



ED STRANDE
50-498 X 5635

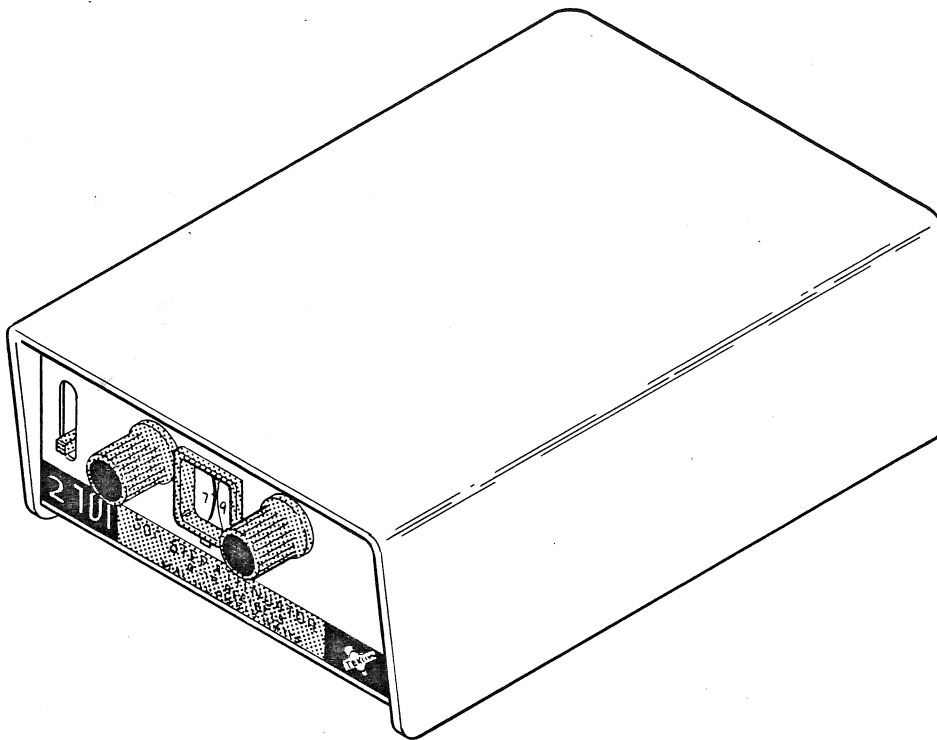
TEKTRONIX®

committed to
technical excellence

data sheet

PRODUCT DISTRIBUTION GROUP-PARTS PUBLICATION

2701
50 OHM STEP ATTENUATOR



NO. 062-1747-00
DATE APRIL 1975 (R)
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INTRODUCTION

Description

The 2701 is a 50 ohm 1 GHz step attenuator that provides signal attenuation up to 79 dB. The Attenuator selects 1 dB and 10 dB incremental steps. Input signals can be ac coupled, dc coupled, or dc terminated in the Attenuator.

Functions of Controls and Connectors

0-9 dB Selector	Selects combination of 1 dB, 2 dB, or two 4 dB attenuator chips.
0-70 dB Selector	Selects combination of one 10 dB, and three 20 dB attenuator chips.
PORT 1/INPUT Connector	Provides a means of coupling the signal to the attenuator.
PORT 2/OUTPUT Connector	Provides a means of coupling the signal from the attenuator.
AC-DC-DC TERM Selector	Selects ac, dc or dc terminated input coupling to the PORT 1/INPUT connector.
COMMON Connector	Provides an external chassis ground point.

Standard Accessories Included

1 Data Sheet 062-1747-00

Options

None

Performance Conditions

The performance limits in this specification are valid with the following conditions:

1. The 2701 must have been performance checked at an ambient temperature of +20°C to +30°C.
2. The 2701 must be operating within the environmental limits described in Electrical Section unless stated otherwise.
3. The 2701 must be terminated into its characteristic impedance. Return loss matched to within 30 dB or better.

Operating Considerations

1. A 50 ohm load should be used at the PORT 2/OUTPUT to minimize system deflection.
2. The return loss (swr) at the PORT 1/INPUT connector is generally better than that at the PORT 2/OUTPUT connector.

