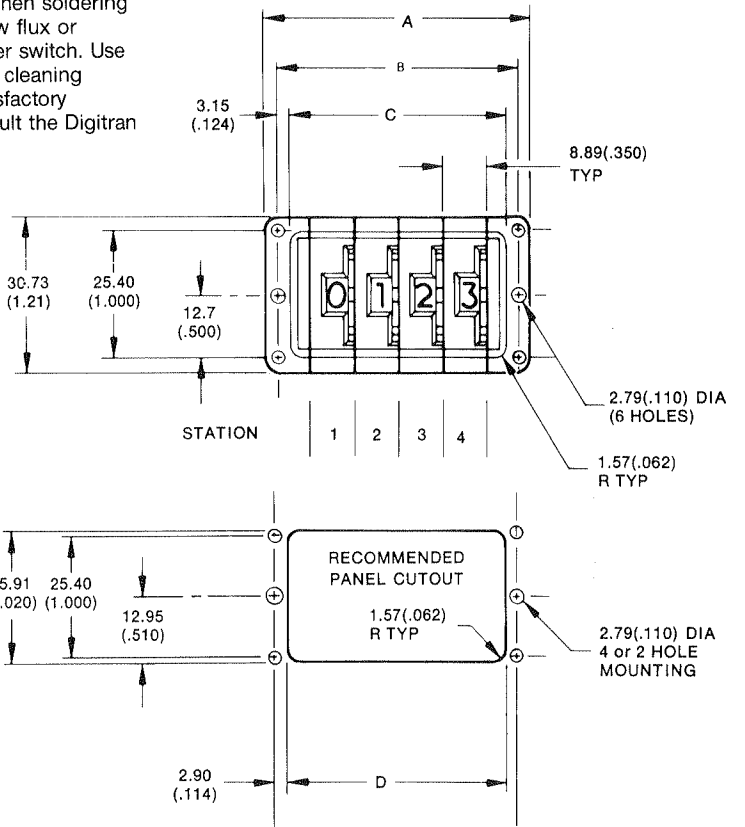
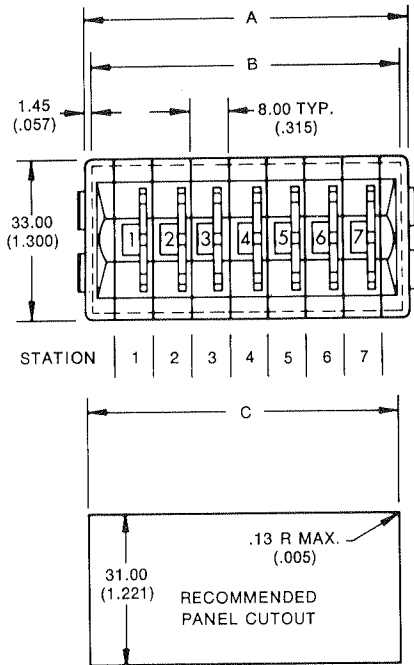
For recommended installation dimensions refer to appropriate series.

Series K23 and R23

Series K29 and R29

(Prime dimensions are metric)

**Important Notice:** When soldering terminals, do not allow flux or cleaning agent to enter switch. Use Isopropyl alcohols for cleaning agents. For other satisfactory cleaning agents, consult the Digitran Company.



For recommended installation dimensions refer to appropriate series.

# Digividers

## Voltage Dividers

### INPUT IMPEDANCE/ACCURACY (% full scale voltage ratio)

#### Kelvin-Varley

DECADES FOR K03, K09, K08, K07, K23, K29	OHMS ±1%	0.1%	0.05%	0.025%	0.01%
2-6	100,000	—0004	—0005	—0006	—0007
2-6	10,000	—0013	—0014	—0015	—0016
2-4	1,000	—0023	—0024	—0025	—0026
2	100	—0033	—0034	—0035	N.A.

Dash numbers are applicable to all Series. All sealed Digividers have conformal coated printed circuit boards and components.

# Digidecade

## Resistance Decades

### STANDARD SERIES • MODEL NUMBERS

SERIES	DASH NUMBER				RANGE AND STEPS
RESOLUTION (%)	ACCURACY (%) SETTING + ZERO RESISTANCE				
	1%	0.5%	0.25%*	0.1%*	
10% (1 Decade)	—0041 —0051 —0001 —0011 —0021 —0031	—0042 —0052 —0002 —0012 —0022 —0032	—0053 —0003 —0013 —0023 —0033	—0054 —0004 —0014 —0024 —0034	0–9 ohms in 1 ohm steps* 0–90 ohms in 10 ohm steps 0–900 ohms in 100 ohm steps 0–9,000 ohms in 1000 ohm steps 0–90,000 ohms in 10,000 ohm steps 0–900,000 ohms in 100K ohm steps
1% (2 Decades)	—0051 —0001 —0011 —0021 —0031	—0052 —0002 —0012 —0022 —0032	—0053 —0003 —0013 —0023 —0033	—0054 —0004 —0014 —0024 —0034	0–99 ohms in 1 ohm steps* 0–990 ohms in 10 ohm steps 0–9,900 ohms in 100 ohm steps 0–99,000 ohms in 1000 ohm steps 0–990,000 ohms in 10K ohm steps
0.1% (3 Decades)	—0001 —0011 —0021 —0031	—0002 —0012 —0022 —0032	—0003 —0013 —0023 —0033	—0004 —0014 —0024 —0034	0–999 ohms in 1 ohm steps* 0–9,990 ohms in 10 ohm steps 0–99,900 ohms in 100 ohm steps 0–999,000 ohms in 1000 ohm steps
0.01% (4 Decades)	—0011 —0021 —0031	—0012 —0022 —0032	—0013 —0023 —0033	—0014 —0024 —0034	0–9,999 ohms in 1 ohm steps* 0–99,990 ohms in 10 ohm steps 0–999,900 ohms in 100 ohm steps
0.001% (5 Decades)	—0021 —0031	—0022 —0032	—0023 —0033	—0024 —0034	0–99,999 ohms in 1 ohm steps* 0–999,990 ohms in 10 ohm steps
0.0001% (6 Decades)	—0031	—0032	—0033	—0034	0–999,999 ohms in 1 ohm steps*

All sealed Digidecades have conformal coated printed circuit boards and components.

\* Decade with 1 ohm steps accurate ±0.5% of setting.

## ORDERING INFORMATION

### To order...

- 1) Specify Series prefix (e.g., K08, R09, etc.).
- 2) Specify number of decades required.
- 3) Specify input impedance and accuracy.

### Sample Part Number

<b>K08</b>	<b>4</b>	<b>—0023</b>
Series Number (Kelvin-Varley Digivider, Series 8000)	Number of Decades	Dash Number from Input Impedance/ Accuracy Chart