COMPONENTS

Correctly identifying electronic parts can be one of the most difficult tasks facing someone building or repairing electronic equipment. As components become even smaller to allow higher density circuit boards, it is increasingly difficult to distinguish the different types such as resistors, capacitors, inductors and subminiature fuses.

Knowing what markings to expect can be a big help when faced with a circuit board full of unfamiliar components.

The information presented here, combined with a basic understanding of components should enable you to correctly identify those most commonly used.

PREFERRED VALUES

The system of preferred values, which is used for resistors, capacitors and inductors, was developed to provide a logical progression from one value to the next, where each value represents an increase by an approximately constant percentage. Depending on the tolerance of the particular components, there can be between 3 and 192 preferred values in each decade.

The more common series are shown in the tables below. Values given for each series are repeated in every decade.

3 PER DECADE (50% TOLERANCE)

10 22 47

12 PER DECADE (10% TOLERANCE)

10 12 15 18 22 27 33 39
47 56 68 82

24 PER DECADE (5% TOLERANCE)

10 11 12 13 15 16 18 20
22 24 27 30 33 36 39 43
47 51 56 62 68 75 82 91

DECIMAL MULTIPLIERS

Decimal multiplier prefixes are in common use to simplify and shorten the notations of quantities such as component values.

Capacitance, for example, is measured in Farads. But the Farad is far too large a unit to be of practical use in most cases. For convenience, we use sub-multiples to save a lot of figures. For example, instead of writing 0.000000000001 Farads, we write 1pF (1 picofarad).

The more common prefixes and the relationships to one another are as follows.

ABBREV.	PREFIX	MULTIPLY BY	OR
p	pico	0.000000000001	10^{-12}
n	nano	0.000000001	10^{-9}
u	micro	0.000001	10^{-6}
m	milli	0.001	10^{-3}
–	UNIT	1	10^{0}
k	kilo	1000	10^{3}
M	mega	1000000	10^{6}

UNITS		
1000 pico units	=	1 nano unit
1000 nano units	=	1 micro unit
1000 micro units	=	1 milli unit
1000 milli units	=	1 unit
1000 units	=	1 kilo unit
1000 kilo units	=	1 mega unit

CIRCUIT NOTATION

Some circuits give component values as they are normally spoken – e.g. 4.7pF for 4.7 picofarads, 5.6nH for 5.6 nanohenries. Others replace the decimal point with the first letter of the sub-multiple e.g. 5n6 for a 5.6nF capacitor or a 5.6nH inductor. Similarly for resistors, 6k8 is the same as 6.8k ohms while 1R5 would mean 1.5 ohms.

TOLERANCE

All components differ from their marked value by some amount. Tolerance specifies the maximum allowed deviation from the specified value. Tolerances are normally expressed as a percentage of the nominal value.

As an example, a component with a marked value of 100 and a tolerance of 5%, could actually be any value between 5% below the marked value (95), and 5% above the marked value (105).

RESISTORS

Most resistors are so small that it is impractical to print their values on them using normal numeric characters. Instead, they are marked using a code of coloured bands.

Resistors made to tolerance of 5% and 10% are marked with 4 bands while higher precision types, such as 2%, 1% or better, may be marked with 5 bands to allow for an extra digit of precision.

HOW TO READ 4-BAND CODES:

At one end of the resistor there will be a gold, silver or brown tolerance band. This band is usually spaced apart from the other three bands. Start with the band nearest to the other end. Its colour represents the first digit of the resistor's value, as shown in the colour code chart. The next band represents the second digit of the resistor's value. The third band represents the decimal multiplier, that is, the number of zeros that we have to put after the first two digits to arrive at the resistor's value. The final band gives us the tolerance of the resistor, silver for 10% types, gold for 5% types, brown for 1% types.

Let's take the resistor shown at the top of the colour chart as an example. Its first band is yellow, representing '4' and the second band is violet, representing '7'. The third band, the multiplier, is orange which tells us to add 3 zeros to the number we already have. This is the same as multiplying it by 1,000. Thus the value of the resistor is 47,000– forty seven thousand ohms or 47kΩ.

Finally, the fourth band, being gold, indicates that the resistor has a 5% tolerance, that is, its actual value will be somewhere between 44,650 and 49,350 ohms.

Some special high-voltage resistors use a yellow tolerance band in lieu of gold. This is simply because the metal particles in the gold paint might compromise the resistor's voltage rating.

WHAT THEY MEAN:

Band one – first figure of value
Band two – second figure of value
Band three – number of zeros/multiplier
Band four – tolerance

TOLERANCE BAND COLOURS:

Brown 1%, red 2%, gold 5%, silver 10%, none 20%.

READING 5-BAND RESISTORS:

Because the final band on these resistors is usually brown or red, it can be a bit more difficult to know which end to start from. In most cases the first four bands are grouped a bit closer together than the fourth and fifth bands. The first two bands are read the same as they are on the 4-band types. The third band supplies the third digit of the value. The fourth band now becomes the multiplier and the fifth represents the tolerance.

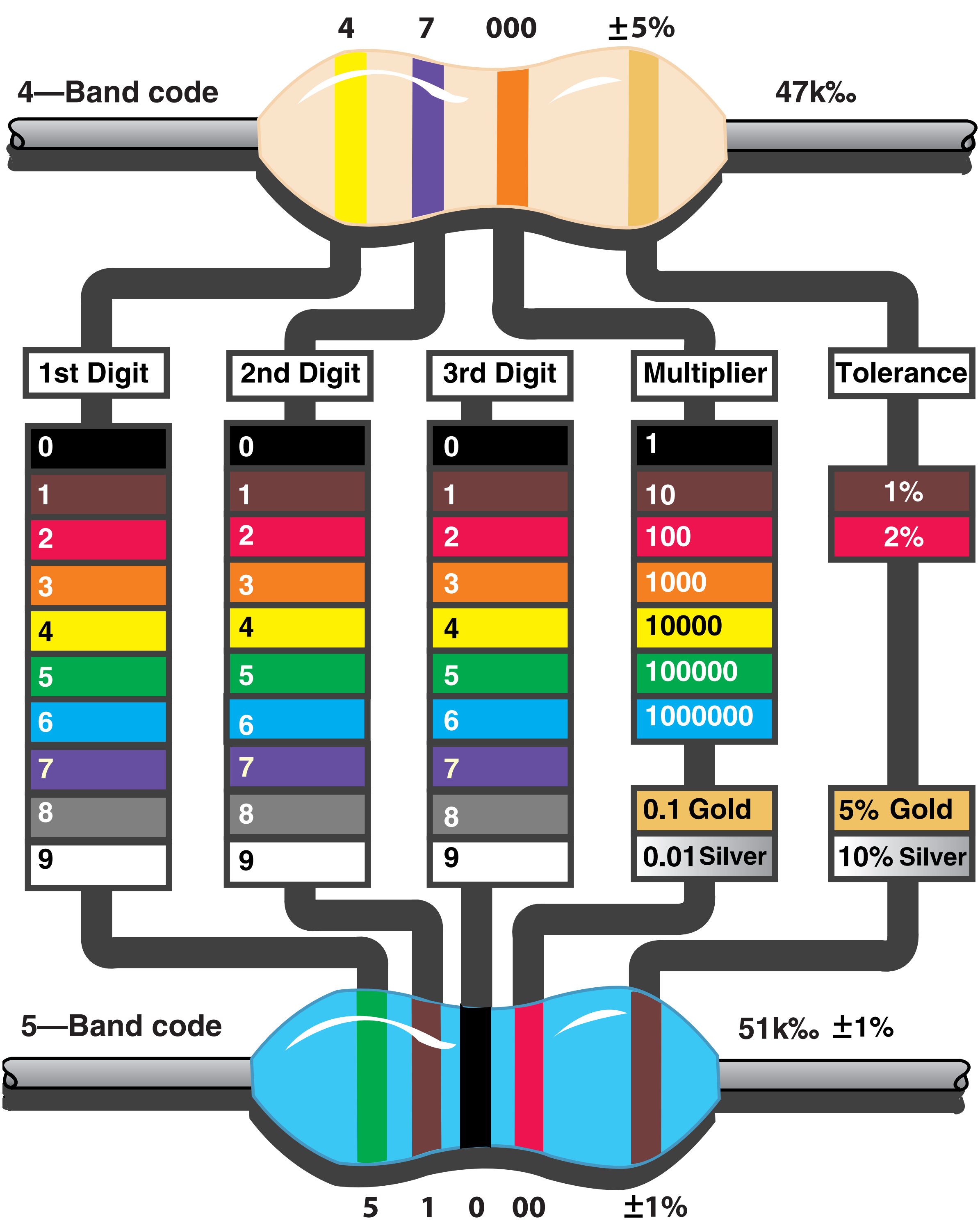
For example, if the 5 bands are, from first to fifth, yellow/orange/black/red/brown, then the three significant digits of the value would be 430', the multiplier would be 2, and the tolerance 1%. Hence, this is the code for a 43000 ohm, 1% resistor.

WHAT THEY MEAN:

Band one – first figure of value
Band two – second figure of value
Band three – third figure of value
Band four – number of zeros/multiplier
Band five – tolerance

RESISTOR COLOUR CODE

RESISTOR COLOUR CODE



CAPACITORS

Capacitors may be marked to show their value, voltage rating, accuracy, temperature stability and other information. Most capacitors are not marked with all of these, however, the value and voltage rating are usually given. Identification can be difficult because of the variety of systems in use.

UNITS

The unit of capacitance is the Farad, but this unit is too large in practice. Most commonly used smaller units are the microfarad (abbreviated uF), nanofarad (nF) and picofarad (pF). The section on decimal multipliers (page 274) shows the relationship between these.

Some capacitance values are commonly expressed by only one unit while others can be expressed under two or more units, e.g. 1uF would rarely be called 1000nF and never 1,000,000 pF, even though these are equivalent. However, 0.0047uF is often expressed as 4.7nF, or as 4700pF.

VALUE

Larger capacitors are marked in microfarads and indicate this by the abbreviations 'uF', 'u' or even the obsolete 'MFD'. Smaller capacitors are marked in nanofarads or picofarads and may abbreviate the unit to 'n' or 'p'.

If the value contains a decimal point the 'u', 'n' or 'p' is sometimes put in place of the decimal point. Therefore a 4.7pF capacitor can be marked as 4p7. If no unit is given, a judgement, based on the capacitor's physical size, must be made to determine which unit is intended. For example, a small ceramic capacitor marked '4.7' is probably 4.7 pF, whereas a large plastic capacitor marked '4.7' is more likely to be 4.7uF. If the value is in nF then this is invariably shown.

Another marking system uses 3 numeric digits to indicate the value in picofarads. The first two digits represent the first two digits of the value and the third digit is the multiplier or number of zeroes.

For example, a capacitor marked 104 would be read as 1, 0, 0000. This would be formatted as 100,000 pF and would commonly be known as 100nF or 0.1uF. Likewise a capacitor marked 472 would be 4700pF, also known as 4.7nF or .0047uF.

A similar system represents these 3 digits using colours taken from the resistor code, instead of numbers.

SOME COMMON VALUES AND THEIR POSSIBLE MARKINGS:

MICROFARADS	NANOFARADS	PICOFARADS	EIA CODE
0.0001uF*	0.1n*	100pF	101
0.00022uF*	0.22n (n22)	220pF	221
0.001uF	1n (1n0)	1,000pF	102
0.0033uF	3.3n (3n3)	3,300pF	332
0.01uF	10n	10,000pF*	103
0.047uF	47n	47,000pF*	473
0.1uF (u1)	100n	100,000pF*	104
0.82uF (u82)	820n	820,000pF*	824
1.0uF (1u0)	1000n*	1,000,000pF*	105

** Not normally expressed in this form.*

VOLTAGE RATING

Voltage rating is usually marked and is often identified by the symbol 'V'. Most electrolytic capacitors clearly indicate their voltage rating. Polyester capacitors usually show the voltage rating but often omit the 'V' symbol. Small ceramic capacitors often show no voltage rating.

If the capacitance and voltage rating are both marked, a unit is also marked for at least one of the quantities so that the two cannot be confused.

TOLERANCE

Tolerance indicates how close a capacitor's actual value is likely to be to its marked value.

A tolerance can be marked numerically, as a code consisting of a single letter, or, on colour-coded capacitors, as a fourth coloured band. The code letter is usually placed immediately after the value. Commonly used tolerance codes are:

CODE	COLOUR	TOL	CODE	COLOUR	TOL
A	–	+20-10 (2)	L	–	+/-15%
C	red	+/-0.25pF (1)	M	black	+/-20%
D	green	+/-0.5pF (1)	N	–	+/-30%
E	white	+/-1.0pF (1)	P		+100 -0
F	brown	+/-1%	Q (2)	–	+30 -10
G	red	+/-2%	S	–	+50 -20
J	green	+/-5%	W	–	+50 -10
K	white	+/-10%	W (2)	–	+40 -20
			Z	grey	+80 -20

(1) used on capacitors <=10pF
(2) used on electrolytic capacitors

POLARITY

Polarity sensitive capacitors, such as electrolytics, are usually marked with a '+' or '-' symbol adjacent to one lead to indicate polarity. Thomson brand tantalum capacitors may have a triangular logo to indicate the positive lead, instead of the '+' symbol.

TEMPERATURE CHARACTERISTICS

All real capacitors exhibit some change in value with varying temperature. Some ceramic types exhibit fairly linear changes and are useful as temperature compensating elements in AC circuits. The temperature coefficients of these types may be marked in letter codes or designated by a coloured spot.

TEMPCO CODE	EIA CODE	JIS CODE	TEMPCO COLOUR	PPM/°C
P100			red/violet	+100
NP0	COG	C	black	0
N30	S1G	H		-30
N033	S1G		brown	-33
N075	U1G		red	-75
N080	U1G	L	red	-80
N150	P2G	P	orange	-150
N220	R2G	R	yellow	-220
N330	S2H	S	green	-330
N470	T2H	T	blue	-470
N750	U2J	U	violet	-750
N1500	P3K	W	orange/orange	-1500
N2200	R3L			-2200
P350/N1000	SL	SL		+350 to -1000

Capacitors using the JIS code sometimes have a second letter to designate the temperature coefficient's tolerance.

