



CTS

R E S I S T O R

ELECTROCOMPONENTS

C A T A L O G

Complete Resistor Products Solutions

CTS, a world leader in the design and manufacture of resistor products, has consistently led the industry in the development of thick film materials and the introduction of standard package configurations. By utilizing the latest electronic technology, such as EDI (Electronic Data Interchange), CTS has established and maintained the shortest lead times in the industry.

Most resistor network users, including the largest and most demanding, exempt CTS products from incoming quality testing. These exemptions generate significant savings for CTS customers without any tradeoff in quality or performance.

CTS solid ceramic resistor products have proven reliability that has made CTS a world leader in the design and manufacture of quality resistor products. CTS has accumulated in excess of 1,965,920,560 hours of life test data with a 95 percent confidence level failure rate of only 0.000397 percent. That's CTS reliability! It's the standard others strive to meet.

CTS Resistor/Electrocomponents is a registered ISO 9001/QS 9000 manufacturer. CTS's dedication to continuous improvement and corrective action programs insure CTS resistor products meet customer expectations for quality, performance and service.

CTS Is Committed To Consistently Manufacturing High-Quality Products

CTS is a certified Class A MRPII user, which assures customers that systems are in place to allow CTS to offer the shortest lead times in the industry and to meet delivery promises every time.

CTS is a good environmental citizen. CTS has eliminated the use of all Ozone Depleting Substances from manufacturing operations.

Application Specific Resistor Products are readily available from CTS. Typically, there are no engineering or tooling charges to supply an Application Specific device to meet the special needs of the customer. Best of all, manufacturing lead times for Application Specific Resistor Products are the same as for standard products.

Catalog Updates On The Web

The CTS Resistor/Electrocomponents catalog is on the World Wide Web at www.ctscorp.com. This web version of the catalog is regularly updated to incorporate new product introductions.

Advantages Of Solid Ceramic Resistor Products

CTS "solid ceramic" resistor products have been manufactured since 1963. These resistor products have the excellent performance characteristics and proven reliability that make CTS the resistor network industry leader. The solid ceramic construction is even more advantageous for surface mounting. Resistor products used in surface mounted applications are exposed to temperature extremes during manufacturing, and to aggressive cleaning procedures thereafter. There are no material interfaces to permit the entry of harmful liquids with the CTS one piece ceramic body.

Solid ceramic construction allows CTS to use substrates that are physically larger than those used by manufacturers of "insert molded" devices without increasing overall package size. This allows CTS products to operate at higher temperatures than similar sized molded products. The design characteristics that allow CTS solid ceramic products to operate at higher temperatures translate into long term reliability.

No Internal Dendrite Growth In CTS Products

Metal migration, commonly called dendrite growth, is a classic cause of internal shorting in electronic devices when silver and/or lead are present. The mechanism for dendrite growth includes a voltage potential between metal electrodes and the presence of moisture. Failure occurs after moisture penetrates the body of a molded network during the thermal shock of soldering and the aqueous cleaning process. Because it does not include a plastic molded outer package, the CTS solid ceramic construction will not support internal dendrite growth.

CTS solid ceramic resistor products offer approximately 60 percent more internal surface area for resistor network design than comparably sized molded products. This extra design space allows CTS to provide many custom circuit designs that are not possible with molded products.

Surface Mount Chips and Chip Arrays



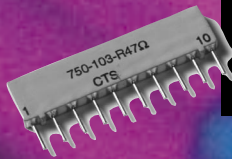
Series	Description	Pads Available	Resistor Power@70°C	PCB Area In²	PCB Area mm²	Comments	See Pages
742	Leadless Chip Array	4-8-16	0.063W	0.0074-028	4.9-17.8	General Purpose, Low Power, Low Cost, Isolated Resistors	6-9
743	Leadless Chip Array	4-8	0.100W	013-026	8.5-16.7	General Purpose, Low Power, Low Cost, Isolated Resistors	6-7
744	Leadless Chip Array	4-8	0.125W	018-036	11.8-23.1	General Purpose, Low Power, Low Cost, Isolated Resistors	6-7
745	Leadless Chip Array	10	0.063W	044	28.4	General Purpose, Low Power, Low Cost, Bussed Resistors	6-9
746	Leadless Chip Array	10	0.031W	012	7.9	General Purpose, Low Power, Low Cost, Bussed Resistors	8-9

Surface Mount Networks



Series	Description	Leads/Pads Available	Package Power@70°C	PCB Area In²	PC B Area mm²	Comments	See Pages
752	Leadless SIP Network	8-9-10-12 16-18 20-24	0.8-1.3W	0.06-.08	38 -54	Low Inductance, Low Capacitance, High Power, High Density, Application Specific Schematics Available	16-17
753	Leadless SIP Network	8-9-10-12 16-18 20-24	0.4-0.55W	0.03-.04	19 -27	Low Inductance, Low Capacitance, High Power, High Density, Application Specific Schematics Available	18-19
766	SO (.150 in.) Narrow Body	8-14-16	0.60-1.2W	0.06-.12	39 -77	Wave Or Reflow Solder, High Density, Application Specific Schematics Available	10-11
767	SO (.220 in.) Medium Body	14-16	1.0-1.5W	0.15-.17	95- 107	Low Cost, Reflow Solder, High Density, Application Specific Schematics Available	12-13
768	SO (.220 in.) Medium Body	14-16-20	1.0-2.0W	0.15-.20	95- 131	Low Cost, Wave Or Reflow Solder, Application Specific Schematics Available	14-15

Through Hole Networks



Series	Description	Leads Available	Package Power@70°C	PCB Area In²	PCB Area mm²	Comments	See Pages
770	Conformal SIP Network	4 to 12	0.4-1.35W	0.04-.12	26-78	Low Cost, Low Power Network	22-23



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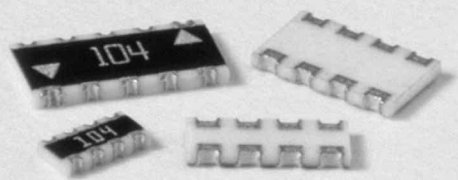
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All specifications are subject to change without notice.
Catalog 3756E

Check Website for latest specifications and
product information.

Concave Chip Resistor Arrays Series 742-745



Thick Film Chip Resistor Arrays

- Low cost
- High density packaging
- Leadless surface mount construction
- Tape & reel packaging
- Solder-coated nickel barrier pads
- Isolated and bussed circuits
- Compatible with all solder processes
Wave, IR reflow, Vapor phase reflow

High Density Packaging:

- 30% less space per resistor than 0603 chip resistors.
- 75% less space per resistor than 0805 chip resistors.

Placement Efficiency:

Arrays require fewer placements than discrete components. Larger overall size eases handling compared to discrete components.

Low Profile:

Can be used in PCMCIA cards

Resistance Tolerance:

Standard: $\pm 5\%$ or $.5\Omega$ (whichever is greater)

Operating Temperature Range:

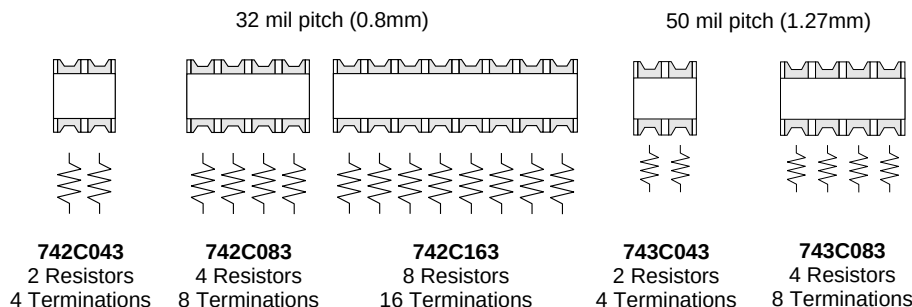
-55°C to $+125^{\circ}\text{C}$

Temperature Coefficient (TCR):

Standard: 200PPM/ $^{\circ}\text{C}$

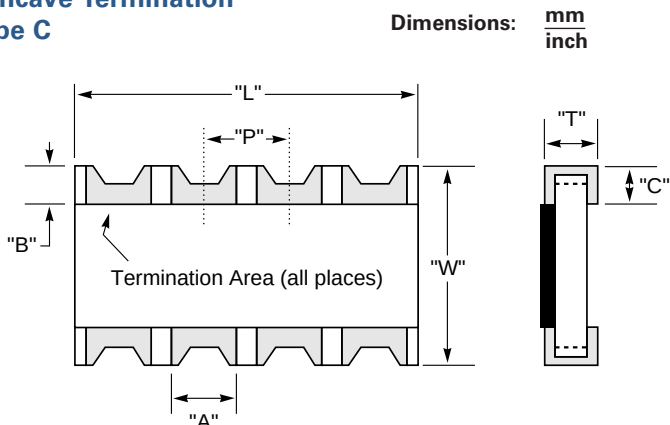
Standard Packages & Style Codes

Concave Termination

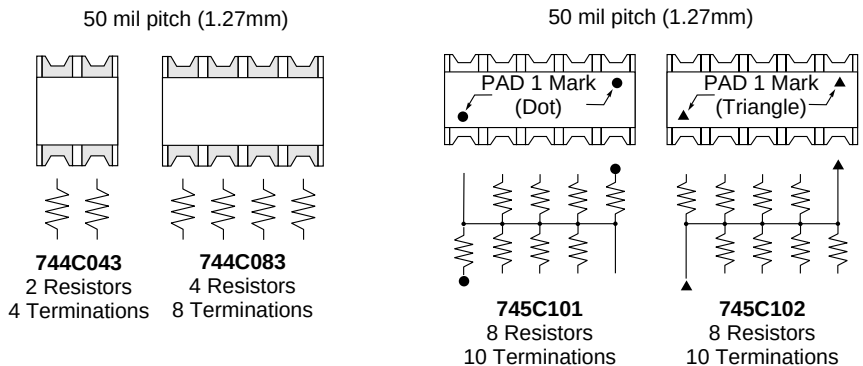


Package Outlines

Concave Termination Type C



Size Code	Part Code	# Pads	# Res.	Circuit	L	W	P	T	A	B	C
0603 x 2	742C043	4	2	Isolated	1.60 ± 0.20 $0.063 \pm .008$						
0603 x 4	742C083	8	4	Isolated	3.20 ± 0.20 $0.126 \pm .008$	1.60 ± 0.20 $0.063 \pm .008$	0.80 ± 0.05 $0.032 \pm .002$	0.60 ± 0.10 $0.024 \pm .004$	0.5 ± 0.15 $0.020 \pm .006$	0.30 ± 0.20 $0.012 \pm .008$	0.40 ± 0.15 $0.016 \pm .006$
0603 x 8	742C163	16	8	Isolated	6.40 ± 0.20 $0.252 \pm .008$						
0805 x 2	743C043	4	2	Isolated	2.54 ± 0.20 $0.100 \pm .008$	2.0 ± 0.20	1.27 ± 0.05	0.60 ± 0.10	0.80 ± 0.15	0.40 ± 0.30	0.55 ± 0.15
0805 x 4	743C083	8	4	Isolated	5.08 ± 0.30 $0.200 \pm .012$	$0.079 \pm .008$	$0.050 \pm .002$	$0.024 \pm .004$	$0.031 \pm .006$	$0.016 \pm .012$	$0.022 \pm .006$
1206 x 2	744C043	4	2	Isolated	2.54 ± 0.20 $0.100 \pm .008$	3.20 ± 0.20	1.27 ± 0.05	0.60 ± 0.10	0.80 ± 0.15	0.50 ± 0.30	0.55 ± 0.15
1206 x 4	744C083	8	4	Isolated	5.08 ± 0.30 $0.200 \pm .012$	$0.126 \pm .008$	$0.050 \pm .002$	$0.024 \pm .004$	$0.031 \pm .006$	$0.020 \pm .012$	$0.022 \pm .006$
1203 x 8	745C101 745C102	10	8	Bussed	6.40 ± 0.20 $0.252 \pm .008$	3.10 ± 0.20 $0.122 \pm .008$	1.27 ± 0.05 $0.050 \pm .002$	0.60 ± 0.15 $0.024 \pm .006$	0.60 ± 0.15 $0.024 \pm .006$	0.35 ± 0.15 $0.014 \pm .006$	0.55 ± 0.15 $0.022 \pm .006$



Series	PCB Area (in ²) Per Resistor	Circuit Type	Resistance Range Ω	70°C Power Per Resistor*	Maximum Operating Voltage
742C	0.0037	Isolated	10 - 1M	0.063W	50V
743C	0.0071	Isolated	10 - 1M	0.100W	100V
744C	0.0094	Isolated	10 - 1M	0.125W	200V
745C	0.0058	Bussed	33 - 100K	0.063W	50V

* Total package power equals total number of resistors times rated power per resistor.

Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

The TCE of the mounting surface will affect the long term reliability of the solder joint between the Series 742-745 and the mounting surface. Application requirements vary and each user must determine if the Series 742-745 is appropriate for the application.

(Ohms)	EIA Code
0 *	000X
10	100
12	120
15	150
18	180
22	220
27	270
33	330
39	390
47	470
51	510
56	560
68	680
75	750
82	820
100	101
110	111
120	121
150	151
180	181
220	221
270	271
330	331
390	391
470	471
510	511
560	561
680	681
820	821
1000	102
1100	112
1500	152
1800	182
2200	222
2700	272

*50m Ω max

(Ohms)	EIA Code
3300	332
3900	392
4700	472
5100	512
5600	562
6800	682
8200	822
10000	103
11000	113
12000	123
15000	153
18000	183
22000	223
27000	273
33000	333
39000	393
47000	473
51000	513
56000	563
68000	683
82000	823
100000	104
110000	114
120000	124
150000	154
180000	184
220000	224
270000	274
330000	334
390000	394
470000	474
510000	514
560000	564
680000	684
820000	824
1000000	105

How to Order Chip Resistor Arrays

742C

Series 742C
743C
744C
745C

08

No. Terminations
04
08
16 (742 only)
10 (745 only)

3

Resistor Code
1% = 4 Digit EIA Code
2%, 5% = 3 digit EIA Code

101

J

Tolerance
J = $\pm 5\%$ (Standard)
G = $\pm 2\%$ F = $\pm 1\%$
x = Zero Ohm Jumper

Schematic
1 Bussed (745)
2 Bussed (745 only)
3 Isolated (742, 743, 744)

NOTE: No dashes or spaces to appear in part number.

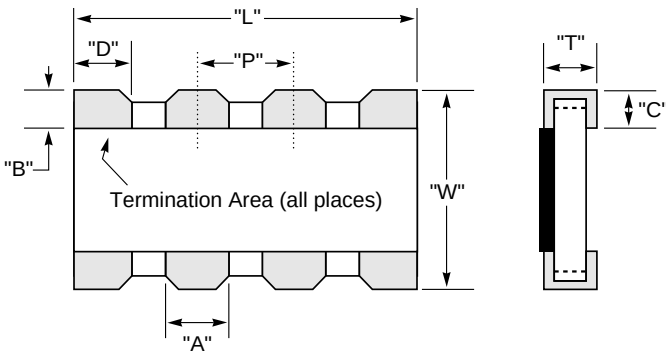
Example: 742C083101J

See page 33 for part marking information.