3. 50 ohm BNC adapters are recommended for non-critical return loss (swr) applications, to extend the precision PORT 1/INPUT and PORT 2/OUTPUT connector life.

4. Useful formulas:

$$\text{Reflection Coefficient } (\rho) \quad \rho < \phi = \frac{Z_L - Z_0}{Z_L + Z_0}$$

Z_0 is the system's characteristic impedance

Z_L is the load impedance

$$\text{Return Loss} = 20 \log \rho$$

$$\text{Standing Wave Ratio (SWR)} = \frac{1 + \rho}{1 - \rho}$$

5. Refer to Table 1 to determine the dB rating for voltage or power ratios up to 100 dB. For current or voltage ratios greater than 10, (or power ratios greater than 100), the ratio can be broken down into two products, the dB found for each separately, then add the two results.

For example: To convert a current or voltage ratio of 200:1 to dB, take the product of the current or voltage ratio for 100:1 (40 dB) and 2:1 (6 dB). Therefore, a current or voltage ratio of 200:1 equals 46 dB.

TABLE 1

Decibels vs Current or Voltage and Power

Current or Voltage Ratio	Power Ratio	-dB+	Current or Voltage Ratio	Power Ratio
1.000	1.000	0	1.000	1.000
0.8913	0.7943	1.0	1.222	1.259
0.7943	0.6310	2.0	1.259	1.585
0.7079	0.5012	3.0	1.413	1.995
0.6310	0.3981	4.0	1.585	2.512
0.5623	0.3162	5.0	1.778	3.162
0.5012	0.2512	6.0	1.995	3.981
0.4467	0.1995	7.0	2.239	5.012
0.3981	0.1585	8.0	2.512	6.310
0.3548	0.1259	9.0	2.818	7.943
0.3162	0.1000	10.0	3.162	10.000
0.2818	0.07943	11.0	3.548	12.59
0.2512	0.06310	12.0	3.981	15.85
0.2239	0.05012	13.0	4.467	19.95
0.1995	0.03981	14.0	5.012	25.12
0.1778	0.03162	15.0	5.623	31.62
0.1585	0.02512	16.0	6.310	39.81
0.1413	0.01995	17.0	7.079	50.12
0.1259	0.01585	18.0	7.943	63.10
0.1122	0.01259	19.0	8.913	79.43
0.1000	0.01000	20.0	10.000	100.00
	10 ⁻³	30.0		10 3
10 ⁻²	10 ⁻⁴	40.0	10 2	10 4
	10 ⁻⁵	50.0		10 5
10 ⁻³	10 ⁻⁶	60.0	10 3	10 6
	10 ⁻⁷	70.0		10 7
10 ⁻⁴	10 ⁻⁸	80.0	10 4	10 8
	10 ⁻⁹	90.0		10 9
10 ⁻⁵	10 ⁻¹⁰	100.0	10 5	10 10

Operating Consideration (cont)

6. Refer to Table 2 for return loss, standing wave ratio (swr) and reflection coefficient magnitude equivalents.

TABLE 2

Return Loss, Standing Wave Ratio (SWR) and Reflection Coefficient Magnitude Equivalents.

Return Loss (dB)	Standing Wave Ratio	Reflection Coefficient Magnitude
5.0	3.570	0.562
10.0	1.925	0.316
11.0	1.785	0.282
12.0	1.671	0.251
13.0	1.577	0.224
14.0	1.499	0.200
15.0	1.433	0.178
16.0	1.377	0.158
17.0	1.329	0.141
18.0	1.288	0.126
19.0	1.253	0.112
20.0	1.222	0.100
21.0	1.196	0.089
22.0	1.173	0.079
23.0	1.152	0.071
24.0	1.135	0.063
25.0	1.119	0.056
26.0	1.106	0.050
27.0	1.094	0.045
28.0	1.083	0.040
29.0	1.074	0.035
30.0	1.065	0.032
35.0	1.036	0.018
40.0	1.020	0.010