LETTER	TEMPCO TOLERANCE
G	+/-30ppm/°C
H	+/-60ppm/°C
J	+/-120ppm/°C
K	+/-250ppm/°C
L	+/-500ppm/°C

For example, a capacitor marked 'CH' would have a temperature coefficient of between +60ppm/ºC and -60ppm/°C ('C'=0, 'H'= +/-60ppm/°C).

Ceramic capacitors with non-linear temperature coefficients sometimes use a 3-digit code to indicate – their operating temperature range and their stability over that range.

The 1st character indicates minimum operating temperature, the 2nd, maximum temperature and the 3rd gives the stability over this temperature range.

1ST CHARACTER TEMP	MIN TEMP °C	2ND CHARACTER °C	MAX
X	-55	5	+85
Y	-30	7	+125
Z	+10		

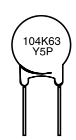
3RD CHARACTER	STABILITY (%)
F	+/-7.5
P	+/-10
R	+/-15
S	+/-22
T	+22/-33
U	+22/-56
V	+22/-82

An example of this is the common 'Z5U' type used in bypass applications. This capacitor operates over the +10° to +85° temperature range and exhibits a stability of +22 to -56% over this temperature range.

PUTTING IT ALL TOGETHER

Knowing how the important information is likely to be marked, we can decode the markings on a capacitor and determine its value, voltage rating, tolerance and sometimes its temperature characteristic.

For example, a capacitor marked 104K 63V Y5P will be 0.1uF (decoded from the 104) having a +/-10% tolerance (decoded from the K), a 63 Volt rating, an operating temperature range of -30° to + 85° (decoded from Y5) and a stability of +/-10% (P) over this range. Likewise, 6n8K63 would indicate 6.8nF (from 6n8), +/-10%, (from K) and 63 Volts (from 63).



104 = 1 0 0000 pF
= 100nF = 0.1 uF
K = ± 10% Tolerance
63 = 63V
Y = -30°C
5 = +85°C
P = ±10% Stability

FILM CAPACITOR TYPES

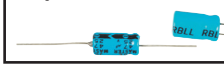
KP	Polypropylene film/foil
KS	Polystyrene film/foil
KT	Polyester film/foil (polyethylene terephthalate PETP)
MK	Metallised plastic film (general)
MKC	Metallised polycarbonate
MKP	Metallised polypropylene
MKT	Metallised polyester (polyethylene terephthalate, PETP)
MKT-P	Metallised polyester/paper
MKY	Metallised low-loss polypropylene
MKL (MKU)	Metallised lacquer (cellulose acetate)

CAPACITORS AND THEIR USES

ALUMINIUM ELECTROLYTIC CAPACITORS

Ideal for use in filtering or smoothing applications in power supplies. Also used for coupling and bypassing in audio circuits and as a timing element in non critical circuits.

Modern aluminium electrolytic capacitors have high reliability and low leakage. Special low leakage versions are available with leakage which rivals that of tantalum capacitors.

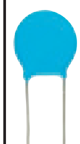


Single ended
(- end) (+ end)

SOLID TANTALUM CAPACITORS

Offer smaller size and lower leakage than standard aluminium electrolytics.

CERAMIC CAPACITORS



Offer low cost and high capacitance in a small physical volume. There are generally two types:

High stability, temperature compensating types for use in resonant circuit and filter applications. These have linear temperature characteristics, and their value is largely independent of voltage and frequency.

Bypass and coupling capacitors for use in less critical applications. These are less stable, have non-linear temperature characteristics and are somewhat voltage dependent.

PAPER CAPACITORS

An original construction, now rarely used. Plastic film capacitors have replaced paper capacitors in most applications.

POLYESTER CAPACITORS

Low cost, good stability and available in a large range of values. These are the most widely used capacitors for general purpose applications.

Greencaps and MKT type capacitors are examples of polyester (polyethylene terephthalate) film capacitors.

POLYCARBONATE CAPACITORS

Offer low temperature coefficient and lower dielectric losses at high frequency. Most often chosen for temperature stability characteristics.

POLYSTYRENE CAPACITORS

Usually chosen for applications requiring tight tolerance coupled with high stability. Predictable temperature coefficient used in conjunction with particular ferrite cores makes highly stable tuned circuits or oscillators.

POLYPROPYLENE CAPACITORS

Offer very low dielectric losses and good temperature coefficient. Used in power electronics applications, e.g. mains capacitors, switching power supplies, inverters and TV deflection circuits.

INDUCTORS

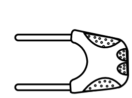
There are a variety of marking systems for small inductors. The value may be marked directly, with a three digit numeric code or a colour code. The tolerance may be marked directly, with a single letter, or a colour code.

The 3-digit numeric code indicates the value in microhenries. The first two digits represent the first two digits of the value and the third is the multiplier, or number of zeroes. For example, the code 472 would be interpreted as 4 7 00uH, or 4.7mH. Likewise, 103 would represent 10mH.

Where coloured bands are used, the system is essentially the same as that used for the resistor colour code, but with the value expressed in microhenries. An exception is that some inductors include an extra, thicker band at one end to identify milspec characteristics.

Tolerance codes are usually placed after the value code. M is used to represent +/-20%, K or a silver band for +/-10%, J or a gold band for +/- 5%.

Resin-dipped radial lead types are often marked with a sequence of coloured dots. The significance of these dots is shown below.



4th Dot (Tolerance)
1st Dot
2nd Dot
3rd Dot (Multiplier)

CAPACITOR CODE AND CONVERSION CHART

MICROFARAD	NANOFARAD.	PICOFARAD	EUROPEAN	EIA/MIL (USA)	COLOUR BAND CODE
0.001uF	1.0nF	1000pF	1n0	102	Brown-Black-Red
0.0012uF	1.2nF	1200pF	1n2	122	Brown-Red-Red
0.0015uF	1.5nF	1500pF	1n5	152	Brown-Green-Red
0.0018uF	1.8nF	1800pF	1n8	182	Brown-Grey-Red
0.0022uF	2.2nF	2200pF	2n2	222	Red-Red-Red
0.0027uF	2.7nF	2700pF	2n7	272	Red-Violet-Red
0.0033uF	3.3nF	3300pF	3n3	332	Orange-Orange-Red
0.0039uF	3.9nF	3900pF	3n9	392	Orange-White-Red
0.0047uF	4.7nF	4700pF	4n7	472	Yellow-Violet-Red
0.0056uF	5.6nF	5600pF	5n6	562	Green-Blue-Red
0.0068uF	6.8nF	6800pF	6n8	682	Blue-Grey-Red
0.0082uF	8.2nF	8200pF	8n2	822	Grey-Red-Red
0.01uF	10nF	10x10^{3}pF*	10n	103	Brown-Black-Orange
0.012uF	12nF	12x10^{3}pF*	12n	123	Brown-Red-Orange
0.015uF	15nF	15x10^{3}pF*	15n	153	Brown-Green-Orange
0.018uF	18nF	18x10^{3}pF*	18n	183	Brown-Grey-Orange
0.022uF	22nF	22x10^{3}pF*	22n	223	Red-Red-Orange
0.027uF	27nF	27x10^{3}pF*	27n	273	Red-Violet-Orange
0.033uF	33nF	33x10^{3}pF*	33n	333	Orange-Orange-Orange
0.039uF	39nF	39x10^{3}pF*	39n	393	Orange-White-Orange
0.047uF	47nF	47x10^{3}pF*	47n	473	Yellow-Violet-Orange
0.056uF	56nF	56x10^{3}pF*	56n	563	Green-Blue-Orange
0.068uF	68nF	68x10^{3}pF*	68n	683	Blue-Grey-Orange
0.082uF	82nF	82x10^{3}pF*	82n	823	Grey-Red-Orange
0.1uF	100nF	10x10^{4}pF*	µ10	104	Brown-Black-Yellow
0.12uF	120nF	12x10^{4}pF*	µ12	124	Brown-Red-Yellow
0.15uF	150nF	15x10^{4}pF*	µ15	154	Brown-Green-Yellow
0.18uF	180nF	18x10^{4}pF*	µ18	184	Brown-Grey-Yellow
0.22uF	220nF	22x10^{4}pF*	µ22	224	Red-Red-Yellow
0.27uF	270nF	27x10^{4}pF*	µ27	274	Red-Violet-Yellow
0.33uF	330nF	33x10^{4}pF*	µ33	334	Orange-Orange-Yellow
0.39uF	390nF	39x10^{4}pF*	µ39	394	Orange-White-Yellow
0.47uF	470nF	47x10^{4}pF*	µ47	474	Yellow-Violet-Yellow
0.56uF	560nF	56x10^{4}pF*	µ56	564	Green-Blue-Yellow
0.68uF	680nF	68x10^{4}pF*	µ68	684	Blue-Grey-Yellow
0.82uF	820nF	82x10^{4}pF*	µ82	824	Grey-Red-Yellow

Notes:

*These values are not normally expressed in nanofarads (nF) or picofarads (pF). Electrolytics are usually marked in microfarads (uF) Capacitor colour code follows a similar system to that used for resistors and is expressed in picofarads. Colour Coding may vary depending on the type of capacitor, age and manufacturers preference. Most modern capacitors are marked using the European or EIA codes.

CAPACITOR CODE AND CONVERSION CHART

MICROFARAD	NANOFARAD.	PICOFARAD	EUROPEAN	EIA/MIL (USA)	COLOUR BAND CODE
1.0uF	1000nF	10x10^{5}pF*	1µ0	105	Brown-Black-Green
1.2uF	1200nF	12x10^{5}pF*	1µ2	125	Brown-Red-Green
1.5uF	1500nF	15x10^{5}pF*	1µ5	155	Brown-Green-Green
1.8uF	1800nF	18x10^{5}pF*	1µ8	185	Brown-Grey-Green
2.2uF	2200nF	22x10^{5}pF*	2µ2	225	Red-Black-Green
2.7uF	2700nF	27x10^{5}pF*	2µ7	275	Red-Red-Green
3.3uF	3300nF	33x10^{5}pF*	3µ3	335	Orange-Orange-Green
3.9uF	3900nF	39x10^{5}pF*	3µ9	395	Orange-White-Green
4.7uF	4700nF	47x10^{5}pF*	4µ7	475	Yellow-Violet-Green
5.6uF	5600nF	56x10^{5}pF*	5µ6	565	Green-Blue-Green
6.8uF	6800nF	68x10^{5}pF*	6µ8	685	Blue-Grey-Green
8.2uF	8200nF	82x10^{5}pF*	8µ2	825	Grey-Red-Green
10.0uF	10000nF	10x10^{6}pF*	10µ	106	Brown-Black-Blue
15.0uF	15000nF	15x10^{6}pF*	15µ	156	Brown-Green-Blue
18.0uF	18000nF	18x10^{6}pF*	18µ	186	Brown-Grey-Blue
22.0uF	22000nF	22x10^{6}pF*	22µ	226	Brown-Black-Blue
27.0uF	27000nF	27x10^{6}pF*	27µ	276	Red-Red-Blue
33.0uF	33000nF	33x10^{6}pF*	33µ	336	Orange-Orange-Blue
39.0uF	39000nF	39x10^{6}pF*	39µ	396	Orange-White-Blue
47.0uF	47000nF	47x10^{6}pF*	47µ	476	Yellow-Violet-Blue
56.0uF	56000nF	56x10^{6}pF*	56µ	566	Green-Blue-Blue
68.0uF	68000nF	68x10^{6}pF*	68µ	686	Blue-Grey-Blue
82.0uF	82000nF	82x10^{6}pF*	82µ	826	Grey-Red-Blue
100uF	100,000nF	10x10^{7}pF*	100µ	107	Brown-Black-Violet
220uF	220,000nF	22x10^{7}pF*	220µ	227	Red-Red-Violet

CAPACITOR TOLERANCES

Brown = +/-1%
Red = +/-2%
Green = +/-5%
White = +/-9% or +/-10%
Black = +/-20%
F = +/-1%
G = +/-2%
J = +/-5%
K = +/-10%
M = +/-20%

CAPACITOR VOLTAGES

(Flat Film Type, Last Band)
Brown = 100 VDC
Red = 250 VDC
Yellow = 400 VDC
Violet = 630 VDC

(Solid Tantalum, Last Band)
Black = 10 VDC
Brown = 1.6 VDC
Red = 4.0 VDC
Orange = 40 VDC
Yellow = 400 VDC
Green = 16 VDC
Silver = 25 VDC
White = 2.5 VDC
Pink = 35 VDC

CAPACITANCE FORMULAE

Parallel: $CT = C1 + C2 + C3 +$

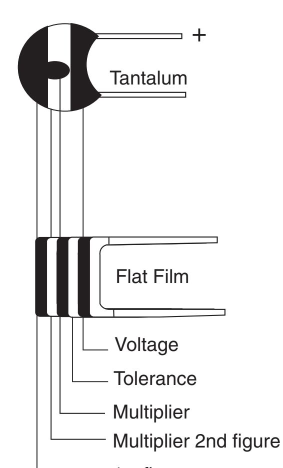
Series: $CT = \frac{C1 \times C2}{C1 + C2}$

$CT = \frac{1}{\frac{1}{C1} + \frac{1}{C2} + \frac{1}{C3} + ..}$

Stored Charge: $Q = C \times E$

Stored Energy: $W = \frac{C \times E2}{2}$

Q = Charge in Coulombs
C = Capacitance in Farads (F)
E = Voltage (V)
W = Energy in Joules
(watt-seconds)



