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H.G.CISIN'S

TV AND RADIO TUBE SUBSTITUTION GUIDE

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TV & RADIO TUBE SUBSTITUTION GUIDE

By H.G.Cisin, Consulting Engineer

The first section of this book contains a unique TUBE SUBSTITUION GUIDE for the replacement of defective tubes in television sets, radios and other electronic equipment, in instances where the identical replacement type is unobtainable. All tubes suggested for substitution have characteristics similar to the tubes they are to replace, WILL FIT IN THE SAME SOCKET and DO NOT REQUIRE ANY CHANGES IN WIRING WHATSOEVER.

The TV PICTURE TUBE SUBSTITUTION GUIDE section emphasizes substitution rather than conversion. In many cases picture tube substitutions are suggested which require no changes of any kind. In other instances, the necessary changes are slight, such as a change in the type of ion trap or in the anode connection. All such changes are clearly indicated and in each case, maximum dimensions are supplied. Knowing the cabinet dimensions, it can readily be determined in advance, whether or not a given substitution is practical.

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TV & RADIO
TUBE SUBSTITUTION GUIDE

Section 1.

Substitution Guide for Replacement of Tubes in Television Sets, Radio Sets and Other Electronic Equipment

Suggested tube substitutions in the following list may be made without any changes of sockets or wiring. In substituting one tube for another, it is necessary to know whether the heaters or filaments are connected in series or in parallel. This information may be obtained readily without consulting a diagram or tracing the circuit. If a burnt-out or defective tube is to be replaced, remove it from its socket. If all other tubes remain lit, the heaters are in parallel. If upon removal of the defective tube, any other tubes show loss of heater glow, the removed tube is part of a series system hookup.

NOTE: Certain tube types in the following list may be substituted only in parallel connected circuits. These are indicated by an asterisk (*) after the tube designation. If no asterisk is used, tube may be substituted in either series or parallel connected heater systems. If the letter "t" in parenthesis (t) follows a tube designation, this indicates that the tube is recommended only as a temporary substitute, since it will not operate as efficiently as the original tube.

Tube	Substitute	Tube	Substitute
1B3	8016	5AZ4	5AW4, 5AX4, 5T4, 5W4, 5Y3, 5Z4, 5Y4
1V	6Z3	5U4	5AW4, 5AX4, 5AZ4, 5T4, 5W4, 5Y3, 5Z4, 5Y4
1X2	1X2A, 1AX2(t)	5Y3	5AW4, 5AX4, 5AZ4, 5T4, 5U4, 5V4, 5W4, 5Z4
5AW4	5U4, 5X4, 5V4		
5AX4	5AZ4, 5U4, 5V4, 5W4, 5Y3, 5Z4		

Tube	Substitute
5X4	5Y4
5Y4	5X4
5Z3	5X3, 80, 83, 83V
6AC7	6AB7, 6AJ7, 6SD7*, 6SJ7*, 6SK7*, 6SS7*, 1852, 1853
6AF4	6AN4
6AG5	6AJ5*, 6AK5*, 6BC5, 6CF6, 5590*, 5591*, 9003*, 9001*
6AH6	6AJ5(t), 6AU6(t), 6BC5*, 6BD6*
6AJ4	6AM4
6AJ5	6AG5*(t), 6AK5(t), 6AU6*(t), 6CF6*(t)
6AJ7	6AB7, 6AC7, 6SD7*, 6SE7*, 6SJ7*, 6SK7*, 6SS7*, 1852, 1853, 5693
6AK5	6AG5*, 6AK5(t), 6AJ5, 6BC5*(t), 6CF6
6AL5	5726
6AN4	6AF4, 6T4
6AQ5	6BM5, 6BF5*(t)
6AT6	6AV6, 6BF6, 6BK6, 6BT6, 6BU6
6AU5	6AV5*, 6BD5*
6AU6	6BA6, 6BD6, 6AG5(t), 6AJ5*(t), 6AK5*(t), 5590, 5591, 9001, 9003
6AV5	6AU5*, 6BD5*
6AV6	6AQ6*, 6AT6, 6BT6
6AX4	6U4, 6W4
6AX5	6U4, 6W5*, 6X5*, 6ZY5*
6BA6	6AU6, 6AG5, 6BC5, 6BD6, 6CB6, 6CG6
6BD6	6AH6*(t)
6BD5	6AU6*(t), 6AV6*(t)
6BF5	6AQ5*
6BF6	6BU6
6BF7	6BG7
6BC5	6AG5*, 6AJ5*(t), 6AN5*(t), 6AK5*(t), 6AS6*(t), 6BH6*(t), 6BJ6*(t), 6CF6
6BG6	6CD6*
6BG7	6BF7
6BH6	6BJ6, 6AS6*, 6BC5*(t), 6CB6*

Tube	Substitute
6BJ6	6AS6*, 6BA6*, 6BC5*(t), 6BH6, 6CB6*
6BK6	6AT6, 6AV6, 6BF6, 6BT6, 6BU6
6BK7	6BQ7, 6BZ7
6BL7	6BX7, 6SL7*(t), 6SN7*, 6SU7*(t), 5591*(t), 5992
6BM5	6AQ5
6BQ6	6CU6
6BQ7	6BK7, 6BZ7
6BQ7A	6BK7, 6BZ7
6BT6	6AQ6*, 6AV6, 6BK6
6BX6	6BY7
6BX7	6BL7
6BZ7	6BK7, 6BQ7
6C5 --	6AD5, 6AE5, 6AF5, 6J5, 6L5*, 6P5
6C6 --	6D6, 77, 78
6C8 --	6F8*
6CB6	6AG5, 6AJ5*(t), 6BC5, 6AK5*, 6SA6*(t), 6CF6, 6BH6*(t), 6BJ6*(t)
6K6 --	6F6*, 6G6*(t), 6L6*, 6U6*, 6V6*, 5581*
6CD6	6BG6*
6CF6	6AG5, 6AJ5*(t), 6AK5, 6BC5, 6CB6, 5590, 5591, 5654
6CG6	6AG5, 6AH6*, 6AJ5*(t), 6AK5*, 6AU6, 6BA6, 6BC5, 6BD6, 5591*, 5654*
6CS6	6BE6
6CU6	6BQ6GT
6F6 --	6G6*(t), 6K6*, 6L6*, 6U6*, 6V6*
6G5 --	6AB5*, 6E5, 6T5, 6U5
6G6 --	6F6, 6K6, 6V6
6H5 --	6U5, 6G5
6J5 --	6AD5, 6AE5, 6AF5, 6C5, 6L5*, 6P5
6J7 --	6K7, 6S7*, 6U7, 6W7*, 7000
6J8 --	6A8, 6D8*, 6K8
6K4 --	6AD4
6K7 --	6J7, 6S7, 6U7, 6W7*
6K8 --	6A8, 6J8