SPECIFICATIONS
ELECTRICAL

Nominal Impedance	50 ohms
Frequency Range	
AC Coupled	From lower bandwidth limit to 1 GHz
DC Coupled	Dc to 1 GHz
Attenuation Range	0 to 79 dB in 1 dB and 10 dB steps
Port 1, Port 2 Channel Isolation	
Max Safe Input Voltage	± 100 V peak to peak, 0.1 μ s duration
Maximum Average Input Power	1.5 W to +65°C ambient, derated linearly to zero watts at 100°C
Signal Coupling	Ac, dc, and dc terminated at PORT 1/ INPUT connector only
Standard Connector	BNC female
Return Loss (SWR)	See Table 3
Insertion Loss	See Table 4
Power Coefficient	
1 to 20 dB	(.003 dB/W x dB) or less, referenced at zero watts
20 to 79 dB	0.060 dB/W or less, referenced at zero watts
Temperature Coefficient	Temperature coefficients are added algebraically for combined unit and decade settings
1 to 9 dB	$[\pm .0002 \text{ dB/dB x } ^\circ\text{C}]$ or $[\pm .0012 \text{ dB/} ^\circ\text{C}]$ whichever is less, referenced at +25 °C
10 to 70 dB	$[\pm .0002 \text{ dB/dB x } ^\circ\text{C}]$ or $[\pm .0012 \text{ dB/} ^\circ\text{C}]$ whichever is less, referenced at +25 °C
Switch Life	At least 100,000 revolutions
Pulse Risetime at 0 dB	150 ps or less

TABLE 3

Return Loss (SWR)¹

10 MHz to 300 MHz	> 300 MHz to 600 MHz	>600 MHz to 1 GHz
50 Ohm Termination at PORT 1/INPUT		
-30 dB or less (1.06 or less)	-25 dB or less (1.32 or less)	-20 dB or less (1.22 or less)
PORT 1/INPUT or PORT 2/OUTPUT (DC Only)		
-20 dB or less (1.22 or less)	-17 dB or less (1.32 or less)	-17 dB or less (1.32 or less)

¹+20 °C to +30 °C with 10 dB mW of power applied.

TABLE 4

Attenuation Accuracy (+20°C to +30°C)

Incremental Insertion Loss Referenced to: Zero Insertion [= - (0.50 dB + 0.14 dB/100 MHz) or Better]		
Attenuator Switch Setting ¹ (dB)	Maximum Deviation from 10 MHz Offset (dB) [Offset at 10 MHz = ± (0.200 dB + 0.008 dB/dB Setting) or Better]	
	10 MHz to 500 MHz	>500 MHz to 1 GHz
-1 to -9	+0.1 to -0.2	+0.1 to -0.5
-10	+0.1 to -0.2	+0.3 to -0.3
-20	+0.3 to -0.2	+0.3 to -0.3
-30	+0.4 to -0.2	+0.3 to -0.3
-40	+0.4 to -0.2	+0.4 to -0.2
-50	+0.7 to -0.2	+0.8 to -0.2
-60	+0.7 to -0.2	+0.8 to -0.2
-70	+0.9 to -0.2	+0.9 to -0.2

¹With any combination of attenuator switch settings, the maximum deviation from 10 MHz offset is added algebraically.