Convex Chip Resistor Arrays Series 742, 745, 746

Package Outlines

Convex Termination Type X



Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

The TCE of the mounting surface will affect the long term reliability of the solder joint between the Series 742, 745, 746 and the mounting surface. Application requirements vary and each user must determine if the Series 742, 745, 746 is appropriate for the application.

Size Code	Part Code	# Pads	# Res.	Circuit	L	W	P	T	A	B	C	D
0603 x 4	742X083	8	4	Isolated	3.2 ± 0.2 0.126±008	1.6 ± 0.2 0.063±008	0.8 ± 0.05 0.032±002	0.5 ± 0.1 0.020±004	0.5 ± 0.15 0.020±006	0.3 ± 0.15 0.012±006	0.3 ± 0.15 0.024±006	N/A
1203 x 8	745X101 745X102	10	8	Bussed	6.4 ± 0.2 0.252±008	3.2 ± 0.2 0.126±008	1.27 ± 0.05 0.050±002	0.6 ± 0.1 0.024±004	0.9 ± 0.15 0.035±006	0.5 ± 0.2 0.020±008	0.5 ± 0.15 0.020±006	1.1 ± 0.15 0.043±006
0603 x 8	746X101	10	8	Bussed	3.3 ± 0.1 0.130±004	1.65 ± 0.15 0.065±006	0.64 ± 0.05 0.025±002	0.6 ± 0.1 0.024±004	0.35 ± 0.05 0.014±002	0.4 ± 0.10 0.016±004	0.45 ± 0.10 0.018±004	0.5 ± 0.05 0.020±002

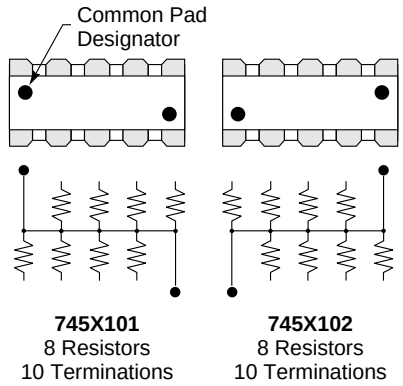
Series	PCB Area (in²) Per Resistor	Circuit Type	Resistance Range Ω	70°C Power Per Resistor*	Maximum Operating Voltage
742X	0.0037	Isolated	10 - 1M	0.063W	50V
745X	0.0058	Bussed	33 - 100K	0.063W	50V
746X	0.0013	Bussed	33 - 100K	0.031W	25V

* Total package power equals total number of resistors times rated power per resistor.

Standard Packages & Style Codes

Convex Termination

50 mil pitch (1.27mm)

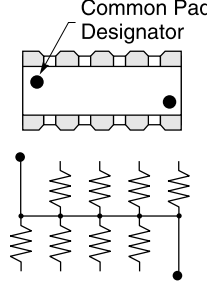


745X101
8 Resistors
10 Terminations

745X102
8 Resistors
10 Terminations

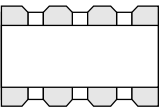
Note: The Marking Concept for Convex and Concave Series 745 is Different.

25 mil pitch (0.64mm)



746X101
8 Resistors
10 Terminations

32 mil pitch (0.8mm)



742X083
4 Resistors
8 Terminations

(Ohms)	EIA Code	(Ohms)	EIA Code
0 *	000X	3300	332
10	100	3900	392
12	120	4700	472
15	150	5100	512
18	180	5600	562
22	220	6800	682
27	270	8200	822
33	330	10000	103
39	390	11000	113
47	470	12000	123
51	510	15000	153
56	560	18000	183
68	680	22000	223
75	750	27000	273
82	820	33000	333
100	101	39000	393
110	111	47000	473
120	121	51000	513
150	151	56000	563
180	181	68000	683
220	221	82000	823
270	271	100000	104
330	331	110000	114
390	391	120000	124
470	471	150000	154
510	511	180000	184
560	561	220000	224
680	681	270000	274
820	821	330000	334
1000	102	390000	394
1100	112	470000	474
1500	152	510000	514
1800	182	560000	564
2200	222	680000	684
2700	272	820000	824
		1000000	105

*50mΩ max

How to Order Chip Resistor Arrays

742X

Series 742X
745X
746X

08

No. Terminations
08
10 (745 and 746 only)

3

Schematic 1 Bussed (745 and 746 only)
2 Bussed (745 and 746 only)
3 Isolated (742)

101

Resistor Code
1% = 4 Digit EIA Code
2%, 5% = 3 Digit EIA Code

J

Tolerance
J = ±5% (Standard)
G = ±2% F=±1%
x= Zero Ohm Jumper

NOTE: No dashes or spaces to appear in part number.

Example: 742X083101J

See page 33 for part marking information.

Surface Mount Series 766



Narrow Body Design

- Series 766 requires 30% less board space than molded products of the same power rating
- Packaged in tape and reel or slide packs
- Solid ceramic construction
- Meets EIA PDP 100 SOGN-0001 outline
- No internal dendrite growth
- Application specific circuits are available
- Compatible with all solder processes Wave, IR reflow, Vapor phase reflow
- Recommended for bottom side attachment

Resistance Range:

Standard: 10Ω to 1 MegΩ

Resistance Tolerance:

Standard: ±2% or 0.5Ω (whichever is greater)

Special: ±0.25% or 0.3Ω (whichever is greater)

Maximum Operating Voltage:

50V not to exceed rated power

Temperature Coefficient:

Standard: 100Ω to 1 MegΩ

±100PPM/°C typical

10Ω to 99Ω

±200PPM/°C typical

Operating Temperature Range:

-55°C to +125°C

Dielectric Strength:

100 VAC

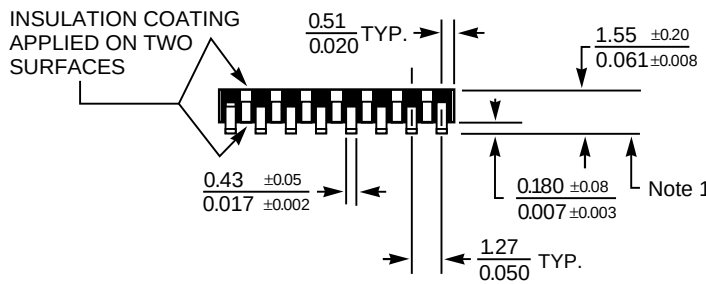
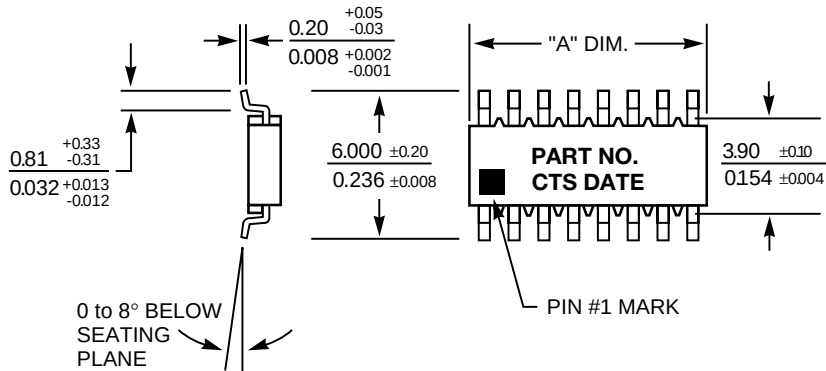
Power Rating (Total Network Power):

	8 Pin	14 Pin	16 Pin
@25°C	0.9w	1.6w	1.8w
@70°C	0.6w	1.0w	1.2w

Maximum Resistor Power:

(not to exceed total network power)

Schematic	1	3	5	7
@25°C	0.12w	0.24w	0.12w	0.12w
@70°C	0.08w	0.16w	0.08w	0.08w



No. of Pins	"A" Dimension
8	4.90 ± 0.10 0.193 ± 0.004
14	8.65 ± 0.10 0.340 ± 0.004
16	9.90 ± 0.10 0.390 ± 0.004 - 0.005

Notes:

1 Lead COPLANARITY 0.10 MAX.
0.004

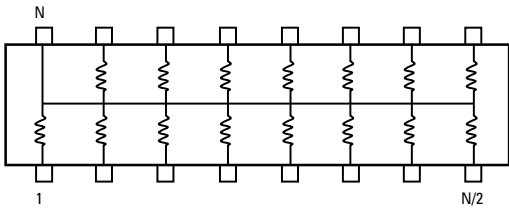
2 mm & inch DIMENSIONS ARE NOT EQUIVALENT

3 General Tolerances mm ±0.25
inch ±0.010

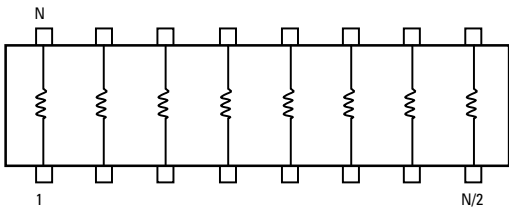
4 Dimensions are mm/in.

Application Notes	pages 24-25
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

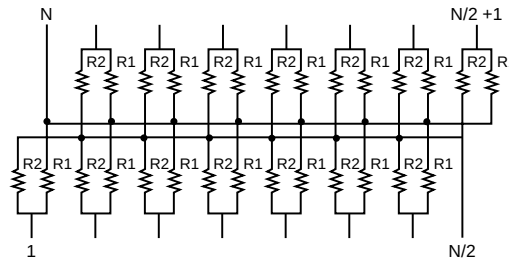
Bussed CTS Schematic 1



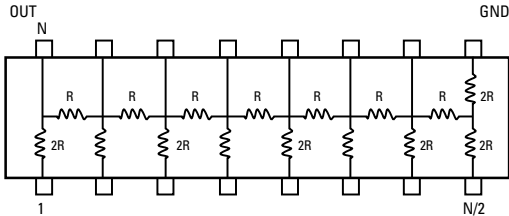
Isolated CTS Schematic 3



Dual Terminator CTS Schematic 5



R/2R Ladder CTS Schematic 7



(Ohms)	EIA Code
0 *	000X
10	100
12	120
15	150
18	180
22	220
27	270
33	330
39	390
47	470
51	510
56	560
68	680
82	820
100	101
110	111
120	121
150	151
180	181
200	201
220	221
270	271
330	331
390	391
470	471
510	511
560	561
680	681
820	821
1000	102
1100	112
1200	122
1500	152
1800	182
2000	202
2200	222
2700	272

(Ohms)	EIA Code
3300	332
3900	392
4700	472
5100	512
5600	562
6800	682
8200	822
10000	103
11000	113
12000	123
15000	153
18000	183
20000	203
22000	223
27000	273
33000	333
39000	393
47000	473
56000	563
68000	683
82000	823
100000	104
110000	114
120000	124
150000	154
180000	184
200000	204
220000	224
270000	274
330000	334
390000	394
470000	474
560000	564
680000	684
820000	824
1000000	105

*3Ω max

How to Order 766 Products

766

Series 766

14

Number of Pins 08
14
16

3

Schematic 1 Bussed
3 Isolated
5 Dual Terminator
7 Ladder

101

Resistor Code
See Page 32
Schematic 5

Tolerance

Schematic 1 & 3

J= ±5%

G= ±2%

F= ±1%

D= ±1/2%

G

All 5 schematic products are 2% tolerance.

TR

Packaging - TR - Tape & Reel
SP - Slide Pack (see page 36)

13

Reel Size 13 = 13" dia.
7 = 7" dia.

Schematic 7

F= ±1LSB

D= ±1/2LSB

(LSB=Least Significant Bit)

NOTE: No dashes or spaces to appear in part number.

Example: 766143101GTR13

See page 33 for part marking information.

Surface Mount Series 767



Ample Space Between Body and Board

Having ample space between body and board allows for fast, thorough cleaning after soldering, and ease of solder joint inspection.

- 0.220" wide body
- Solid ceramic construction
- No internal dendrite growth
- Clearance for ease of board cleaning 0.030"
- Compatible with EIA PDP-100 SOGN-0002
- 24mm tape & reel or slide packs
- Application specific circuits are available
- Compatible with all solder processes
Wave, IR reflow, Vapor phase reflow

Resistance Range:

Standard: 10Ω to 1 MegΩ

Resistance Tolerance:

Standard: $\pm 2\%$ or 0.5Ω (whichever is greater)
Special: $\pm 0.25\%$ or 0.3Ω (whichever is greater)

Maximum Operating Voltage:

50V not to exceed rated power

Temperature Coefficient:

Standard: 100Ω to 1 MegΩ
 $\pm 100\text{PPM}/^\circ\text{C}$ typical
10Ω to 99Ω
 $\pm 200\text{PPM}/^\circ\text{C}$ typical

Operating Temperature Range:

-55°C to +125°C

Dielectric Strength:

100 VAC

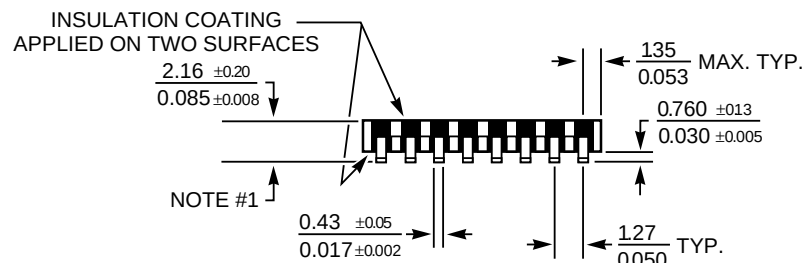
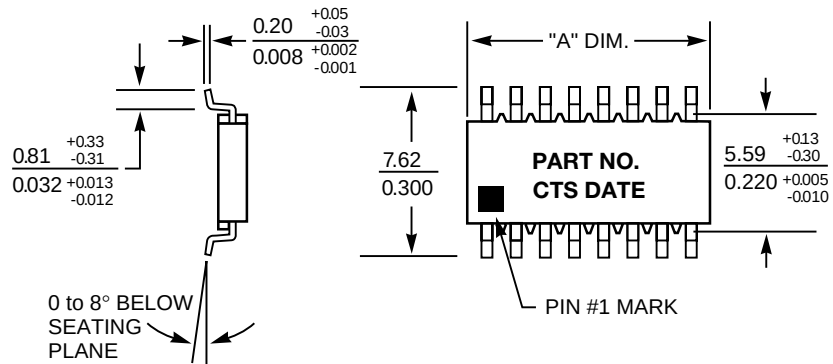
Power Rating (Total Network Power):

	14 Pin	16 Pin
@25°C	2.0w	2.3w
@70°C	1.3w	1.5w

Maximum Resistor Power:

(not to exceed total network power)

Schematic	1	3	5	7
@25°C	0.15w	0.3w	0.15w	0.15w
@70°C	0.1w	0.2w	0.1w	0.1w



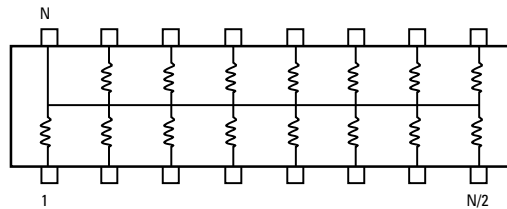
No. of Pins	"A" Dimension
14	9.91 +0.25 / -0.13
	0.390 +0.010 / -0.005
16	11.18 +0.25 / -0.13
	0.440 +0.010 / -0.005

Notes:

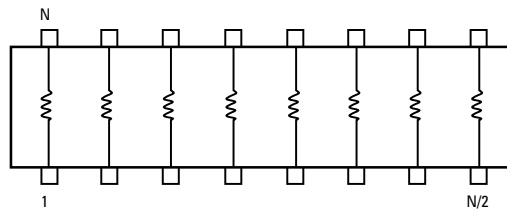
- 1 Lead COPLANARITY 0.10 MAX. 0.004
- 2 mm & inch DIMENSIONS ARE NOT EQUIVALENT
- 3 General Tolerances mm ± 0.25 inch ± 0.010
- 4 Dimensions are mm/in.