Tube	Substitute
6L5	6AD5*, 6AE5*, 6C5*
6L6	6F6*, 6K6*, 6U6, 6V6, 1614, 5881*
6L7	1612
6N6	6AB6*
6N7	6Y6*, 6Z7*
6P5	6AD5, 6AE5, 6AF5, 6C5, 6J5, 6L5*
6Q7	6B6, 6R7, 6T7*, 6V7
6R7	6Q7, 6T7*, 6V7
6R8	6T8
6S7	6J7*, 6K7*, 6U7*, 6W7
6SA7	6SB7Y
6SB7Y	6SA7
6SL7GT	6SL7WGT, 6SU7GTY, 5691*
6SN7	6BL7*, 6BX7*, 6SL7*, 6SN7WGT, 5692
6SQ7	6SR7, 6ST7*, 6SZ7*
6SR7	6SQ7, 6ST7*, 6SZ7*
6SS7	6SJ7*, 6SK7*
6ST7	6SQ7*, 6SR7*
6SU7	6SL7, 6SN7(t)
6SV7	6SF7
6SZ7	6SQ7*, 6SR7*
6T5	6AB5*, 6E5, 6G5, 6U5
6T7	6B6, 6Q7*, 6R7*, 6V7
6T8	6AK8, 6R8
6U4	6AX5, 6W4
6U5/6G5	6AB5*, 6E5, 6N5*
6U6	6F6*, 6G6*(t), 6K6*, 6L6*(t) 6V6*, 6W6(t), 5881
6V6	6F6*, 6G6*(t), 6K6, 6L6*, 6U6,* 6W6*, 6Y6*
6V7	6R7, 6T7*
6W4	6U4, 6AX4
6W5	6AX5*, 6X5*, 6ZY5*
6W6	6F6*(t), 6G6*, 6K6*, 6L6*, 6U6, 6V6, 6Y6, 5881*

Tube	Substitute
6W7	6J7*,6K7*,6S7 6U7*
6X5	6AX5*, 6W5*
6X8	6U8(t)
6Y6	6G6*(t),6K6*, 6L6*,6U6*,6V6*
6Y7	6N7*, 6Z7*
6Z3	1V
6Z7	6N7*, 6Y7*
6ZY5	6AX5*,6W5*, 6X5*, 1274*
7A4	7B4, XXL
7A5	7B5*, 7C5*
7A7	7B7*, 7C7*
7A8	7B8*, 7J8*,7S7*
7AB7	1204
7AD7	7AG7*(t), 7AH7*(t), 7AJ7*(t), 7AK7*(t), 7B7*(t),7C7*(t), 7G7*(t),7H7*(t), 7L7*(t),7T7*(t), 7V7*(t)
7AF7	7F7, 7N7*
7AG7	7AH7,7B7(t), 7C7(t),7AJ7*(t),

Tube	Substitute
7AG7	7AK7*(t), 7G7*, 7H7*,7L7*,7T7*, 7V7*
7AH7	7AG7, 7B7(t), 7C7(t), 7AJ7*, 7AK7*(t),7G7*(t), 7H7*(t), 7L7*(t), 7T7*(t), 7V7*(t)
7AJ7	7AH7*, 7AK7*(t), 7B7*(t), 7C7*(t),7G7*(t), 7V7*(t), 7H7, 7L7, 7T7
7AK7	7AH7*(t),7AJ7*(t), 7B7*(t),7C7*(t), 7G7*(t),7H7*(t), 7L7*(t),7T7*(t), 7V7*(t)
7B4	7A4, XXL
7B5	7A5*, 7C5*
7B6	7E6
7B7	7AH7, 7C7
7B8	7A8
7C4	1203A
7C5	7A5*, 7B5*
7C6	7B6*
7C7	7B7, 7H7*
7E5	1201
7E6	7B6, 7C6*

Tube	Substitute
7E7	7R7
7F7	7AF7, 7N7*
7F8	7F8W
7G8	1206
7T7	1273
7V7	7B7*, 7C7*, 7G7, 1232
7Y4	7Z4*
7Z4	7Y4
12A4	12B4
12A8	12K8
12AK7	12AX7
12AT7	12AU7, 12AV7*, 12AX7, 12BH7*
12AU7	12AT7, 12AV7*, 12AX7, 12AY7, 12AZ7*
12AV7	12AT7*, 12AU7*, 12AX7*, 12AY7*, 12AZ7, 12BH7*
12AX7	12AT7, 12AU7, 12AV7*, 12AY7 12AZ7*, 12BH7*
12AZ7	12AT7*, 12AU7*(t), 12AX7*(t), 12AV7 12AY7*(t), 12BH7*
12B4	12A4
12BH7	12AZ7*
12BU6	12AT6(t), 12AV6(t), 12BF6, 12BK6(t), 12BT6(t)
12BZ7	12AX7*
12K8	12A8
12SN7	12SL7*, 12SX7
12SX7	12SL7*, 12SN7
12SY7	12SA7
14A7/12B7	14C7, 14H7, 1280, 1284
14AF7/XXD	14F7, 14N7*
14B6	14E6
14B8	14J7, 14S7
14C5	14A5*
14C7	12B7, 14A7, 14H7, 1280, 1284
14E6	14B6
14E7	14R7
14W7	See end of list
19C8	19T8
19T8	19C8
19X3	19Y3

Tube	Substitute
19Y3	19X3
25A6	25B6, 25C6, 25L6, 5824
25B6	25A6, 25G6, 25L6, 25N6, 5824
25L6	25A6, 25B6, 25C6, 25N6, 5824
25C6	25A6, 25B6, 25L6, 25N6, 5824
25Y5	25Z5
25Z5	25Y5
50AX6	50Z6
50L6	50C6
50Y7	50Z7
50Z6	50AX6
50Z7	50Y7
80	83, 83V
83	5Z3
83V	5Z3, 80, 83
117N7	117P7
117L7/117M7	117N7, 117P7
1614	5881
5590	6CF6*
5591	6CF6*
5881	6F6*, 6K6*, 6U6*, 6V6*, 6L6, 1614
8016	1B3

Tube	Substitute
14W7	12B7, 14A7, 14C7, 14H7, 1280, 1284

Section 2.

