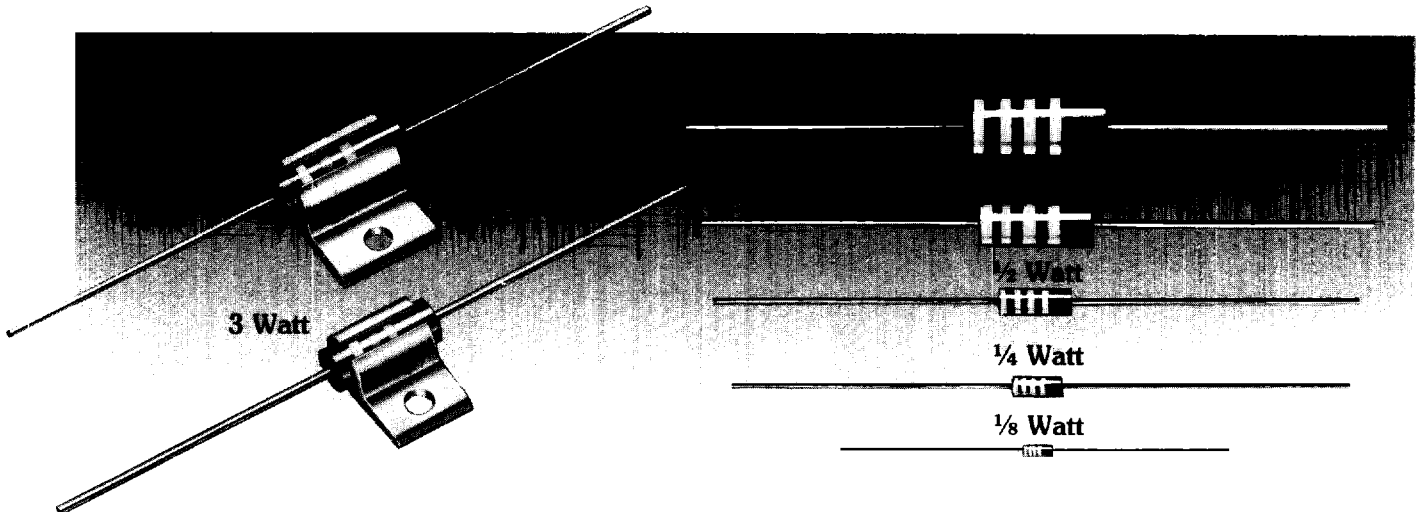




# Hot-Molded Carbon Composition Fixed Resistors

( $\frac{1}{8}$ W through 4W @ 70°C)



## KEY CHARACTERISTICS

- MIL-SPEC Reliability
- Pulse Withstanding
- Power Dissipation
- High Frequency Stability
- Low Inductance
- Rugged Construction
- Dependable Performance
- Ultra-High Resistance Values

## Features and Benefits

**Uniform Quality** — Consistent performance for over 50 years! Same quality built into all parts — regardless of value, rating or tolerance. MIL-SPEC and Industrial grade parts are made using the same process.

**Reliable** — Recognized as the **most** reliable of all electronic components, Allen-Bradley Hot-Molded Carbon Composition resistors provide freedom from catastrophic failure when used within ratings.

**Predictable performance** — Because of their outstanding uniformity, Allen-Bradley Hot-Molded Carbon Composition resistors exhibit consistent responses to environment and loading.

**Conservative ratings** — All performance specifications are based on extensive testing and massive field experience.

**Rugged construction** — The solid, integral structure, combining leads, insulation, and resistance material in the exclusive Allen-Bradley hot-molding process provides exceptional strength and resistance to damage in automatic handling machinery.

**Wide range of values** — Available in standard EIA resistance values from 1 ohm to 100 megohms. Special values available on request.

**High resistance values** — Resistance values from 100

megohms to 1 million megohms (1 teraohm) are available on special order in Types BB, CB, and EB.

**Solderable leads** — Hot solder coated leads remain easy to solder even after long periods in stock.

**Tracking** — Allen-Bradley resistors exhibit extremely uniform tracking characteristics. For example, in flip-flop circuits, resistors used in pairs which are drawn from the same package or reel (a normal mass production practice) will track with each other throughout changes of temperature, humidity, and load. This assures reliable circuit performance throughout the design life of the equipment.

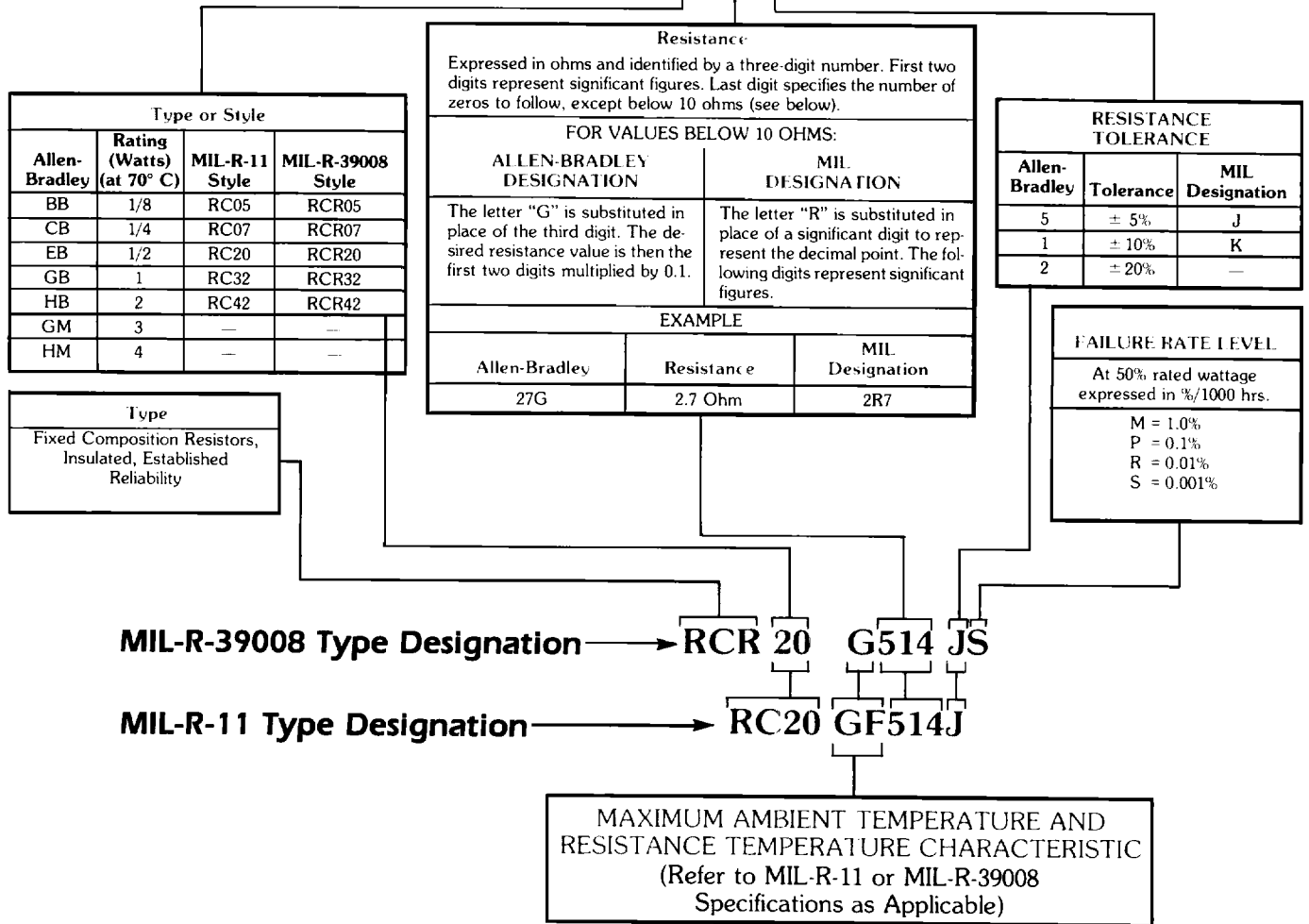
**Durable color coding** — Baked-on color code paints are resistant to solvents, and also resist the abrasion and chipping associated with automatic handling. They remain bright and easily readable even after long periods of use.

**Temperature stable** — Between 0° C and 85° C, Allen-Bradley Hot-Molded Carbon Composition resistors exhibit a very low temperature characteristic, typically less than two percent deviation from room temperature values, less in low resistance values.

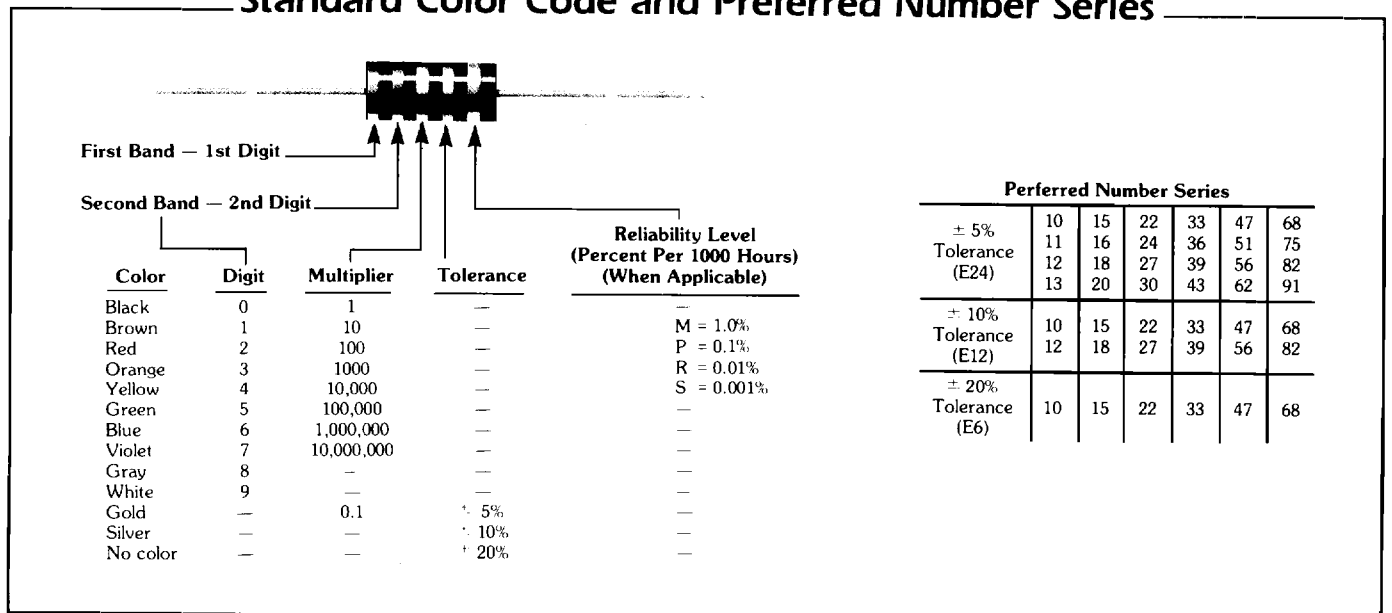
# Explanation of Part Numbers

All Allen-Bradley Hot-Molded Carbon Composition resistors are identified by a Part Number which will provide information as to the type of resistor, resistance value, and tolerance. The Part Number is merely for identification on drawings, specifications, ordering, and other areas where it is convenient to use a Part Number to describe a particular resistor. The only markings that appear on the resistor are the Color Code bands.