Application Notes	pages 24-25
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

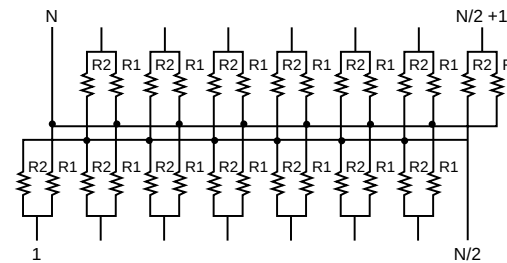
Bussed CTS Schematic 1



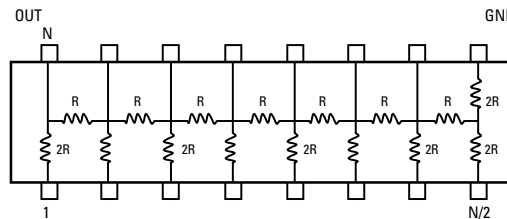
Isolated CTS Schematic 3



Dual Terminator CTS Schematic 5



R/2R Ladder CTS Schematic 7



(Ohms)	EIA Code	(Ohms)	EIA Code
0 *	000X	3300	332
10	100	3900	392
12	120	4700	472
15	150	5100	512
18	180	5600	562
22	220	6800	682
27	270	8200	822
33	330	10000	103
39	390	11000	113
47	470	12000	123
51	510	15000	153
56	560	18000	183
68	680	20000	203
82	820	22000	223
100	101	27000	273
110	111	33000	333
120	121	39000	393
150	151	47000	473
180	181	56000	563
200	201	68000	683
220	221	82000	823
270	271	100000	104
330	331	110000	114
390	391	120000	124
470	471	150000	154
510	511	180000	184
560	561	200000	204
680	681	220000	224
820	821	270000	274
1000	102	330000	334
1100	112	390000	394
1200	122	470000	474
1500	152	560000	564
1800	182	680000	684
2000	202	820000	824
2200	222	1000000	105
2700	272		

*3Ω max

How to Order Series 767 Products

Application specific custom products are marked with either a customer part number or a non-descriptive CTS part number. Send documentation to a CTS Sales Office giving schematic, resistor values and tolerance, and other non-standard information. See pages 24-25 for application notes.

767

Series 767

14

Number of Pins
14
16

3

Schematic
1 Bussed
3 Isolated
5 Dual Terminator
7 Ladder

101

Resistor Code
See Page 32
Schematic 5

Tolerance
Schematic
1 & 3
J= $\pm 5\%$
G= $\pm 2\%$
F= $\pm 1\%$
D= $\pm 1/2\%$

G

Schematic
5
All 5 schematic
products are
2% (not marked)
tolerance.

TR

Packaging - TR - Tape & Reel
SP - Slide Pack (see page 36)

Schematic
7
F= $\pm 1\text{LSB}$
D= $\pm 1/2\text{LSB}$
(LSB=Least
Significant Bit)

NOTE: No dashes or spaces to appear in part number.

Example: 767143101GTR

See page 33 for part marking information.

Surface Mount Series 768



Medium Body, Small Outline Products

- Low profile—board to network clearance of 0.005"/0.010"
- Conforms to EIA PDP-100 SOGN-0002
- 24mm tape & reel or slide
- Application specific circuits are available
- No internal dendrite growth
- Compatible with all solder processes
Wave, IR reflow, Vapor phase reflow
- Recommended for bottom side attachment

Resistance Range:

Standard: 10Ω to 1 MegΩ

Resistance Tolerance:

Standard: ±2% or 0.5Ω (whichever is greater)
Special: ±0.25% or 0.3Ω (whichever is greater)

Maximum Operating Voltage:

50V not to exceed rated power

Temperature Coefficient:

Standard: 100Ω to 1 MegΩ
±100PPM/°C typical
10Ω to 99Ω
±200 PPM/°C typical

Operating Temperature Range:

-55°C to +125°C

Dielectric Strength:

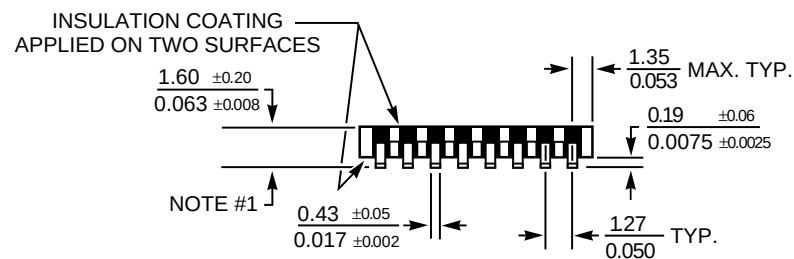
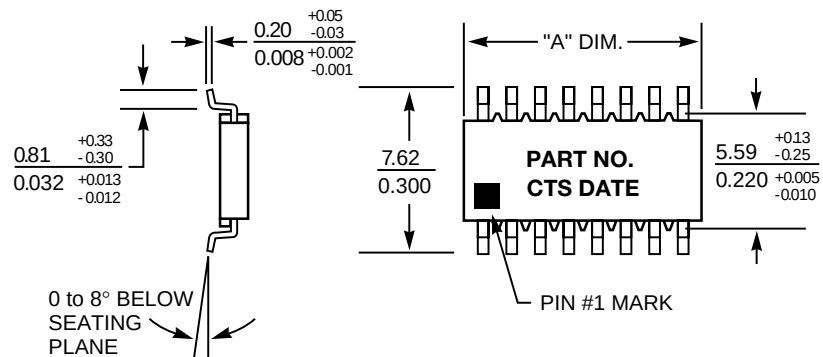
100 VAC

Power Rating (Total Network Power):

	14 Pin	16 Pin	20 Pin
@25°C	2.0w	2.3w	3.0w
@70°C	1.3 w	1.5w	2.0w

Maximum Resistor Power:

(not to exceed total network power)				
Schematic	1	3	5	7
@25°C	0.15w	0.3w	0.15w	0.15w
@70°C	0.1w	0.2w	0.1w	0.1w



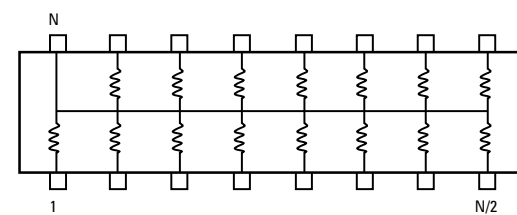
No. of Pins	"A" Dimension
14	9.91 + 0.25 / - 0.13
	0.390 + 0.010 / - 0.005
16	11.18 + 0.25 / - 0.13
	0.440 + 0.010 / - 0.005
20	13.70 + 0.25 / - 0.13
	0.540 + 0.010 / - 0.005

Notes:

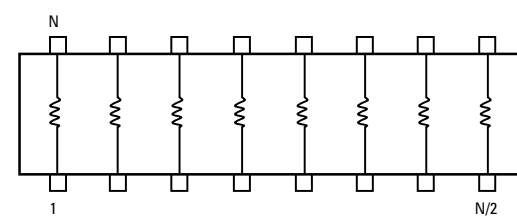
- 1 Lead COPLANARITY 0.10 MAX. 0.004
- 2 mm & inch DIMENSIONS ARE NOT EQUIVALENT
- 3 General Tolerances mm ±0.25 inch ±0.010
- 4 Dimensions are mm/in.

Application Notes	pages 24-25
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

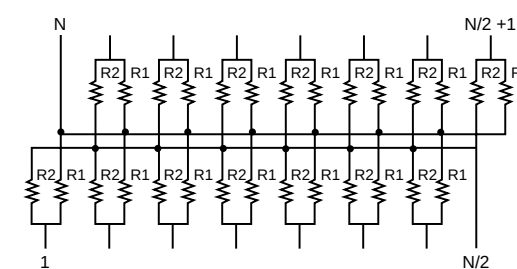
Bussed CTS Schematic 1



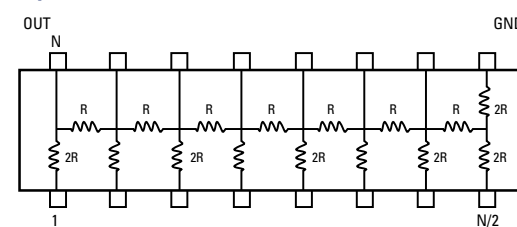
Isolated CTS Schematic 3



Dual Terminator CTS Schematic 5



R/2R Ladder CTS Schematic 7



(Ohms)	EIA Code	(Ohms)	EIA Code
0 *	000X	3300	332
10	100	3900	392
12	120	4700	472
15	150	5100	512
18	180	5600	562
22	220	6800	682
27	270	8200	822
33	330	10000	103
39	390	11000	113
47	470	12000	123
51	510	15000	153
56	560	18000	183
68	680	20000	203
82	820	22000	223
100	101	27000	273
110	111	33000	333
120	121	39000	393
150	151	47000	473
180	181	56000	563
200	201	68000	683
220	221	82000	823
270	271	100000	104
330	331	110000	114
390	391	120000	124
470	471	150000	154
510	511	180000	184
560	561	200000	204
680	681	220000	224
820	821	270000	274
1000	102	330000	334
1100	112	390000	394
1200	122	470000	474
1500	152	560000	564
1800	182	680000	684
2000	202	820000	824
2200	222	1000000	105
2700	272		

*3Ω max

How to Order Series 768 Products

Application specific custom products are marked with either a customer part number or a non-descriptive CTS part number. Send documentation to a CTS Sales Office giving schematic, resistor values and tolerance, and other non-standard information. See pages 24-25 for application notes.

768	14	3	101	G	TR
Series 768	Number of Pins 14 16 20		Resistor Code See Page 32 Schematic 5		Packaging - TR - Tape & Reel SP - Slide Pack (see page 36)
Schematic	1 Bussed 3 Isolated 5 Dual Terminator 7 Ladder		Tolerance Schematic 1 & 3 J= ±5% G= ±2% F= ±1% D= ±1/2%	Schematic 5 All 5 schematic products are 2% tolerance. (not marked)	Schematic 7 F= ±1LSB D= ±1/2LSB (LSB=Least Significant Bit)

NOTE: No dashes or spaces to appear in part number.

Example: 768143101GTR

See page 33 for part marking information.

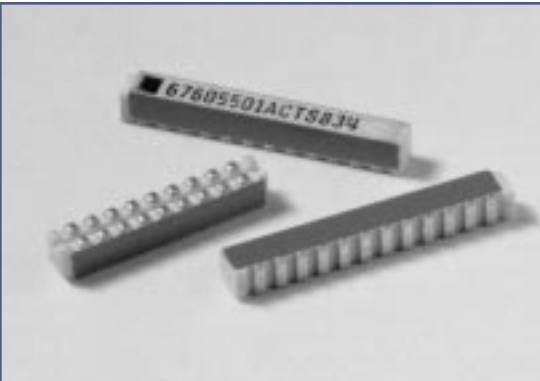


CTS Resistor/Electrocomponents • 406 Parr Road • Berne, IN • 46711 • fax: (219) 589-3243 • www.ctscorp.com • 768B

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Surface Mount Series 752



In-Line Surface Mount Resistor Products

- High density packaging
- Low profile
- Input/outputs available:
 - Dual Row Terminations - 16, 18, 20, 24
 - Single Row Terminations - 8, 9, 10, 12
- Nickel barrier solder-coated pads
- Designed for visual inspection of solder joints
- Designed for board cleaning
- 24mm tape & reel packaging
- Application specific circuits are available
- Compatible with all solder processes
 - Wave, IR reflow, Vapor phase reflow

Resistance Range:

Standard: 10Ω to 1 MegΩ

Resistance Tolerance:

Standard: ±2% or 0.5Ω (whichever is greater)
Special: ±1% or 0.3Ω (whichever is greater)

Maximum Operating Voltage:

25V not to exceed rated power

Temperature Coefficient:

Standard: ±200PPM/°C
Special: ±100PPM/°C
(33Ω to 1 MegΩ)

Dielectric Strength:

100 VAC

Operating Temperature Range:

-55°C to +125°C

Power Rating (Total Network Power):

Number of input/outputs (watts)

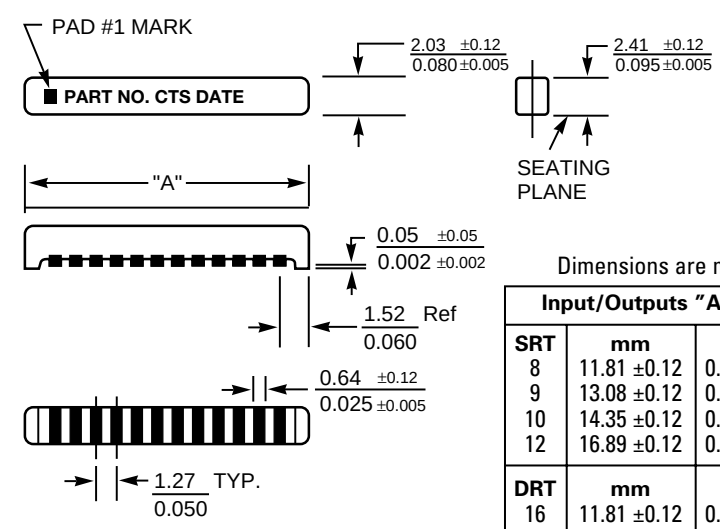
SRT	8	9	10	12	16	18	20	24
DRT								
@25°C	1.2	1.3	1.4	1.7	1.4	1.5	1.6	2.0
@70°C	0.8	0.85	0.9	1.1	0.9	0.95	1.0	1.3