Television Picture Tube Replacement Guide

Picture tubes are listed in the following INDEX according to type designations, starting with 7AP4 and ending with 30BP4. Wherever substitution is possible, each type number is followed by the number of a SUBSTITUTION GROUP. Tubes in any individual substitution group are interchangeable, some directly with no changes whatsoever, while others require certain changes.

Easy as A, B, C to Find Tubes Which Are 100% Interchangeable.

Use the INDEX to find the tube to be replaced. This will direct you to the SUBSTITUTION GROUP to which this tube belongs. Next, refer to the KEY column of this group. If tube to be replaced has an "A" in the KEY column, any other tube in this particular group with an "A" in the same column may be used as a substitute without any changes whatsoever. If tube to be replaced has a "B" in the KEY column, it can be replaced without changes, by any tube in the same group with a "B"in that column. Similarly, tubes with "C" are 100% replaceable by other tubes with "C", if in the same substitution group.

In other words, all tubes with the same letter in the KEY column in any particular substitution group are directly interchangeable, since they are identical in all essential features including basing, dimensions, external coating, type of ion trap, etc. This feature makes it as easy as A, B, C to locate a 100% interchangeable picture tube using this guide.

If no letter appears in the KEY COLUMN after any particular tube, this indicates that this tube, while interchangeable with other tubes in its group, will require changes or that it has different dimensions from the other tubes. In many instances, these changes are slight. Their extent can be determined readily by consulting the characteristics given under the other column headings.

Explanation of Other Column Headings in Substitution Group Tables

The FACE DESCRIPTION column tells whether face of tube is clear, gray, gray frosted, etc. Differences in this column do not affect interchangeability. Treated and frosted screens reduce reflections of external light; aluminized screens give increased brightness, while gray faced tubes improve contrast.

The BASING column designations refer to the basing diagrams which follow Substitution Group 32. These show the socket wiring used with each tube. No changes in the socket wiring are needed in any individual substitution group, with the exception of Group 1. Where two different basing designations are shown with identical socket wiring such as 12L and 12M these are used merely to indicate the absence or presence of external conductive coating.

The DIMENSIONS column permits selection of a suitable substitution tube to fit the cabinet dimensions. Where the neck length of the tube to be replaced is longer than that of the replacement, there may not be sufficient room for best adjustment of the focus coil, yoke and ion trap. It is better to select a replacement tube with the same or slightly longer neck length.

Presence or absence of EXTERNAL TUBE COATING must be taken into consideration when making picture tube substitutions. When a tube without external coating is used to replace one with this coating, it is necessary to connect a 500 MMF condenser of suitable high voltage rating between anode and chassis. When a tube with external coating is used to replace one without such coating, the external coating must be grounded to the chassis.

The ANODE CONNECTOR column shows whether ball or cavity connector is used. If the replacement tube has a different connector, the change must be made accordingly.

Note from the ION TRAP column that some replacement tubes do not require an ion trap. If a different ion trap is specified for the new tube, this should be installed.

The MAXIMUM ANODE VOLTAGE column gives the rating of each tube. If the set operating voltage is higher than the maximum rating of the tube, it is undesirable to use the tube as a replacement.

When substituting an electrostatic or self-focusing tube for a magnetically focused tube, remove the focus coil from the tube neck and mount it in the cabinet as far from the tube as possible. It should not be disconnected from the circuit unless it is replaced by an equivalent inductance or focus resistance. In substituting an automatic electrostatic focus tube for an electrostatic focus tube, no change in socket wiring is needed and it is unnecessary to remove the focus electrode lead from the socket.

How to Use the TV Picture Tube Guide to Select a Replacement Tube

a. Carefully read the preceding instructions regarding column headings and necessary adjustments.

b. Locate the tube you wish to replace in the following INDEX and find the substitution group for this tube.

c. Pick a tube which is directly interchangeable by consulting the KEY column (tubes with same letters in same group are directly interchangeable). If no tube in the group is directly interchangeable, select the replacement tube which requires the least number of changes. (Different type faces such as bold, italics, regular, indicate need for changes).

d. Note significant differences in neck length and anode voltages, checking with preceding instructions to determine whether substitution is feasible. Make sure tube selected as a replacement will fit cabinet.

EXAMPLE: To Replace a 17AP4 Tube. This tube is in SUBSTITUTION GROUP 18. Since there is no letter in the KEY column, there is no direct replacement. The 17BP4A shown in bold face is identical with the 17AP4 in every respect except in overall length and in neck length. The longer neck length will not affect the substitution. If the 17BP4A is not available, the 17BP4B or 17BP4C may be used as substitutes or the more popular 17JP4 (shown in italics). Its higher anode voltage rating of 18 KV permits it to be used in a set supplying an operating voltage of 16 KV. The most popular tubes are listed in bold faced type. Other popular tubes are shown in italics.