## Industrial Type Designation → EB5145



## Standard Color Code and Preferred Number Series



# Types BB, CB, EB, GB, HB, GM, HM

Nominal Resistance in Ohms			Rated Continuous Working Voltage (RCWV) DC or RMS Volts									Resistor Part Number			Resistance Color Code		
TOLERANCE COLOR CODE			WATTAGE and TYPE									Type	Value Code	Tolerance	Resistance Color Code		
4th BAND												1 <sup>1</sup>		1/4 <sup>2</sup>	1/2 <sup>2</sup>	1 <sup>2</sup>	2 <sup>2</sup>
Gold ±5%	Silver ±10%	None ±20%	BB	CB	EB	GB	HB	GM	GM	HM	HM	XX	000	X	1st digit	2nd digit	Number of zeros after 1st and 2nd digit
1.0	1.0	1.0	—	—	0.707	1.00	—	1.73	2.00	—	—		10G		Brown	Black	Gold
1.1	—	—	—	—	0.742	1.05	—	1.82	2.10	—	—		11G		Brown	Brown	Gold
1.2	1.2	—	—	—	0.775	1.10	—	1.90	2.19	—	—		12G		Brown	Red	Gold
1.3	—	—	—	—	0.806	1.14	—	1.97	2.28	—	—		13G		Brown	Orange	Gold
1.5	1.5	1.5	—	—	0.866	1.22	—	2.12	2.45	—	—		15G		Brown	Green	Gold
1.6	—	—	—	—	0.894	1.26	—	2.19	2.53	—	—		16G		Brown	Blue	Gold
1.8	1.8	—	—	—	0.949	1.34	—	2.32	2.68	—	—		18G		Brown	Gray	Gold
2.0	—	—	—	—	1.00	1.41	—	2.45	2.83	—	—		20G		Red	Black	Gold
2.2	2.2	2.2	—	—	1.05	1.48	—	2.57	2.97	—	—		22G		Red	Red	Gold
2.4	—	—	—	—	1.10	1.55	—	2.68	3.10	—	—		24G		Red	Yellow	Gold
2.7	2.7	—	0.581	0.822	1.16	1.64	—	2.85	3.29	—	—		27G		Red	Violet	Gold
3.0	—	—	0.612	0.866	1.22	1.73	—	3.00	3.46	—	—		30G		Orange	Black	Gold
3.3	3.3	3.3	0.642	0.908	1.28	1.82	—	3.15	3.63	—	—		33G		Orange	Orange	Gold
3.6	—	—	0.671	0.949	1.34	1.90	—	3.29	3.79	—	—		36G		Orange	Blue	Gold
3.9	3.9	—	0.698	0.987	1.40	1.97	—	3.42	3.95	—	—		39G		Orange	White	Gold
4.3	—	—	0.733	1.04	1.47	2.07	—	3.59	4.15	—	—		43G		Yellow	Orange	Gold
4.7	4.7	4.7	0.766	1.08	1.53	2.17	—	3.76	4.34	—	—		47G		Yellow	Violet	Gold
5.1	—	—	0.798	1.13	1.60	2.26	—	3.91	4.52	—	—		51G		Green	Brown	Gold
5.6	5.6	—	0.837	1.18	1.67	2.37	—	4.10	4.73	—	—		56G		Green	Blue	Gold
6.2	—	—	0.880	1.24	1.76	2.49	—	4.31	4.98	—	—		62G		Blue	Red	Gold
6.8	6.8	6.8	0.922	1.30	1.84	2.61	—	4.52	5.22	—	—		68G		Blue	Gray	Gold
7.5	—	—	0.968	1.37	1.94	2.74	—	4.74	5.48	—	—		75G		Violet	Green	Gold
8.2	8.2	—	1.01	1.43	2.02	2.86	—	4.96	5.73	—	—		82G		Gray	Red	Gold
9.1	—	—	1.07	1.51	2.13	3.02	—	5.22	6.03	—	—		91G		White	Brown	Gold
10	10	10	1.12	1.58	2.24	3.16	4.47	5.48	6.32	6.32	7.07		100		Brown	Black	Black
11	—	—	1.17	1.66	2.34	3.32	4.69	5.74	6.63	6.63	7.42		110		Brown	Brown	Black
12	12	—	1.22	1.73	2.45	3.46	4.90	6.00	6.93	6.93	7.75		120		Brown	Red	Black
13	—	—	1.28	1.80	2.55	3.61	5.10	6.24	7.21	7.21	8.06		130		Brown	Orange	Black
15	15	15	1.37	1.94	2.74	3.87	5.48	6.71	7.75	7.75	8.66		150		Brown	Green	Black
16	—	—	1.41	2.00	2.83	4.00	5.66	6.93	8.00	8.00	8.94		160		Brown	Blue	Black
18	18	—	1.50	2.12	3.00	4.24	6.00	7.35	8.48	8.48	9.49		180		Brown	Gray	Black
20	—	—	1.58	2.24	3.16	4.47	6.32	7.75	8.94	8.94	10.0		200		Red	Black	Black
22	22	22	1.66	2.34	3.32	4.69	6.63	8.12	9.38	9.38	10.5		220		Red	Red	Black
24	—	—	1.73	2.45	3.46	4.90	6.93	8.48	9.80	9.80	11.0		240		Red	Yellow	Black
27	27	—	1.84	2.60	3.67	5.20	7.35	9.00	10.4	10.4	11.6		270		Red	Violet	Black
30	—	—	1.94	2.74	3.87	5.48	7.75	9.49	11.0	11.0	12.2		300		Orange	Black	Black
33	33	33	2.03	2.87	4.06	5.74	8.12	9.95	11.5	11.5	12.8		330		Orange	Orange	Black
36	—	—	2.12	3.00	4.24	6.00	8.48	10.4	12.0	12.0	13.4		360		Orange	Blue	Black
39	39	—	2.21	3.12	4.42	6.24	8.83	10.8	12.5	12.5	14.0		390		Orange	White	Black
43	—	—	2.32	3.28	4.64	6.56	9.27	11.4	13.1	13.1	14.7		430		Yellow	Orange	Black
47	47	47	2.42	3.43	4.85	6.86	9.70	11.9	13.7	13.7	15.3		470		Yellow	Violet	Black
51	—	—	2.52	3.57	5.05	7.14	10.1	12.4	14.3	14.3	16.0		510		Green	Brown	Black
56	56	—	2.65	3.74	5.29	7.48	10.6	13.0	15.0	15.0	16.7		560		Green	Blue	Black
62	—	—	2.78	3.94	5.57	7.87	11.1	13.6	15.7	15.7	17.6		620		Blue	Red	Black
68	68	68	2.92	4.12	5.83	8.25	11.7	14.3	16.5	16.5	18.4		680		Blue	Gray	Black
75	—	—	3.06	4.33	6.12	8.66	12.2	15.0	17.3	17.3	19.4		750		Violet	Green	Black
82	82	—	3.20	4.53	6.40	9.06	12.8	15.7	18.1	18.1	20.2		820		Gray	Red	Black
91	—	—	3.37	4.77	6.74	9.54	13.5	16.5	19.1	19.1	21.3		910		White	Brown	Black
100	100	100	3.54	5.00	7.07	10.0	14.1	17.3	20.0	20.0	22.4		101		Brown	Black	Brown
110	—	—	3.71	5.24	7.42	10.5	14.8	18.2	21.0	21.0	23.5		111		Brown	Brown	Brown
120	120	—	3.87	5.48	7.75	11.0	15.5	19.0	21.9	21.9	24.5		121		Brown	Red	Brown
130	—	—	4.03	5.70	8.06	11.4	16.1	19.7	22.8	22.8	25.5		131		Brown	Orange	Brown
150	150	150	4.33	6.12	8.66	12.2	17.3	21.2	24.5	24.5	27.4		151		Brown	Green	Brown
160	—	—	4.47	6.32	8.94	12.6	17.9	21.9	25.3	25.3	28.3		161		Brown	Blue	Brown
180	180	—	4.74	6.71	9.49	13.4	19.0	23.2	26.8	26.8	30.0		181		Brown	Gray	Brown
200	—	—	5.00	7.07	10.0	14.1	20.0	24.5	28.3	28.3	31.6		201		Red	Black	Brown
220	220	220	5.24	7.42	10.5	14.8	21.0	25.7	29.7	29.7	33.2		221		Red	Red	Brown
240	—	—	5.48	7.75	11.0	15.5	21.9	26.8	31.0	31.0	34.6		241		Red	Yellow	Brown
270	270	—	5.81	8.22	11.6	16.4	23.2	28.5	32.9	32.9	36.7		271		Red	Violet	Brown
300	—	—	6.12	8.66	12.2	17.3	24.5	30.0	34.6	34.6	38.7		301		Orange	Black	Brown
330	330	330	6.42	9.08	12.8	18.2	25.7	31.5	36.3	36.3	40.6		331		Orange	Orange	Brown
360	—	—	6.71	9.49	13.4	19.0	26.8	32.9	37.9	37.9	42.4		361		Orange	Blue	Brown
390	390	—	6.98	9.87	14.0	19.7	27.9	34.2	39.5	39.5	44.2		391		Orange	White	Brown
430	—	—	7.33	10.4	14.7	20.7	29.3	35.9	41.5	41.5	46.4		431		Yellow	Orange	Brown
470	470	470	7.66	10.8	15.3	21.7	30.7	37.6	43.4	43.4	48.5		471		Yellow	Violet	Brown

<sup>1</sup> Rating at 70° C, derated to zero at 130° C.