Maximum Resistor Power:

(Not to Exceed Total Network Power)

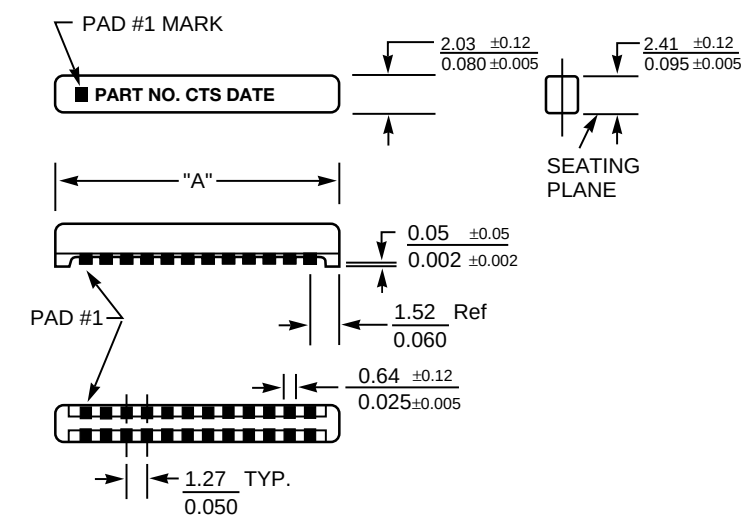
	Bussed & Dual Terminator Schematic	Isolated Schematic
@25°C	0.12w	0.24w
@70°C	0.08w	0.16w

Single Row Termination (SRT)



Input/Outputs "A" Dim.		
SRT	mm	in.
8	11.81 ±0.12	0.465 ±0.005
9	13.08 ±0.12	0.515 ±0.005
10	14.35 ±0.12	0.565 ±0.005
12	16.89 ±0.12	0.665 ±0.005
DRT	mm	in.
16	11.81 ±0.12	0.465 ±0.005
18	13.08 ±0.12	0.515 ±0.005
20	14.35 ±0.12	0.565 ±0.005
24	16.89 ±0.12	0.665 ±0.005

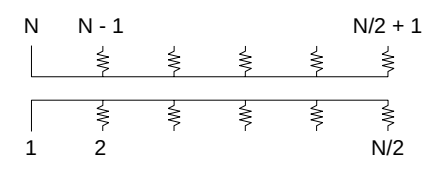
Dual Row Termination (DRT)



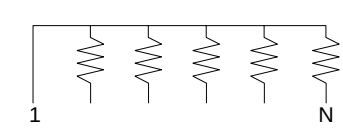
The TCE of the mounting surface will affect the long term reliability of the solder joint between the Series 752 and the mounting surface. Application requirements vary and each user must determine whether the Series 752 is appropriate for the application. Thermal shock data for solder joint fatigue is available on request.

Application Notes	pages 24-25
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

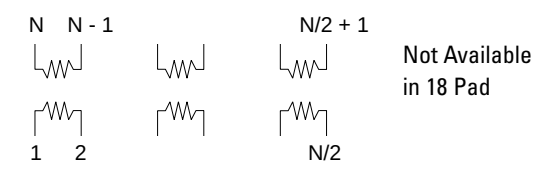
Bussed DRT Schematic 1



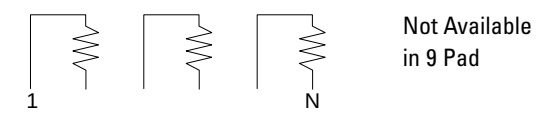
Bussed SRT Schematic 1



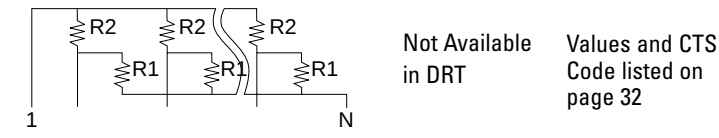
Isolated DRT Schematic 3



Isolated SRT Schematic 3



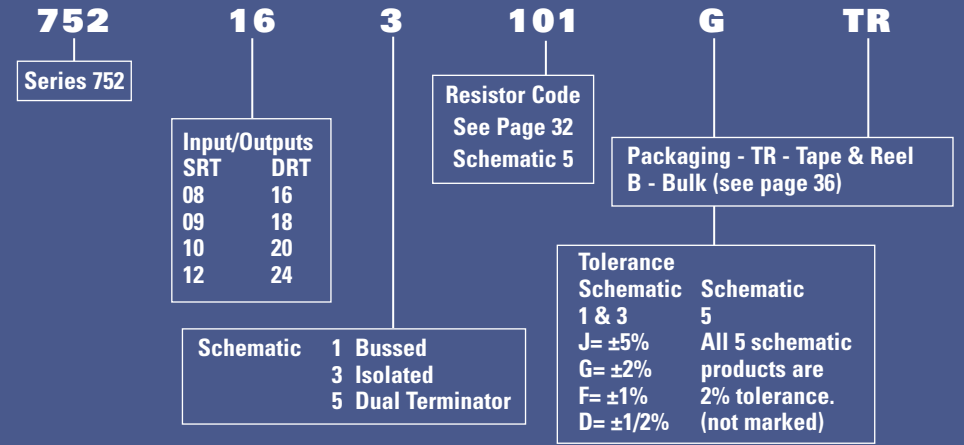
Dual Terminator SRT Schematic 5



(Ohms)	EIA Code	(Ohms)	EIA Code
10	100	3300	332
12	120	3900	392
15	150	4700	472
18	180	5100	512
22	220	5600	562
27	270	6800	682
33	330	8200	822
39	390	10000	103
47	470	11000	113
51	510	12000	123
56	560	15000	153
68	680	18000	183
82	820	20000	203
100	101	22000	223
110	111	27000	273
120	121	33000	333
150	151	39000	393
180	181	47000	473
200	201	56000	563
220	221	68000	683
270	271	82000	823
330	331	100000	104
390	391	110000	114
470	471	120000	124
510	511	150000	154
560	561	180000	184
680	681	200000	204
820	821	220000	224
1000	102	270000	274
1100	112	330000	334
1200	122	390000	394
1500	152	470000	474
1800	182	560000	564
2000	202	680000	684
2200	222	820000	824
2700	272	1000000	105

How to Order Series 752 Products

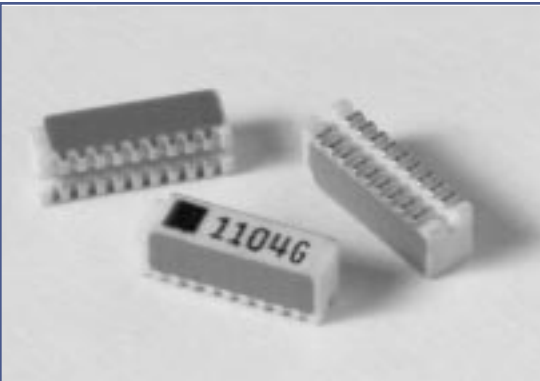
Application specific custom products are marked with either a customer part number or a non-descriptive CTS part number. Send documentation to a CTS Sales Office giving schematic, resistor values and tolerance, and other non-standard information. See pages 24-25 for application notes.



NOTE: No dashes or spaces to appear in part number. Example: 752163101GTR See page 33 for part marking information.



Surface Mount Series 753



In-Line Surface Mount Resistor Products

- High density packaging
- Solid ceramic construction
- Low profile
- Available terminations per package:
 - Dual Row Terminations – 16, 18, 20, 24
 - Single Row Terminations – 8, 9, 10, 12
- Solder-coated pads
- Designed for visual inspection of solder joints
- Designed for board cleaning
- 16mm tape & reel packaging

Resistance Range:

Standard: 10Ω to 1 MegΩ

Resistance Tolerance:

Standard ±2% or 0.5 ohm (whichever is greater)
Special: ±1% or 0.3 ohm (whichever is greater)

Maximum Operating Voltage:

25V not to exceed rated power

Temperature Coefficient:

Standard: ±200PPM/°C

Operating Temperature Range:

-55°C to +125°C

Power Rating (Total Network Power):

Number of input/outputs

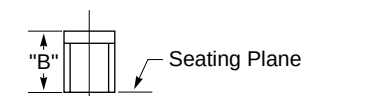
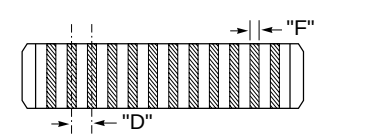
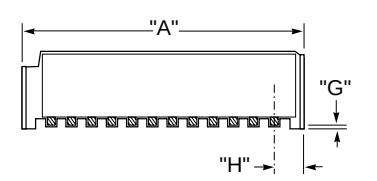
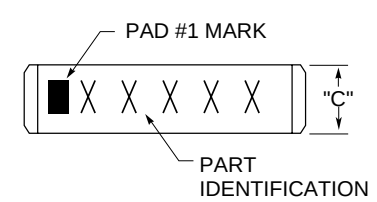
	SRT	8	9	10	12	16	18	20	24
DRT									
@25°C	0.60	0.64	0.68	0.82	0.60	0.64	0.68	0.82	
@70°C	0.40	0.43	0.45	0.55	0.40	0.43	0.45	0.55	

Maximum Resistor Power:

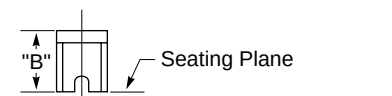
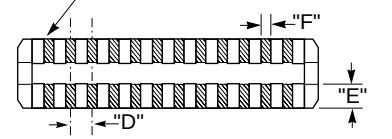
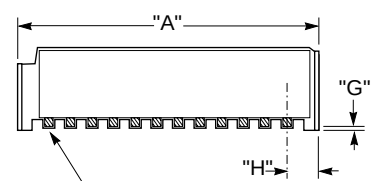
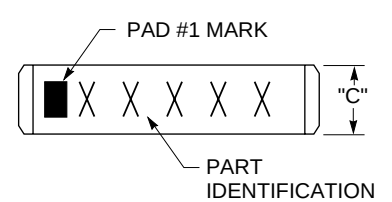
(Not to Exceed Total Network Power)

	Bussed & Dual	Isolated
@25°C	0.06w	0.12w
@70°C	0.04w	0.08w

Single Row Termination (SRT)



Dual Row Termination (DRT)



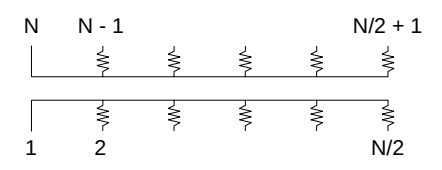
Dim.	mm.	In.
B	2.41±0.12	0.095±0.005
C	2.03±0.12	0.080±0.005
D	0.64±0.12	0.025±0.005
E	0.71±0.12	0.028±0.005
F	0.33±0.08	0.013±0.003
G	0.08±0.08	0.003±0.003
H	0.89 Ref.	0.035 Ref.

Terminations	"A" Dimension	
	mm. ±0.12	In. ±0.005
8	6.22	0.245
9	6.86	0.270
10	7.49	0.295
12	8.76	0.345
16	6.22	0.245
18	6.86	0.270
20	7.49	0.295
24	8.76	0.345

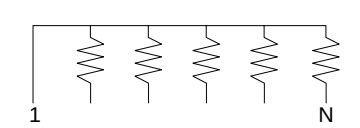
The TCE of the mounting surface will affect the long term reliability of the solder joint between the Series 753 and the mounting surface. Application requirements vary and each user must determine whether the Series 753 is appropriate for the application. Thermal shock data for solder joint fatigue is available on request.

Application Notes	pages 24-25
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

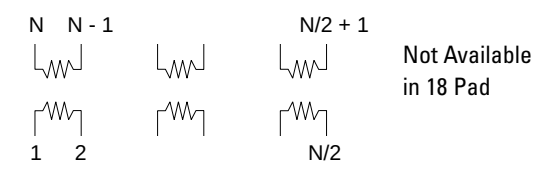
Bussed DRT Schematic 1



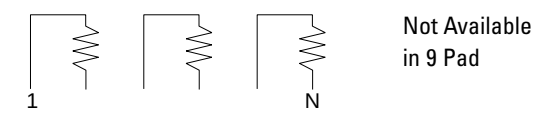
Bussed SRT Schematic 1



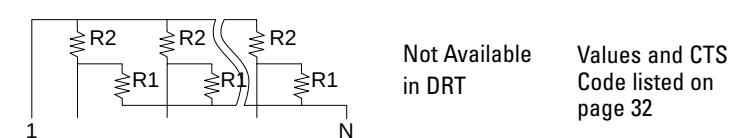
Isolated DRT Schematic 3



Isolated SRT Schematic 3



Dual Terminator SRT Schematic 5



(Ohms)	EIA Code	(Ohms)	EIA Code
10	100	3300	332
12	120	3900	392
15	150	4700	472
18	180	5100	512
22	220	5600	562
27	270	6800	682
33	330	8200	822
39	390	10000	103
47	470	11000	113
51	510	12000	123
56	560	15000	153
68	680	18000	183
82	820	20000	203
100	101	22000	223
110	111	27000	273
120	121	33000	333
150	151	39000	393
180	181	47000	473
200	201	56000	563
220	221	68000	683
270	271	82000	823
330	331	100000	104
390	391	110000	114
470	471	120000	124
510	511	150000	154
560	561	180000	184
680	681	200000	204
820	821	220000	224
1000	102	270000	274
1100	112	330000	334
1200	122	390000	394
1500	152	470000	474
1800	182	560000	564
2000	202	680000	684
2200	222	820000	824
2700	272	1000000	105

How to Order Series 753 Products

Application specific custom products are marked with either a customer part number or a non-descriptive CTS part number. Send documentation to a CTS Sales Office giving schematic, resistor values and tolerance, and other non-standard information. See pages 24-25 for application notes.

753
Series 753

16
Terminations
08 16
09 18
10 20
12 24

3
101
Resistor Code
See Page 32
Schematic 5

G
TR
Packaging -
TR - Tape & Reel
B - Bulk
(see page 36)

Schematic
1 Bussed
3 Isolated (not available in 9 or 18 I/Os)
5 Dual Terminator (5 not available in 16, 18, 20 or 24 I/Os.)

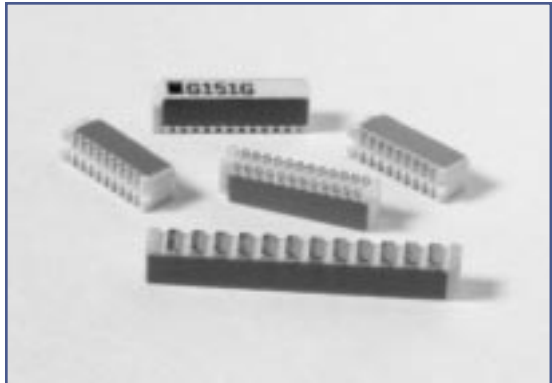
Tolerance
1 & 3
G= ±2%
F= ±1%
5
All 5 schematic products are 2% tolerance. (not marked)

NOTE: No dashes or spaces to appear in part number.