INDEX

Type Number	Substitution Group
7AP4	None
7CP4	1
7DP4	1
7HP4	2
7NP4	3
7QP4	2
7RP4	None
7TP4	None
7WP4	3
8AP4	4
8AP4A	4
9AP4	None
9CP4	None
10BP4	5
10BP4A	5
10CP4	5
10DP4	None
10EP4	5
10FP4	5
10FP4A	5
10MP4	6
10MP4A	6
10RP4	None
10SP4	None
12AP4	None
12CP4	None
12JP4	7
12KP4	7
12KP4A	7
12LP4	7
12LP4A	7
12QP4	7
12QP4A	7
12RP4	7
12TP4	7
12UP4	8
12UP4A	8
12UP4B	8
12VP4	9
12VP4A	9
12WP4	None
12XP4	None
12YP4	7
14BP4	10
14BP4A	10
14CP4	10
14DP4	10
14EP4	10
14FP4	10
14GP4	None
14HP4	None
14KP4	None
15AP4	11
15CP4	11
15DP4	11
15EP4	None
16ABP4	13-16-21
16ACP4	12
16AEP4	13
16AP4	14
16AP4A	14
16AP4B	14
16CP4	11
16DP4	12
16DP4A	12
16EP4	14
16EP4A	14
16EP4B	14
16FP4	12
16GP4	15
16GP4A	15
16GP4B	15
16GP4C	15
16HP4	12
16HP4A	12
16JP4	12
16JP4A	12
16KP4	16
16KP4A	16
16LP4	11
16LP4A	11
16MP4	12
16MP4A	12
16QP4	16
16RP4	16
16SP4	17
16SP4A	17
16TP4	16
16UP4	16
16VP4	17
16WP4	17
16WP4A	17
16XP4	16
16YP4	17
16ZP4	11
17AP4	18
17BP4	18
17BP4A	18
17BP4B	18
17BP4C	18
17CP4	20
17CP4A	20
17FP4	21
17FP4A	21
17GP4	None
17HP4	13
17HP4A	13
17JP4	18
17KP4	13-18-21
17LP4	22
17LP4A	22
17QP4	19
17RP4	13
17SP4	19-22
17TP4	None
17UP4	19
17VP4	22
17YP4	None
19AP4	23
19AP4A	23
19AP4B	23
19AP4C	23
19AP4D	23
19DP4	24
19DP4A	24
19EP4	25
19FP4	24
19GP4	24
19JP4	25
19QP4	26
20BP4	None
20CP4	25
20CP4A	25
20CP4C	25
20DP4	25
20DP4A	25
20FP4	27
20GP4	27
20HP4	26
20HP4A	26
20HP4B	26
20JP4	25-26-27
20LP4	26
20MP4	26
21AP4	None
21DP4	None
21EP4	28
21EP4A	28
21EP4B	28
21FP4	29
21FP4A	29
21JP4	None
21KP4	28-29
21KP4A	28-29
21MP4	None
21WP4	25
21XP4	26
21XP4A	26
21YP4	26
21ZP4	25
21ZP4A	25
22AP4	30
22AP4A	30
24AP4	31
24AP4A	31
24AP4B	31
24BP4	None
24CP4	None
24DP4	None
27AP4	None
27EP4	32
27GP4	32
27LP4	None
27MP4	None
27NP4	32
27RP4	32
30BP4	None

SUBSTITUTION GROUPS

Type Number	Key (See "Introductory Notes")	Face Description	Basing	Maximum Dimensions in Inches			External Tube Coating	Anode Connector	Ion Trap	Maximum Anode Voltage (KV)
				Over-all Length	Diameter or Height x Width	Neck Length				
GROUP 1: ***Glass, spherical, round, electrostatic-focus, 50° to 57° deflection angles.***										
7CP4		Clear	**8BQ**	13 13/16	7 1/8	7 3/8	**No**	**Ball**	**None**	8
7DP4		Clear	12R	14 7/16	7 3/16	8 5/16	Yes	Cavity	Double	8
GROUP 2: ***Glass, spherical, round, magnetic-focus, 50° to 52° deflection angles.***										
7HP4		Clear	12N	13 3/8	7 3/16	7 3/16	Yes	Ball	Double	8.8
7QP4		Clear	12D	13 1/4	7 3/16	7 1/8	**No**	**Cavity**	**Single**	**10**
GROUP 3: ***Glass, spherical, round, projection, magnetic-focus, 35° deflection angle.***										
7NP4		Clear	14N	20 1/8	7 3/16	10 5/8	No	Cap	None	80
7WP4		Clear	14N	20 1/16	7 3/16	10 5/8	**Yes**	Cap	None	80
GROUP 4: ***Metal, spherical, round, magnetic-focus, 54° deflection angle.***										
8AP4	A	Clear	12H	14 5/8	8 11/16	7 3/16	—	Cone Lip	Single	9
8AP4A	A	Gray	12H	14 5/8	8 11/16	7 3/16	—	Cone Lip	Single	9

Type Number	Key (See "Introductory Notes")	Face Description	Basing	Maximum Dimensions in Inches			External Tube Coating	Anode Connector	Ion Trap	Maximum Anode Voltage (KV)
				Over-all Length	Diameter or Height x Width	Neck Length				
GROUP 5: *Glass, spherical, round, magnetic-focus, 50° to 54° deflection angles.*										
10BP4	A	Clear	12N	18	10⅝	8⅜	Yes	Cavity	Double	10
10BP4A	A	Gray	12N	18	10⅝	8⅜	Yes	Cavity	Double	10
10CP4		Clear	12N	17	10⅝	7⁷⁄₁₆	Yes	**Ball**	Double	**12**
10EP4		Clear	12N	18	10⅝	8⅜	Yes	**Ball**	Double	**12**
10FP4	B	Clear, Alum.	12N	18	10⅝	8⅜	Yes	Cavity	**None**	**12**
10FP4A	B	Gray, Alum.	12N	18	10⅝	8⅜	Yes	Cavity	**None**	**12**
GROUP 6: *Glass, spherical, round, magnetic-focus, 52° deflection angle.*										
10MP4	A	Clear	12G	17⅜	10⁹⁄₁₆	7¾	Yes	Cavity	Double	10
10MP4A	A	Gray	12G	17⅜	10⁹⁄₁₆	7¾	Yes	Cavity	Double	10
GROUP 7: *Glass, spherical, round, magnetic-focus (unless otherwise indicated), 50° to 56° deflection angles.*										
12JP4		Clear	12D	18	12¾₁₆†	7¼	**No**	**Ball**	*None*	12
12KP4	A	Clear, Alum.	12N	18	12⁹⁄₁₆	7⁵⁄₁₆	Yes	Cavity	*None*	12
12KP4A	A	Gray, Alum.	12N	18	12⁹⁄₁₆	7⁵⁄₁₆	Yes	Cavity	*None*	12
12LP4	B	Clear	12N	19⅛	12½	8⁷⁄₁₆	Yes	Cavity	Double	12
12LP4A	B	Gray	12N	19⅛	12½	8⁷⁄₁₆	Yes	Cavity	Double	12
12QP4	C	Clear	12D	17⅞	12⁹⁄₁₆	7³⁄₁₆	**No**	**Ball**	**Single**	12
12QP4A	C	Gray	12D	17⅞	12⁹⁄₁₆	7³⁄₁₆	**No**	**Ball**	**Single**	12
12RP4		Clear	12D	18	12¾₁₆†	7¼	**No**	**Ball**	**Single**	12
12TP4		Clear	12D	19⅛	12½	8⁷⁄₁₆	**No**	Cavity	Double	12
12YP4*		Clear	12N	19⅛	12½	8⁷⁄₁₆	Yes	Cavity	**Single**	12