<sup>2</sup> Rating at 40° C, derated to zero at 150° C.

<sup>2</sup> Rating at 70° C, derated to zero at 150° C.

# Types BB, CB, EB, GB, HB, GM, HM

Nominal Resistance in Ohms

TOLERANCE COLOR CODE			Rated Continuous Working Voltage (RCWV) DC or RMS Volts									Resistor Part Number			Resistance Color Code		
4th BAND			WATTAGE and TYPE									Type BB CB EB etc.	Value Code	Tolerance 5 = 5% 1 = 10% 2 = 20%	1st BAND	2nd BAND	3rd BAND
Gold ± 5%	Silver ± 10%	None ± 20%	1/8 [1]	1/4 [2]	1/2 [2]	1 [2]	2 [2]	3 [2]	4 [3]	4 [2]	5 [3]	XX	000	X	1st digit	2nd digit	Number of zeros after 1st and 2nd digit
510	—	—	7.98	11.3	16.0	22.6	31.9	39.1	45.2	45.2	50.5		511		Green	Brown	Brown
560	560	—	8.37	11.8	16.7	23.7	33.5	41.0	47.3	47.3	52.9		561		Green	Brown	Brown
620	—	—	8.80	12.4	17.6	24.9	35.2	43.1	49.8	49.8	55.7		621		Blue	Red	Brown
680	680	680	9.22	13.0	18.4	26.1	36.9	45.2	52.2	52.2	58.3		681		Blue	Gray	Brown
750	—	—	9.68	13.7	19.4	27.4	38.7	47.4	54.8	54.8	61.2		751		Violet	Green	Brown
820	820	—	10.1	14.3	20.2	28.6	40.5	49.6	57.3	57.3	64.0		821		Gray	Red	Brown
910	—	—	10.7	15.1	21.3	30.2	42.7	52.2	60.3	60.3	67.5		911		White	Brown	Brown
1000	1000	1000	11.2	15.8	22.4	31.6	44.7	54.8	63.2	63.2	70.7		102		Brown	Black	Red
1100	—	—	11.7	16.6	23.4	33.2	46.9	57.4	66.3	66.3	74.2		112		Brown	Brown	Red
1200	1200	—	12.2	17.3	24.5	34.6	49.0	60.0	69.3	69.3	77.5		122		Brown	Red	Red
1300	—	—	12.8	18.0	25.5	36.1	51.0	62.4	72.1	72.1	80.6		132		Brown	Orange	Red
1500	1500	1500	13.7	19.4	27.4	38.7	54.8	67.1	77.5	77.5	86.6		152		Brown	Green	Red
1600	—	—	14.1	20.0	28.3	40.0	56.6	69.3	80.0	80.0	89.4		162		Brown	Blue	Red
1800	1800	—	15.0	21.2	30.0	42.4	60.0	73.5	84.8	84.8	94.9		182		Brown	Gray	Red
2000	—	—	15.8	22.4	31.6	44.7	63.2	77.5	89.4	89.4	100		202		Red	Black	Red
2200	2200	2200	16.6	23.4	33.2	46.9	66.3	81.2	93.8	93.8	105		222		Red	Red	Red
2400	—	—	17.4	24.5	34.6	49.0	69.3	84.8	98.0	98.0	110		242		Red	Yellow	Red
2700	2700	—	18.4	26.0	36.7	52.0	73.5	90.0	104	104	116		272		Red	Violet	Red
3000	—	—	19.4	27.4	38.7	54.8	77.5	94.9	110	110	122		302		Orange	Black	Red
3300	3300	3300	20.3	28.7	40.6	57.4	81.2	99.5	115	115	128		332		Orange	Orange	Red
3600	—	—	21.2	30.0	42.4	60.0	84.8	104	120	120	134		362		Orange	Blue	Red
3900	3900	—	21.1	31.2	44.2	62.4	88.3	108	125	125	140		392		Orange	White	Red
4300	—	—	23.2	32.8	46.4	65.6	92.7	114	131	131	147		432		Yellow	Orange	Red
4700	4700	4700	24.2	34.3	48.5	68.6	97.0	119	137	137	153		472		Yellow	Violet	Red
5100	—	—	25.2	35.7	50.5	71.4	101.0	124	143	143	160		512		Green	Brown	Red
5600	5600	—	26.5	37.4	52.9	74.8	106	130	150	150	167		562		Green	Blue	Red
6200	—	—	27.8	39.4	55.7	78.7	111	136	157	157	176		622		Blue	Red	Red
6800	6800	6800	29.2	41.2	58.3	82.5	117	143	165	165	184		682		Blue	Gray	Red
7500	—	—	30.6	43.3	61.2	86.6	122	150	173	173	194		752		Violet	Green	Red
8200	8200	—	32.0	45.3	64.0	90.6	128	157	181	181	202		822		Gray	Red	Red
9100	—	—	33.7	47.7	67.4	95.4	135	165	191	191	213		912		White	Brown	Red
10000	10000	10000	35.4	50.0	70.7	100.0	141	173	200	200	224		103		Brown	Black	Orange
11000	—	—	37.1	52.4	74.2	105	148	182	210	210	235		113		Brown	Brown	Orange
12000	12000	—	38.7	54.8	77.5	110	155	190	219	219	245		123		Brown	Red	Orange
13000	—	—	40.3	57.0	80.6	114	161	197	228	228	255		133		Brown	Orange	Orange
15000	15000	15000	43.3	61.2	86.6	122	173	212	245	245	274		153		Brown	Green	Orange
16000	—	—	44.7	63.2	89.4	126	179	219	253	253	283		163		Brown	Blue	Orange
18000	18000	—	47.4	67.1	94.9	134	190	232	268	268	300		183		Brown	Gray	Orange
20000	—	—	50.0	70.7	100.0	141	200	245	283	283	316		203		Red	Black	Orange
22000	22000	22000	52.4	74.2	105	148	210	257	297	297	332		223		Red	Red	Orange
24000	—	—	54.8	77.5	110	155	219	268	310	310	346		243		Red	Yellow	Orange
27000	27000	—	58.1	82.2	116	164	232	285	329	329	367		273		Red	Violet	Orange
30000	—	—	61.2	86.6	122	173	245	300	346	346	387		303		Orange	Black	Orange
33000	33000	33000	64.2	90.8	128	182	257	315	363	363	406		333		Orange	Orange	Orange
36000	—	—	67.1	94.9	134	190	268	329	379	379	424		363		Orange	Blue	Orange
39000	39000	—	69.8	98.7	140	197	279	342	395	395	442		393		Orange	White	Orange
43000	—	—	73.3	104	147	207	293	359	415	415	464		433		Yellow	Orange	Orange
47000	47000	47000	76.6	108	153	217	307	376	434	434	485		473		Yellow	Violet	Orange
51000	—	—	79.8	113	160	226	319	391	452	452	505		513		Green	Brown	Orange
56000	56000	—	83.7	118	167	237	335	410	473	473	529		563		Green	Blue	Orange
62000	—	—	88.0	124	176	249	352	431	498	498	557		623		Blue	Red	Orange
68000	68000	68000	92.2	130	184	261	369	452	500	522	583		683		Blue	Gray	Orange
75000	—	—	96.8	137	194	274	387	474	500	548	612		753		Violet	Green	Orange
82000	82000	—	101	143	202	286	405	496	500	573	640		823		Gray	Red	Orange
91000	—	—	107	151	213	302	427	500	500	603	675		913		White	Brown	Orange

Nominal Resistance in Megohms																	
0.1	0.1	0.1	112	158	224	316	447	500	500	632	707		104		Brown	Black	Yellow
0.11	—	—	117	166	234	332	469	500	500	663	742		114		Brown	Brown	Yellow
0.12	0.12	—	122	173	245	346	490	500	500	693	750		124		Brown	Red	Yellow
0.13	—	—	128	180	255	361	510	500	500	721	750		134		Brown	Orange	Yellow
0.15	0.15	0.15	137	194	274	387	548	500	500	750	750		154		Brown	Green	Yellow
0.16	—	—	141	200	283	400	566	500	500	750	750		164		Brown	Blue	Yellow
0.18	0.18	—	150	212	300	424	600	500	500	750	750		184		Brown	Gray	Yellow
0.20	—	—	150	224	316	447	632	500	500	750	750		204		Red	Black	Yellow
0.22	0.22	0.22	150	234	332	469	663	500	500	750	750		224		Red	Red	Yellow
0.24	—	—	150	245	346	490	693	500	500	750	750		244		Red	Yellow	Yellow

[1] Rating at 70° C, derated to zero at 130° C.

[3] Rating at 40° C, derated to zero at 150° C.

[2] Rating at 70° C, derated to zero at 150° C.