WIRE AND COAXIAL CABLE SPECIFICATIONS

Type	Nom. Imp Zo	Outer Dia. (mm)	Nom. Attenuation (dB/100m) 50 MHz	100 MHz	200 MHz	400 MHz	1 GHz	Vel. Factor %	Cap. pF/m	Volt. Vrms
RG-6/U	75	6.85	4.9	6.9	10.2	14.4	19.7	78	57.2	–
RG-8/U	52	10.3	5.2	7.2	10.5	15.4	29.2	66	96.8	5000
RG-9/U	51	10.67	5.2	7.2	10.5	15.4	29.2	66	98.4	5000
RG-11/U	75	10.29	4.3	6.6	9.5	13.8	23.3	66	67.3	5000
RG-58/U	53.5	4.95	10.2	14.8	22.3	32.8	55.8	66	93.5	1900
RG-58A/U	50	4.95	10.8	16.1	23.9	37.7	70.5	66	101	1900
RG-58C/U	50	4.95	10.8	16.1	23.9	37.7	70.5	66	101	1900
RG-59/U	73	6.15	7.9	11.2	16.1	23.3	39.4	66	68.9	2300
RG-59B/U	75	6.15	7.9	11.2	16.1	23	39.4	66	67.3	2300
RG-62/U	93	6.04	6.2	8.9	12.5	17.7	28.5	84	44.3	700
RG-62B/U	93	6.15	6.6	9.5	13.8	20	36.1	84	44.3	700
RG-122/U	50	4.06	14.8	23	32.8	49.9	87	66	101	190
RG-141A/U	50	4.83	6.9	10.5	15.4	22.6	42.7	69.5	95.1	1900
RG-142B/U	50	4.95	8.9	12.8	18.4	26.9	44.3	69.5	95.2	1900
RG-174/U	50	2.56	21.7	29.2	39.4	57.4	98.4	66	101	1500
RG-178B/U	50	1.83	34.4	45.9	62.3	91.9	150.9	69.5	95.1	1000
RG-179B/U	75	2.54	27.9	32.8	41.0	52.5	78.7	69.5	64	1200
RG-180B/U	95	3.56	15.1	18.7	24.9	35.1	55.8	69.51	49.2	1500
RG-187A/U	75	2.66	27.9	32.8	41	52.5	78.7	69.5	64	1200
RG-188A/U	50	2.59	31.5	37.4	46.6	54.8	101.7	69.5	95.2	1200
RG-196A/U	50	1.93	34.4	45.9	62.3	91.9	150.9	69.5	95.2	1200
RG-213/U	50	10.29	5.2	7.2	10.5	15.4	29.2	66	101	5000
RG-214/U	50	10.8	5.2	7.2	10.5	15.4	29.2	66	101	5000
RG-223/U	50	5.38	10.1	14.8	21	30.2	53.5	66	101	1900
RG-303/U	50	4.31	6.9	10.5	15.4	22.6	42.7	69.5	95.2	1900
RG-316/U	50	2.49	30.8	34.1	43.3	54.1	101.7	69.5	95.2	1200
BEL 9913	50	10.29	3.0	4.6	5.9	8.5	14.8	84	78.7	–

Note: Except for Belden 9913, all specifications are referenced to MIL-C-17D/F or JAN-C-17A as applicable. Actual cables often exhibit lower losses than those specified above.

WINDING WIRE DATA

B&S Gauges	SWG	Metric mm	Dia. mils	Ohms per 1000ft	Dia. mm	Ohms per km
12	–	–	80.81	1.588	2.053	5.210
–	14	–	80.00	1.658	2.032	5.440
–	–	2.000	78.74	1.673	2.000	5.448
–	15	–	72.00	2.001	1.829	6.563
13	–	–	71.96	2.003	1.828	6.572
–	–	1.800	70.87	2.065	1.800	6.775
14	–	–	64.08	2.525	1.628	8.284
–	16	–	64.00	2.532	1.626	8.307
–	–	1.600	62.99	2.614	1.600	8.575
15	–	–	57.07	3.184	1.450	10.47
–	17	–	56.00	3.307	1.422	10.85
–	–	1.400	55.12	3.414	1.400	11.20
16	–	–	50.82	4.016	1.291	13.18
–	–	1.250	49.21	4.282	1.250	14.05
–	18	–	48.00	4.501	1.219	14.77
17	–	–	45.26	5.064	1.150	16.61
–	–	1.120	44.09	5.333	1.120	17.50
18	–	–	40.30	6.385	1.024	20.95
–	–	1.000	39.37	6.691	1.000	21.95
–	20	–	36.00	8.002	0.9144	26.25
19	–	–	35.89	8.051	0.9119	26.41
–	–	0.9000	35.51	8.222	0.9000	27.10
–	21	–	32.00	10.13	0.8128	33.23
20	–	–	31.96	10.15	0.8120	33.30
–	–	0.800	31.50	10.45	0.8000	34.30
21	–	–	28.46	12.80	0.7231	41.99
–	22	–	28.00	13.23	0.7112	43.40
–	–	0.7100	27.95	13.27	0.7100	43.55
22	–	–	25.35	16.14	0.6440	52.95
–	–	0.6300	24.80	15.85	0.6300	55.31
–	23	–	24.00	18.00	0.6096	59.07
23	–	–	22.57	20.36	0.5734	66.80
–	–	0.5600	22.04	21.33	0.5600	70.00
–	24	–	22.00	21.43	0.5588	70.30
24	–	–	20.10	25.67	0.5107	84.22
–	25	–	20.00	25.93	0.5080	85.06
–	–	0.5000	19.69	26.76	0.5000	87.81
–	26	–	18.00	32.01	0.4572	105.0
25	–	–	17.90	32.37	0.4548	106.2
–	–	0.4500	17.72	33.04	0.4500	108.4
–	27	–	16.40	38.55	0.4162	126.5
26	–	–	15.94	40.81	0.4050	133.9
–	–	0.4000	15.75	41.28	0.4000	137.2
–	28	–	14.80	47.35	0.3759	155.3
27	–	–	14.20	51.47	0.3608	168.9
–	–	0.3550	13.97	53.10	0.3550	174.2
–	29	–	13.60	56.07	0.3454	184.0
28	–	–	12.64	64.90	0.3211	212.9
–	30	0.3150	12.40	67.45	0.3150	221.2
–	31	–	11.60	77.07	0.2946	252.9
29	–	–	11.26	81.83	0.2861	268.5
–	–	0.2800	11.02	85.34	0.2800	280.0
–	32	–	10.80	88.91	0.2743	291.7
30	–	–	10.03	103.2	0.2548	338.6
–	33	–	10.00	103.7	0.2540	340.2
–	–	0.2500	9.842	107.0	0.2500	351.2
–	34	–	9.200	122.5	0.2337	402.0
31	–	–	8.928	130.1	0.2268	426.8
–	–	0.2240	8.819	133.3	0.2240	437.5
–	35	–	8.400	147.0	0.2134	482.2
32	–	–	7.950	164.1	0.2020	538.4
–	36	–	7.600	179.5	0.1930	589.1
–	–	0.1800	7.087	206.5	0.1800	677.5
33	–	–	7.080	206.9	0.1799	678.8
–	37	–	6.800	224.3	0.1727	735.8

COPPER CABLE CHARACTERISTICS

Number & Size of Strands	Nominal Conductor Area (sq. mm)	Nominal Current Rating (Amps)	Maximum Resistance per metre (ohms 35°C)	Nearest Equivalent AWG (B&S)
10 x 0.12	0.11	1.1	0.17	27
7 x 0.16	0.14	1.4	0.13	26
1 x 0.5	0.20	2.0	0.10	24
14 x 0.14	0.22	2.2	0.088	24
7 x 0.2	0.22	2.2	0.086	24
1 x 0.6	0.28	2.8	0.067	23
1 x 0.7	0.38	3.8	0.049	21
14 x 0.2	0.44	4.4	0.043	21
10 x 0.25	0.49	4.9	0.039	20
63 x 0.10	0.49	4.9	0.039	20
50 x 0.12	0.55	5.0	0.035	20
60 x 0.12	0.68	6.8	0.028	19
89 x 0.1	0.70	7.0	0.027	19
24 x 0.2	0.75	7.5	0.025	18
112 x 0.10	0.88	8.8	0.022	18
30 x 0.2	0.94	9.4	0.020	17
1 x 1.13	1.0	10.0	0.019	17
32 x 0.2	1.0	10.0	0.019	17
512 x 0.05	1.0	10.0	0.019	17
168 x 0.1	1.32	13.0	0.014	16
7 x 0.5	1.4	14.0	0.014	16
30 x 0.25	1.5	15.0	0.013	15
26 x 0.3	1.8	17.0	0.010	15
168 x 0.12	1.9	18.0	0.010	14
26 x 0.32	2.1	19.0	0.0091	14
7 x 0.67	2.5	22.0	0.0077	13
1 x 1.78	2.5	22.0	0.0076	13
252 x 0.127	3.2	29.0	0.0059	12
41 x 0.32	3.3	30.0	0.0057	12
315 x 0.12	3.6	30.0	0.0053	12
630 x 0.12	7.13	50	0.0027	9
1666 x 0.12	18.84	120	0.0010	5

Note: The nominal current ratings are intended as guidelines for low power, electronics, communications and control applications only.

PROPERTIES OF COPPER

(Based upon the IEC International Annealed Copper Standard.)

Volume resistivity @ 20°C:
0.0000017241 ohm-cm

Mass resistivity @ 20°C:
0.15328 ohm-grams/sq. metre

Temperature coefficient @ 20°C:
0.0039

Tensile strength:
2350 kg/sq. cm

Melting point: 1083°C

NOTE: Dick Smith Electronics does not stock all cables and wires shown. Data is presented for comparative purposes.

CHOOSE THE RIGHT CABLE

The following 6 steps should help when trying to choose a suitable wire size for hooking up marine and auto accessories, extension speakers and the like.

1 Decide how much of the available supply voltage you are prepared to lose. All practical wires have some finite resistance, so it is impossible not to lose some voltage.

2 Divide the figure obtained in (1) by the maximum current which you expect to draw through the wire. This result is the tolerable resistance of your wiring.

3 Divide the result obtained in (2) by the total length (in metres) of the wiring loop. Include the distance from the power source to the load, and back again. This result is the maximum resistance of the desired wire in ohms per metre.

4 From the chart above, select a wire which has a 'resistance per metre' figure which is equal to or less than the desired value.

5 Check that the 'nominal current rating' in the table is not exceeded. If it is, then you may need to select a larger wire size with an adequate rating. While the figures given are conservative, they must not be exceeded in 240V applications and may need derating in higher temperature situations.

6 Finally, when purchasing the wire, verify that its insulation is rated to withstand the voltage and temperature for your particular application.

EXAMPLE: You wish to install a 12V, 55W light on a boat. The current drawn by the light will be (55/12) 4.6 amps. You calculate that the length of the wiring loop is 5 metres.

Step 1 Lets say that you'll tolerate a loss of 5% of the available 12V supply, i.e. 0.6V.

Step 2 Divide 0.6V by 4.6A to obtain 0.13 ohms.

Step 3 Divide 0.13 ohms by 5 metres to obtain 0.026 ohms per metre.

Step 4 Referring to the chart, you will find that 24 x 0.2mm wire appears to be suitable as its resistance is 0.025 ohms per metre.

Step 5 The 'nominal current rating' for this cable is 7.5A and on this basis it is still suitable.

Step 6 As you are dealing with a 12V system and are able to keep the wire away from hot areas and protect it from abrasion, there is unlikely to be any problem related to the insulation.

BIPOLAR TRANSISTORS

Note: Some small signal transistors may have a TO-92 case and a 'PN' prefix. The electrical specifications are the same, only the case is changed. See case outline TO-92(72) for pin detail.
Not all devices in this section are stocked by Dick Smith Electronics.