GROUP 8: ***Metal, spherical, round, magnetic-focus, 54° deflection angle.***

12UP4	A	Clear	12D	19	12½	8 1/16	—	Cone Lip	**Double**	12
12UP4A	A	Gray	12D	19	12½	8 1/16	—	Cone Lip	**Double**	12
12UP4B		Gray, Treated	12D	19	12½	8 1/16	—	Cone Lip	Single	12

GROUP 9: ***Glass, spherical, round, magnetic-focus, 55° deflection angle.***

12VP4	A	Clear	12G	18⅜	12½	7 11/16	Yes	Cavity	Double	12
12VP4A	A	Gray	12G	18⅜	12½	7 11/16	Yes	Cavity	Double	12

GROUP 10: ***Glass, spherical, rectangular, magnetic-focus, 65° deflection angle.***

14BP4	A	Gray	12N	17 3/16	9 13/16 x 12 5/8	7 23/32	Yes	Cavity	Single	14
14BP4A	A	Gray, Treated	12N	17 3/16	9 13/16 x 12 5/8	7 23/32	Yes	Cavity	Single	14
14CP4	A	Gray	12N	17⅛	9 27/32 x 12 21/32	7 21/32	Yes	Cavity	Single	14
14DP4		Gray	12D	17⅛	9 27/32 x 12 21/32	7 21/32	**No**	Cavity	**Double**	14
14EP4		Gray	12N	16 17/32	9 27/32 x 12 21/32	7 1/16	Yes	Cavity	Single	14
14FP4		Gray	12D	16½	9 27/32 x 12 21/32	7 1/16	**No**	Cavity	Single	14

GROUP 11: ***Glass, spherical, round, magnetic-focus, 50° to 57° deflection angles.***

15AP4		Clear	12D	20⅞	15¾	7 1/16	**No**	**Ball**	*None*	**15**
15CP4		Clear	12D	21⅞	15¾	8 3/16	**No**	Cavity	Double	**15**
15DP4		Clear	12D	20⅞	15¾	7 1/16	**No**	**Ball**	**Single**	**15**
16CP4		Clear	12D	21⅞	15 15/16	6 13/16	**No**	Cavity	Double	**15**
16LP4	A	Clear	12N	22⅝	16	7 9/16	Yes	Cavity	Double	14
16LP4A	A	Gray	12N	22⅝	16	7 9/16	Yes	Cavity	Double	14
16ZP4		Gray	12N	22⅝	16	7 9/16	Yes	Cavity	Double	*16*

Type Number	Key (See "Introductory Notes")	Face Description	Basing	Maximum Dimensions in Inches			External Tube Coating	Anode Connector	Ion Trap	Maximum Anode Voltage (KV)
				Over-all Length	Diameter or Height x Width	Neck Length				
GROUP 12: ***Glass, spherical, round, magnetic-focus (unless otherwise indicated), 60° to 62° deflection angles.***										
16ACP4*		Clear	12N	21 1/8	16	8 1/4	Yes	Cavity	**Single**	14
16DP4		Clear	12D	21	16	8 5/16	**No**	Cavity	Double	**15**
16DP4A		Gray	12D	21	16	7 15/16	**No**	Cavity	Double	**15**
16FP4		Clear	12D	20 5/8	16 3/8	7 3/16	**No**	**Ball**	**Single**	*16*
16HP4	A	Clear	12N	21 5/8	16	8 9/16	Yes	Cavity	Double	14
16HP4A	A	Gray	12N	21 5/8	16	8 9/16	Yes	Cavity	Double	14
16JP4	B	Clear	12N	21 1/8	16 3/8	7 11/16	Yes	Cavity	Double	14
16JP4A	B	Gray	12N	21 1/8	16 3/8	7 11/16	Yes	Cavity	Double	14
16MP4	C	Clear	12N	22 1/8	16 3/8	8 11/16	Yes	Cavity	Double	14
16MP4A	C	Gray	12N	22 1/8	16 3/8	8 11/16	Yes	Cavity	Double	14
GROUP 13: ***Glass, spherical, rectangular, low-voltage electrostatic-focus (unless otherwise indicated), 65° deflection angle.***										
16ABP4*		Gray	12N	19 1/8	11 5/8 x 14 7/8	7 11/16	Yes	Cavity	Single	16
16AEP4		Gray	12L	19 1/8	11 5/8 x 14 7/8	7 11/16	Yes	Cavity	Single	16
17HP4	A	Gray	12L	19 9/16	12 3/8 x 15 1/2	7 11/16	Yes	Cavity	Single	16
17HP4A	A	Gray, Treated	12L	19 9/16	12 3/8 x 15 1/2	7 11/16	Yes	Cavity	Single	16
17KP4*		Gray	12P	19 5/8	12 3/8 x 15 1/2	7 11/16	Yes	Cavity	Single	16
17RP4	A	Gray	12L	19 5/8	12 3/8 x 15 1/2	7 11/16	Yes	Cavity	Single	16

GROUP 14: ***Metal, spherical, round, magnetic-focus, 53° to 60° deflection angles.***

16AP4	A	Clear	12D	$22\frac{5}{8}$	16	$7\frac{5}{8}$	—	Cone Lip	Double	14
16AP4A	A	Gray	12D	$22\frac{5}{8}$	16	$7\frac{5}{8}$	—	Cone Lip	Double	14
16AP4B	A	Gray, Frosted	12D	$22\frac{5}{8}$	16	$7\frac{5}{8}$	—	Cone Lip	Double	14
16EP4	B	Clear	12D	20	16	$6\frac{15}{16}$	—	Cone Lip	Double	14
16EP4A	B	Gray	12D	20	16	$6\frac{15}{16}$	—	Cone Lip	Double	14
16EP4B		Gray, Treated	12D	20	16	$6\frac{15}{16}$	—	Cone Lip	**Single**	14