# Types BB, CB, EB, GB, HB, GM, HM

Nominal Resistance in Megohms			Rated Continuous Working Voltage (RCWV) DC or RMS Volts									Resistor Part Number			Resistance Color Code		
TOLERANCE COLOR CODE			WATTAGE and TYPE									Type BB CB EB etc. XX	Value Code 000	Tolerance 5 = 5% 1 = 10% 2 = 20% X	Resistance Color Code		
4th BAND			1/8 1	1/4 2	1/2 2	1 2	2 2	3 2	4 3	4 2	5 3				1st BAND 1st digit	2nd BAND 2nd digit	3rd BAND Number of zeros after 1st and 2nd digit
Gold ± 5%	Silver ± 10%	None ± 20%	BB	CB	EB	GB	HB	GM	GM	HM	HM						
0.27	0.27	—	150	250	350	500	735	500	500	750	750		274	Red	Violet	Yellow	
0.30	—	—	150	250	350	500	750	500	500	750	750		304	Orange	Black	Yellow	
0.33	0.33	0.33	150	250	350	500	750	500	500	750	750		334	Orange	Orange	Yellow	
0.36	—	—	150	250	350	500	750	500	500	750	750		364	Orange	Blue	Yellow	
0.39	0.39	—	150	250	350	500	750	500	500	750	750		394	Orange	White	Yellow	
0.43	—	—	150	250	350	500	750	500	500	750	750		434	Yellow	Orange	Yellow	
0.47	0.47	0.47	150	250	350	500	750	500	500	750	750		474	Yellow	Violet	Yellow	
0.51	—	—	150	250	350	500	750	500	500	750	750		514	Green	Brown	Yellow	
0.56	0.56	—	150	250	350	500	750	500	500	750	750		564	Green	Blue	Yellow	
0.62	—	—	150	250	350	500	750	500	500	750	750		624	Blue	Red	Yellow	
0.68	0.68	0.68	150	250	350	500	750	500	500	750	750		684	Blue	Gray	Yellow	
0.75	—	—	150	250	350	500	750	500	500	750	750		754	Violet	Green	Yellow	
0.82	0.82	—	150	250	350	500	750	500	500	750	750		824	Gray	Red	Yellow	
0.91	—	—	150	250	350	500	750	500	500	750	750		914	White	Brown	Yellow	
1.0	1.0	1.0	150	250	350	500	750	500	500	750	750		105	Brown	Black	Green	
1.1	—	—	150	250	350	500	750	500	500	750	750		115	Brown	Brown	Green	
1.2	1.2	—	150	250	350	500	750	500	500	750	750		125	Brown	Red	Green	
1.3	—	—	150	250	350	500	750	500	500	750	750		135	Brown	Orange	Green	
1.5	1.5	1.5	150	250	350	500	750	500	500	750	750		155	Brown	Green	Green	
1.6	—	—	150	250	350	500	750	500	500	750	750		165	Brown	Blue	Green	
1.8	1.8	—	150	250	350	500	750	500	500	750	750		185	Brown	Gray	Green	
2.0	—	—	150	250	350	500	750	500	500	750	750		205	Red	Black	Green	
2.2	2.2	2.2	150	250	350	500	750	500	500	750	750		225	Red	Red	Green	
2.4	—	—	150	250	350	500	750	500	500	750	750		245	Red	Yellow	Green	
2.7	2.7	—	150	250	350	500	750	500	500	750	750		275	Red	Violet	Green	
3.0	—	—	150	250	350	500	750	500	500	750	750		305	Orange	Black	Green	
3.3	3.3	3.3	150	250	350	500	750	500	500	750	750		335	Orange	Orange	Green	
3.6	—	—	150	250	350	500	750	500	500	750	750		365	Orange	Blue	Green	
3.9	3.9	—	150	250	350	500	750	500	500	750	750		395	Orange	White	Green	
4.3	—	—	150	250	350	500	750	500	500	750	750		435	Yellow	Orange	Green	
4.7	4.7	4.7	150	250	350	500	750	500	500	750	750		475	Yellow	Violet	Green	
5.1	—	—	150	250	350	500	750	500	500	750	750		515	Green	Brown	Green	
5.6	5.6	—	150	250	350	500	750	500	500	750	750		565	Green	Blue	Green	
6.2	—	—	150	250	350	500	750	500	500	750	750		625	Blue	Red	Green	
6.8	6.8	6.8	150	250	350	500	750	500	500	750	750		685	Blue	Gray	Green	
7.5	—	—	150	250	350	500	750	500	500	750	750		755	Violet	Green	Green	
8.2	8.2	—	150	250	350	500	750	500	500	750	750		825	Gray	Red	Green	
9.1	—	—	150	250	350	500	750	500	500	750	750		915	White	Brown	Green	
10	10	10	150	250	350	500	750	500	500	750	750		106	Brown	Black	Blue	
11	—	—	150	250	350	500	750	500	500	750	750		116	Brown	Brown	Blue	
12	12	—	150	250	350	500	750	500	500	750	750		126	Brown	Red	Blue	
13	—	—	150	250	350	500	750	500	500	750	750		136	Brown	Orange	Blue	
15	15	15	150	250	350	500	750	500	500	750	750		156	Brown	Green	Blue	
16	—	—	150	250	350	500	750	500	500	750	750		166	Brown	Blue	Blue	
18	18	—	150	250	350	500	750	500	500	750	750		186	Brown	Gray	Blue	
20	—	—	150	250	350	500	750	500	500	750	750		206	Red	Black	Blue	
22	22	22	150	250	350	500	750	500	500	750	750		226	Red	Red	Blue	
24	—	—	150	250	350	500	750	500	500	750	750		246	Red	Yellow	Blue	
27	27	—	150	250	350	500	750	500	500	750	750		276	Red	Violet	Blue	
30	—	—	150	250	350	500	750	500	500	750	750		306	Orange	Black	Blue	
33	33	33	150	250	350	500	750	500	500	750	750		336	Orange	Orange	Blue	
36	—	—	150	250	350	500	750	500	500	750	750		366	Orange	Blue	Blue	
39	39	—	150	250	350	500	750	500	500	750	750		396	Orange	White	Blue	
43	—	—	150	250	350	500	750	500	500	750	750		436	Yellow	Orange	Blue	
47	47	47	150	250	350	500	750	500	500	750	750		476	Yellow	Violet	Blue	
51	—	—	150	250	350	500	750	500	500	750	750		516	Green	Brown	Blue	
56	56	—	150	250	350	500	750	500	500	750	750		566	Green	Blue	Blue	
62	—	—	150	250	350	500	750	500	500	750	750		626	Blue	Red	Blue	
68	68	68	150	250	350	500	750	500	500	750	750		686	Blue	Gray	Blue	
75	—	—	150	250	350	500	750	500	500	750	750		756	Violet	Green	Blue	
82	82	—	150	250	350	500	750	500	500	750	750		826	Gray	Red	Blue	
91	—	—	150	250	350	500	750	500	500	750	750		916	White	Brown	Blue	
100	100	100	150	250	350	500	750	500	500	750	750		107	Brown	Black	Violet	

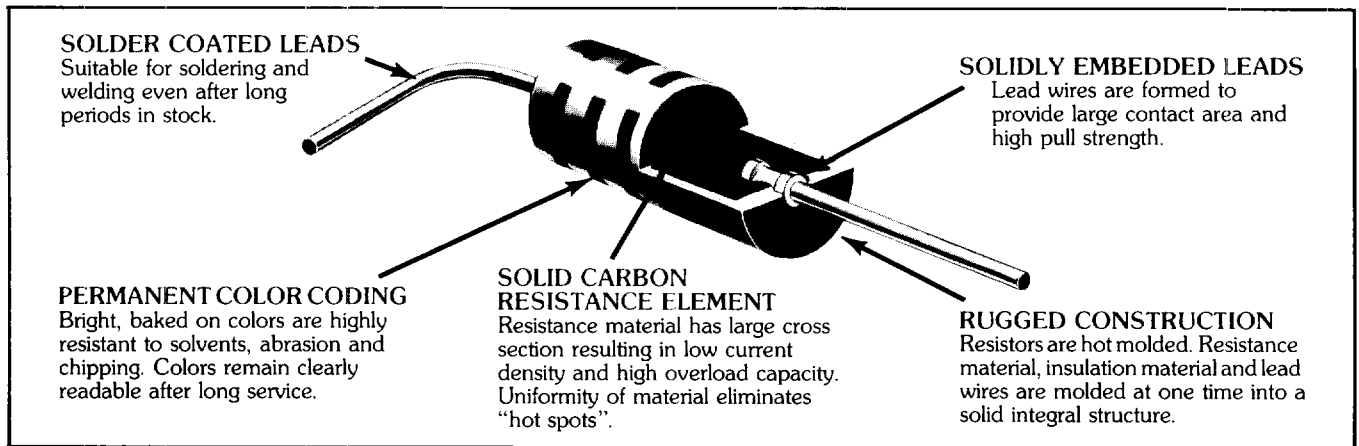
1 Rating at 70° C, derated to zero at 130° C.

2 Rating at 40° C, derated to zero at 150° C.

3 Rating at 70° C, derated to zero at 150° C.

# Important Electrical and Mechanical Characteristics

## Hot-Molded Carbon Composition Fixed Resistors



### ■ TEST VOLTAGE ■ EFFECT OF MOISTURE ■ CONDITIONING

**Moisture absorption and the use of too low test voltages will cause the resistance value to read higher than when measured under standard conditions. It is important to understand these characteristics to facilitate using the parts effectively.**

**Resistance measurement** — Measured resistance value is dependent upon the resistor temperature, the test voltage, and the dryness of the resistor. Accurate correlation between repeated measurements, especially at different times, and different locations, requires that these three conditions be essentially the same.

**Resistor temperature** — Slight variations in resistor body temperature are not significant in room temperature measurements. However, the temperature of the resistor body may increase appreciably when tested at too high a voltage or when the voltage is applied for too long a time, causing excessive heating.

**Resistor test voltage** — The test voltage is very important and sometimes misunderstood or overlooked. This is because a tester is often unaware of the actual voltage that the instrument used is applying to the resistor under test. Commonly used instruments, such as highly accurate resistance bridges, digital voltmeters, or ATE devices, employ relatively low voltages to make measurements (usually between 0.1 volt and 1.0 volt and seldom higher than 10 volts). This does not cause significant differences for low resistance values, where the use of low test voltages is specified; however, for higher resistance values, such as, 100K ohms or higher, a test voltage of 100 volts is specified and use of a low voltage test instrument will result in readings higher than actual value. For reference purposes, the voltages listed below should be used to obtain an accurate measure of the resistance value:

Nominal Resistance Range	Recommended Test Voltage (DC Volts)
1.0 to 9.1 ohms	0.3 volt
10 to 91 ohms	1.0 volt
100 to 910 ohms	3.0 volts
1000 to 9100 ohms	10.0 volts
10K to 91K ohms	30.0 volts
100K ohms and higher	100.0 volts

Consult the table on Page 12 to obtain the appropriate Resistance-Voltage Coefficient application factors (%/Volt) for different test voltages.

**Effect of moisture absorption** — Moisture attraction is a generic characteristic of carbon, and when the Hot-Molded Carbon Composition resistor absorbs moisture, e.g., during shipment and storage, its resistance value will always increase. Under high humidity conditions it is not unusual for parts to increase 6% in resistance value in as little as 72 hours. The characteristic is reversible, and dehumidifying the parts is easily accomplished either by storing them in a controlled, low-humidity area or by conditioning them in a convection oven at 100°C. The chart below lists the proper conditioning parameters.

Rating	Conditioning Time @ 100°C
1/8 W	25 Hours
1/4 W	50 Hours
1/2 W	75 Hours
1 W	120 Hours
2 W	130 Hours

**Solderability** — Allen-Bradley Hot-Molded Carbon Composition resistors meet the solderability requirements of MIL-R-39008 and MIL-STD-202, Method 208.

**Resistance to solvents** — The color code remains legible after resistors are subjected to the Resistance To Solvents test of MIL-STD-202, Method 215. Also, the resistors will withstand the Color Code Solvent Resistance test described in Paragraph 6.19 on Page 24 of this catalog, which includes ultrasonically agitated liquids at elevated temperature.