TYPE MAT	CASE	POL	VCE mA	VCB	Ic	VCES	@ Ic mA	hFe	@ Ic mA	FT MHz	@ Ic mA	PTOT mW	USE	COMPARABLE TYPES
BC107	TO-18	NS	45	50	100	0.25	10	110-450	2	300	10	300	G.P. S.S. amp.	BC207, BC147, BC182
BC108	TO-18	NS	20	30	100	0.25	10	110-800	2	300	10	300	G.P. S.S. amp.	BC208, BC148, BC183
BC109	TO-18	NS	20	30	100	0.25	10	200-800	2	300	10	300	Low noise S.S. amp	BC209, BC149, BC184
BC109C	TO-18	NS	20	30	100	0.25	10	420-800	2	300	10	300	Low noise high gain	BC209C, BC149C, BC184C
BC177	TO-18	PS	45	50	100	0.3	10	75-260	2	150	10	300	G.P. S.S. amp.	BC157, BC307, BC212
BC178	TO-18	PS	25	30	100	0.3	10	75-500	2	150	10	300	G.P. S.S. amp.	BC158, BC308, BC213
BC179	TO-18	PS	20	25	100	0.3	10	125-500	2	150	10	300	G.P. S.S. amp.	BC159, BC309, BC214
BC327	TO-92VAR1	PS	45	50	500	0.7	500	100-600	100	100	10	625	Output	2N3638
BC328	TO-92VAR1	PS	25	30	500	0.7	500	100-600	100	100	10	625	Output	BC327
BC337	TO-92VAR1	NS	45	50	500	0.7	500	100-600	100	100	10	625	Output	2N3642
BC338	TO-92VAR1	NS	25	30	500	0.7	500	100-600	100	100	10	625	Output	BC337
BC546	TO-92VAR1	NS	65	80	100	0.6	100	110-450	2	300	10	500	G.P. S.S. amp.	
BC547	TO-92VAR1	NS	45	50	100	0.6	100	110-800	2	300	10	500	G.P. S.S. amp.	BC107, BC207, BC147
BC548	TO-92VAR1	NS	30	30	100	0.6	100	110-800	2	300	10	500	G.P. S.S. amp.	BC108, BC208, BC148
BC549	TO-92VAR1	NS	30	30	100	0.6	100	200-800	2	300	10	500	Low noise S.S. amp.	BC109, BC209, BC149
BC549C	TO-92VAR1	NS	30	30	100	0.6	100	420-800	2	300	10	500	Low noise high gain	BC109C, BC149C
BC556	TO-92VAR1	PS	65	80	100	0.65	100	75-475	2	200	10	500	G.P. S.S. amp.	
BC557	TO-92VAR1	PS	45	50	100	0.65	100	75-800	2	200	10	500	G.P. S.S. amp.	BC157
BC558	TO-92VAR1	PS	30	30	100	0.65	100	75-800	2	200	10	500	G.P. S.S. amp.	BC158
BC559	TO-92VAR1	PS	30	30	100	0.65	100	125-800	2	200	10	500	G.P. S.S. amp.	BC159
BC639	TO-92(74)	NS	80	100	1A	0.5	500	40-250	150	130		1W	Audio O/P	MU9610, TT801
BC640	TO-92(74)	PS	80	100	1A	0.5	500	40-250	150	50		1W	Audio O/P	MU9660, TT800
BD139	TO-126	NS	80	100	1.5A	0.5	500	40-250	150	250	50	8W	G.P. O/P	40409
BD140	TO-126	PS	80	100	1.5A	0.5	500	40-250	150	75	50	8W	G.P. O/P	40410
BD262	TO-126	PS	60	60	4A	2.5	1.5A	750	1.5A	7	1.5A	36W	High gain Darl. O/P	BD266
BD263	TO-126	NS	60	80	4A	2.5	1.5A	750	1.5A	7	1.5A	36W	High gain Darl. O/P	BD267
BD266A	TO-220	PS	80	80	8A	2	3A	750	3A	7		60W	High gain Darl. O/P	
BD267A	TO-220	NS	80	100	8A	2	3A	750	3A	7		60W	High gain Darl. O/P	
BD681	TO-126	NS	100	100	4A	2.5	1.5A	750	1.5A	1		40W	Darlington O/P	BD263
BD682	TO-126	PS	100	100	4A	2.5	1.5A	750	1.5A	1		40W	Darlington O/P	BD262
BF173	TO-72(28)	NS	25	40	25			40-100	7	550	5	230	T.V. I.F. amp.	
BF199	TO-92VAR2	NS	25	40	25			37	7	550		500	H.F. amp.	BF180
BF463	TO-202	PS	250	250	500			40-180	30	20		2W	H.V. med. power.	
BF469	TO-126	NS	250	250	50			50	25	60	10	1.8W	G.P. high-V. amp.	
BF470	TO-126	PS	250	250	50			50	25	60	10	1.8W	G.P. high-V. amp.	
BFR90	SOT-37(2)	NS	15	20	25			25-250	14	5GHz	14	180	Wideband amp..	
BFR91	SOT-37(2)	NS	12	15	35	0.3	30	25-250	30	5GHz	30	180	Wideband amp.	
BFY90	TO-72(25)	NS	15	30	25			25-125	2	1GHz	2	200	Wideband amp.	
BUX80	TO-3	NS	400	800	10A	1.5	5A	30	1.2A	8		100W	Deflection, high current SW	
MJ802	TO-3	NS	90	100	30A	0.8	7.5A	25-100	7.5A	2	1A	200W	High power output	
MJ2955	TO-3	PS	60	70	15A	1.1	4A	20-70	4A	2.5	500	115W	G.P. power	
MJ4502	TO-3	PS	90	100	30A	0.8	7.5A	25-100	7.5A	2	1A	200W	High power output	
MJ10012	TO-3	NS	400	600	10A	2	6A	100-2K	6A			175W	Power Darlington	
MJ15003	TO-3	NS	140	140	20A	1	5A	25-150	5A	2	500	250W	High power output	
MJ15004	TO-3	PS	140	140	20A	1	5A	25-150	5A	2	500	250W	High power output	
MJE340	TO-126	NS	300		500	0.75	100	30-240	50			20W	G.P. H.V. power	
MJE350	TO-126	PS	300		500	0.77	100	30-240	50			20W	G.P. H.V. power	
MJE2955T	TO-220	PS	60	70	10A	1.1	4A	20-100	4A	2	500	75W	G.P. power	TIP2955
MJE3055T	TO-220	NS	60	70	10A	1.1	4A	20-100	4A	2	500	75W	G.P. power	TIP3055
MPSA14	TO-92(72)	NS	30	30	500	1.5	100	20000	100	125	10	625	G.P. Darlington	
MPSA65	TO-92(72)	PS	30	30	500	1.5	100	20000	100	100	10	625	G.P. Darlington	
MRF629	TO-39A	NS	16	36	400			20-200	100			5W	UHF power	
MRF660	TO-220A	NS	16	36	2.4A			20-160	250			25W	UHF power	
PN100	TO-92(72)	NS	35	60	500	0.5	100	60-240	150	350	50	600	G.P. amp/switch	PN2222, 2N3643
PN2907	TO-92(72)	PS	40	60	600	0.4	150	100-300	150	200	50	625	High S. switch	
PN200	TO-92(72)	PS	35	60	500	0.5	150	50-400	150	200	50	600	G.P. amp/switch	2N3638, BC214, PN3645
TIP31B	TOP-66	NS	80	80	3A	1.2	3A	25	1A	3	500	40W	Power output	
TIP32B	TOP-66	PS	80	80	3A	1.2	3A	25	1A	3	500	40W	Power output	
TIP142	TOP-3	NS	100	100	10A	2	5A	>1000	5A			125W	Audio output	TIP140, TIP141
TIP147	TOP-3	PS	100	100	10A	2	5A	>1000	5A			125W	Audio output	TIP145, TIP146
TIP2955	TOP-3	PS	70	100	15A	1.1	4A	20	4A	3	500	90W	Power output	MJE2955
TIP3055	TOP-3	NS	70	100	15A	1.1	4A	20	4A	3	500	90W	Power output	MJE3055
2N2222A	TO-18	NS	40	75	800	1.6	500	100-300	150	300	20	500	High S. switch	
2N3019	TO-39	NS	80	140	1A	0.5	500	50-100	500	100	50	800	H.F. amp	
2N3053	TO-39	NS	40	60	700	1.4	150	50-250	150	100	50	2.86W	G.P. switch	BD137
2N3054	TO-66	NS	60	90	4A	0.1	200	25-100	500	0.8	200	25W	Audio output	TIP31B
2N3055	TO-3	NS	60	70	15A	1.1	4A	20-70	4A	2.5	500	115W	G.P. power	BDY20
2N3563	TO-106	NS	15	30	50			20-200	8	600	8	200	RF – IF amp	BF173
2N3564	TO-106	NS	15	30	100	0.3	20	20-500	15	400	15	200	RF – IF amp	BF167
2N3565	TO-106	NS	25	30	50	0.35	1	150-600	1	400	1	200	Low level amp	BC108, BC208
2N3566	TO-105	NS	30	40	200	1	100	150-600	10	40	30	300	G.P. amp & switch	BC183
2N3567	TO-105	NS	40	80	500	0.25	150	40-120	150	60	50	300	G.P. amp & switch	BC337
2N3568	TO-105	NS	60	80	500	0.25	150	40-120	150	60	50	300	G.P. amp & switch	
2N3569	TO-105	NS	40	80	500	0.25	150	100-300	150	60	50	300	G.P. amp & switch	
2N3638A	TO-105	PS	25	25	500	0.25	50	100	50	150	50	300	G.P. amp & switch	BC328
2N3641	TO-105	NS	30	60	500	0.22	150	40-120		250	50	350	G.P. amp & switch	BC337
2N3642	TO-105	NS	45	60	500	0.22	150	40-120		250	50	350	G.P. amp & switch	BC337
2N3643	TO-105	NS	30	60	500	0.22	150	100-300	150	250	50	350	G.P. amp & switch	BC337
2N3644	TO-105	PS	45	45	500	1	300	100-300	150	200	20	300	G.P. amp & switch	BC327
2N3645	TO-105	PS	60	60	500	1	300	100-300	150	200	20	300	G.P. amp & switch	
2N3771	TO-3	NS	40	50	30A	2	15A	15-60	15A	0.2	1A	150W	Power output	
2N3866	TO-39	NS	30	55	400			10-200	50	500	50	1W	VHF amp	
2N3904	TO-92(72)	NS	40	60	200	0.2	10	100-300	10	300	10	310	Low level amp	BC167A, BF194
2N3905	TO-92(72)	PS	40	40	200	0.4	50	50-200	10	200	20	310	G.P. amp & switch	
2N3948	TO-39	NS	20	36	400			15	50	700	50	1W	VHF amp	
2N4030	TO-39	PS	60	60	1A	0.5	500	25	500	260	100	800	G.P. amp & switch	
2N4250	TO-106	PS	40	40	100	0.25	10	250-700	0.1	50		200	Low level amp	BC559
2N4258	TO-106	PS	12	12	50	0.5	50	30-120	10	700	10	200	Saturated switch	
2N4427	TO-39	NS	20	40	400	0.4	100	10-200	100	500	50	1W	VHF/UHF driver	2N3866
2N5401	TO-92(72)	PS	150	160	6000	0.5	50	60-240	10	100	10	625	H.V. switch	MPSL51
2N6557	TO-202	NS	250	250	500			>40	50	45		2W	H.V. med power	
2SC710	TO-92/76	NS	25	30	30			90	1	100		200	G.P. RF amp	BFS18
2SC1306	TOP-66	NS	65	65	3A			40-200	500	300		12W	H.F. output	2SC2166
2SC1307	TOP-66	NS	70	70	8A			20-150	2A	150		25W	H.F. output	2SC1969
2SC1674	TO-92(74)	NS	20	30	20	0.3	10	40-180	1	600	1	250	VHF amp	
2SC1969	TOP-66	NS	30	60	6A			10-180	10	150		20W	H.F. output	2SC1307
2SC2166	TOP-66	NS	75	75	4A			35-180	100					
2SC2694	T-40	NS	17	35	20A			10-180	1A	800		140W	VHF output	MRF247
2SC3355	TO-92(74)	NS	12	20	100			50-300	20	6.5GHz	20	600	UHF SS	MRF573
2SC3358	MX	NS	12	20	100			50-300	20	7GHz	20	250	UHF SS	MRF573

TRIACS

Type	CASE	Vdrm	It (rms) (A)	Ifsm (A)	Igt (mA)	Vgt (T = 25°C)	Pg (av) (W)	Ih (mA)	dv/dt (V/uS)	Comments (25°C)
BT137-500	TO-220	500	8	55	35 (70-+)	1.5	0.5	20	100	(Gate o/c)
BT139-500	TO-220	500	16	140	35 (75-+)	1.5	0.5	30	100	(Gate o/c)
BT139-600	TO-220	600	16	140	35 (75-+)	1.5	0.5	30	100	(Gate o/c)
BTA10-600B	TO-220	600	10	100	50 (100-+)			50	100 @400V	(Isolated Tab)
BTA41-600B	TOP-3	600	40	300	50 (100-+)	1.5	1.0	80	250	(Isolated Tab)
Q4006L4	TO-220	400	6	65	25 (50-+)	2.5 max all modes	0.9	60 max	100 typ	(Gate o/c)
SC141D	TO-220	400	6	74	50 (50-+)	2.5 "	0.5	50 max	100 typ	(Gate o/c)
SC146D	TO-220	400	10	110	50 (50-+)	2.5 "	0.5	50 max	150 typ	(Gate o/c)
SC151D	TO-220	400	15	110	50 (50-+)	2.5 "	0.5	50 max	250 typ	(Gate o/c)

FETS

Type	Case	BVgss V	@ Ig (uA)	Vgs (off) Min	Max	@ Vds	Id (nA)	Idss (mA) Min	Max	@ Vds	Vgs	YFS (umhos) Min	Max @	Vds	Ptot mW	Use/Comments
BF245B	TO-92 Var 1	30	1	0.5	8	15	10	6	15	15	0	3000	6500	15	300	N/CH Junction audio to H.F.
BF981	SOT-103	>6		2.5		10	20mA	4	25	10	0		14000 typ.		225	N/CH Dual gate MOS. VHF AMP.
BF998	SMT	>6	±10		2.5	8	20mA	2	18	10	0/4		24000 typ.	8	200	N/CH VHF/UHF dual gate SMT
BFR84	TO-72(2)	>6	100	1.5	3.8	10		20	55	10	0		15000 typ.	10	300	N/CH VHF dual gate
MFE131	TO-72(2)	±6	±10		4	15	200mA		30	15	0	8000	20000	15	300	N/CH Dual gate MOS. VHF amp.
MPF102	TO-92(72)	25	10	0.5	8	15	2	2	20	15	0	2000	7500	15	310	N/CH Junction – VHF
MPF105	TO-92(72)	25	1		8	15	10	4	16	15	0	2000	6000	15	310	N/CH Junction – audio Sw.
MPF106	TO-92(72)	25	1	0.5	4	15	10	4	10	15	0	2500	7000	15	310	N/CH Junction – RF
MPF131	262	±6	±10		4	15	200mA	3	30	15	0	8000	20000	15	350	N/CH Dual gate MOS. VHF amp
2N4342	TO-92(72)	25	10		5	10		12	30	10	0		6000	10	180	P/CH Junction – audio Sw.
2N5245	TO-92(77)	30	1	1.5	6	10		1	18		0		5800 typ.	10	360	N/CH VHF/UHF MIXER
2n5247	to-92(72)	25	10	0.5	6	15	10	1	5	15	0	1000	5000	15	625	n/ch Junction – audio Sw.
2N5459	TO-92(72)	25	1	2	8	15	10	4	9	15	0	2000	6000	15	310	N/CH Junction – audio Sw.
2N5484	TO-92(72)	25	1	0.3	3	15	10	1	5	15	0	3000	6000	15	310	N/CH Junction – VHF
2N5485	TO-92(72)	25	1	0.5	4	15	10	4	10	15	0	3500	7000	15	310	N/CH Junction – VHF
2N5486	TO-92(72)	25	1	2	6	15	10	8	20	15	0	4000	8000	15	310	N/CH Junction – VHF
3SK40	TO-72(2)	±6	±10		4	15	200mA		25	15	0	8000		15	250	N/CH Dual gate MOS. VHF amp.
3SK121	2-6F1A	–5		–2.5	4	5	100mA	20	45	5	0		17000 typ.	10	200	N/CH UHF GaAs dual gate