GROUP 15: ***Metal, spherical, round, magnetic-focus, 70° deflection angle.***

16GP4	A	Gray	12D	$17\frac{11}{16}$	16	7	—	Cone Lip	Single	14
16GP4A	A	Clear	12D	$17\frac{11}{16}$	16	7	—	Cone Lip	Single	14
16GP4B	A	Gray, Frosted	12D	$17\frac{11}{16}$	16	7	—	Cone Lip	Single	14
16GP4C	A	Clear, Frosted	12D	$17\frac{11}{16}$	16	7	—	Cone Lip	Single	14

GROUP 16: ***Glass, spherical, rectangular, magnetic-focus (unless otherwise indicated), 65° deflection angle.***

16ABP4*		Gray	12N	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{11}{16}$	Yes	Cavity	Single	16
16KP4	A	Gray	12N	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{11}{16}$	Yes	Cavity	Single	16
16KP4A	A	Gray, Alum.	12N	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{11}{16}$	Yes	Cavity	Single	16
16QP4		Gray	12D	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$8\frac{1}{16}$	**No**	Cavity	**Double**	16
16RP4	A	Gray	12N	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{11}{16}$	Yes	Cavity	Single	16
16TP4		Gray	12N	$18\frac{1}{2}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{1}{16}$	Yes	Cavity	Single	*14*
16UP4		Gray	12D	$18\frac{5}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{1}{8}$	**No**	Cavity	Single	**15**
16XP4		Gray	12D	$19\frac{1}{8}$	$11\frac{5}{8}$x$14\frac{7}{8}$	$7\frac{11}{16}$	**No**	Cavity	**Double**	**15**

GROUP 17: ***Glass, spherical, round, magnetic-focus, 70° deflection angle.***

16SP4	A	Clear	12N	$17\frac{11}{16}$	16	$7\frac{3}{16}$	**Yes**	Cavity	Double	**14**
16SP4A	A	Gray	12N	$17\frac{11}{16}$	16	$7\frac{3}{16}$	**Yes**	Cavity	Double	**14**
16VP4		Gray	12D	$17\frac{7}{16}$	16	$7\frac{1}{16}$	No	Cavity	**Single**	15
16WP4		Gray	12D	$18\frac{1}{8}$	16	$7\frac{5}{8}$	No	Cavity	Double	15
16WP4A		Gray	12N	$18\frac{1}{8}$	16	$7\frac{5}{8}$	**Yes**	Cavity	Double	*16*
16YP4		Gray	12N	$17\frac{11}{16}$	16	$7\frac{3}{16}$	**Yes**	Cavity	**Single**	**14**

Type Number	Key (See "Introductory Notes")	Face Description	Basing	Maximum Dimensions in Inches: Over-all Length	Diameter or Height x Width	Neck Length	External Tube Coating	Anode Connector	Ion Trap	Maximum Anode Voltage (KV)
GROUP 18: *Glass, spherical, rectangular, magnetic-focus (unless otherwise indicated), 65° deflection angle.*										
17AP4		Gray	12N	19	12⅜x15½	7 1/16	Yes	Cavity	Single	16
17BP4		Gray	12D	19⅝	12⅜x15½	7 1/16	**No**	Cavity	Single	16
17BP4A	A	Gray	12N	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	16
17BP4B	A	Gray, Alum.	12N	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	16
17BP4C	A	Gray, Treated	12N	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	16
17JP4		Gray	12N	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	**18**
17KP4*		Gray	12P	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	16
GROUP 19: *Glass, cylindrical, rectangular, magnetic-focus (unless otherwise indicated), 65° to 70° deflection angles.*										
17QP4		Gray	12N	19 9/16	12⅜x15½	7 1/16	Yes	Cavity	Single	16
17SP4*		Gray	12N	19 9/16	12⅜x15½	7 1/16	Yes	Cavity	Single	**14**
17UP4		Gray	12N	19 9/16	12⅜x15½	7 1/16	Yes	Cavity	Single	**14**
GROUP 20: *Metal, spherical, rectangular, magnetic-focus, 66° deflection angle.*										
17CP4	A	Gray, Frosted	12D	19	12⅜x16 1/16	7⅜	—	Cone Lip	Single	16
17CP4A	A	Gray	12D	19	12⅜x16 1/16	7⅜	—	Cone Lip	Single	16
GROUP 21: *Glass, spherical, rectangular, high-voltage electrostatic-focus (unless otherwise indicated), 65° deflection angle.*										
16ABP4*		Gray	12N	19⅛	11⅝x14⅞	7 1/16	Yes	Cavity	Single	**16**
17FP4	A	Gray	12L	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	18
17FP4A	A	Gray	12L	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	18
17KP4*		Gray	12P	19⅝	12⅜x15½	7 1/16	Yes	Cavity	Single	**16**

GROUP 22: ***Glass, cylindrical, rectangular, low-voltage electrostatic-focus (unless otherwise indicated), 65 to 66 deflection angles.***

17LP4	A	Gray	12L	19⁹⁄₁₆	12³⁄₈x15½	7¹¹⁄₁₆	Yes	Cavity	Single	16
17LP4A	A	Gray	12L	19⁹⁄₁₆	12³⁄₈x15½	7¹¹⁄₁₆	Yes	Cavity	Single	16
17SP4*		Gray	12N	19⁹⁄₁₆	12³⁄₈x15½	7¹¹⁄₁₆	Yes	Cavity	Single	**14**
17VP4	A	Gray	12L	19⁹⁄₁₆	12³⁄₈x15½	7¹¹⁄₁₆	Yes	Cavity	Single	16

GROUP 23: ***Metal, spherical, round, magnetic-focus, 66° deflection angle.***

19AP4	A	Clear	12D	22	18¾	7⅜	—	Cone Lip	Single	19
19AP4A	A	Gray	12D	22	18¾	7⅜	—	Cone Lip	Single	19
19AP4B	A	Gray, Frosted	12D	22	18¾	7⅜	—	Cone Lip	Single	19
19AP4C	A	Gray, Alum.	12D	22	18¾	7⅜	—	Cone Lip	Single	19
19AP4D	A	Clear, Frosted	12D	22	18¾	7⅜	—	Cone Lip	Single	19