**Military qualification** — The Allen-Bradley Hot-Molded Carbon Composition resistors meet or exceed all applicable military specifications including MIL-R-39008, Resistors, Fixed, Composition (Insulated), Established Reliability, and are fully qualified in all wattage sizes and all resistance values to the best reliability level, the "S" level, with a failure rate lower than 0.001% per 1000 hours.

## Metal Clad Fixed Resistors, Types GM & HM

The Allen-Bradley Type GM and HM resistors are insulated Type GB and HB Hot-Molded Carbon Composition resistors fitted with metal clamps which surround the major portion of the resistor. The metal clamps provide rigid mounting and efficient heat transfer from the resistors to the metal chassis or panels on which they are mounted.

**Performance characteristics** — The performance characteristics for Types GM and HM are the same as for Types GB and HB, respectively, as shown in the table on Page 12 with the following exceptions.

**Nominal resistance range** —

Type GM — 2.7 ohms to 22 megohms

Type HM — 10 ohms to 22 megohms

**Standard tolerances** —  $\pm 5\%$ ,  $\pm 10\%$

**Power rating** — When mounted on the equivalent of a steel panel 4 inches (101.60 mm) square and 0.05 inch (1.27 mm) thick

Type	70°C Ambient	40°C Ambient
GM	3 watts	4 watts
HM	4 watts	5 watts

**Rated continuous working voltage (RCWV)** —

Type GM  $\sqrt{3.0 \times R}$  or 500 volts, whichever is less

Type HM  $\sqrt{4.0 \times R}$  or 750 volts, whichever is less

**Weight** — Approximate (with nominal length leads)

Type GM 4.7 gm

Type HM 8.0 gm

**Insulation resistance** — 100,000 megohms minimum between resistor leads and metal clamp

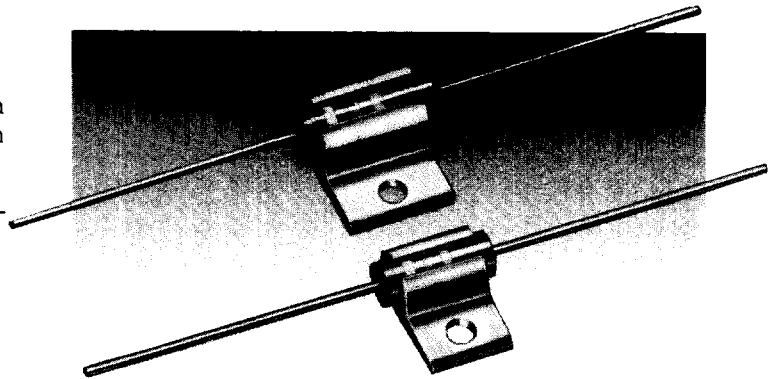
**Dielectric withstanding voltage** — At sea level, 1500 volts

**Short time overload** —  $\pm (2.5\% + 0.05 \text{ ohm})$ , maximum

**Capacitance** — Between resistor leads and metal clamp

Type GM 5.6 pF (approximately)

Type HM 9.0 pF (approximately)



## Very High Megohm Resistors

**General** — Very high resistance values of our hot-molded fixed composition resistors are generally provided in the smaller body sizes, namely type BB, CB, or EB. Since wattage dissipation is not a concern for these high values, there is virtually no need for the larger Type GB or HB.

**Resistance value** — May be specified in megohms, gigohms, or teraohms, at 100 VDC. The practical upper resistance limit for production quantities is 1 teraohm.

**Note:** It is recognized that many applications involve use of voltages lower than 100 volts. Measurement of such high resistance values at low voltage is at best a marginal procedure and definitely is not suitable on a volume production basis. Therefore, in choosing a nominal for a particular application it is recommended that correlation measurement be made, especially for any large quantity usage, since measurement of very high resistance values is not simple and reading differences can occur, particularly from inadequate instrumentation.

## Performance Characteristics

**Resistance – temperature characteristic** — The resistance-temperature characteristic is the same parabolic shaped curve as for our standard values, with the vertex near the room temperature region. The following table shows the extent of this variation over the  $-25^\circ$  to  $+85^\circ\text{C}$  temperature range. In the  $0^\circ$  to  $-55^\circ\text{C}$  range, which would describe most ordinary environments, it can be seen that the curve is in the relatively flat part of the parabola, and the percent change is relatively small.

$-25^\circ\text{C}$		$0^\circ\text{C}$		$+25^\circ\text{C}$	$+55^\circ\text{C}$	$+85^\circ\text{C}$		
MIN	MAX	MIN	MAX	NOMINAL	MIN	MAX	MIN	MAX
-0.9	+7.4	-1.0	+3.1	1G*	-2.2	+2.8	-2.8	+7.2
-1.0	+8.1	-1.1	+3.4	10G	-2.4	+3.0	-3.0	+7.9
-1.1	+8.7	-1.2	+3.7	100G	-2.6	+3.3	-3.3	+8.5
-1.1	+9.0	-1.3	+3.8	500G	-2.8	+3.5	-3.3	+8.8

\*G =  $10^9$  OHMS

**Resistance-voltage coefficient** — Up to  $-0.1\%$  per volt typical,  $-0.2\%$  per volt maximum over the range of 1 volt to 100 volts.

**Note:** The resistance voltage characteristic is relatively consistent but is not linear, especially at the low voltage end where the low sensitivity of the measuring instrument makes accurate measurement difficult.

**Humidity** — As is the case with standard values, the effect of moisture is a function of the body size, resistance value, humidity level, duration of exposure, and temperature. It is the same completely reversible characteristic; that is, resistance value increases with increasing high humidity exposure and decreases toward its original starting point as it dries out, without permanent degradation. Gigaohm values of the Type EB when subjected to 240 hours exposure to 95% R.H. at  $40^\circ\text{C}$  may have up to  $25\% \Delta R$  and we would use that figure for all very high values.

**Load life** — Load life is usually not a concern since practically no power is being dissipated. The standard life test limits of 6% maximum  $\Delta R$  in 1,000 hours would also apply to these resistors.

**Shelf life** — For shelf life, or aging at room temperature, the conventional time span of interest is 1 year, and we would use a 6% maximum  $\Delta R$  for this condition also.

**Marking** — Standard EIA color code marking can be used for all resistance values up to 9 multiplier (White Band). That is, 91,000 megohms or 91 gigaohms. However, for gigaohm values, the preferred marking is none on the resistor itself, with all necessary identification appearing on the package. When more than one value is involved in an application, special single or multiple color bands are generally used. However, the choice of colors should be approved by the factory prior to assignment.

**General mechanical and environmental** — These resistors are made in the same manner using the same basic materials and processes as standard Allen-Bradley hot-molded fixed composition resistors. Therefore, they have the same general characteristics and properties as listed in the standard catalog publication.

**Packaging** — High megohm resistors (values above 100 megohms) are normally supplied in standard card pack and placed in foil bags, or on tape and reel.

1. Definition: Any resistance value over 100 megohms. (EIA standard values are not applicable.)
2. Types Available: BBH, CBH, and EBH.
3. Resistance Range: Although values as high as 20 teraohms have occasionally been produced, the practical upper resistance limit for production is 1 teraohm.

Values in the high end of the resistance range are sometimes referred to as follows:

Gigaohm values  
(1 gigaohm = 1,000 megohms, or  $10^9$  ohms)

Teraohm values  
(teraohm = 1 million megohms, or  $10^{12}$  ohms)

Resistance Range		Multipliers
100 meg to less than	1,000 meg	7
1,000 meg to less than	10,000 meg	8
10,000 meg to less than	100,000 meg	9
1000,000 meg to less than	1,000,000 meg	X
1,000,000 meg to less than	10,000,000 meg	Y
10,000,000		Z

4. Tolerances: the standard and most widely used tolerances for these parts are 20% and 30%. They are also available in 10% tolerance. At the lower end of the high megohm range, namely from 100 megohms to 1,000 megohms, 5% tolerance is available.

4. Tolerances: the standard and most widely used tolerances for these parts are 20% and 30%. They are also available in 10% tolerance. At the lower end of the high megohm range, namely from 100 megohms to 1,000 megohms, 5% tolerance is available.

5. Part Identification: All resistance values up to and including 100 megohms shall use the standard part number as described in fixed resistor Publication ROFR. For values above 100 megohms the letter H shall be added after the first two letters, i.e., BBH, CBH, or EBH.

Values above 100 megohms, up to and including 1,000 megohms are available in 5%, 10%, 20% and 30% tolerance.

**Example:**

EBH8082 ( $8 \times 10^9$ ) 8,000 megohms  $\pm 20\%$

Values over 1,000 megohms are available in 10%, 20%, and 30% tolerance.

**Example:**

CBH1191 ( $1.1 \times 10^{10}$ ) 11,000 megohms  $\pm 10\%$

For values from 100,000 megohms to less than 1,000,000 megohms substitute the letter X for the sixth digit in the part number, where X means add 10 zeros.

**Example:**

EBH50X1 ( $5 \times 10^{11}$ ) 500,000 megohms  $\pm 10\%$

For values from 1,000,000 megohms to less than 10,000,000 megohm substitute the letter Y for the sixth digit in the part number where Y means and 11 zeros.

**Example:**

EBH10Y3 ( $10^{12}$ ) 1,000,000 megohms  $\pm 30\%$

For values of 10,000,000 megohms and higher substitute the letter Z for the sixth digit in the part number, where Z means add 12 zeros.