POWER FETS

Type	Ptot Case	Vds (max) (W)	Id (max) (V)	Vgs (thres.) (A)	Gfs min	Ciss max	Rds umhos	(pF)	(ohms)	Comment
BUK456-60A	TO-220	150	60	52	2.1	4	17M	2000	0.028	Inverters
BUK456-60A	TO-220	150	60	52	2.1	4	17M	2000	0.028	Inverters
BUK457-600B	TO-220	150	600	7.1	2.1	4	8M typ.	1800	1.2	Mains SMPS
BUZ71A	TO-220	40	50	13	2.1	4	4M	600	0.12	Nch power MOSFET
IRF520	TO-220	60	100	9.2	2	4	4M	350	0.25	Nch power MOSFET
IRfp450	to-247	180	500	14	2.0	4.0	14m	2700	0.4	Nch power MOSFET
MTP3055E	TO-220	40	60	12	2	4.5	4M	500	0.15	Nch power MOSFET
php6n60e	to-220	125	600	6.5	3.0	4.0	5m	1500	1.2	Nch power MOSFET
VN10K	TO-92(76)	1	60	0.3	0.3	2.5	100K	48	5	Nch DMOS FET
VN88AF	TO-202F	12.5	80	2	0.8	2				Nch VMOS FET
2SJ48	TO-3	100	120	7	0.15	1.45	1M	900	1	Pch power MOSFET
2SJ49	TO-3	100	140	7	0.15	1.45	1M	900	1	Pch power MOSFET
2SJ162	TOP-3	100	160	7	0.15	1.45	1M	900	1	Pch power MOSFET
2SK133	TO-3	100	120	7	0.15	1.45	1M	600	1	Nch power MOSFET
2SK134	TO-3	100	140	7	0.15	1.45	1M	600	1	Nch power MOSFET
2SK1058	TOP-3	100	160	7	0.15	1.45	1M	600	1	Nch power MOSFET
60n06	to-220	150	60	60	2.0	4.0	20M	1950	0.014	Nch power MOSFET

SMALL SIGNAL DIODES

Type	Case	Vr	If (ma)	Cd (pF)	Vf	@	If(mA)	Ir (ua)	@ Vr	Trr (ns)	Use /Comparable Types
Germanium											
OA47	DO-7	25	110	3.5	0.45		10	100	25	70	Gold bonded G.P. switching
OA90	DO-7	20	45		1.5		10	450	20		G.P. point contact OA70, OA80
OA91	DO-7	90	50		1.9		10	180	75		G.P. point contact OA71, 79, 81
DSOA91	DO-7	50	30	1	1		5	200	10		G.P. OA91, 1N60
1N60	DO-7	40	30	1	0.05		0.375	200	10		AM/FM detector
OA95	DO-7	90	50		1.5		10	110	0.75		G.P. point contact
Silicon											
BA102	DO-7	20		20-45	Cd Ratio 1.4	@	4V/10V				Variable capacitance
BA234/4	DO-35	20	100	<2	1		100	0.1	15		UHF Sw.
BAW62	SOD-27	75	200	2	0.75	@	5	5	75	4	High speed silicon Sw.
BB119	DO-35	15		20-25 @ 4V	Cd Ratio >1.3		4V/10V				Varicap – replaces BA102
BB122	DO-35	30		12 @ 3V	Cd Ratio 5.2	@		0.05	28		Varicap VHF UHF
BB212	TO-92	12		500-620 @ 0.5V	Cd Ratio >22.5		0.5V/8V	0.05	10		AM dual varicap
1N914A	DO-35	75	75	4	1		10	5	75	4	Small signal Sw. 1N4148
1N4148	DO-35	75	200	4	1		10	0.025	20	4	Small signal Sw. 1N914A
1N4448	DO-35	75	300	4	1		100	0.025	6	4	G.P. silicon Sw. 1N4148
5082-2800	DO-7	70	15	2	0.41		1	0.2	50	0.1	Schottky, UHF detector, mixer switch

RECTIFIERS

Type	Vr	If (a)	Ifsm (a)	Vf	@ If (A)	Ir (ua)	@ Vr	Use
BYX98/600	600	10	75	1.4	10	200	600	Power rectifier stud mount
1N4004	400	1	30	1.1	1	5	400	G.P. rectifier
1N4007	1000	1	30	1.1	1	5	1000	G.P. rectifier
BY229-400	400	7	60	1.85	20			SMPS trr = 150nS
1N4936	400	1	30	1.3	1	5	400	SMPS trr = 200nS
1N5404	400	3	200	1.1	3	5	400	G.P. rectifier
1N5408	1000	3	200	1.1	3	5	1000	G.P. rectifier
P600M	1000	6	400	0.9	6	25	1000	G.P. rectifier
6a10	1000	6	350	1.0	6	10	1000	G.P. rectifier
FB5006	600	50	500	1.2 (per leg)	25	10	600	High current bridge
3504	400	35	400	1.2 (per leg)	17.5	10	400	High current bridge
P04	400	6		1.3 (per leg)	6	10	400	Medium duty mini bridge
KBL04	400	4	200	1.1 (per leg)	3	10	400	G.P bridge
KBPC804	400	8	200	1.0 (per leg)	4	10	400	High current bridge
KBL10/407	1000	4	200	1.1 (per leg)	2	10	1000	G.P bridge SIL pins
W04	400	1.5	50	1.1 (per leg)	1	10	400	Mini bridge
W06	600	1.5	30	1.1 (per leg)	1	10	600	G.P bridge
2W06	600	2	50	1.0 (per leg)	1	10	600	G.P bridge
DB155G	600	1.5	50	1.1 (per leg)	1	10	600	Mini bridge DIL pins
1N5819	40	1	25	0.6	1	1mA	40	Schottky barrier
1N5822	40	3	80	0.525	3	2mA	40	Schottky barrier

SCRS

Type	Case	VDRM	IT (RMS) (A)	IFSM (A)	IGT (mA)	VGT	PG (AV) (W)			DV/DT (V/uS)	COMMENTS (25°C)
BT151-500R	TO-220	500	12	100	15 max	1.5 max	0.5	20	max	200	(RGK=100)
BT169B	TO-92A	200	0.8	8	.2 max	0.8 max	0.1	5	max	25	(RGK=1k)
C103B	TO-92	200	0.8	8	.2 max	0.8 max	0.01	5	max	20	(RGK=1k)
C106Y	TO-202	30	4	20	.2 max	0.8 max	0.1	5	max	8	(RGK=1k)
C106D	TO-126/TO-202	400	4	20	.2 max	0.8 max	0.1	3	max	8	(RGK=1k)
C122D	TO-220	400	8	82	25 max	1.5 max	0.5	3	max	50	(Gate o/c)
C122E	TO-220	500	8	82	25 max	1.5 max	0.5	30	max	50 typ	(Gate o/c)
C203B	TO-92A	200	0.8	8	.2 max	0.8 max	0.01	5	max	20 typ	
C220D	TO-48	400	10	82	25 max	1.5 max	0.5	30	max	50 typ	
P0103AA	TO-92A	100	0.8		.02-.2	0.8 max	0.1	5	max	100 typ	
P0103AB	TO-92	100	0.8		.02-.2	0.8 max	0.1	5	max	100 typ	
S4008	TO-220	400	8	85	25 max	1.5 max	0.5	30	max	50 typ	(Gate o/c)
S6008L	TO-220	600	8	85	25 max	1.5 max	0.5	30	max	50 typ	(Gate o/c)
SPS420	TO-48	400	20	200	25 max	2.0 max	0.5	50	max	200	(Gate o/c)
TYN608	TO-220	600	8	80	15 max	1.5 max	–	30	max	200 typ	
TYN608G	TO-220	600	8	80	25 max	1.5 max	–	45	max	500	
tyn816	to-220	800	16	160	25 max	1.5 max	1	40	max	500 min	(Gate o/c)

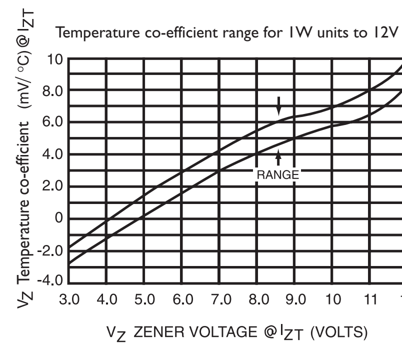
ZENER DATA

Type No. ▲ 400mW Series	Nominal Type No. ▼ 1 Watt Series	Test Current Zener Volt. VZ@IZT (V)	IZT (mA) 400mW	1W
1N746	1N4728	3.3	20	
1N747	1N4729	3.6	20	
1N748	1N4730	3.9	20	
1N750	1N4732	4.7	20	53
1N751	1N4733	5.1	20	49
1N752	1N4734	5.6	20	45
1N753	1N4735	6.2	20	41
1N754,1N957	1N4736	6.8	18.5	37
1N755,1N958	1N4737	7.5	16.5	34
1N756,1N959	1N4738	8.2	15	31
1N757,1N960	1N4739	9.1	14	28
1N758,1N961	1N4740	10	14	25

▲ (DC Power Dissipation: 400 milliwatts @ 50°C Ambient) (Derate 3.2mW/°C above 50°C)

TYPE NO. ▲ 400MW SERIES	NOMINAL TYPE NO. ▼ 1 WATT SERIES	TEST CURRENT ZENER VOLT. VZ@IZT (V)	IZT (MA) 400MW	1W
IN962	1N4741	11	12.5	23
1N759, 1N963	1N4742	12	11.5	21
1N964	1N4743	13	10.5	19
1N965	1N4744	15	9.5	17
1N966	1N4745	16	8.5	15.5
1N967,1N4112	1N4746	18	7.8	14
1N968	1N4747	20	7	12.5
1N969	1N4748	22	6.2	11.5
1N970	1N4749	24	5.6	10.5
1N971	1N4750	27	5.3	9.5
1N972	1N4751	30	5.3	8.5
1N973	1N4752	33	5.2	7.5

▼ (DC Power Dissipation: 1 W @ 50°C Ambient) (Derate 6.67mW/°C above 50°C). This range will dissipate up to 3W @ 75°C with 10mm lead length as heatsink.

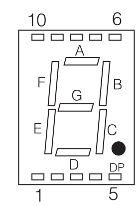


DISCRETE OPTOELECTRONICS

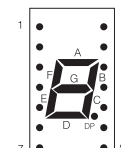
7-SEGMENT LEDS

Characteristics		Z 4118	Z 4104		Z 4146	Z 4118	Z-4130	Z4146
Common terminal pol.		Anode	Cathode		Anode	Anode	Cathode	Anode
Digit size	7.6mm	7.6mm	13.2mm		7.6mm	14.2mm	13.1mm	
Colour	Red	Red	Red	Red	Orange	Red		
Av. fwd. seg. current		25mA	25mA		25mA	25mA	25mA	25mA
Segment voltage	1.7	1.7	1.7	2.0	2.0	1.7		
Min. rev. brkdn. volt.		5	5	5	5	5	5	
Max. rev. current	100uA	100uA	100uA		100uA	10uA	10uA	
Seg. intensity (typ.)		450ucd	450ucd		500ucd	750ucd	4500ucd	8500ucd
Max. seg. dissipation		55mW	55mW		55mW	85mW	100mW	110mW
Connections								
Seg. A	1	10	7	1	7	7		
Seg. B	13	9	6	13	6	6		
Seg. C	10	8	4	10	4	4		
Seg. D	8	5	2	8	2	2		
Seg. E	7	4	1	7	1	1		
Seg. F	2	2	9	2	9	9		
Seg. G	11	3	10	11	10	10		
Dec. Pt.	9	7	5	9	5	5		
Common	3, 14	1, 6	3, 8	3, 14	3,8	3,8		

Note: Not all devices in this section are stocked by Dick Smith Electronics.



Z 4145 Z 4150 Z 4151
Z 4130 Z 4133 Z 4146



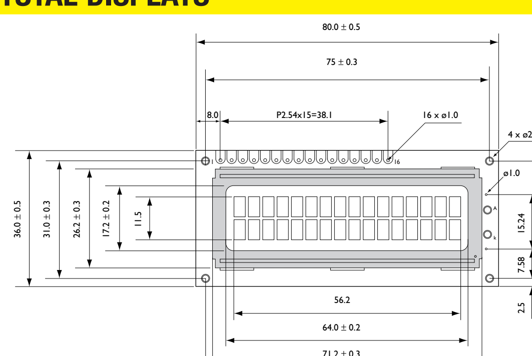
Z 4103 Z 4105
Z 4117 Z 4118

Z 4170 / Z 4172 LIQUID CRYSTAL DISPLAYS

The Z 4170 and Z 4172 are self-contained Liquid Crystal Displays (LCDs).
Both modules can display 2 rows of 16 characters, and both include a CMOS interface and drive IC to enable simple connection to a 4 or 8-bit microprocessor. 96 alpha-numeric characters are available from an in-built character generator, and up to 8 characters can be user defined. The Z 4172 includes a back-light feature. A full data sheet is included with each unit.

Interface Pin Functions

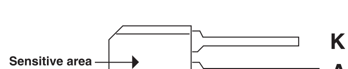
Pin No	Symbol	Function
1	Vss	Ground (0V)
2	Vdd	Logic supply (+5V)
3	VO	Contrast adjustment
4	RS	Data/instruction select
5	R/W	Read/write select
6	E	Signal enable
7-14	D0-D7	Data bus
15	A	LED backlight (Z 4172 only)
16	K	LED backlight (Z 4172 only)



Z 1956 SILICON PIN INFRARED PHOTO DIODE

Silicon PIN photo diode encapsulated in a black plastic package which acts as an infrared filter.

Reverse voltage	Vr max	30V
Power dissipation @ 25°C	Ptot	100mW
Junction temperature	Tj	100°C
Dark reverse current (Vr=10V Ee=0)	Idr	30nA
Light reverse current (Ee=5mW/cm2)	Ilr	200uA typ
Wavelength of peak response	Ipk	940nm



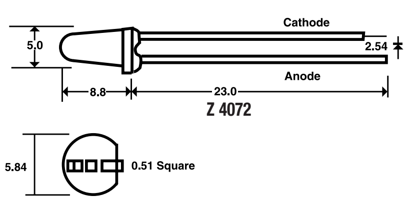
Z 3235 INFRARED EMITTING DIODE

High Intensity Gallium Arsenide infrared emitting diodes intended for remote control applications. Smoke coloured end looking encapsulation.