ENVIRONMENTAL

Temperature

Operating	0°C to +65°C ambient
Non-Operating	-55°C to +75°C

Altitude

Operating	To 20,000 feet
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Vibration	0.25 inches double amplitude frequency swept at 20-55-20 Hz for 1 hour
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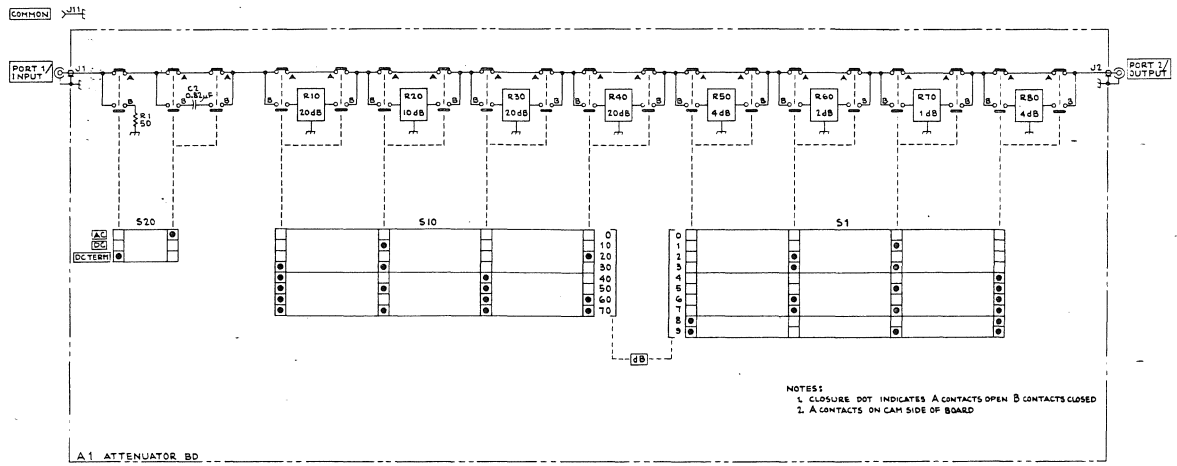
Shock	2 shocks 60 g, 11 ms per face or 1 shock 500 g, 1 ns per face
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Humidity	Meets MIL-STD-202C Method 106 B
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Dimensions	2.5(6.4cm)H, 4.5(11.4cm)W, 7.4(18.8cm)L.
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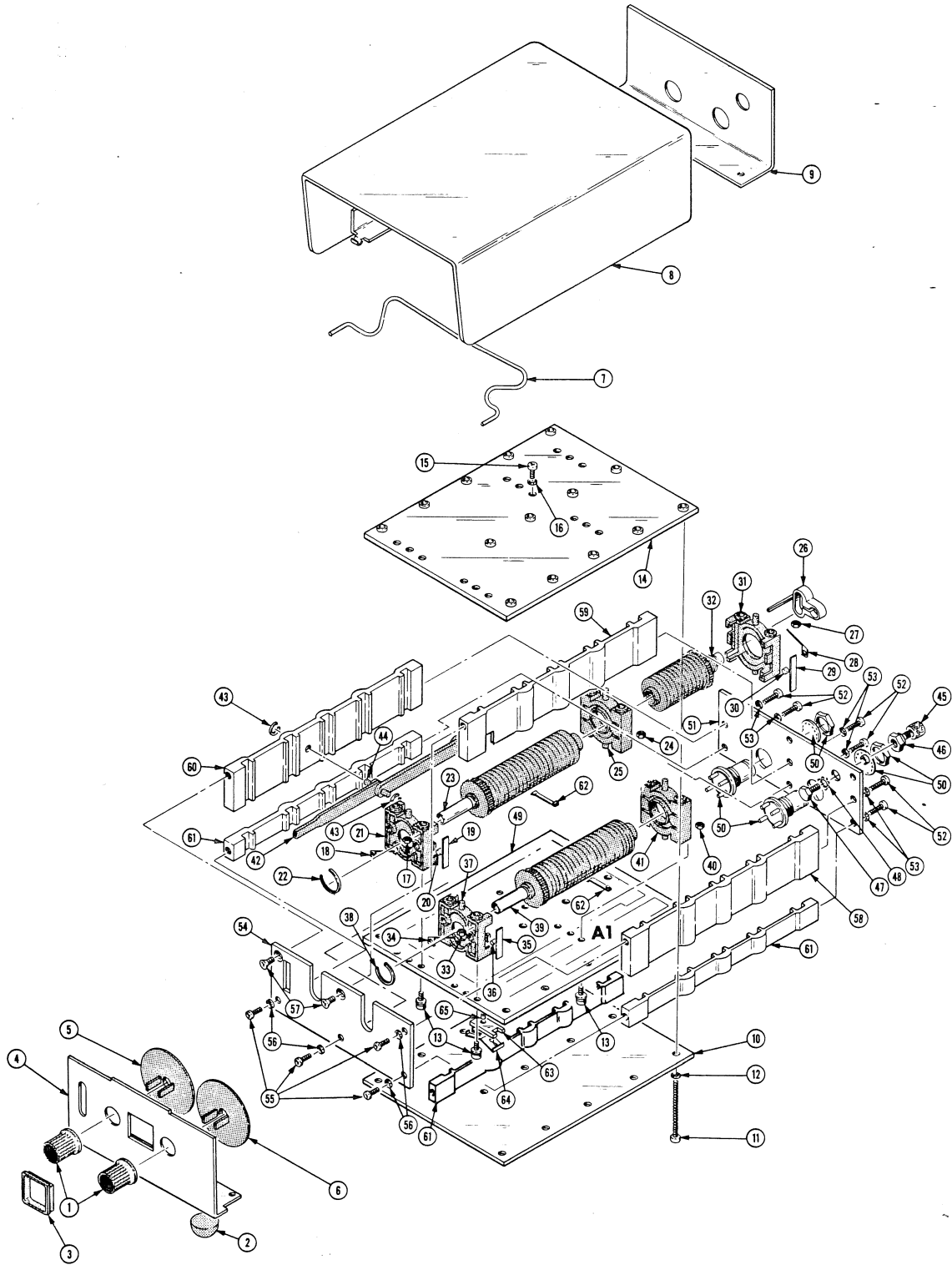
Net Weight	2-3/8 lbs. (1.08 kg)
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ELECTRICAL PARTS LIST