**Example:**

BBH10Z3 ( $10^{13}$ ) 10,000,000 megohms  $\pm 30\%$

For Reference:

$10^2 = 100$	$10^8 = 100,000,000$
$10^3 = 1,000$	$10^9 = 1,000,000,000$
$10^4 = 10,000$	$10^{10} = 10,000,000,000,000$
$10^5 = 100,000$	$10^{11} = 100,000,000,000,000$
$10^6 = 1,000,000$	$10^{12} = 1,000,000,000,000,000$
$10^7 = 10,000,000$	$10^{13} = 10,000,000,000,000,000$



# Performance Characteristics

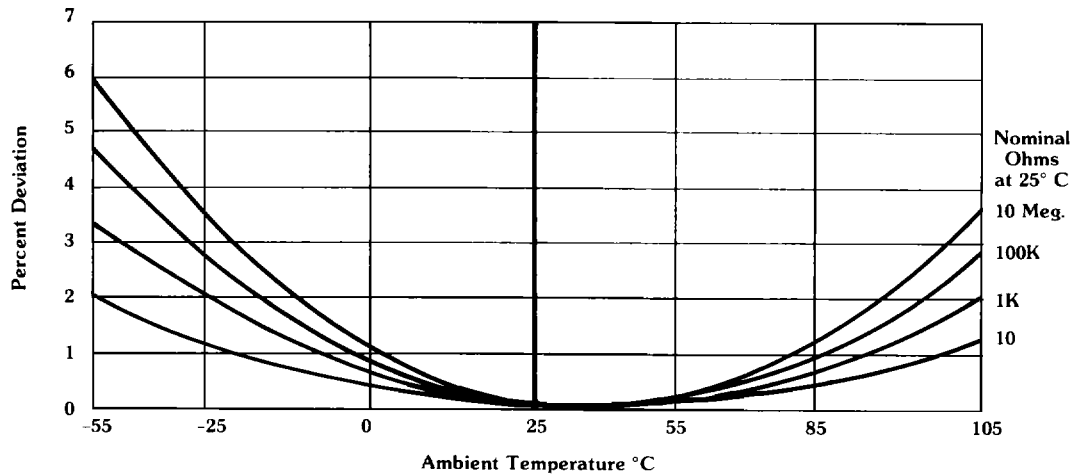
Characteristics		Hot-Molded Carbon Composition Resistors					
		¼ Watt Type BB	¼ Watt Type CB	½ Watt Type EB	1 Watt Type GB	2 Watt Type HB	
<b>Insulation Resistance [6.6]</b> Minimum		10,000 megohms	10,000 megohms	10,000 megohms	10,000 megohms	10,000 megohms	
<b>Dielectric Withstanding Voltage [6.5]</b>	At Sea Level Atmospheric Press.	300 volts	500 volts	700 volts	1000 volts	1500 volts	
	At 3.4" (86,36 mm) Hg (Simulated 50,000 ft. [15240 meters])	200 volts	325 volts	450 volts	625 volts	625 volts	
<b>Resistance-Voltage Coefficient [6.4]</b> Maximum instantaneous change in resistance per volt based on $\Delta R$ for $\Delta V$ of (1.0-0.1) RCWV.  <b>Nominal Resistance</b> (ohms)	10K	- 0.020%/volt	- 0.015%/volt	- 0.010%/volt	- 0.007%/volt	- 0.010%/volt	
	100K	- 0.030	- 0.020	- 0.015	- 0.012	- 0.015	
	1 Meg	- 0.045	- 0.025	- 0.020	- 0.015	- 0.020	
	10 Meg	- 0.050	- 0.030	- 0.030	- 0.020	- 0.020	
	22 Meg	- 0.050	- 0.035	- 0.035	- 0.020	- 0.020	
100 Meg	- 0.055	- 0.035	- 0.035	- 0.025	- 0.025		
<b>Load Life [6.12]</b> 1000 hours operating at RCWV at 70° C ambient for duty cycle of 1½ hour "on", ½ hour "off". Permanent resistance change.	Maximum	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	
	Typical	- 3%	- 3%	- 3%	- 3%	- 3%	
<b>Load Life (temperature-derated)</b> 1000 hours (1½ hour "on", ½ hour "off") at RCWV derated per temperature according to chart on Page 9. Tested at temperatures between 70°C and maximum ambient temperature. Permanent resistance change. [6.12 modified with respect to voltage applied, as described above.]	Maximum	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	+ 4 <sub>1/2</sub> - 6	
	Typical	- 4%	- 4%	- 4%	- 4%	- 4%	
<b>Short-Time Overload [6.11]</b> 5 seconds at 2½ times RCWV; voltage limit as stated. Maximum permanent resistance change.	Voltage Limits	200 volts	400 volts	700 volts	1000 volts	1000 volts	
	Maximum	±(2.5% + 0.05 ohm)	±(2% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	
	Typical	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	
<b>Terminal Strength [6.13]</b> 5 lb. (2,27 Kgm) Pull Test. Three turn Twist Test. Maximum permanent resistance change.		+ (1% + 0.05 ohm) (2 lb. Pull Test) (0.91 Kgm)	±(1% + 0.05 ohm)	+ (1% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	
<b>Effect of Solder Heat [6.14]</b> Leads immersed to .125 in. (3,18 mm) of body in 350°C solder for 3 seconds. Maximum permanent resistance change.		±(2% + 0.05 ohm) (250°C Solder)	±(2% + 0.05 ohm)	±(3% + 0.05 ohm)	±(3% + 0.05 ohm)	±(3% + 0.05 ohm)	
<b>Vibration [6.17]</b> 10-2000 Hz, 0.06 inch (1,52 mm) peak-to-peak or 20G, whichever is less.	Mechanical or Electrical Damage	No Damage	No Damage	No Damage	No Damage	No Damage	
	Maximum Permanent Resistance Change	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	±(1% + 0.05 ohm)	
<b>Shock [6.16]</b> 100g, 6 ms, sawtooth, 10 shocks, 2 planes.	Mechanical or Electrical Damage	No Damage	No Damage	No Damage	No Damage	No Damage	
	Maximum Permanent Resistance Change	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	
<b>Moisture Resistance [6.9]</b> Temporary resistance change. See comment on page 9.	Maximum	+ 15 <sub>1/2</sub> - 0	+ 12 <sub>1/2</sub> - 0	+ 14 <sub>1/2</sub> 0	+ 8 <sub>1/2</sub> 0	+ 7 <sub>1/2</sub> - 0	
	Typical	+ 9%	+ 6%	+ 7%	+ 5%	+ 4%	
<b>Humidity Characteristic (steady state) [6.10]</b> 240 hours at + 40° C and 95% relative humidity. Temporary resistance change.  <b>Nominal Resistance</b> (ohms)	10	Maximum	+ 8 <sub>1/2</sub> 0	+ 5 <sub>1/2</sub> - 0	+ 4 <sub>1/2</sub> - 0	+ 3 <sub>1/2</sub> - 0	+ 3 <sub>1/2</sub> - 0
		Typical	+ 4%	+ 3%	+ 2%	+ 2%	+ 1%
	1000	Maximum	+ 9 <sub>1/2</sub> 0	+ 6 <sub>1/2</sub> - 0	+ 6 <sub>1/2</sub> - 0	+ 4 <sub>1/2</sub> - 0	+ 4 <sub>1/2</sub> - 0
		Typical	+ 5%	+ 4%	+ 4%	+ 2%	+ 2%
	100K	Maximum	+ 11 <sub>1/2</sub> 0	+ 9 <sub>1/2</sub> - 0	+ 8 <sub>1/2</sub> - 0	+ 5 <sub>1/2</sub> - 0	+ 5 <sub>1/2</sub> 0
		Typical	+ 8%	+ 6%	+ 6%	+ 3%	+ 2.5%
	10 Meg. and 100 Meg.	Maximum	+ 13 <sub>1/2</sub> - 0	+ 10 <sub>1/2</sub> - 0	+ 9 <sub>1/2</sub> - 0	+ 5 <sub>1/2</sub> - 0	+ 5 <sub>1/2</sub> 0
		Typical	+ 9%	+ 8%	+ 7%	+ 3%	+ 2.5%
<b>Low Temperature Operation [6.7]</b> After 1 hour at - 65, + 0 - 5° C, apply RCWV for 45 minutes. Remove RCWV, return to room temperature. Resistance change measured 24 hours after test.	Maximum	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	
	Typical	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	
<b>Temperature Cycling [6.8]</b> Limits: - 55° C and + 85° C. Resistance change after five cycles.	Maximum	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	±(2% + 0.05 ohm)	
	Typical	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	+ 0.5%	

# Temperature Characteristics

In addition to the maximum values given in this table, typical curves of temporary resistance change due to temperature are illustrated below.

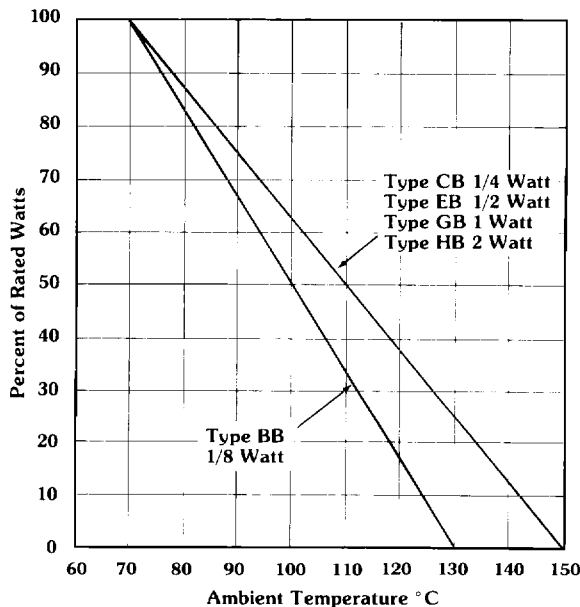
Resistance – Temperature Characteristic [6.3]	-55° C	-25° C	-15° C	0° C	+25° C	+55° C	+65° C	+85° C	+105° C
	Range (%)	Range (%)	Range (%)	Range (%)	Nominal Ohms	Range (%)	Range (%)	Range (%)	Range (%)
Maximum temporary resistance change from the +25° C initial resistance value. Note — Linear interpolation approximates intermediate values.	+0.2 to + 3.8	-0.2 to + 2.0	-0.2 to + 1.5	-0.2 to + 0.9	1	-1.1 to - 0.5	-1.5 to + 0.7	-2.0 to + 1.3	-2.5 to + 2.0
	+0.2 to + 2.6	-0.2 to + 1.3	-0.2 to + 1.0	-0.2 to + 0.6	2.7	-0.4 to + 0.5	-0.5 to + 0.7	-0.5 to + 1.3	-0.4 to + 2.0
	+0.2 to + 3.8	-0.3 to + 2.0	-0.3 to + 1.5	-0.3 to + 0.9	10	-0.6 to + 0.8	-0.7 to + 1.1	-0.8 to + 2.0	-0.6 to + 3.0
	+0.3 to + 5.1	-0.3 to + 2.7	-0.4 to + 2.0	-0.4 to + 1.1	100	-0.8 to + 1.0	-0.9 to + 1.5	-1.0 to + 2.6	-0.8 to + 4.0
	+0.3 to + 6.4	-0.4 to + 3.4	-0.5 to + 2.5	-0.5 to + 1.4	1000	-1.0 to + 1.3	-1.2 to + 1.8	-1.3 to + 3.3	-1.0 to + 5.0
	+0.4 to + 7.7	-0.5 to + 4.0	-0.6 to + 3.0	-0.6 to + 1.7	10K	-1.2 to + 1.5	-1.4 to + 2.2	-1.5 to + 3.9	-1.2 to + 6.0
	+0.5 to + 8.9	-0.6 to + 4.7	-0.7 to + 3.5	-0.7 to + 2.0	100K	-1.4 to + 1.8	-1.6 to + 2.6	-1.8 to + 4.6	-1.4 to + 7.1
	+0.5 to + 10.2	-0.7 to + 5.4	-0.9 to + 4.0	-0.8 to + 2.3	1 Meg	-1.6 to + 2.0	-1.9 to + 3.0	-2.0 to + 5.2	-1.6 to + 8.1
	+0.6 to + 11.5	-0.8 to + 6.0	-0.9 to + 4.5	-0.9 to + 2.6	10 Meg	-1.8 to + 2.3	-2.1 to + 3.3	-2.3 to + 5.9	-1.8 to + 9.1
	+0.6 to + 11.9	-0.8 to + 6.3	-0.9 to + 4.7	-0.9 to + 2.6	22 Meg	-1.9 to + 2.4	-2.2 to + 3.5	-2.4 to + 6.1	-1.9 to + 9.4
	+0.7 to + 12.8	-0.8 to + 6.7	-1.0 to + 5.0	-0.9 to + 2.8	100 Meg	-2.0 to + 2.5	-2.4 to + 3.7	-2.5 to + 6.6	-2.0 to + 10.1