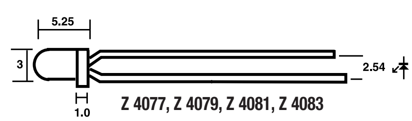
Forward voltage	Vf	1.2V @ 20mA
Continuous reverse voltage	Vr	5V
Forward current (d.c.)	If max	50mA
Peak forward current (300pps, 1us pulse)	Ifpk	3A
Total power dissipation up to Tamb=25°C	Ptot max	100mW
Junction temperature	Tj	100°C
Radiant incidence @ If=20mA	Eo	1mW/cm2
Wavelength of peak emission	Ipk	940nm

HIGH PERFORMANCE LEDs

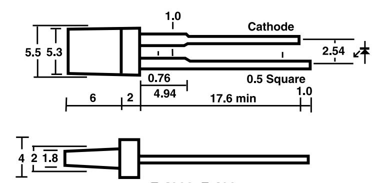
TYPE		NOMINAL SIZE (mm)	LENS	FWD. VOLTAGE (@ 20mA)	MAX. CONT. FWD. CURRENT (mA)	MAX. REV. VOLTAGE	LUMINOUS INTENSITY (mcd)	@ CURRENT (mA)	PEAK WAVELENGTH (nm)
Z 3820	Blue	3 dia.	Water clear	3.5	30	5	700	20	468
Z 3800	White	3 dia.	Water clear	3.5	30	5	1500	20	–
Z 4077	Red	3 dia.	Red diffused	2.1	15	5	2	10	697
Z 4079	Green	3 dia.	Green diffused	2.2	30	5	18	10	565
Z 4081	Yellow	3 dia.	Yellow diffused	2.2	20	5	15	10	585
Z 4083	Orange	3 dia.	Orange diffused	2.0	30	5	15	10	635
Z 3902	Blue	5 dia.	Water clear	3.5	30	5	1800	20	475
Z 3905	Blue	5 dia.	Water clear	3.6	30	5	5600	20	475
Z 3980	White	5 dia.	Water clear	3.6	30	5	2300	20	–
Z 3982	White	5 dia.	Water clear	5	20	5	8000	30	456
Z 4015	Green	5 dia.	Water clear	3.5	30	5	14000	20	512
Z 4033	Amber yellow	5 dia.	Water clear	2.0	50	5	6500	20	595
Z 4071	Red/green	5 dia.	White diffused	2.0	25	5	126/49	20	660/567
Z 4072	Red	5 dia.	Water clear	1.8	40	4	1000	20	660
Z 4074	Red	5 dia.	Water clear	1.8	40	4	2300	20	660
Z 4031	Sunset red	5 dia.	Water clear	2.0	50	5	8000	20	640
Z 4085	Red	5 dia.	Red diffused	2.1	15	5	3	10	697
Z 4087	Green	5 dia.	Green diffused	2.2	30	5	15	10	565
Z 4089	Yellow	5 dia.	Yellow diffused	2.2	20	5	12	10	585
Z 4091	Orange	5 dia.	Orange diffused	2.0	30	5	12	10	635
Z 4044	Flashing red	5 dia.	Red	12	60	5	390	25	660
Z 4046	Flashing green	5 dia.	Green	12	60	5	98	25	567
Z 4060	Red	10 dia.	Red diffused	2.0	30	5	40	20	625
Z 4067	Red	10 dia.	Water cear	1.9	50	5	6000	20	660
Z 4200	Red	1.8 x 5.0	Red	2.1	30	5	5.1	20	690
Z 4202	Green	1.8 x 5.0	Red	2.1	30	5	27	20	565
Z 4204	Yellow	1.8 x 5.0	Yellow	2.1	30	5	27	20	565



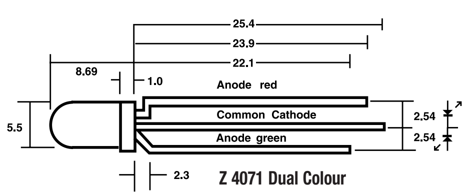
Z 4072



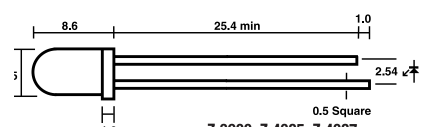
Z 4077, Z 4079, Z 4081, Z 4083



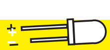
Z 4093, Z 4095



Z 4071 Dual Colour



Z 3900, Z 4085, Z 4087, Z 4089, Z 4091



FLASHING LEDs

	Z 4042 GREEN	Z 4044 RED	Z 4046 GREEN	UNITS
Nominal size	5	5	5	mm
Operating voltage range	3-10	3-15	3-15	V
Intensity (typ. @ 10V)	10	390	98	mcd
Peak wavelength	565	660	567	nm
Flash rate (approx @ 10V)	2	2.4	2.4	Hz
Duty cycle	25	25	25	%
Max. rev. voltage	0.6	5	5	V

Z 4801 LIGHT DEPENDENT RESISTOR (LDR)

RATINGS

Max. voltage	100V
Power dissipation (at 25°C)	50mW

CHARACTERISTICS

Dark resistance	> 10 M ohm
Resistance @ 10 Lux	48-140k ohm
Peak spectral response	560-620 nm

The approximate relationship between illumination and resistance is given by,

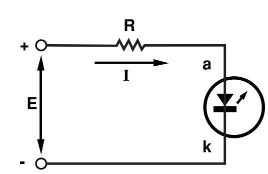
$\mathbf{R} = \mathbf{AL}^{-0.85}$ where;
R = resistance,
A = a constant (approx. 340-990 x 10^3),
L = light level in Lux

USING LEDs

When using a Light Emitting Diode (LED) as an indicator, use the following formula to determine series resistance for various voltages: R = (E-Vf) x 1000/I, where R is the resistance in ohms, E is the DC supply voltage, I is the LED current in mA and Vf is the forward voltage drop of the LED, typ. 2V.

ie. With Vf=2V, LED current=20mA,

for	6V,	R=220 ohms
	9V,	R=330 ohms
	12V,	R=560 ohms
	24V,	R=1200 ohms



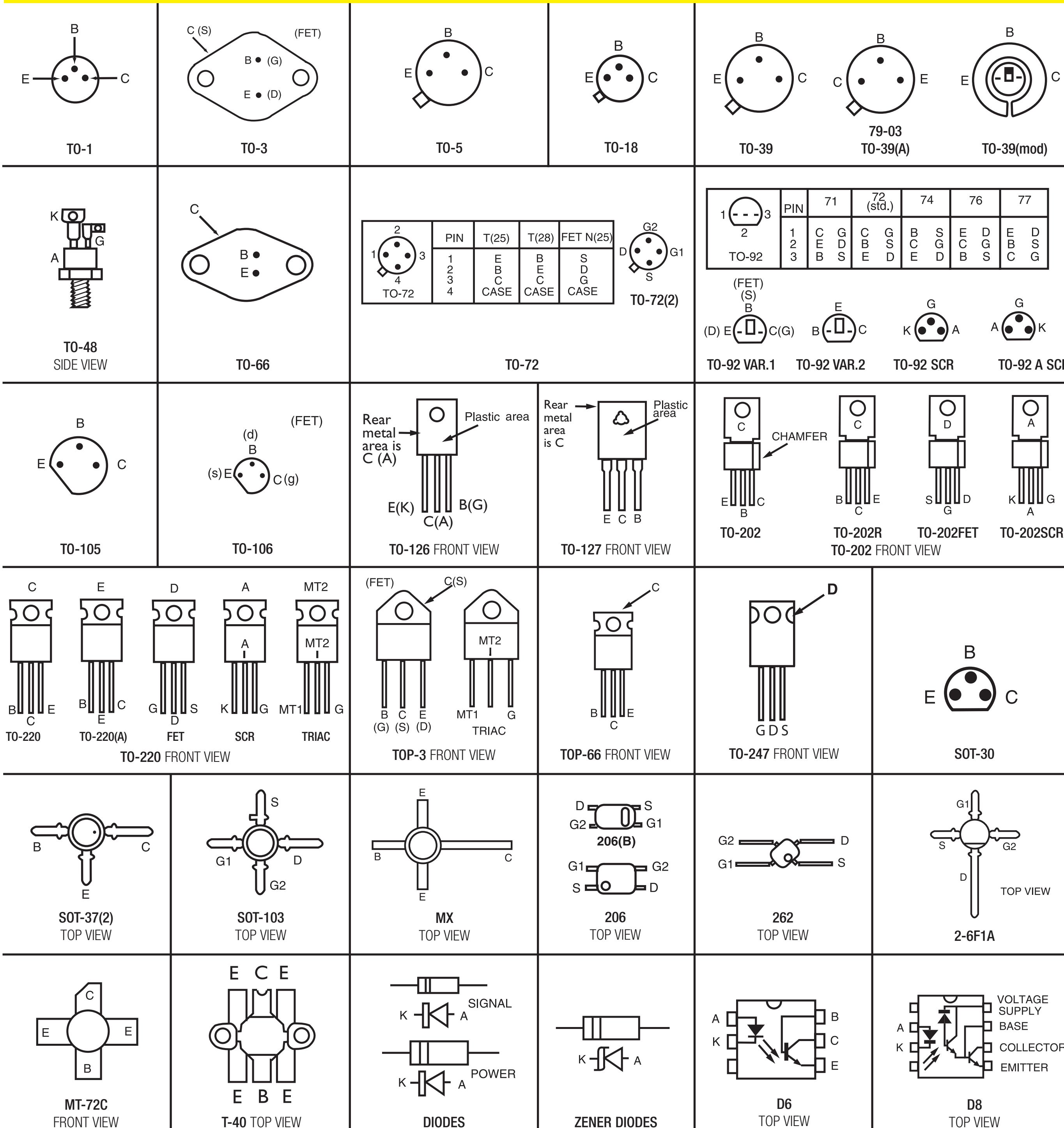
Note: This does not apply to flashing LEDs. Flashing LEDs can be driven from a voltage source, ie without a resistor.

Z 4710 BR100/03

Breakover voltage at dV/dt=10V/ms	V_{BO}	28 to 36V
Breakover voltage symmetry	Vs	3V
Breakover current at V=0.98 V_{BO}	I_{BO}	100µA
Maximum power dissipation	P_{TOT}	150mW

SEMICONDUCTOR OUTLINES

BOTTOM VIEW UNLESS OTHERWISE STATED



NTC THERMISTOR

These Negative Temperature Coefficient (NTC) Thermistors are useful for temperature sensing, temperature compensation, automatic gain control and fluid flow monitoring. They are not for use in conducting, reducing or aggressive gases or fluids. The resistance of the R1890 and R1895 can be calculated from the formula:

$$R = Ae^{B/T}$$

where, **R** is the thermistor resistance in ohms,
T is the temperature in Kelvin,
e is the natural logarithm base (2.718) and
A & B are constants which should be calculated from measurements on each particular thermistor for best accuracy.

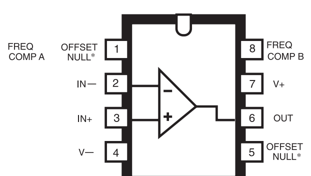
For nominal values of B and R, A is approximately 0.0277.

SPECIFICATIONS	R 1890	R 1895
Maximum permissible current at zero power	25mA	10mA
Operating temperature range	-20°C to +125°C	-30°C to +125°C
Thermal time constant	18s	24s
Resistance value at 25°C	100k ohms	100k ohms
B-Constant (@ 25° and 85°C)	4400	4400

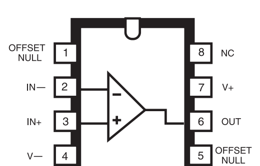
OPERATIONAL AMPLIFIERS HANDY REFERENCE GUIDE

TYPE	DEVICE	INPUT OFFSET VOLT. MAX (mV)	INPUT OFFSET CURRENT MAX (nA)	INPUT BIAS CURRENT MAX (nA)	VOLT. GAIN MIN (VOLTS/V)	UNITY GAIN B.W. TYP (MHz)	SLEW RATE AV=1 TYP (V/us)	OUTPUT VOLT. SWING R1=10K (VS=+/-15) (V)	SUPPLY MIN (V)	VOLTAGE MAX (V)	CMRR MIN (dB)	DIFFERENTIAL INPUT VOLT. (V)	SUPPLY CURRENT TA=25C (NOTE 1) MAX (mA)	INTERNAL FREQ. COMP.
	SINGLE OP AMPS													
LM301	GP amplifier	10	70	300	15k	1	0.5	+/-12	+/-3	+/-18	70	+/-30	3	No
LM741	GP amplifier	7.5	300	800	15k	1	0.5	+/-12	+/-3	+/-18	70	+/-30	2.8	Yes
LM308	Low input current	10	1.5	10	15k	1	0.3	+/-13	+/-2	+/-18	80	+/-1.0(Note 2)	0.8	No
NE5534	Low noise	5	400	2000	15k	10	6	+/-12	+/-3	+/-22	70	+/-0.5(Note 2)	8	No
OP27	Low noise precision	0.22	135	150	450k	5	1.7	+/-11	+/-4	+/-22	96	+/-0.7(Note 2)	5.7	Yes
TL071	JFET low noise	13	2	7	15k	3	13	+/-12	+/-3.6	+/-18	70	+/-30	2.5	Yes
LF351	JFET low noise	13	4	8	15k	4	13	+/-12	+/-4	+/-18	70	+/-30	3.4	Yes
TLC251	Prog low power CMOS	10	0.3	0.6	7.5k	0.7	0.6	7.8(Vs=10V)	1.4	18	60	+/-18	0.22	Yes
CA3130	MOSFET input	15	0.03	0.05	50k	4	10	+/-6(Vs=+/-8)	+/-2.5	+/-8	70	+/-8	15	No
CA3140	MOSFET input	15	0.03	0.05	20k	4.5	9	+/-12	+/-2	+/-18	70	+/-8	6	Yes
LM10CL	Inc. voltage Ref.	5	3	40	3k	0.1	*	6.94(Vs=7v)	1.1	7	74	+/-7	0.57	Yes
LM3080	Transconductance	5	500	5000	5.4mmho	2@Ao1	50	+/-12	+/-2	+/-18	80	+/-5	typ 1.1	No
LM627	Precision Op-amp	0.1	25	25	4M	14	4.5	+/-14.0	+/-3.5	+/-18	120	25mA(Note 2)	4.8	Yes
	DUAL OP AMPS													
LM1458	GP amplifier	7.5	300	800	15k	1	0.5	+/-12	+/-3	+/-18	70	+/-30	5.6	Yes
LM358	Low power	9	150	500	15k	1	0.5	+/-12	+/1.5	+/-16	65	32	2	Yes
LM833	Hi-Fi	5	200	1000	30k	15	7	+/-12	+/-5	+/-18	80	+/-30	8	Yes
TL072	JFET low noise	13	2	7	15k	3	13	+/-12	+/-3.6	+/-18	70	+/-30	5	Yes
LF353	JFET low noise	13	4	8	15k	4	13	+/-12	+/-6	+/-18	70	+/-30	6.5	Yes
LM13600	Transconductance	4	600	8000	5.4mmho	2@Ao1	50	+/-12	+/-2	+/-18	80	+/-5	typ 2.6	No
	QUAD OP AMPS													
LM324	GP amplifier	9	150	500	15k	1	0.5	+/-13	+/-1.5	+/-16	65	32	3	Yes
UA4136	GP low noise	7.5	300	800	15k	3	1	+/-12	+/-2	+/-18	70	+/-30	11	Yes
TL074	JFET low noise	13	2	7	15k	3	13	+/-12	+/-3.6	+/-18	70	+/-30	10	Yes
LF347	JFET low noise	13	4	8	15k	4	13	+/-12	+/-4.5	+/-18	70	+/-30	11	Yes
LM614	Inc. volt Ref.	7	50	250	25k	>1	0.8	12.4	+3	+36	80	36	typ 0.8	Yes
LM3900	Norton amp	*	*	200	1.2k	2.5	20	10	+4	+32	*	*	10	Yes