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	-----	-----		CKT BOARD ASSY:ATTENUATOR		
C2	283-0355-00			CAP., FXD, CER DI:0.82UF, 20%, 100V	56289	11C2419Z5U824N101
J1	131-1097-00			CONNECTOR, RCPT, :BNC, FEMALE, CKT CARD MT	80009	131-1097-00
J2	131-1097-00			CONNECTOR, RCPT, :BNC, FEMALE, CKT CARD MT	80009	131-1097-00
J11	355-0131-00			STUD, BDG POST:GROUND	80009	355-0131-00
R1	307-1040-00			TERM, THK FILM:50 OHM	80009	307-1040-00
R10	307-1038-00			ATTENUATOR, FXD:50 OHM, 20DB	80009	307-1038-00
R20	307-1037-00			ATTENUATOR, FXD:50 OHM, 10DB	80009	307-1037-00
R30	307-1038-00			ATTENUATOR, FXD:50 OHM, 20DB	80009	307-1038-00
R40	307-1038-00			ATTENUATOR, FXD:50 OHM, 20DB	80009	307-1038-00
R50	307-1036-00			ATTENUATOR, FXD:50 OHM, 4DB	80009	307-1036-00
R60	307-1035-00			ATTENUATOR, FXD:50 OHM, 2DB	80009	307-1035-00
R70	307-1034-00			ATTENUATOR, FXD:50 OHM, 1DB	80009	307-1034-00
R80	307-1036-00			ATTENUATOR, FXD:50 OHM, 4DB	80009	307-1036-00
S1	105-0656-00			ACTUATOR, CAM SW:DUAL ATTENUATOR	80009	105-0656-00
S10	105-0654-00			ACTUATOR, CAM SW:SINGLE ATTENUATOR	80009	150-0654-00
S20	105-0655-00			ACTUATOR, CAM SW:AC-DC	80009	105-0655-00