Example: 753163101GTR

See page 33 for part marking information.





High Speed Digital Termination Networks

- Low inductance leadless construction
- Excellent high frequency response
- Very low crosstalk
- High power dissipation versus board space
- Spice models available for circuit simulation
- Solder-coated nickel barrier pads
- Tape & reel packaging per EIA 481
- Designed to work with standard automated surface mount pick & place solder processes

Resistance Tolerance:

Standard $\pm 2\%$ or 0.5Ω (whichever is greater)
Special: $\pm 1\%$

Temperature Coefficient (TCR):

Standard: $\pm 200\text{PPM}/^\circ\text{C}$

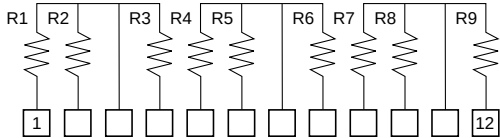
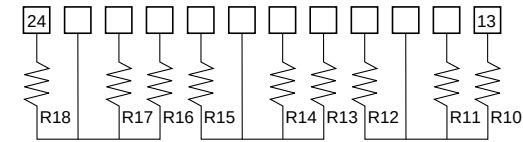
Operating Temperature Range:

-55°C to $+125^\circ\text{C}$

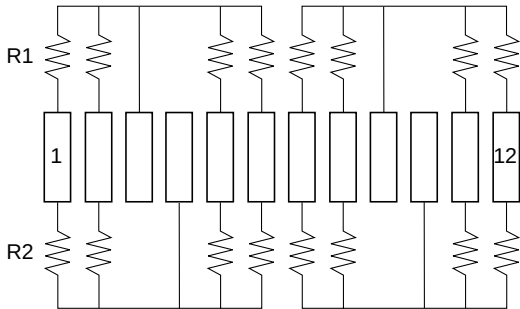
GTL & ECL Terminators - Series 752 & 753

See pages 16-19 for physical dimensions, power rating and other 752 & 753 information.

GTL Termination



ECL Termination



GTL Standard Resistance Values			
Value	Code	Value	Code
39 Ω	390	100 Ω	101
47 Ω	470	110 Ω	111
50 Ω	500	120 Ω	121
51 Ω	510	150 Ω	151
56 Ω	560	180 Ω	181
62 Ω	620	220 Ω	221
68 Ω	680	270 Ω	271
75 Ω	750	330 Ω	331
82 Ω	820		

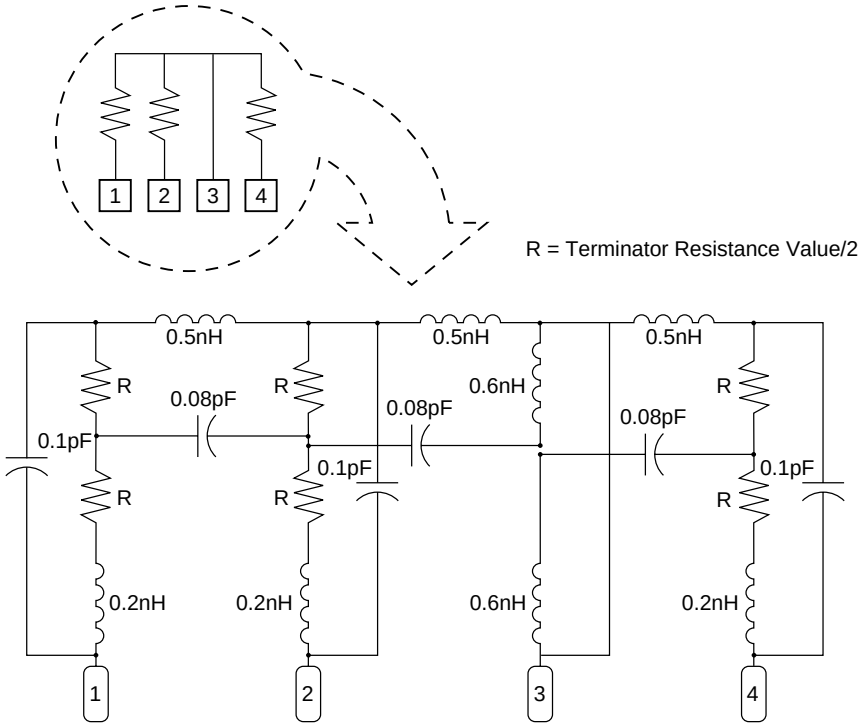
See page 19 for available value codes

ECL Standard Resistance Values			
R1	R2	Thev	Code
81 Ω	130 Ω	50 Ω	500A
120 Ω	200 Ω	75 Ω	750B
162 Ω	260 Ω	100 Ω	101B
220 Ω	270 Ω	121 Ω	121B
180 Ω	390 Ω	123 Ω	121A
220 Ω	330 Ω	130 Ω	131A
330 Ω	390 Ω	180 Ω	181A
330 Ω	470 Ω	190 Ω	191A

See page 32 for available value & CTS codes

Standard Product Offering					
Termination Type	CTS Series#	Rated Package Power @25 $^\circ\text{C}$	Resistor Power @25 $^\circ\text{C}$	Term. Pitch	Term. Lines
GTL (parallel)	753	0.82W	0.06W	0.025"	18
	752	2.0W	0.08W	0.050"	
ECL (Thevenin)	753	0.82W	0.06W	0.025"	8
	752	2.0W	0.08W	0.050"	

Spice Equivalent Circuit



R = Terminator Resistance Value/2

Testing based on TDR pulse using a Tektronix 11802 digitizing scope. 28ps pulse applied, 1ns filter applied on 1ns measurement. Terminator value tested = 50Ω .

Apply 250mV	Spice Result 1nS	Measured Result 1nS	Spice Result 28pS	Measured Result 28pS
Apply P1				
View P2	4.4mV	4.5mV	48mV	34mV
View P4	3.1mV	3.0mV	28mV	22mV
Apply P2				
View P1	4.4mV	5.0mV	55mV	34mV
View P4	3.0mV	2.4mV	30mV	16mV
Apply P4				
View P1	3.1mV	3.0mV	30mV	22mV
View P4	3.0mV	2.6mV	30mV	16mV

How to Order Series GTL & ECL Products

753

Series 752
Series 753

24

Pads
24 (GTL)
12 (ECL)

G

Termination
G=GTL
E=ECL

101

Resistor Code
3 digit EIA

G

Tolerance
J = $\pm 5\%$
G = $\pm 2\%$ (standard)
F = $\pm 1\%$ or $.5\Omega$

TR

Packaging -
TR - Tape & Reel
B - Bulk
(see page 36)

NOTE: No dashes or spaces to appear in part number.

Example: 75324G101GTR

See page 33 for part marking information.



Single-In-Line Conformal Series 770



- Low Profile Conformal Products**
CTS' expertise in resistor network technology is available in space-saving conformal products.
- High-reliability cermet resistors
 - Space saving over individual resistors
 - Available in odd or even number of pins from 4 to 12 leads
 - 2.54mm/100in. pin spacing

Resistance Range:
Standard: 10Ω through 1 MegΩ

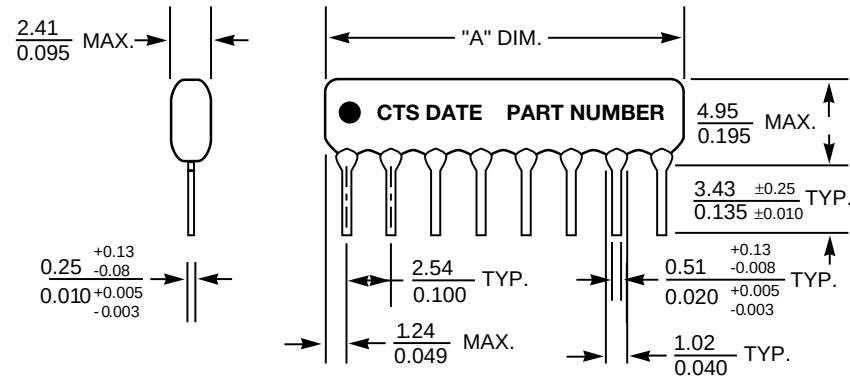
Resistance Tolerance:
Standard: ±2% or 0.5Ω (whichever is greater)

Maximum Operating Voltage:
100V not to exceed rated power

Temperature Coefficient:
100Ω to 1 MegΩ
±100PPM/°C typical
22Ω to 99Ω
±200PPM/°C typical

Operating Temperature Range:
-55°C to +125°C

Dielectric Strength:
100 VAC

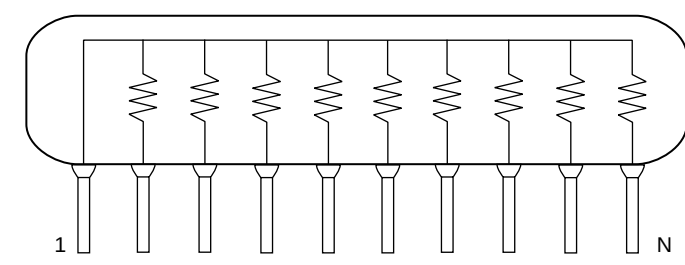


- NOTES:**
- General Tolerances mm ±0.25
inch ±0.010
 - Dimensions are mm/in.
 - Copper Alloy Leads, Solder-coated
 - Product Color Blue

Number Pins	"A" Dimension ±0.25/0.010	Package Power @25°C	Package Power @70°C
4	10.11/0.398	0.60 W	0.40 W
5	12.65/0.498	0.83 W	0.52 W
6	15.19/0.598	0.96 W	0.64 W
7	17.30/0.698	1.18 W	0.76 W
8	20.27/0.798	1.32 W	0.88 W
9	22.81/0.898	1.49 W	1.00 W
10	25.35/0.998	1.66 W	1.11 W
11	27.89/1.098	1.83 W	1.24 W
12	30.43/1.198	2.00W	1.35 W
Schematic		Resistor Power @25°C	Resistor Power @70°C
1 & 5		0.15 W	0.10 W
3		0.30 W	0.20 W

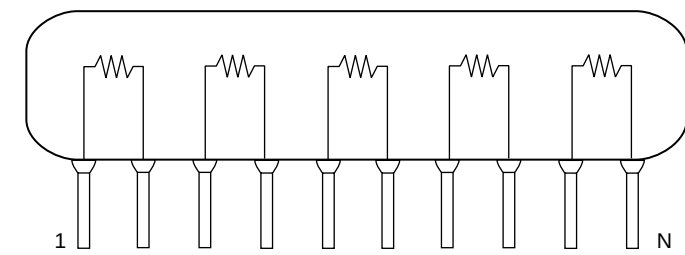
Power Derating	page 33
Land Patterns	pages 34-35
Packaging	pages 36-37
Environmental Performance Specifications	pages 38-39

Bussed CTS Schematic 1



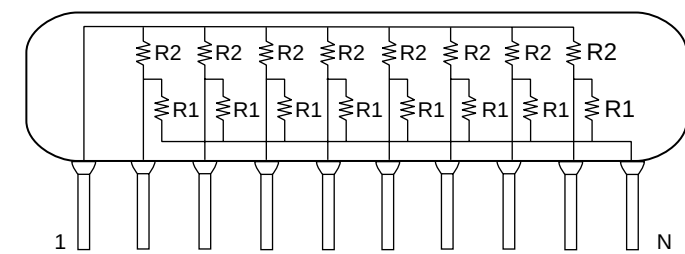
Available in
4 through 12 Pins

Isolated CTS Schematic 3



Available in
4, 6, 8, 10, 12 Pins

Dual Terminator CTS Schematic 5



Available in
6, 8, 10 Pins

(Ohms)	EIA Code	(Ohms)	EIA Code
10	100	3300	332
12	120	3900	392
15	150	4700	472
18	180	5100	512
22	220	5600	562
27	270	6800	682
33	330	8200	822
39	390	10000	103
47	470	11000	113
51	510	12000	123
56	560	15000	153
68	680	18000	183
75	750	20000	203
82	820	22000	223
100	101	27000	273
110	111	33000	333
120	121	39000	393
150	151	47000	473
180	181	51000	513
200	201	56000	563
220	221	68000	683
270	271	82000	823
330	331	100000	104
390	391	110000	114
470	471	120000	124
510	511	150000	154
560	561	180000	184
680	681	220000	224
820	821	270000	274
1000	102	330000	334
1100	112	390000	394
1200	122	470000	474
1500	152	510000	514
1800	182	560000	564
2200	222	680000	684
2700	272	820000	824
		1000000	105

How to Order Series 770 Products

770

Series 770

10

Number of Pins

3

Schematic
1 Bussed
3 Isolated
5 Dual Terminator

103

Resistor Code Schematics 1 & 3
Resistor Value Schematic 5
Example 220/330 = 220Ω/330Ω
All standard part numbers are ±2%

NOTE: No dashes or spaces to appear in part number.

Example: 770103103

See page 33 for part marking information.

Application Specific Products

Application specific resistor products are readily available from CTS to provide the designer with optimum performance and cost effective solutions. There are no tooling or engineering charges to supply resistor products with application specific schematics. Lead times for application specific products are the same as standard manufactured products. Application specific products are available in 752, 753, 766, 767 and 768 products.

Examples of Application Specific Products:

- 1. Customer part number to maintain design confidentiality.
- 2. Multiple and/or non-standard resistor values.
- 3. Resistor products designed for low capacitance or inductance.
- 4. Non-standard tolerances or matching requirements.
- 5. Non-standard schematics.

Application Specific Schematics

Resistor values, tolerance, TCR, power rating and circuit connections are the factors which determine the resistor network design to meet circuit designers’ optimum performance and cost goals.

The following information is provided to assist you in specifying application specific products which meet performance requirements at the lowest cost.

- 1. Similar resistor values should be grouped on a resistor network. Each group of resistor values may require a different resistor ink formulation. Normally a larger range of resistor values can be obtained in a single resistor ink if the pin-outs are selected by the network designer.
- 2. Usually, three resistor ink formulations are the maximum that can be used on a network. Each formulation required will increase the cost.
- 3. The power dissipation of each resistor should be specified based on performance requirements. Total power must conform to the maximum package power specification unless it is specified which resistors are operated at a given time.

- 4. Maximum operating voltage should be specified for each resistor when the resistor value is high enough to supersede the power rating.
- 5. Crossovers should be avoided. If necessary, a second level is provided by utilizing the opposite side of the substrate surface.
- 6. The TCR of each resistor is affected by the geometry of the resistor and the number of resistor formulations required. TCR tracking between resistors screened at the same time is dependent on the comparative resistor length. TCR of ±200 PPM is considered standard for multiple formulation products or resistors of 100 ohms or less.
- 7. Buried nodes should be avoided. Resistance values must be read with special test equipment that may result in reduced measuring accuracy.
- 8. The tolerance of each resistor should be specified based on the circuit requirements. Resistor tolerance of ±0.25% is usually the closest tolerance available. A tolerance of ±2% is standard for all 752, 753, 766, 767 and 768 products.
- 9. Consult with the factory prior to finalization of application specific products to obtain the optimum network design.
- 10. The table on page 25 shows general empirical rules which usually apply to application specific schematics. Actual capabilities are dependent on the required schematic and should be verified by CTS.