## Typical Resistance – Temperature Characteristics



Percent Resistance Deviation from 25°C Value for Various Nominal Resistance Values and Temperatures.

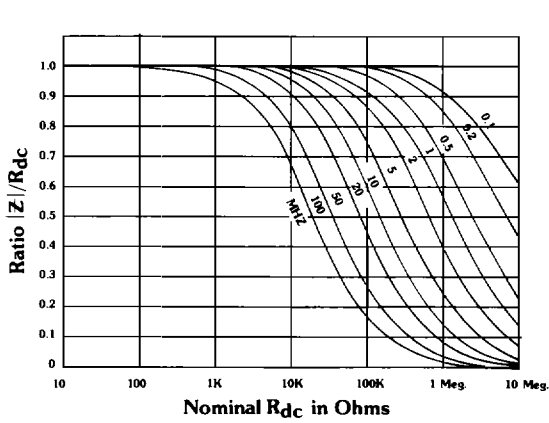
## Derating with Respect to Ambient Temperature



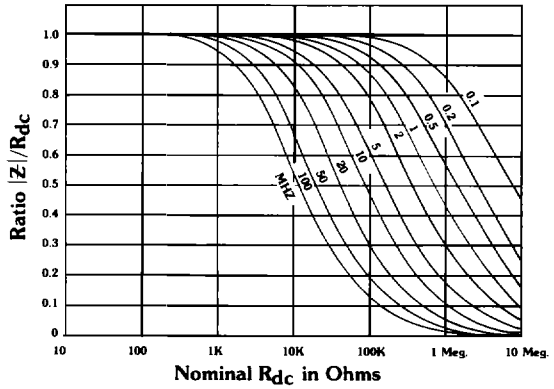
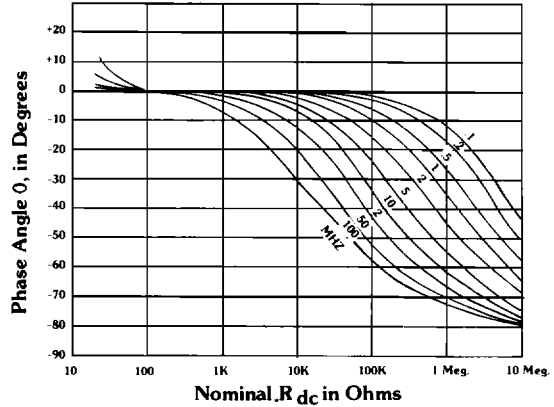
**Derating** — For resistors operated in ambient temperatures above 70°C, the change in resistance after 1000 hours under conditions similar to the Load Life Test will be less than +4% to -6% when the load wattage is derated in accordance with the curve shown. The most significant factor in proper derating to achieve minimal permanent resistance change over long periods of operation is the resultant surface temperature of the resistor. (See Note 6 under General Application Information on Page 27.)

# Typical High Frequency Characteristics

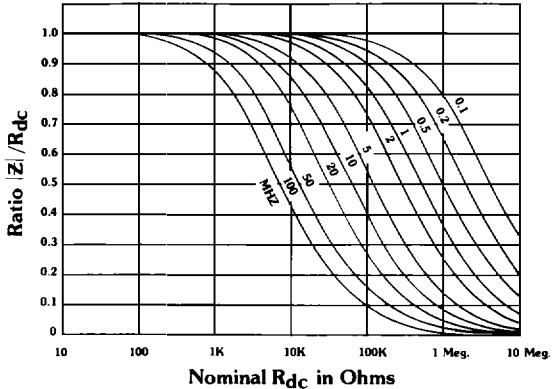
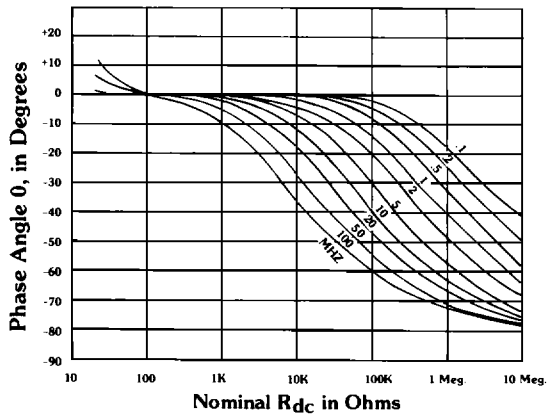
Measurement conditions – The curves below give typical values of impedance to DC resistance ratio and phase angle from 100 KHz to 100 MHz. Care was taken in test fixture design to prevent distributed capacitance-to-ground along the length of the resistor from contributing to measured values. Lead length was held at one-quarter inch to standardize the lead inductance contribution. User's circuit variations from test conditions in mounting position and lead length can have a significant effect on the high frequency characteristics.



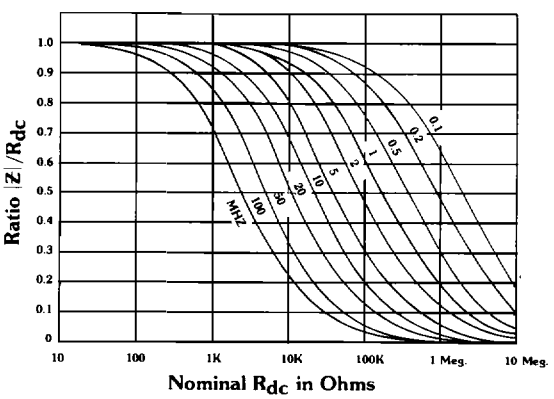
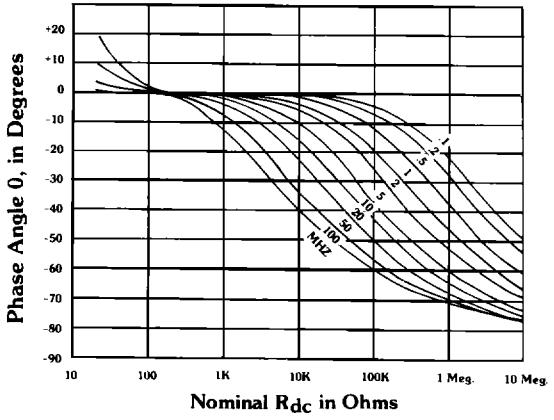
1/8W (Types BB, RC05 & RCR05) & 1/4W (Types CB, RC07 & RCR07)



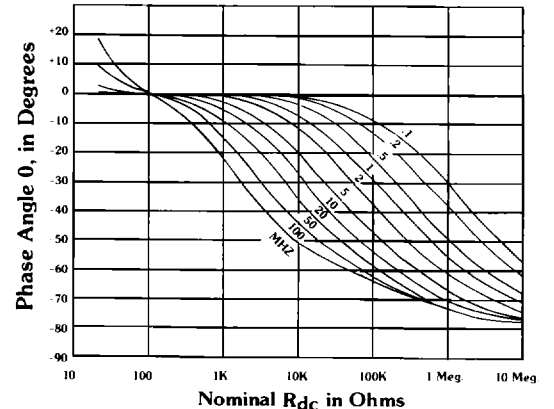
1/2W (Types EB, RC20 & RCR20)



1W (Types GB, RC32 & RCR32)



2W (Types HB, RC42 & RCR42)



## Packaging Methods for Allen-Bradley Hot-Molded Carbon Composition Resistors

Allen-Bradley Hot-Molded Carbon Composition resistors are packaged to ensure maximum protection during shipment and storage, and maximum utility during end product circuit assembly operations. Two basic types of packaging are available to choose from: double lead tape reels or corrugated card packs (Note: the 1/8 W resistors are packed bulk in boxes instead of in card packs because of their small size and fragile leads).

### CARD PACKAGING

The Allen-Bradley card packaging is designed to protect the resistor leads during shipping and handling, and it provides a handy reference for customer inventory stock checking and pre-assembly kitting operations. The strip quantities are factory standards, and factory-direct order minimums are based upon these standards. The chart below lists this information for reference:

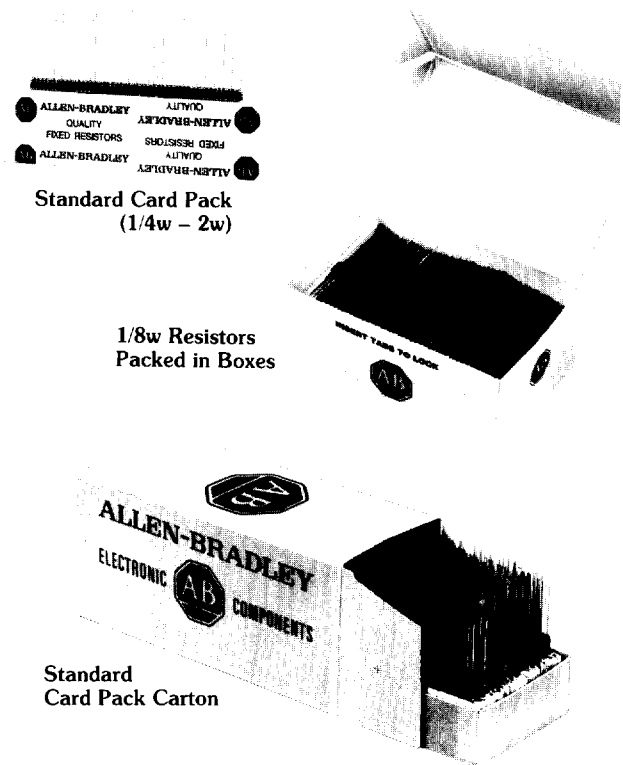
#### Standard Card Packaging Quantities

A-B TYPE	BB RC05 RCR05	CB RC07 RCR07	EB RC20 RCR20	GB RC32 RCR32	HB RC42 RCR42
Qty. per Card	N/A	50 pcs.	50 pcs.	25 pcs.	25 pcs.
Qty. per Carton	1,000 pcs.	1,000 pcs.	1,000 pcs.	500 pcs.	250 pcs.