EXPLODED



MECHANICAL PARTS LIST

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Qty	1 2 3 4 5	Name & Description	Mfr	
							Code	Mfr Part Number
1-1	366-1605-00			2		KNOB:GRAY,DB SEL,0.252 ID X 706" OD	80009	366-1605-00
	-----			2		. EACH KNOB INCLUDES:		
	213-0153-00			1		. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-2	348-0430-00			4		FOOT,PLASTIC:0.625 OD X 0.32 W/ADH BACK	74932	SJ5027
-3	426-1272-00			1		FRAME,WINDOW:READOUT	80009	426-1272-00
-4	333-2005-00			1		PANEL,FRONT:	80009	333-2005-00
						(ATTACHING PARTS)		
	211-0166-00			2		SCREW,MACHINE:4-40 X 1.750",PNH,STL,CD PL	83385	OBD
	210-0054-00			2		WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
						-----*		
-5	354-0531-01			1		RING,KNOB SKIRT:1 LEFT	80009	354-0531-01
-6	354-0531-02			1		RING,KNOB SKIRT:1 RIGHT	80009	354-0531-02
-7	348-0433-00			1		STAND,ELEC EQPT:	80009	348-0433-00
-8	380-0439-01			1		HOUSING,ATTEN:W/BRACKET	80009	380-0439-01
						(ATTACHING PARTS)		
	211-0166-00			6		SCREW,MACHINE:4-40 X 1.750",PNH,STL,CD PL	83385	OBD
	210-0054-00			6		WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
						-----*		
-9	386-3217-00			1		PANEL,REAR:	80009	386-3217-00
						(ATTACHING PARTS)		
	211-0166-00			3		SCREW,MACHINE:4-40 X 1.750",PNH,STL,CD PL	83385	OBD
	210-0054-00			3		WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
						-----*		
	672-0496-00			1		CKT BOARD ASSY:ATTENUATOR SWITCH	80009	672-0496-00
-10	200-1779-00			1		. COVER,ATTEN:	80009	200-1779-00
						(ATTACHING PARTS)		
-11	211-0166-00			3		. SCREW,MACHINE:4-40 X 1.750",PNH,STL,CD PL	83385	OBD
-12	210-0054-00			3		. WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
						-----*		
	263-1116-00			1		. ACTR ASSY,CAM S:	80009	263-1116-00
-13	211-0116-00			10		. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						-----*		
-14	386-3236-00			1		. . SUPPORT,SWITCH:5.60 X 4.15,ALUMINUM	80009	386-3236-00
						(ATTACHING PARTS)		
-15	211-0097-00			10		. . SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
-16	210-0054-00			10		. . WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
						-----*		
-17	210-0406-00			3		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-18	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-19	214-1139-02			2		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-20	214-1127-00			2		. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-21	401-0081-02			1		. . BEARING,CAM SW:FRONT	80009	401-0081-02
						(ATTACHING PARTS)		
-22	354-0391-00			1		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
						-----*		
-23	105-0656-00			1		. . ACTUATOR,CAM SW:DUAL ATTENUATOR	80009	105-0656-00
-24	210-0406-00			4		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-25	401-0115-00			1		. . BEARING,CAM SW:CENTER	80009	401-0115-00
-26	105-0243-02			1		. . LEVER,SWITCH:MACHINED	80009	105-0243-02
						(ATTACHING PARTS)		
	213-0214-00			1		. . SCREW,CAP SCH:2-56 X 0.375"HEX HD STL	70278	OBD
						-----*		
-27	210-0406-00			3		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-28	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00
-29	214-1139-02			2		. . SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-30	214-1127-00			2		. . ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-31	401-0081-02			1		. . BEARING,CAM SW:FRONT	80009	401-0081-02
						(ATTACHING PARTS)		
	354-0391-00			1		. . RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
						-----*		
-32	105-0655-00			1		. . ACTUATOR,CAM S:AC-DC	80009	105-0655-00
-33	210-0406-00			3		. . NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-34	131-0963-00			1		. . CONTACT,ELEC:GROUNDING	80009	131-0963-00