Low Resistor Values Available

Resistor Values of 0.2Ω — 10Ω are available on selected networks for current sensing applications.

Capability Guidelines	Resistance Ranges		
Characteristics for Thick Film Products	10Ω-30Ω	31Ω-99Ω	100Ω-1Meg
Best Absolute tolerance	±0.3Ω	±0.3Ω	±0.25%
Ratio Match (50:1 max ratio)*	±0.3Ω	±0.3Ω	±0.25%
Parallel Circuit Resistance Tolerance(>50:1 ratio* in Loop)	±0.3Ω	±0.3Ω	±0.25%
Parallel Circuit Resistance Tolerance(<50:1 ratio* in Loop)	±0.3Ω	±0.3Ω	±0.25%
Best TCR (-55°C to +125°C)	±200PPM	±100PPM	±100PPM
Best TCR Tracking <3:1 ratio* (Same ink/same side)	75PPM	50PPM	50PPM
Best TCR Tracking >3:1 ratio* (Same ink/same side)	100PPM	75PPM	75PPM
Maximum Resistor Power	2 X (total package power) (Total number of resistors)		
(Not to exceed maximum package power)	*Ratio = $\frac{\text{Highest Resistance Value}}{\text{Lowest Resistance Value}}$		

CTS Catalog Schematics

CTS -1 Bussed Schematic

The bussed schematic consists of (N-1) resistors (with N equal to the number of pins) of the same value connected to a common buss. These products are commonly used as pull up/down resistors or as impedance matching terminating resistors. They can also be used in other applications where the circuit requires a number of same value resistors connected to a common point.

CTS -3 Isolated Schematic

The isolated schematic consists of (N/2) resistors of the same value which are electrically isolated from each other. Normally these products are used as current limiting resistors and termination resistors. They can also be used in other applications where the circuit requires a number of same value resistors which connect to various points. Since all resistors on the same network are processed identically, isolated products have been used to fabricate very accurate voltage dividers at low cost by selectively connecting resistors in series.

CTS -5 Dual Terminator Schematic

The dual terminator schematic consists of (2N-2) resistors of two different values with each resistor value connected to a common buss. The resistor values form standard Thevenin equivalent resistance values which are used for termination to two different voltages. These products are typically used for ECL termination.

CTS -7 R/2R Schematic

The R/2R ladder network is commonly used for digital to analog or analog to digital conversions by successive steps. Input signals are applied at each bit of the ladder and the signal is taken from the output terminal where the signal is used to drive an operational amplifier. R/2R ladder products are available with a ladder accuracy of ±1/2 LSB (least significant bit) up to a maximum of 8 bits and ±1 LSB for 9 bits.



Series 106 3D TrackStik®

3 Axis Ceramic Strain Gage Pointing Device

Features:

- Smooth X and Y Motion Control
- Solid Ceramic Thick Film Strain Resistors
- Low Cost Pointing Solution
- No Moving Mechanical Parts
- Durable & Reliable
- Linear & Repeatable Output
- Very Low Output Hysteresis
- Built in Metallic ESD Shield
- Proven Cermet Resistor Technology
- Patent Pending Construction

Applications:

- Cursor Control for Computer Display
- Directional Control for Joy Stick Applications
- Video Game Controllers

Standard Resistance Value:

3.2KΩ

Standard Resistor Tolerance:

±5.0%

Standard Resistance Match:

±1.0%

Cycle Life:

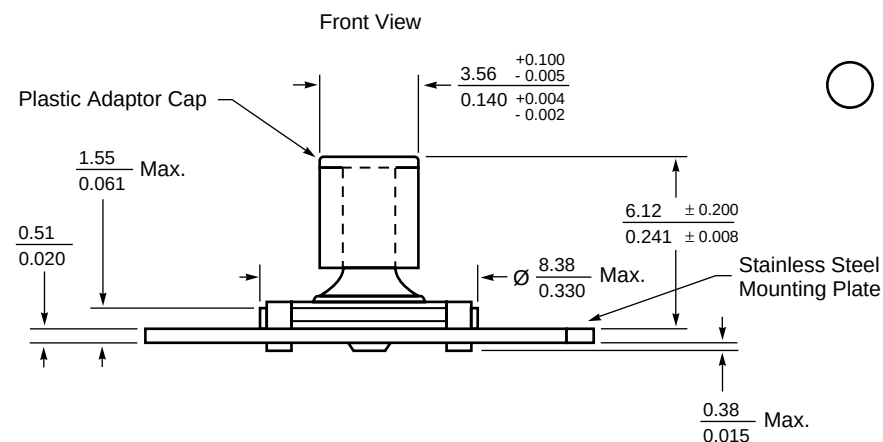
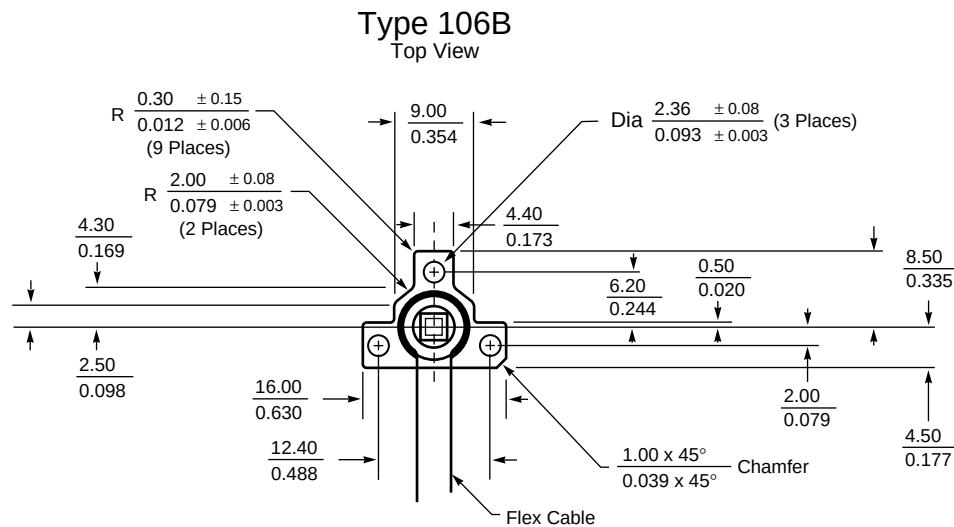
>8,000,000 cycles

Maximum Force:

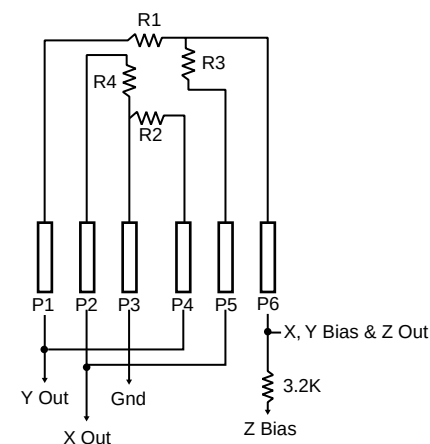
Horizontal 3Kg
Vertical 10Kg

Typical Output Characteristics:

X,Y Axis ≈2.4μV/V/gram
Z Axis ≈0.225μV/V/gram

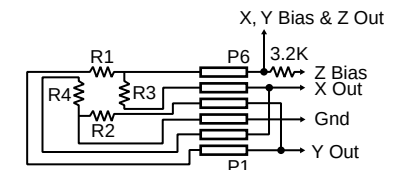
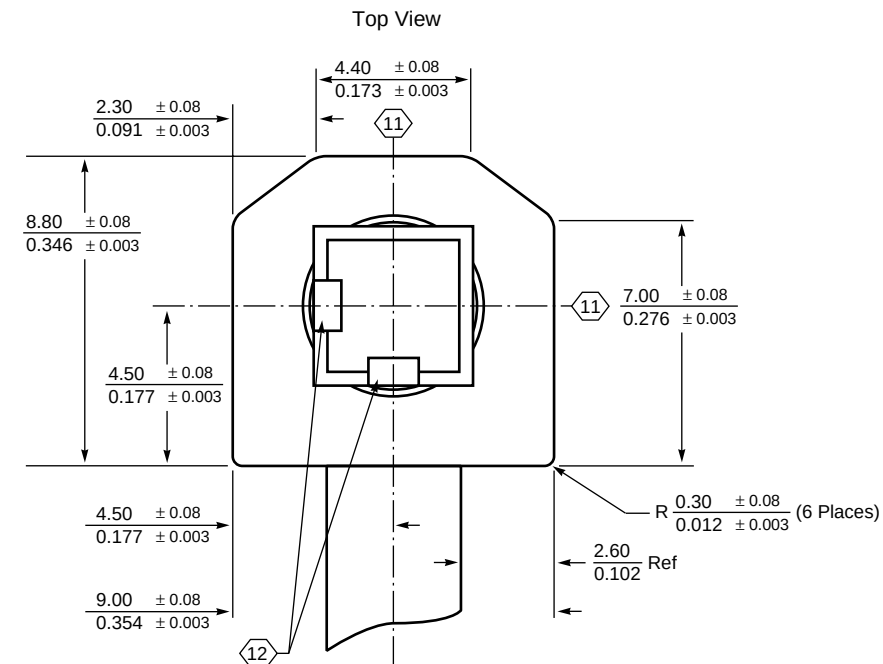


Electrical Schematic

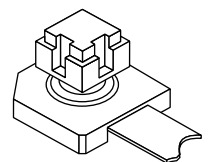


Series 108 3D TrackStik®

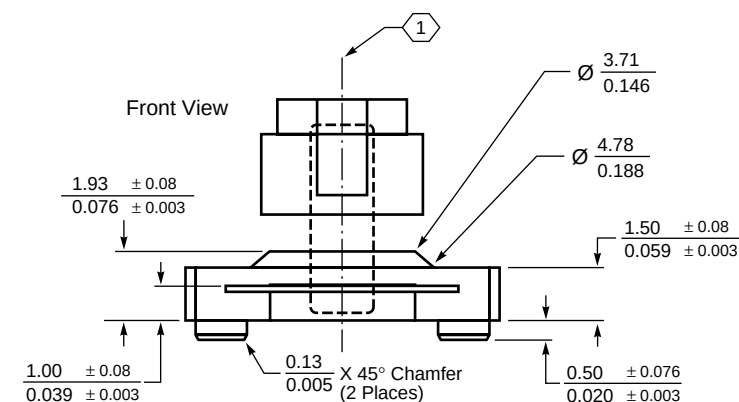
3 Axis Ceramic Strain Gage Pointing Device



Electrical Schematic



Isometric View
Scale = 4X



NOTES:

1. General Tolerances mm ±0.25
inch ±0.010
2. Dimensions are mm/in.
3. Overall post heights can be achieved by interchanging the Plastic Adaptor Cap.
4. The X, Y output sensitivity is dependent on the overall post height.
5. The actual pin assignment for the electrical schematic is dependent on the configuration of the flex cable.
6. Custom configurations for the base mounting plate, post height and flex cable can be accommodated.

Series 106 & 108 Pointing Device

Technology

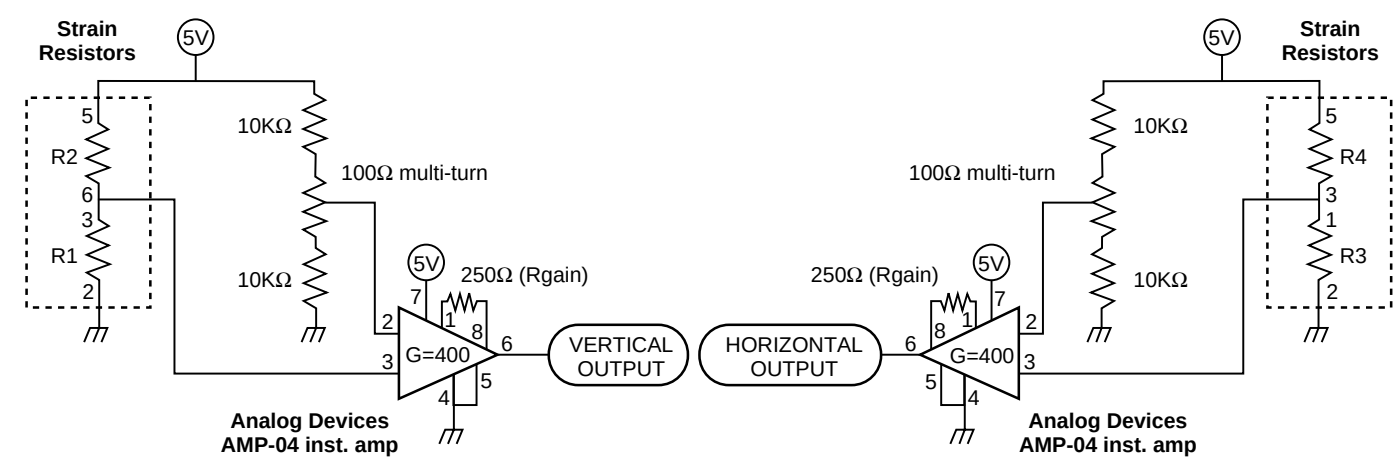
CTS strain gage resistors are fabricated using conventional thick film on ceramic processes. However, the thick film resistor inks are specially formulated to be sensitive to mechanical stress. When the resistor is stressed, a repeatable change in resistance occurs. This resistance change associated with the strain resistor is negative under compression, and positive under tension.

The pointing device is constructed using a square ceramic post with strain sensitive resistors located on each side (north, south, east and west). The resistors are strategically located so the maximum stress is realized when pressure is applied perpendicular to the top of the post.

In a typical pointing device application, the resistors on opposite sides of the ceramic post are configured in two voltage divider circuits (north/south, east/west). The output voltage of each divider changes with respect to the applied force. Both direction and force can be determined from the output of the voltage dividers.

There are no moving electromechanical components and therefore no mechanical components to wear out with these pointing devices.

Example Circuit to Amplify X and Y Outputs



NOTES:

$$V_{\text{divider}} = \frac{R_1}{(R_1 + R_2)} \times 5V$$

$$V_{\text{out}} = (V_{\text{ref}} - V_{\text{divider}}) \times 400 \quad \text{Output Change} = 9.2\mu V/\text{gram} \times \text{Gain} \quad \text{Gain} = 400$$

Adjust VREF to get 2.0 volts output in the steady state position. Maximum swing for the output is 0 volts to + 4.0 volts. All resistors should be metal film or equivalent.