GROUP 24: ***Glass, spherical, round, magnetic-focus, 66° deflection angle.***

19DP4	A	Clear	12N	21⅞	19	7⁵⁄₁₆	**Yes**	Cavity	Double	**17**
19DP4A	A	Gray	12N	21⅞	19	7⁵⁄₁₆	**Yes**	Cavity	Double	**17**
19FP4		Gray	12D	22½	19	7⅞	No	Cavity	Double	19
19GP4		Gray	12D	21⅞	19	7⅛	No	Cavity	**Single**	19

GROUP 25: ***Glass, spherical, rectangular, magnetic-focus (unless otherwise indicated), 65° to 66° deflection angles.***

19EP4		Gray	12D	21½	13³³⁄₃₂x17⅛	7¹¹⁄₁₆	**No**	Cavity	Single	**19**
19JP4		Gray	12D	21³⁄₁₆	13⁵⁄₁₆x17³⁄₁₆	7⅜	**No**	Cavity	Single	18
20CP4	A	Gray	12D	21¹³⁄₁₆	15⅛x18⅞	7⅜	**No**	Cavity	Single	18
20CP4A		Gray	12N	21¹³⁄₁₆	15⅛x18⅞	7⅜	Yes	Cavity	Single	18
20CP4C	A	Gray, Treated	12D	21¹³⁄₁₆	15⅛x18⅞	7⅜	**No**	Cavity	Single	18
20DP4		Gray	12D	22⅛	15⅛x18⅞	7¹¹⁄₁₆	**No**	Cavity	Single	18
20DP4A		Gray	12N	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	18
20JP4*		Gray	12P	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	18
21WP4		Gray	12N	22⅝	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	18
21ZP4		Gray	12D	23³⁄₃₂	15¾x20⁷⁄₁₆	7¹¹⁄₁₆	**No**	Cavity	Single	18
21ZP4A		Gray	12N	23⅜	15¾x20⁷⁄₁₆	7¹¹⁄₁₆	Yes	Cavity	Single	18

Type Number	Key (See "Introductory Notes")	Face Description	Basing	Maximum Dimensions in Inches: Over-all Length	Maximum Dimensions in Inches: Diameter or Height x Width	Maximum Dimensions in Inches: Neck Length	External Tube Coating	Anode Connector	Ion Trap	Maximum Anode Voltage (KV)
GROUP 26: ***Glass, spherical, rectangular, low-voltage electrostatic-focus (unless otherwise indicated), 65° to 66° deflection angles.***										
19QP4		Gray	12L	21½	13⁵⁄₁₆x17³⁄₁₆	7¹¹⁄₁₆	Yes	Cavity	Single	**18**
20HP4	A	Gray	12M	22⅛	15⅛x18⅞	7¹¹⁄₁₆	**No**	Cavity	Single	16
20HP4A	B	Gray	12L	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	16
20HP4B	A	Gray, Treated	12M	22⅛	15⅛x18⅞	7¹¹⁄₁₆	**No**	Cavity	Single	16
20JP4*		Gray	12P	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	**18**
20LP4	B	Gray	12L	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	16
20MP4	B	Gray	12L	22⅛	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	16
21XP4	C	Gray	12L	22⅝	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	**18**
21XP4A	C	Gray	12L	22⅝	15⅛x18⅞	7¹¹⁄₁₆	Yes	Cavity	Single	**18**
21YP4		Gray	12L	23⅜	15¾x20⅞	7¹¹⁄₁₆	Yes	Cavity	Single	**18**
GROUP 27: ***Glass, spherical, rectangular, high-voltage electrostatic-focus (unless otherwise indicated), 65° to 66° deflection angles.***										
20FP4		Gray	12M	22⅛	15⅛x18⅞	7¹¹⁄₁₆	No	Cavity	Single	18
20GP4		Gray	12L	22⅛	15⅛x18⅞	7¹¹⁄₁₆	**Yes**	Cavity	Single	18
20JP4*		Gray	12P	22⅛	15⅛x18⅞	7¹¹⁄₁₆	**Yes**	Cavity	Single	18
GROUP 28: ***Glass, cylindrical, rectangular, magnetic-focus (unless otherwise indicated), 65° to 70° deflection angles.***										
21EP4		Gray	12D	23⅜	15¾ x20⅞	7¹¹⁄₁₆	**No**	Cavity	Single	18
21EP4A	A	Gray	12N	23⅜	15¾ x20⅞	7¹¹⁄₁₆	Yes	Cavity	Single	18
21EP4B	A	Gray, Alum.	12N	23⅜	15¾ x20⅞	7¹¹⁄₁₆	Yes	Cavity	Single	18
21KP4*		Gray	12D	23¼	15¹¹⁄₁₆x20³⁄₁	7¹¹⁄₁₆	**No**	Cavity	Single	18
21KP4A*		Gray	12P	23⅜	15¹¹⁄₁₆x20³⁄₈	7¹¹⁄₁₆	Yes	Cavity	Single	18

GROUP 29: ***Glass, cylindrical, rectangular, low-voltage electrostatic-focus (unless otherwise indicated), 65° to 70° deflection angles.***

21FP4		Gray	12M	22⅜	15¾ x20⅞	7 11/16	**No**	Cavity	Single	18
21FP4A		Gray	12L	22⅜	15¾ x20⅞	7 11/16	Yes	Cavity	Single	18
21KP4*		Gray	12D	23¼	15 11/16x20⅜	7 11/16	**No**	Cavity	Single	18
21KP4A*		Gray	12P	23⅜	15 11/16x20⅜	7 11/16	Yes	Cavity	Single	18

GROUP 30: ***Metal, spherical, round, magnetic-focus, 70° deflection angle.***

22AP4	A	Clear	12D	23⅜	21 13/16	7 5/16	—	Cone Lip	Single	19
22AP4A	A	Gray	12D	23⅜	21 13/16	7 5/16	—	Cone Lip	Single	19

GROUP 31: ***Metal, spherical, round, magnetic-focus, 70° deflection angle.***

24AP4	A	Gray	12D	24 7/16	24⅛	7 11/32	—	Cone Lip	Single	16
24AP4A	A	Gray, Alum.	12D	24 7/16	24⅛	7 11/32	—	Cone Lip	Single	16
24AP4B	A	Gray, Treated	12D	24 7/16	24⅛	7 11/32	—	Cone Lip	Single	16

GROUP 32: ***Glass, spherical, rectangular, magnetic-focus, 85° to 90° deflection angles.***

27EP4	Gray, Alum.	12D	23 7/16	20 13/32x25 15/32	7 11/16	No	Cavity	Single	20
27GP4	Gray	12D	23 7/16	20 5/32 x25 11/32	7 11/16	No	Cavity	Single	*22.5*
27NP4	Gray	12N	23⅜	20 11/32x25 13/32	7 11/16	**Yes**	Cavity	Single	**18**
27RP4	Gray, Alum.	12N	23 7/16	20 13/32x25 15/32	7 11/16	**Yes**	Cavity	Single	20

The data in this Substitution Chart
Courtesy CBS Hytron

* Tube has automatic electrostatic-focus. This tube may be used as a substitute only. Replace it with other automatic electrostatic-focus tubes of the same Substitution Group.