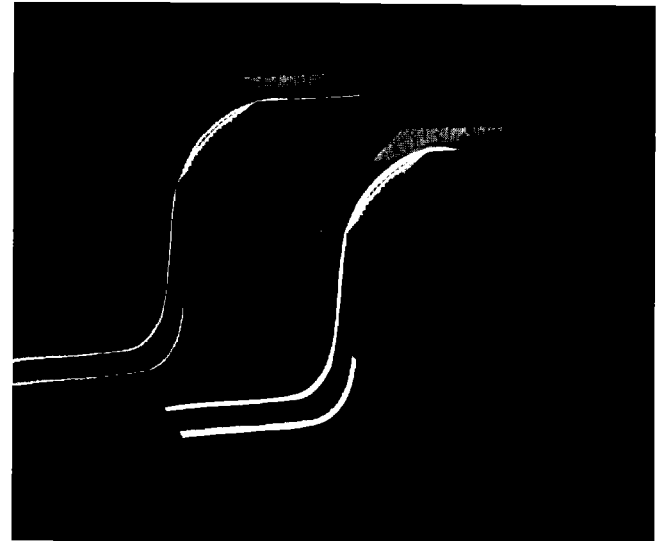
## Allen-Bradley Tape Reel Packaging

Allen-Bradley offers a wide variety of double lead tape reel options to support automatic assembly operations. The octagon reels are made using corrugated fiberboard sides glued to a strong fiberwound core. Each reel is provided with metal bearings having a 0.562" (14.27 mm) diameter hole for simple mounting on automatic assembly equipment. The reels are disposable after use. Although the adhesive tape used is of the highest quality, storage for more than one year is not recommended due to normal adhesive aging. A minimum of 12" (304.80 mm) of free tape is provided at each end of a reel to facilitate setup and splicing. To ensure proper alignment and trouble-free feeding, interliner paper is wound between all layers throughout the reels for 1/8 W and 1/4 W resistors, and between the first several layers starting at the core of each reel for 1/2 W, 1 W and 2 W resistors. Inclusion of interliner paper throughout the reel for 1/2 W, 1 W and 2 W resistors is optional. One turn of corrugated wrapping is added to the outside of each reel to protect the parts during shipping, handling and storage.

The information on the next two pages is provided to assist in selection of the desired type of tape reel packaging. Page 16 contains a reference guide to the Allen-Bradley tape reel codes by resistor type, tape spacing, pitch and reel quantity (please note that the listing includes a number of types that do not conform to E.I.A. Standard RS-296-E, and care must be taken to select the proper type). Also, Allen-Bradley offers a complete set of options for tape reel packaging (see Note 4 on Page 16).



### STANDARD PACKAGE (Untrimmed Leads)



### OPTIONAL PACKAGE (Trimmed Leads)

Contact the factory for assistance when ordering parts packaged to your specific requirements. Page 13 features complete dimensional reference information on the Allen-Bradley tape reels. Included are notations regarding such important information as whether the leads are trimmed near the outside edges of the lead tape and optional reel quantities. Contact our Application Engineering Department for further assistance whenever the need arises.

# Allen-Bradley Resistor Tape Reel Packaging Code Guide

A-B Type	Rating	A-B Tape Reel Codes		Tape Spacing	Pitch	Qty. <sup>2</sup> Reel	E.I.A. Class	Important Packaging Comments <sup>3</sup>
		Standard	RS-296-E <sup>1</sup>					
BB RC05 RCR05	1/8 W	L01	L01	2.062"	.200"	2000	I	The standard overall length of the 1/8 W resistor is 2.145" (54,48mm). At the listed tape spacings, the leads will not extend beyond outside edges of tape.
		L30	L30	2.062"	.200"	1000	I	
		L36	L36	2.062"	.200"	500	I	
		L05	L05	1.812"	.200"	2000	*	
CB RC07 RCR07 and EB RC20 RCR20	1/4 W and 1/2 W	L01	L01	2.062"	.200"	2500	I	The standard overall lengths of the 1/4 W and 1/2 W resistors are 3.250" (82,55mm) and 3.375" (85,73mm), respectively. When parts are ordered tape reeled to E.I.A. specification RS-296-E, the excess leads will be trimmed near the outside edges of the lead tape and the resultant resistor leads will be shortened accordingly with reference to the tape spacing selected.
		L08	L08	2.062"	.200"	5000	I	
		L04	*	2.438"	.200"	2500	*	
		L09	*	2.438"	.200"	5000	*	
		L10	L10	2.500"	.200"	2500	II	
		L11	L11	2.500"	.200"	5000	II	
		L03	*	2.812"	.200"	2500	*	
		L13	*	2.812"	.200"	5000	*	
		L31	L31	2.874"	.200"	2500	III	
L39	L39	2.874"	.200"	5000	III			
GB RC32 RCR32	1 W	R12	N/A	2.062"	.375"	2000	I	The standard overall length of the 1 W resistor is 3.562" (90,47mm). When parts are ordered tape reeled to E.I.A. specification RS-296-E, the excess leads will be trimmed near the outside edges of the lead tape and the resultant resistor leads will be shortened accordingly with reference to the tape spacing selected.
		L04	N/A	2.438"	.375"	2000	*	
		L10	N/A	2.500"	.375"	2000	II	
		L01	N/A	2.874"	.375"	2000	III	
		L47	N/A	2.874"	.375"	2000	III	
		L30	N/A	2.874"	.375"	1000	III	
		L03	N/A	3.062"	.375"	2000	*	
		R01	R01	2.062"	.400"	2000	I	
		R02	R02	2.500"	.400"	2000	II	
		R03	R03	2.874"	.400"	2000	III	
HB RC42 RCR42	2 W	R12	N/A	2.062"	.375"	1000	I	The standard overall length of the 2 W resistor is 3.688" (93,68mm). When parts are ordered tape reeled to E.I.A. specification RS-296-E, the excess leads will be trimmed near the outside edges of the lead tape and the resultant resistor leads will be shortened accordingly with reference to the tape spacing selected.
		L04	N/A	2.438"	.375"	1000	*	
		L10	N/A	2.500"	.375"	1000	II	
		L01	N/A	2.874"	.375"	1000	III	
		L03	N/A	3.062"	.375"	1000	*	
		R01	R01	2.062"	.400"	1000	I	
		R02	R02	2.500"	.400"	1000	II	
		R03	R03	2.874"	.400"	1000	III	

KEY: "\*" Denotes Non-E.I.A.-Standard Tape Spacing and "N/A" Denotes NOT Applicable due to Non-E.I.A.-Standard Pitch

- 1** Important specifications of E.I.A. standard RS-296-E for lead taping axial components:
  - A. Tape spacing standards: Class I=2.062" (52,39mm), Class II=2.500" (63,50mm) and Class III=2.874" (73,00mm)
  - B. Pitch standards: 0.200" (5,08mm) and 0.400" (10,16mm).
  - C. No resistor lead extension beyond outside edges of lead tape.
- 2** Interliner paper throughout the tape reel is standard with the 1/8 W and 1/4 W resistors, and it is optional for the 1/2 W, 1 W and 2 W resistors. Reel quantities for 1 W and 2 W resistors may vary from those listed above when optional interliner paper is specified throughout the reel.
- 3** The width of the lead tape is 0.250" (6,35mm) for reference in calculating the approximate lead length remaining after trimming to meet requirements of E.I.A. specification RS-296-E.
- 4** Options available for tape reel packaging include (contact factory for information):
  - A. Interliner paper throughout reels for 1/2 W, 1 W and 2 W resistors.
  - B. Specialized configurations of interliner paper, tape leaders and tape trailers.
  - C. Moisture resistant anti-static bag packaging (with or without desiccant).
  - D. Individual corrugated carton outer pack for unit reels.

# Reel Packaging Dimensions

A-B Type	Rating	Tape Spacing .059 (1,50)	Standard Qty. (per reel)	Across Hubs A	Between Flanges AA	Across Points B	Across Flats BB	Between Hub Holes E			
				Maximum	Approximate	Maximum	Maximum	Approximate			
BB RC05 RCR05	1/8 W	1.812" (46,02)	2000	2.688 (68,28)	2.440 (61,98)	6.500 (165,10)	6.000 (152,40)	1.812 (46,02)			
				3.625 (92,08)	2.810 (71,37)			2.750 (69,85)			
				500 1000 2000							
CB RC07 RCR07 and EB RC20 RCR20	1/4 W and 1/2 W	2.062" (52,37)	2500 5000	3.625 (92,08)	2.810 (71,37)	9.750 (247,65)	9.000 (228,60)	2.750 (69,85)			
				2.438" (61,93)	3.812 (96,82)			3.530 (89,66)	13.188 (334,98)	12.188 (309,58)	2.938 (74,63)
				2.500" (63,50)							
				2.812" (71,42)							
GB RC32 RCR32	1 W	2.062" (52,37)	1000 2000	3.625 (92,08)	2.810 (71,37)	13.188 (344,98)	12.188 (309,58)	3.188 (80,98)			
				2.438" (61,93)	3.625 (92,08)				3.530 (89,66)		
				2.500" (63,50)	4.000 (101,60)				3.810 (96,77)		
				2.874" (73,00)							
HB RC42 RCR42	2 W	2.062" (52,37)	1000	3.812 (96,82)	3.530 (89,66)	13.188 (344,98)	12.188 (309,58)	3.188 (80,98)			
				2.438" (61,93)							
				2.500" (63,50)							
				2.874" (73,00)							
		3.062" (77,77)	1000	4.000 (101,60)	3.810 (96,77)						