Information

Temperature Sensitivity

CTS pointing devices are capable of operating over a temperature range of -50°C to +105°C. TCR tracking of the strain resistors is +50 ppm. This gives a worst case error of less than 0.001% over the operating temperature range. Maximum error on the output stage due to temperature change is 0.4% with an amplifier gain of 400.

Hysteresis

The hysteresis or “repeatability error” of the resistors when configured as a voltage divider is less than ±0.025%. Maximum hysteresis error on the output stage is 1.0% with an amplifier gain of 400.

Flex Cables

Polyimide flex cables can be designed for custom circuit routing and are available with pressure sensitive adhesive for flex cable assembly. The pitch may be different on the PWB end from the connector end. Tooling is required to manufacture custom polyimide flex cables.

Output Linearity and Calculation of Angular Output

Output of the voltage divider circuit is specified to be linear within ±1.0%.

Actual output voltage is calculated by multiplying the maximum output voltage by the cosine of the angle of the applied force.

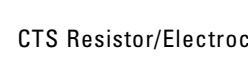
Connectors

Pointing sticks are available in either four or six pin connector configurations. The six pin connector option can be supplied on a single sided PWB, but the four connection requires a two sided PWB. Flex cables can be supplied with a 1.0, 0.8 or 0.5 mm connector pitch.

How to Order Series 106 and 108

CTS pointing sticks are manufactured to customer order to meet mounting dimensions of the customer’s application. A drawing or sketch specifying the desired mounting configuration is required.

Variations such as the height of the post, the size of the mounting base and the shape of the flex cable can be optimized for specific applications. CTS has application engineers available to assist you with your application. For more information about CTS products consult your local CTS sales representative and the World Wide Web.





Series 109 3D SurfStik™

3 Axis Ceramic Strain Gage Pointing Device

Features:

- Compatible with Standard Surface Mount Process
- Compatible to CTS 105, 106 and 108 Series TrackStik®
- Ultra Small Size
- Full X, Y and Z Motion Control
- Durable & Reliable
- Linear & Repeatable Output
- Proven Cermet Resistor Technology

Applications:

- Cursor Control for Computer Display
 - Notebook Computer
 - Internet Appliance
 - Palm Top & Hand Held computer
 - Sub-Notebook Computer
- Directional Control for Joy Stick Applications
- Video Game Controllers

Standard Resistance Value:

2.5KΩ

Standard Bridge Resistance Tolerance:

±1.0%

Standard Resistance Match:

±1.0%

Output Linearity:

1.0%

Operating Temperature:

-20°C to +80°C

Maximum Reflow Temperature:

215°C for 15 seconds

Cycle Life:

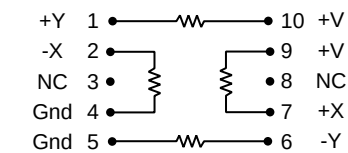
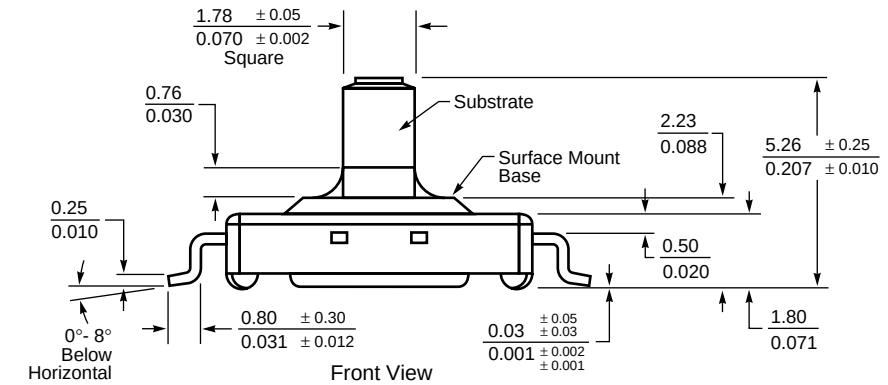
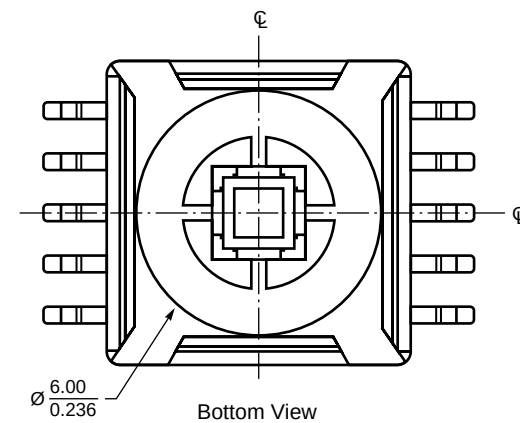
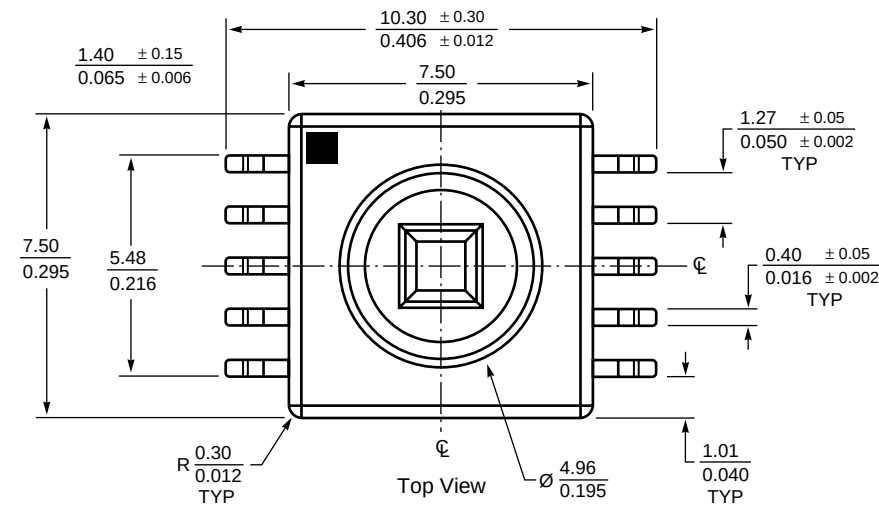
>8,000,000 cycles

Maximum Force:

Horizontal 4Kg
Vertical 20Kg

Typical Output Characteristics:

X,Y Axis ≈0.85μV/V/gram
Z Axis ≈0.125μV/V/gram



Schematic Diagram

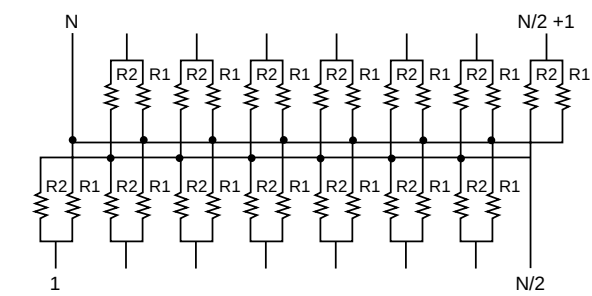
NOTES:

1. General Tolerances mm ±0.127
inch ±0.005
2. Dimensions are mm/in.
3. Overall post heights can be achieved by utilizing a Plastic Adaptor Cap.
4. The X, Y output sensitivity is dependent on the overall post height.

Dual Terminator

CTS Dual Terminator Schematics

Standard CTS Dual Terminator products contain (2N-2) resistors of two different values with each resistor value connected to a common buss. CTS assigns the resistance value portion of the standard part numbers of the dual terminator network in two different methods.



The Series 770 part number includes the actual values of the resistors in the dual terminator. For example:

770105180/470 R1=180Ω R2=470Ω

The Series 752, 766, 767 and 768 part number includes the EIA Code value of the Thevenin equivalent resistances of R1 and R2. The Thevenin equivalent resistance is calculated in the following way: the suffix letter relates only to the sequence of variations which equal the same equivalent resistance. Reference chart.

Req = $\frac{R1R2}{R1 + R2}$

Examples:

766165131A	R1=220Ω	R2=330Ω	Req=132Ω
767145191A	R1=330Ω	R2=470Ω	Req=194Ω
768205131C	R1=180Ω	R2=470Ω	Req=130Ω

Pin N/2 is common to R2 and Pin #N is common to R1 on CTS Series 766, 767 and 768 .

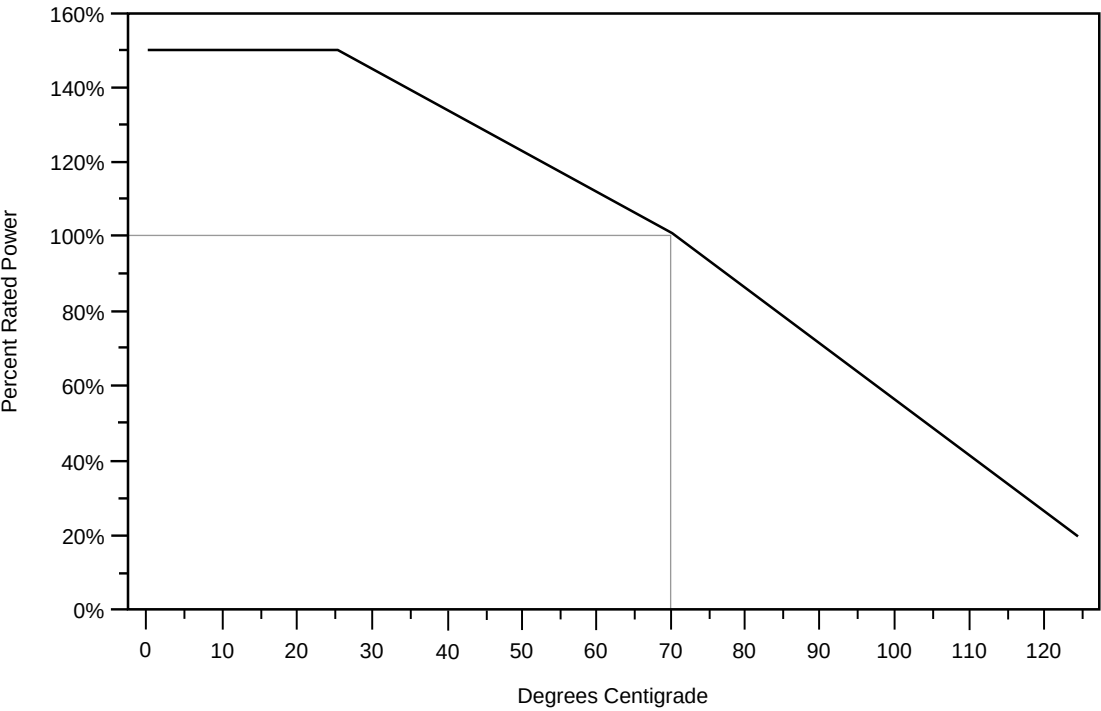
Pin #1 is common to R2 and Pin N is common to R1 on all CTS Series 752, 753 and 770 dual terminator schematics.

- 1. All tolerances ±2%.
- 2. Other values available on request.
- 3. Suffix letter has no significance—assigned in sequential order.

Dual Terminator Resistor Values & Codes

R1 Ohms	R2 Ohms	Thevenin Equivalent	CTS Code	R1 Ohms	R2 Ohms	Thevenin Equivalent	CTS Code
25	50	15 ohm	150A	270	180	108 ohm	111C
30	50	19 ohm	190A	271	131	88 ohm	880A
30	620	29 ohm	290A	330	470	194 ohm	191A
33	4.7K	33 ohm	330A	330	680	222 ohm	221A
36	620	34 ohm	340A	330	390	179 ohm	181A
43	620	40 ohm	400A	330	220	132 ohm	131D
68	189	50 ohm	500B	330	330	165 ohm	171B
75	620	67 ohm	670A	360	720	240 ohm	241B
80	220	59 ohm	590A	360	600	225 ohm	231A
81	130	50 ohm	500A	390	620	239 ohm	241A
81	2.2K	78 ohm	780A	470	1K	320 ohm	321A
100	200	67 ohm	670B	470	680	278 ohm	281A
100	430	81 ohm	810A	470	940	313 ohm	311A
100	150	60 ohm	600A	500	500	250 ohm	251A
106	169	65 ohm	650A	560	910	347 ohm	351A
110	220	73 ohm	730A	560	1K	359 ohm	361A
118	178	71 ohm	710A	680	1K	405 ohm	401A
120	200	75 ohm	750B	750	750	375 ohm	381A
120	180	72 ohm	720A	750	2.3K	566 ohm	571A
120	120	60 ohm	600B	1K	3.3K	767 ohm	771A
150	150	75 ohm	750A	1K	2K	667 ohm	671A
160	260	99 ohm	990A	1.1K	2.2K	733 ohm	731A
160	240	96 ohm	960A	1.2K	1.2K	600 ohm	601A
160	270	100 ohm	101D	1.5K	1.5K	750 ohm	751A
162	260	100 ohm	101B	1.5K	3.3K	1031 ohm	102A
180	300	113 ohm	111B	2K	2K	1000 ohm	102B
180	470	130 ohm	131C	2.2K	5.6K	1579 ohm	162A
180	390	123 ohm	121A	2.2K	4.4K	1467 ohm	152A
180	270	108 ohm	111A	2.2K	3.3K	1320 ohm	132A
180	220	99 ohm	101A	3K	6.2K	2022 ohm	202A
200	1.5K	176 ohm	171D	3K	2K	1200 ohm	122A
220	330	132 ohm	131A	3.3K	4.7K	1939 ohm	192A
220	270	121 ohm	121B	3.9K	3.3K	1788 ohm	182A
220	220	110 ohm	111D	4.7K	22K	3873 ohm	392A
240	170	100 ohm	101C	5K	5K	2500 ohm	252A
240	620	173 ohm	171C	6.8K	22K	5194 ohm	522A
250	250	125 ohm	131B	10K	51K	8361 ohm	842A
270	470	171 ohm	171A	50K	100K	33,333 ohm	333A

Power Derating Curve for Resistor Networks



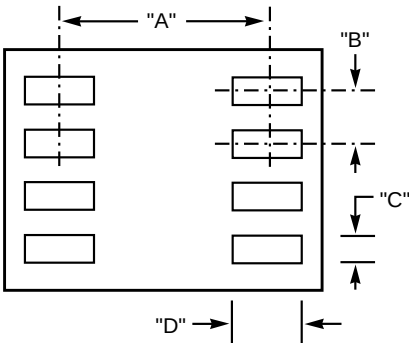
Part Marking

The following chart indicates the characters marked on parts with standard marking.