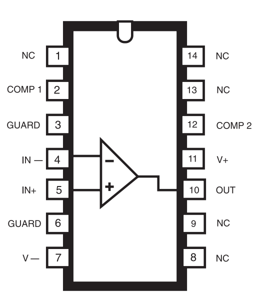
** Not Specified. Note 1: Supply current for all channels in the package. Note 2: Inputs have shunt diode protection, current must be limited. Note 3: Dick Smith Electronics may not stock all devices listed.*



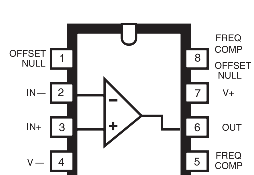
301, 308 *301 only



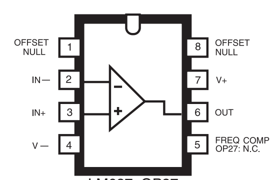
741, TL071, LF351, AD711



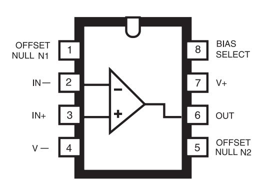
308



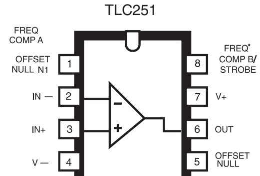
NE5534



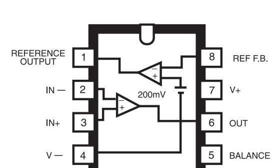
LM627, OP27



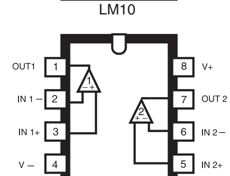
TLC251



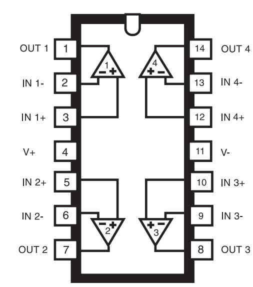
CA3130, CA3140 *CA3130 ONLY



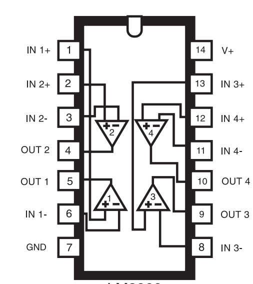
LM10



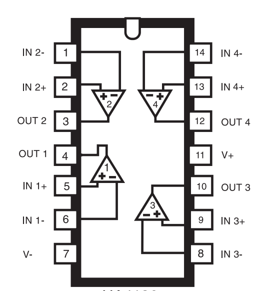
TL072, LF353, LM833, 1458, AD712, LM358



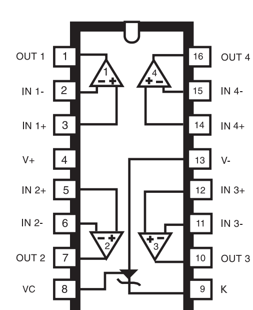
LM324, TL074, LF347



LM3900



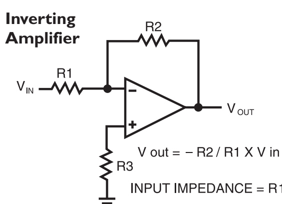
UA4136



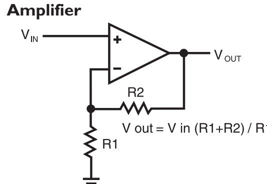
LM614

AMPLIFIER CONFIGURATIONS

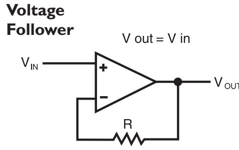
Inverting Amplifier



Non-Inverting Amplifier



Voltage Follower



555 TIMER (LM/NE555 BIPOLAR, TLC555 CMOS)

GENERAL

The 555 Timer is a highly versatile low-cost IC specifically designed for precision timing applications. It can also be used in monostable multi-vibrator, astable multi-vibrator and Schmitt trigger applications.

BIPOLAR 555

The 555 has many attractive features. It can operate from 4.5 volts to 16 volts. Its output can source (supply) or sink (absorb) load current up to a maximum of 200mA and so can directly drive loads such as relays, LEDs, low-power lamps, and high impedance speakers. When used in the 'timing' mode, the IC can readily produce accurately timing periods variable from a few microseconds to several hundred seconds via a single R-C network. Timing periods are virtually independent of supply rail voltage, have a temperature coefficient of only .005% per ˚C, can be started via a TRIGGER command signal, and can be aborted by a RESET command signal.

When used in the monostable mode, the IC produces output pulses with typical rise and fall times of a mere nS.

When used in the astable mode both the frequency and the duty cycle of the waveform can be accurately controlled with two external resistors and one capacitor.

CMOS 555

Due to its high impedance inputs (typically $10^{12}\Omega$), it is capable of producing accurate time delays and oscillations while using less expensive, smaller timing capacitors than NE555. Like the NE555, the TLC555 achieves both monostable (using one resistor and one capacitor) and astable (using two resistors and one capacitor) operation. In addition, 50% duty cycle astable operation is possible using only a single resistor and one capacitor. The TLC555 will operate at frequencies up to 2MHz and is fully compatible with CMOS, TTL, and MOS logic.

While the complementary CMOS output is capable of sinking over 100mA and sourcing over 10mA, the TLC555 exhibits greatly reduced supply current spikes during output transitions. This minimises the need for the large decoupling capacitors required by the NE555.

MONOSTABLE OPERATION

In the monostable mode, the timer functions as a one-shot. Referring to the circuit the external capacitor is initially held discharged by a transistor inside the timer.

When a negative trigger pulse is applied to lead 2, the flip-flop is set, releasing the short circuit across the external capacitor, driving the output HIGH. The voltage across the capacitor, increases exponentially with the time constant **t=R1C1**. When the voltage across the capacitor equals 2/3 VCC, the comparator resets the flip-flop which then discharges the capacitor rapidly and drives the output to its LOW state.

The circuit triggers on a negative-going input signal when the level reaches **1**/3 VCC. Once triggered, the circuit remains in this state until the set time has elapsed, even if it is triggered again during this interval. The duration of the output HIGH state is given by **t=1.1 R1C1**. The timing interval is independent of supply. When Reset is not used it should be tied high to avoid any possibility of false triggering.

ASTABLE OPERATION

When the circuit is connected as shown it triggers itself and free runs as a multivibrator. The external capacitor charges through R**1** and R2 and discharges through R2 only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

In the astable mode of operation, C**1** charges and discharges between **1**/3 VCC and 2/3 VCC. As in the triggered mode, the charge and discharge times and therefore frequency are independent of the supply voltage.

The charge time (output HIGH) is given by:

t1 = 0.693 (R1 + R2) C1

and the discharge time (output LOW) by:

t2 = 0.693 (R2) C1

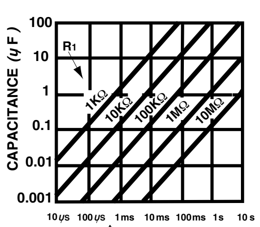
Thus the total period T is given by:

T = t1 + t2 = 0.693 (R1 + 2R2) C1

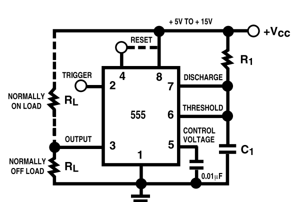
The frequency of oscillation is then:

$$f = \frac{1}{T} = \frac{1.44}{(R1 + 2R2)\,C1}$$

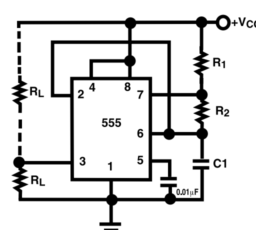
The duty cycle is given by: $D = \dfrac{R2}{R1 + 2R2}$



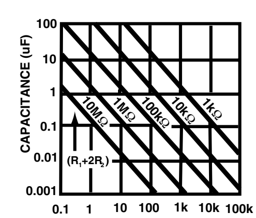
Time Delay vs R1 and C1



Basic Monostable Circuit



Basic Astable Circuit



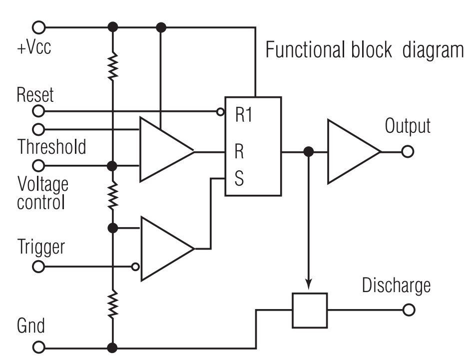
Free Running Frequency

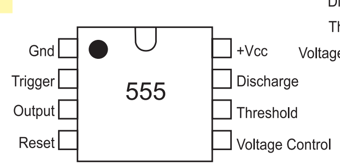
SPECIFICATIONS VCC = 15V UNLESS OTHERWISE STATED

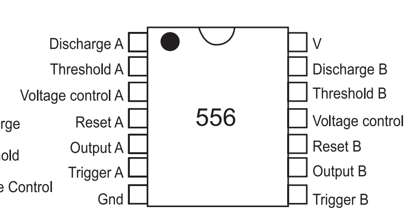
TA = 25˚C PARAMETERS	LM/NE555C CONDITIONS	LIMITS MIN	TYP	MAX	TLC555C CONDITIONS	LIMITS MIN	TYP	MAX
Supply Voltage		4.5		16V		2		18
Supply Current	(RL=∞, Vop=low)		10mA	15mA	(RL=∞, Vop=low)		360uA	
Power Dissipation				600mW				600mW
Threshold Voltage	(% of Vcc)		67%		(%of Vcc)		67%	
Threshold Current			0.1	0.25uA	(Vcc=5V)		10pA	
Trigger Voltage	(% of Vcc)		33%		(% of Vcc)		33%	
Trigger Current			0.5uA		(Vcc=5V)		10pA	
Reset Voltage		0.4	0.5	1V		0.4	1.1	1.5
Reset Current			0.1	0.4mA	(Vcc=5V)		10pA	
High Level Output	(Iol=100mA)	12.75	13.3V		(Iol=10mA)	12.5V	14.2V	
Low Level Output	(Iol=100mA)		2	2.5V	(Iol=100mA)		1.28V	3.2V
Output Current	Sink			200mA			100mA	
	Source			200mA			10mA	
Initial Error of Timing Interval		1%				1%		

FUNCTION TABLE

RESET	TRIGGER VOLTAGE	THRESHOLD VOLTAGE	OUTPUT	DISCHARGE SWITCH
Low	Irrelevant	Irrelevant	Low	On
High	<1/3 Vcc	Irrelevant	High	Off
High	>1/3 Vcc	>2/3 Vcc	Low	On
High	>1/3 Vcc	<2/3 Vcc	As previously established	







VOLTAGE REGULATORS

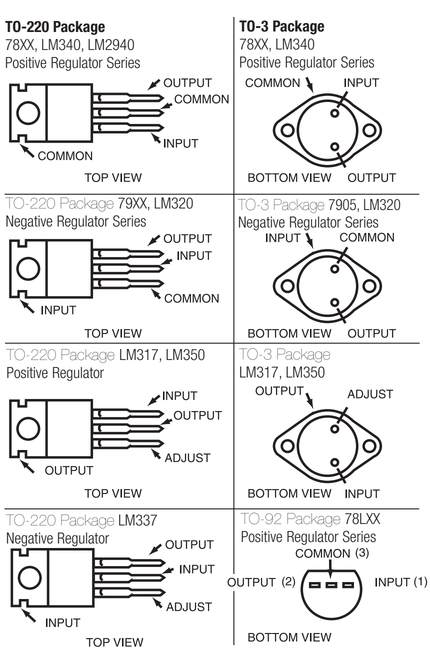
THREE TERMINAL VOLTAGE REGULATORS

These voltage regulators almost make power supply building unnecessary since they require only a filtered DC voltage input. They are essentially indestructible (if used within manufacturer's specs) because of internal current limiting and thermal shutdown should a short occur. They are ideally suited to local, on-board regulation simplifying power supply distribution systems. Excellent for TTL and project supplies. With the advent of microprocessors and microcomputers, these regulators have been used extensively in power supplies for such systems. This type of use typifies their versatility and reliability. Another area of supply regulation use is with analogue operational amplifiers. These circuits usually call for both + and – complementary rail voltages. These three terminal devices ideally suit such requirements.