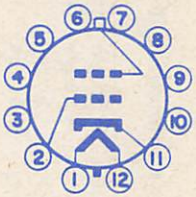
† This tube has a face-plate radius of curvature of 20 inches. Dimension A (see Outline Drawings) of this tube is approximately half an inch larger than that of other tubes in this group. Inspect the particular mask to determine if this additional half inch can be accommodated.

Outline and Basing Diagrams

8BQ

12D

12G



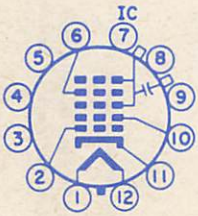
12H

12L

12M

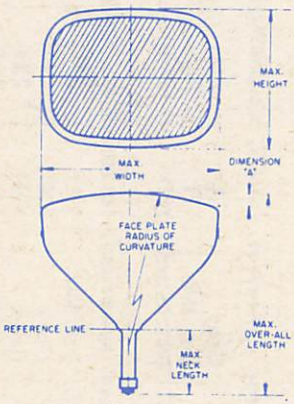
12N

12P

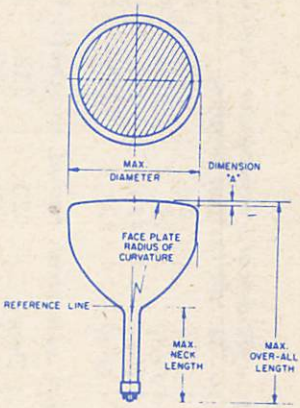


12R

14N



RECTANGULAR PICTURE TUBE



ROUND PICTURE TUBE

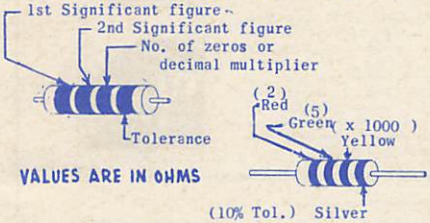
HOW TO READ COLOR CODED MOLDED RESISTORS AND CAPACITORS

Due to present manufacturing methods, molded composition resistors, molded wire-wound resistors, molded condensers and molded r.f.chokes are almost identical in appearance. The first problem therefore is how to distinguish one type of component from another.

Molded composition resistors employ a single width band as the first significant figure. In counting bands, start at the band closest to the end of the component, or if distance is the same at each end due to use of four or more bands, start to count at the band furthest from the silver or gold band.

Wire-wound molded resistors employ a double width band as the first significant figure. Molded composition r.f. chokes use three bands only. In older models, r.f. chokes may be marked with a single band or dot. Molded composition capacitors of 10 MMF or more use five bands or dots, whereas resistors never use more than four bands.

HOW TO READ COMPOSITION RESISTOR COLOR CODE

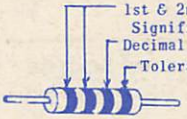


Value 25,000 ohms - ±10% Tolerance

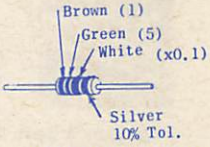
Color	1st & 2nd Sig. Figure	Multiply by
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1000
Yellow	4	10000
Green	5	100000
Blue	6	1000000
Violet	7	10000000
Gray	8	100000000
White	9	1000000000
Gold	+5% Tolerance	
Silver	±10% Tolerance	
No Color	±20% Tolerance	

HOW TO READ MOLDED CAPACITOR COLOR CODE - Condensers less than 10 MMF. Values are obtained in MMF. (Micromicrofarads)

Color	First & 2nd Sig. Figure	Decimal Multip.	Tolerance Plus or minus
Black	0		
Brown	1		
Red	2		
Orange	3		
Yellow	4		
Green	5		
Blue	6		
Violet	7		
Gray	8	0.01	
White	9	0.1	
Silver			±10%
Gold			± 5%
4th Band Absent			±20%



WHITE or GRAY 3rd BAND NOT USED ON RESISTORS, ONLY ON CAPACITORS LESS THAN 10 MMF.



1.5 MMF 10% tolerance

HOW TO READ COLOR CODING OF MOLDED R.F. CHOKES

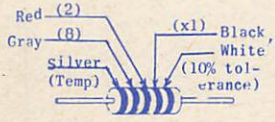
Molded r.f. chokes employ three bands, one at one end and two close together at the other end. Start at the end which has the two close-together bands. The number corresponding to the color of the first band is the first significant figure. The number corresponding to the color of the 2nd band is the second significant figure. The colors and their corresponding numbers are the same as in the resistor color code.

The band separated from the other two is the decimal multiplier. For example, if the first of the close-together bands (or dots) is red and the second is yellow, this gives the number 24. If the separated band at the other end of the choke is silver, this signifies that 24 must be multiplied by .01 and that the r.f. choke has a value of .24 microhenrys.

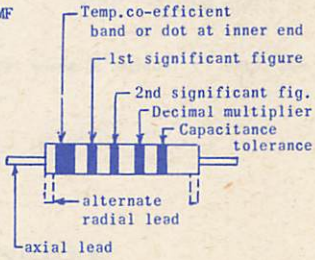
HOW TO READ MOLDED CAPACITOR COLOR CODE

Condensers 10MMF or over
Values obtained are in MMF

Color	1&2 Sig. Fig.	Multiply by	Tol.	Temp. Coef.
Black	0	1	±20%	0
Brown	1	10	± 1%	-33
Red	2	100	± 2%	-75
Orange	3	1000	±2½%	-150
Yellow	4	10000	-	-220
Green	5		± 5%	-330
Blue	6		-	-470
Violet	7		-	-750
Gray	8		±25%	-
White	9		±10%	-



82 MMF ± 10%



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