MECHANICAL PARTS LIST

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscnt	Qty						Name & Description	Mfr	
					1	2	3	4	5		Code	Mfr Part Number
1-35	214-1139-02			2	.	.	.	.	.	SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-36	214-1127-00			2	.	.	.	.	.	ROLLER,DETENT:0.125 DIA X 0.125 INCH L	80009	214-1127-00
-37	401-0081-02			1	.	.	.	.	.	BEARING,CAM SW:FRONT	80009	401-0081-02
										(ATTACHING PARTS)		
-38	354-0391-00			1	.	.	.	.	.	RING,RETAINING:0.395"FREE ID X 0.025" STL	97464	3100-43-CD
-39	105-0654-00			1	.	.	.	.	.	ACTUATOR,CAM S:SINGLE ATTENUATOR	80009	105-0654-00
-40	210-0406-00			4	.	.	.	.	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-41	401-0115-00			1	.	.	.	.	.	BEARING,CAM SW:CENTER	80009	401-0115-00
-42	105-0653-00			1	.	.	.	.	.	LEVER,SWITCH:AC-DC	80009	105-0653-00
										(ATTACHING PARTS)		
-43	354-0392-00			2	.	.	.	.	.	RING,RETAINING:	79136	5555-12MD
										- - - * - - -		
-44	214-1479-00			1	.	.	.	.	.	PIN,DOWEL:	80009	214-1479-00
-45	200-0103-00			1	.	.	.	.	.	NUT,PLAIN,KNURL:0.25-28 X 0.375" OD,BRASS	80009	200-0103-00
-46	355-0131-00			1	.	.	.	.	.	STUD,BDG,POST:	80009	355-0131-00
										(ATTACHING PARTS)		
-47	212-0084-00			1	.	.	.	.	.	SCREW,MACHINE:8-32 X 0.312 INCH,HEX HD STL	83385	OBD
-48	210-0007-00			1	.	.	.	.	.	WASHER,LOCK:EXT #8	70318	1108-00-00-0541C
										- - - * - - -		
-49	----- ¹			1	.	.	.	.	.	CKT BD ASSY:ATTENUATOR(SEE A1 EPL)		
-50	131-1697-00			2	.	.	.	.	.	CONTACT,ELEC:0.093 DIA FEM,CKT BD MT	00779	226287-1
-51	386-3219-00			1	.	.	.	.	.	PLATE,CONN MFG:BNC	80009	386-3219-00
										(ATTACHING PARTS)		
-52	211-0012-00			9	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-53	210-0054-00			9	.	.	.	.	.	WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
										- - - * - - -		
-54	386-3218-00			1	.	.	.	.	.	SUBPANEL,FRONT:	80009	386-3218-00
										(ATTACHING PARTS)		
-55	211-0012-00			4	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.375 INCH,PNH STL	83385	OBD
-56	210-0054-00			4	.	.	.	.	.	WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
-57	211-0038-00			2	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.312"100 DEG,FLH STL	83385	OBD
										- - - * - - -		
-58	337-2173-00			1	.	.	.	.	.	SHIELD,ELEC:TOP	80009	337-2173-00
-59	337-2173-02			1	.	.	.	.	.	SHIELD,ELEC:TOP,W/STRIP LINE NOTCH	80009	337-2173-02
-60	337-2173-01			1	.	.	.	.	.	SHIELD,ELEC:TOP,W/LEVER MTG HOLE	80009	337-2173-01
-61	337-2174-00			3	.	.	.	.	.	SHIELD,ELEC:BOTTOM	80009	337-2174-00
-62	131-1031-00			19	.	.	.	.	.	CONTACT ASSY,EL:CAM SWITCH,TOP	80009	131-1031-00
	131-1030-00			19	.	.	.	.	.	CONTACT ASSY,EL:CAM SWITCH,BOTTOM	80009	131-1030-00
										(ATTACHING PARTS)		
	210-0779-00			19	.	.	.	.	.	RIVET,TUBULAR:0.051 OD X 0.115 INCH LONG	42838	RA-29952715
										- - - * - - -		
-63	-----			-	.	.	.	.	.	ATTEN,FXD:(SEE R1,10,20,30,40,50,60,70,80)		
-64	344-0248-00			9	.	.	.	.	.	CLIP,ATTENUATOR:	80009	344-0248-00
-65	214-1797-00			18	.	.	.	.	.	PIN,ATTEN CLIP:	80009	214-1797-00

¹Replaceable under 672-0496-00 Assembly only.

CROSS INDEX MFR. CODE NUMBER TO MANUFACTURER

MFR.CODE	MANUFACTURER	ADDRESS	CITY,STATE,ZIP
00779	AMP, INC.	P. O. BOX 3608	HARRISBURG, PA 17105
42838	NATIONAL RIVET AND MFG. CO.	1-21 EAST JEFFERSON ST.	WAUPUN, WI 53963
70278	ALLIED STEEL AND CONVEYORS, DIV. OF SPARTON CORP.	17333 HEALY	DETROIT, MI 48212
70318	ALLMETAL SCREW PRODUCTS CO., INC.	821 STEWART AVE.	GARDEN CITY, NY 11530
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74932	INDUSTRIAL SPECIALTIES, INC.	24121 MOUND ROAD	WARREN, MI 48091
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P. O. BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111