Part	Series	No. of Pins/Pads	Schematic	R	Resistor Value or Code	Tolerance	Date Code YRWK
742, 743, 744					✓		
745, 746			✓		✓		
752 12 & 24 pad 10 & 20 pad 9 & 18 pad 8 & 16 pad	✓	✓	✓		✓	✓	3-digit 3-digit 3-digit 3-digit
753 12 & 24 pad 10 & 20 pad 9 & 18 pad 8 & 16 pad			✓		✓	✓	2-digit 2-digit
766, 767, 768	✓	✓	✓		✓	✓	4-digit
770	✓	✓	✓		✓		4-digit

Surface Mount Land Patterns

Concave and Convex Chip Resistor Arrays 742-746

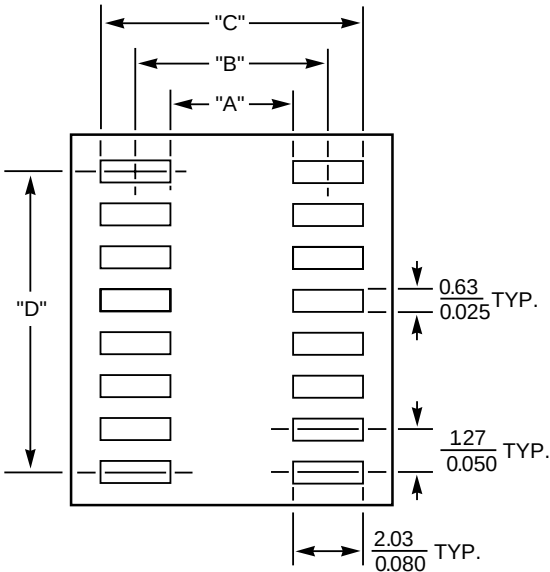


Concave/Convex

Series	Dimensions mm/inch			
	A	B	C	D
742	1.80 0.071	0.80 0.032	0.50 0.020	0.90 0.035
743	1.90 0.075	1.27 0.050	0.80 0.032	1.20 0.047
744	3.00 0.118	1.27 0.050	0.80 0.032	1.30 0.051
745	3.00 0.118	1.27 0.050	0.80 0.032	1.30 0.051
746	1.52 0.060	0.64 0.025	0.35 0.014	0.80 0.032

NOTE:
Land Patterns for Concave and Convex termination can be the same.

Surface Mount Series 766, 767 & 768



Lead Count	A	B	C	D
766-8P	3.60 0.140	5.60 0.220	7.60 0.300	3.81 0.150
766-14P	3.60 0.140	5.60 0.220	7.60 0.300	7.60 0.300
766-16P	3.60 0.140	5.60 0.220	7.60 0.300	8.90 0.350
767-14	5.34 0.210	7.37 0.290	9.40 0.370	7.60 0.300
767-16	5.34 0.210	7.37 0.290	9.40 0.370	8.90 0.350
768-14	5.34 0.210	7.37 0.290	9.40 0.370	7.60 0.300
768-16	5.34 0.210	7.37 0.290	9.40 0.370	8.90 0.350
768-20	5.34 0.210	7.37 0.290	9.40 0.370	11.43 0.450

Surface Mount Series 752

Stencil Opening

	DRT Solder Paste Stencil Opening			
	K	Sw	S	Q
4 mil 752	0.66 0.026	0.76 0.030	1.52 0.060	0.38 0.015
6 mil 752	0.051 0.020	0.064 0.025	1.40 0.055	0.30 0.012

Land Patterns

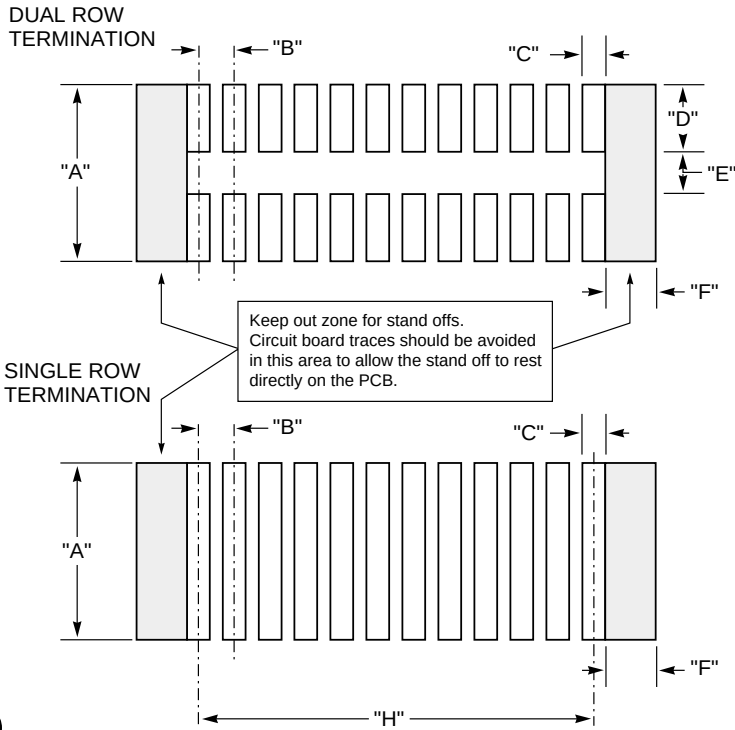
Dim.	In.	mm.
A	0.125	3.18
B	0.050	1.27
C	0.030	0.76
D	0.050	1.27
E	0.025	0.64
F	0.050	1.27

Stencil Opening

	SRT Solder Paste Stencil Opening			
	K	Sw	S	Q
4 mil 752	2.40 0.095	0.76 0.030	NA	0.38 0.015
6 mil 752	1.90 0.075	0.63 0.025	NA	0.33 0.013

No. of Pads	"H" In.	Dim mm
8	0.350	8.89
9	0.400	10.16
10	0.450	11.43
12	0.550	13.97
16	0.350	8.89
18	0.400	10.16
20	0.450	11.43
24	0.550	13.97

Series 752 & 753 Land Patterns



Surface Mount Series 753

Stencil Opening

	DRT Solder Paste Stencil Opening			
	K	Sw	S	Q
4 mil 753	0.51 0.020	0.30 0.012	1.32 0.052	0.15 0.006
6 mil 753	0.028 0.011	0.030 0.012	1.47 0.058	0.15 0.006

Land Patterns

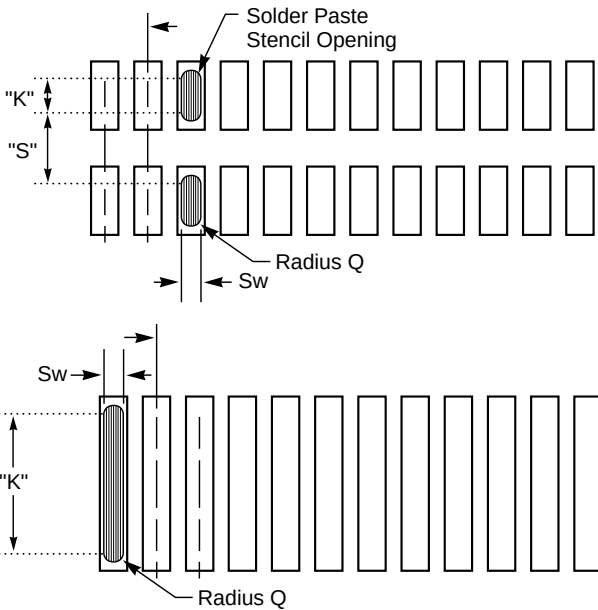
Dim.	In.	mm.
A	0.120	3.05
B	0.025	0.64
C	0.017	0.43
D	0.050	1.27
E	0.020	0.51
F	0.035	0.89

Stencil Opening

	SRT Solder Paste Stencil Opening			
	K	Sw	S	Q
4 mil 753	2.75 0.108	0.30 0.012	NA	0.15 0.006
6 mil 753	1.72 0.068	0.30 0.012	NA	0.15 0.006

No. of Pads	"H" In.	Dim mm
8	0.175	4.44
9	0.200	5.08
10	0.225	5.72
12	0.275	6.99
16	0.175	4.44
18	0.200	5.08
20	0.225	5.72
24	0.275	6.99

Series 752 & 753 Stencil Openings



Standard Packaging

Series 752, 753, 766, 767, 768

Tape & Reel Specifications per EIA-481-2

Carrier Tape:	Resistivity <1 X105 ohm/sq.
Cover Tape:	Antistatic .004 max.
Reels:	Molded plastic
Cover Tape Pull:	30 To 130 gr.
Slide Pacs:	Antistatic

Bar Coding Available

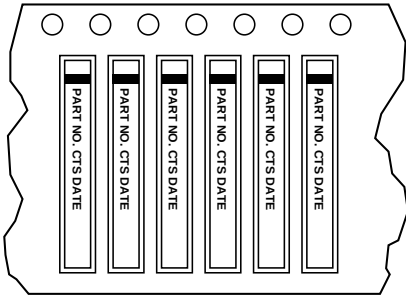
Bar coding of reel and boxes available on request.
CTS normally uses code configuration 39 in accordance with (AIM) USS 39 symbol specification.
Outer container marketing per EIA-556.

Series 742,743,744,745, 746

Tape & Reel	742C043	742C083 742X083	742C163	743C043	743C083	744C043	744C083	745C101 745C102	745X101 745X102	746X101
Parts/Reel	5000	5000	4000	4000	4000	4000	4000	4000	4000	5000
Pitch	4mm	4mm	4mm	4mm	4mm	4mm	8mm	4mm	4mm	4mm
Carrier Width	8mm	8mm	12mm	8mm	12mm	8mm	12mm	12mm	12mm	8mm
Material	paper	paper	plastic	plastic	plastic	plastic	plastic	plastic	plastic	paper
Reel diameter	7"	7"	7"	7"	7"	7"	7"	7"	7"	7"

Series 752

Tape & Reel	TR1	TR2
Parts/reel	5000 STD 1000 min.	2000 STD 1000 min.
Tape width	24mm	24mm
Tape pitch	4mm	12mm
Reel diameter	13"	13"

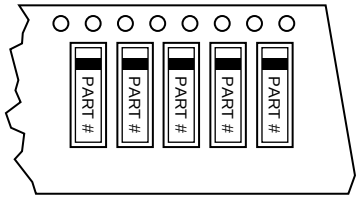


Bulk Pack 250 parts/bag

DIRECTION OF FEED

Series 753

Tape & Reel	TR1	TR2
Parts/reel	5000 STD 1000 min.	2000 STD 1000 min.
Tape width	16mm	16mm
Tape pitch	4mm	8mm
Reel diameter	13"	13"



Bulk Pack 250 parts/bag

DIRECTION OF FEED

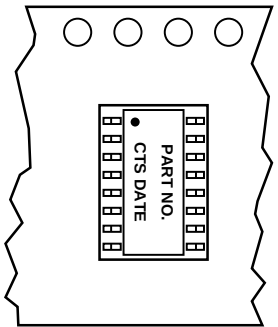
Series 770

Bulk Pack All Products 250 Parts/Bag
Slide Pack Tube Length = 457mm/18 in

# Pins	4	5	6	7	8	9	10	11	12
Qty/Tube	50	40	32	28	24	22	19	18	16

Series 766/767/768

Network	8 Pin	14 Pin	16 Pin	14 Pin	16 Pin	20 Pin
Package	766	766	766	767/768	767/768	768
Tape & Reel						
Tape width	12mm	16mm	16mm	24mm	24mm	24mm
Tape pitch	8mm	8mm	8mm	12mm	12mm	12mm
Reel diameter	13"	13"	13"	13"	13"	13"
#parts/reel*	3,000	3,000	3,000	2,000	2,000	2,000
Reel diameter	7"	7"	7"			
#parts/reel*	800	800	800			
Slide Packs						
Tube length	20"	20"	20"	20"	20"	20"
#parts/slide pac*	99	56	49	48	43	35



DIRECTION OF FEED

*nominal full reels or slide packs

Environmental Performance Specifications

Test	Max. ΔR	Mil. Std. 202 Method	Test Cond.	Test Description
Thermal Cycling Series 752, 753, 766, 770 Series 767, 768 Series 742, 743, 744, 745, 746	0.5% 0.25% 1.0%	107	B	5 cycles, -65°C to +125°C 5 cycles, -55°C to +125°C
Short Time Overload Series 766, 770 Series 752, 753 Series 767, 768 Series 742, 745 Series 743 Series 744 Series 746	0.5% 0.5% 0.25% 2.0% 2.0% 2.0% 2.0%			2 1/2 x rated voltage, 5 sec (100V Max.) 2 1/2 x rated voltage, 5 sec (50V Max.) 2 1/2 x rated voltage, 5 sec. (100V Max.) 2 1/2 x rated voltage, 5 sec (100V Max.) 2 1/2 x rated voltage, 5 sec. (200V Max.) 2 1/2 x rated voltage, 5 sec (400V Max.) 2 1/2 x rated voltage, 5 sec (50V Max.)
Moisture Resistance Series 752, 753, 766, 767, 768, 770 Series 742, 743, 744, 745, 746	0.5% 2.0%	106		240 hours, 0.1 rated load, -10°C to +65°C, 90% RH
Load Humidity Series 752, 753, 766, 767, 768, 770	1.0%			1000 hours, 0.1 rated load, 70°C, 85-92% RH
High Temp Exposure Series 752, 753, 766, 767, 768, 770 Series 742, 743, 744, 745, 746	1.0% 1.0%			240 hours, no load, @ 125°C 1000 hours, no load, @ 125°C
Load Life Series 752, 753, 766, 767, 768 Series 770 Series 742, 743, 744, 745, 746	1.0% 1.0%	108	F D	2000 hours @ 70°C, rated load 1000 hours @70°C, rated load 1000 hours @ 70°C, rated load
Resistance to Solder Heat Series 752, 753, 766, 767, 768 Series 770 Series 742, 743, 744, 745, 746	0.25% 0.25% 1.0%		A B	30 seconds @ 218°C, dwell 3 second dwell @ 350°C solder 10 second dwell @ 260°C solder
Resistance to Leach Series 742, 743, 744, 745, 746, 752, 753	N/A			120 seconds @ 260°C solder
Mechanical Shock Series 752, 753, 766, 767, 768, 770	0.25%	213	I	100g, 1 msec., 3 shocks each plane
Vibration Series 752, 753, 766, 767 768, 770		0.25%	204	D 20g, 10-2000Hz, 4 hours/plane

Test	Max. ΔR	Mil. Std. 202 Method	Test Cond.	Test Description
Terminal Strength Series 766, 767, 768 Series 770	0.25%			0.9 Kg. pull, 30 sec., two 45° bends 2.0 Kg. pull, 30 sec., three 45° bends
Low Temp Storage Series 752, 753, 766, 767 768, 770	0.25%			24 hours @ -65°C, no load
Low Temp Operation Series 752, 753, 766, 767 768, 770	0.25%			45 min @ -65°C, full load
Flammability (UL) Series 752, 753, 766, 767 768, 770	N/A			94V-0
Non-Fungus per MIL-STD 810C Series 752, 766, 767, 768, 770				
Resistance to Solvents	Series All		Isopropyl alcohol	
Solderability	Series All		RMA Flux, 230°C, 5 Seconds dip, 95% coverage	

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TENNESSEE

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