The addition of protection diodes, as shown in the 317/350 application circuit, is recommended if there is any possibility of the regulator input or output being shorted to ground. These may also be necessary if significant (1uF) capacitance is connected between ground and either the common or output terminals of the regulator.

TYPE	POL CASE	VIN MAX	VOUT MIN	VOUT TYP.	VOUT MAX	IOUT (NOM) A.	DROP-OUT VOLT.
78L05Z	pos. TO-92	30	4.8	5	5.2	0.1	2.2
78L12Z	pos. TO-92	30	11.5	12	12.5	0.1	2.2
78L15Z	pos. TO-92	35	14.4	15	15.6	0.1	2.2
7805T	pos. TO-220	35	4.8	5	5.2	1	2.5
7808T	pos. TO-220	35	7.7	8	8.3	1	2.5
7812T	pos. TO-220	35	11.5	12	12.5	1	2.5
7815T	pos. TO-220	35	14.4	15	15.6	1	2.5
7805K	pos. TO-3	35	4.8	5	5.2	1	2
7812K	pos. TO-3	35	11.5	12	12.5	1	2
7815K	pos. TO-3	35	14.4	15	15.6	1	2
7905T	neg. TO-220	35	-4.8	-5	-5.2	1	2.3
7912T	neg. TO-220	35	-11.5	-12	-12.5	1	2.3
7915T	neg. TO-220	35	-14.4	-15	-15.6	1	2.3
7905K	neg. TO-3	35	-4.8	-5	-5.2	1	2.3
LM317T	pos. TO-220	40		adj. 1.2 to 37		1.5	3
LM317K	pos. TO-3	40		adj. 1.2 to 37		1.5	3
LM350T	pos. TO-220	35		adj. 1.2 to 32		3	3
LM350K	pos. TO-3	35		adj. 1.2 to 32		3	3
LM337T	neg. TO-220	40		adj. -1.2 to -371.5		3	
LM-2940CT-5	pos. TO-220	26	4.75	5	5.25	1	<1
LM-2940T-8	pos. TO-220	26	7.6	8	8.4	1	<1
LM-2940T-10	pos. TO-220	26	9.5	10	10.5	1	<1
LM-2940CT-12	pos. TO-220	26	11.4	12	12.6	1	<1
LM-2941CT	pos. TO-220	26V		adj. 5 to 20		1.5	<1

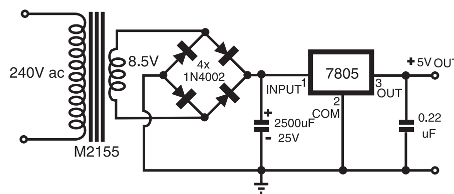
For all devices listed, the maximum junction temperature is 125°C. Except for TO-92 packages, maximum junction to case thermal resistance is 4°/watt. For TO-92 packages, junction to ambient thermal resistance is 230°/W.



TYPICAL POWER SUPPLY

OUTPUT: 5V @ 1A

The same basic circuit can be used with other regulators of different voltages, only the input AC voltage has to be changed to accommodate the requirement of the regulator, E.g. If an output of 12V was the requirement, a 7812 IC could be used with an AC input voltage of 15V.

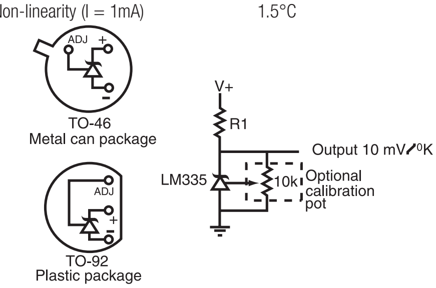


LM335 PRECISION TEMPERATURE SENSOR

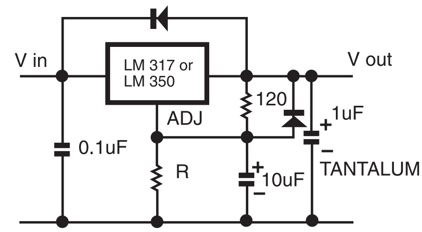
The LM335 operates as a two terminal zener having a breakdown voltage directly proportional to absolute temperature (10mV per Kelvin).

An adjustment terminal is provided, and maximum accuracy is realised when this is used to set the output voltage to 2.982 volts @ 25°C.

Max. rev. current	15mA
Continuous operating temp.	-40°C to 100°C
Operating output voltage	
(Tc = 25°C, I = 1mA) typ	2.98V
Max. uncalibrated temp. error	
(Tc = 25°C, I = 1mA)	6°C
Output voltage tempco.	10mV/°C
Dynamic impedance	0.6 ohms
Non-linearity (I = 1mA)	1.5°C



LM317 OR LM350 SERIES



1. Choose Resistor R as follows:
   R = (96 x Vout) – 120
   Where **R** is in ohms and Vout is in volts.
2. Vin should be at least 2.5 volts greater than Vout.
3. Capacitor voltage ratings must be chosen appropriately.
4. The protection diodes shown will be necessary if the input or output of the regulator is shorted to ground.
   1A types should be adequate.

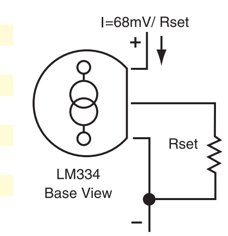
LM334 ADJUSTABLE CURRENT SOURCE

Operating voltage
1-30

Max power dissipation
200mW

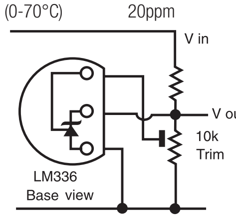
Voltage sensitivity
0.1%/V

Temperature sensitivity
+0.33%/°C



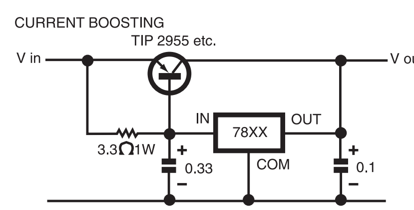
LM336 REFERENCE DIODES

	LM336-2.5	LM336-5.0
Max fwd current (mA)	10	10
Untrimmed ref voltage	2.44-2.54	4.9-5.1
Dynamic impedance (ohms)	1	2
Temp stability (0-70°C)	20ppm	20ppm

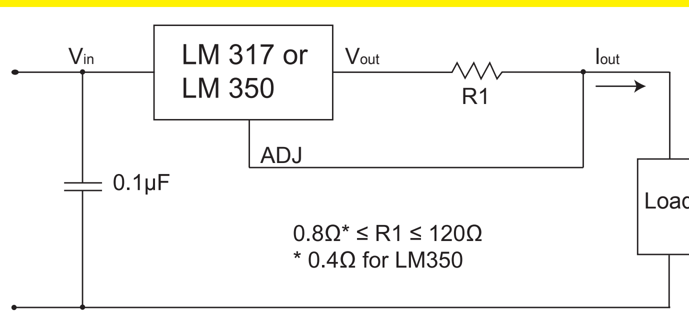


INCREASING THE OUTPUT CURRENT OF THE REGULATOR

By adding a PNP power transistor to a positive regulator, the output current can be increased above the normal rating of the regulator itself. The circuit shown below can be expected to deliver in excess of 4A with the pass transistor mounted on a heatsink. The same conditions can also be implemented with a negative regulator, the difference being the polarities of components, the pass transistor in this case would be an NPN type such as a 2N3055.



USING THE LM317 OR LM350 AS A CURRENT REGULATOR

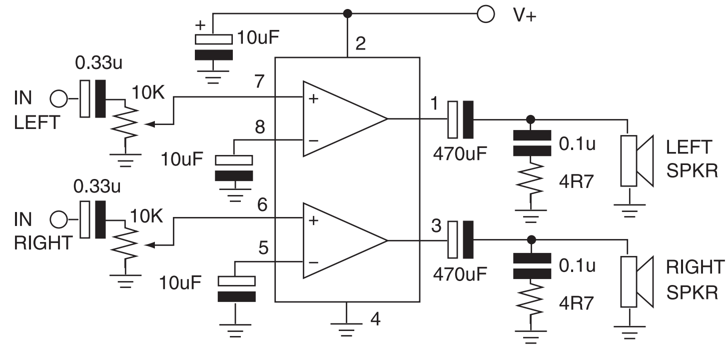


Z 6070 TDA2822M DUAL LOW-VOLTAGE POWER AMPLIFIER

The TDA2822M offers low voltage, low quiescent current operation and high power output from an 8-pin DIP package.

SPECIFICATIONS:

Supply voltage:	1.8-15 volt
Quiescent current:	9mA max
Gain:	39dB typ
Channel balance:	1dB
Input resistance:	100k ohm
Power output (typ.):	220mW @ 6 volt, 16 ohms
(1kHz, 10% dist.):	380mW @ 6 volt, 8 ohms
	1000mW @ 9 volt, 8 ohms
	650mW @ 6 volt, 4 ohms
	110mW @ 3 volt, 4 ohms
Rth j-amb:	100 K/W
Rth j-pin:	70 K/W
Max junction temp:	150˚C



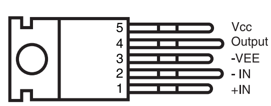
LM1875 20 WATT AMPLIFIER IC

The LM1875 is a monolithic power amplifier IC which takes advantage of advanced techniques to achieve low distortion, even at high output levels. Other features include high gain, fast slew rate and a wide power bandwidth, large output voltage swing, high current capability and wide supply range.
The device is internally compensated for gains of 10 and greater.

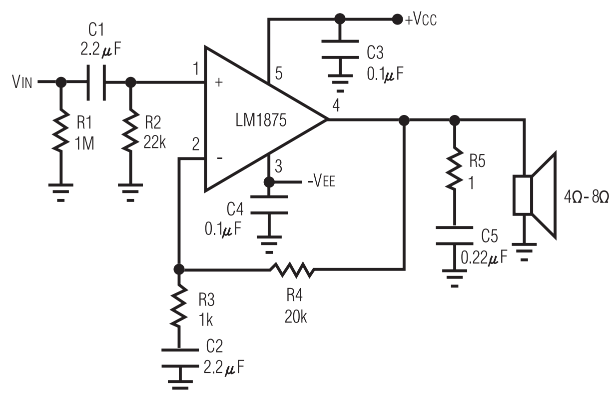
SPECIFICATIONS:

Supply voltage:	+/-30 volt max
Quiescent current:	100mA max
THD 20W/1KHz:	0.015% typ
Open loop gain:	90dB typ
Current limit:	4A typ
Thermal resistance:	2°C/W typ
(junction to case)	
Junction temperature:	150°C max

TO-220 Power package (T)



Front view

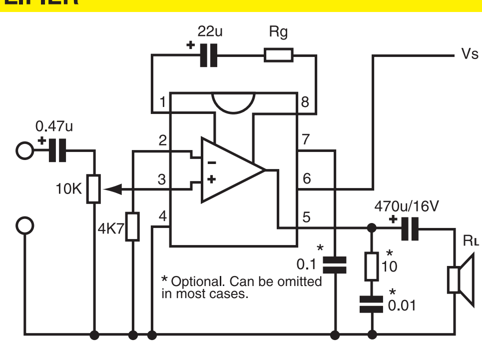


LM386 POWER AMPLIFIER

The LM386 power amplifier IC is ideal for low voltage applications. The gain is internally set at 20, but may be increased up to 200 by adding components between pins 1 and 8.

Gain	Rg
20	∞
50	680
100	180
200	0

Output Power (mW)			
Vs (volts)	Rl (ohms) 4	8	16
12	380	660	780
9	380	560	400
6	250	250	150
5	190	160	90



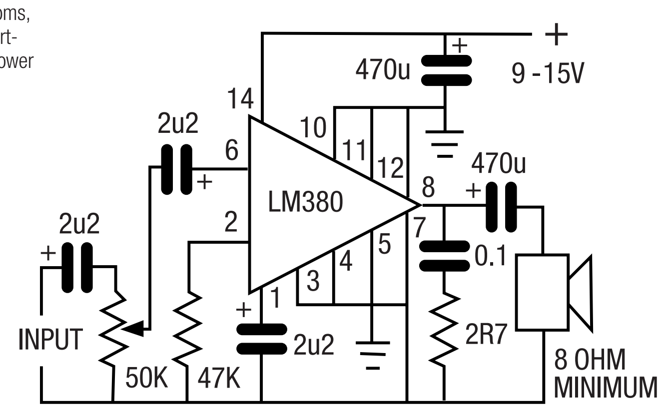
LM380 2.5 WATT AMPLIFIER IC

The LM380 is an amplifier IC for general purpose audio applications such as intercoms, small audio amplifiers, headphone amplifiers, TV and radio sound. The output is short-circuit proof and the device has internal thermal limiting. It is also suitable for low power DC operation such as for controlling a small motor or servo control.

The gain is internally set at 34dB, a voltage gain of 50.

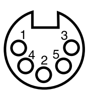
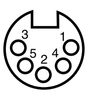
SPECIFICATIONS:

Supply voltage:	10-22 volts
Gain:	34dB
Output power:	2.5 watt (min.)
	(into 8 ohms, @ 3% THD)
Peak current:	1.3 amps
Input resistance:	150k ohms
Bandwidth:	100kHz
THD:	<0.2%
Quiescent current:	7mA typ



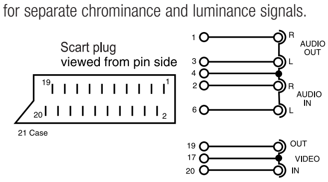
COMMON CONNECTORS

DIN CONNECTORS

Contact Arrangement	Application		Connections 1	2	3	4	5
MALE PLUG	Microphone	Mono (balanced)	Hot lead		Return lead		
		Mono (unbalanced)	Hot lead				
	Microphone	Stereo (balanced)	Hot lead of left-hand channel		Return lead of left-hand channel	Hot lead of right-hand channel	Return lead of right-hand channel
		Stereo (unbalanced)	Hot lead of left-hand channel			Hot lead of right-hand channel	
FEMALE SOCKET	Turntable	Monaural system		Screen earth	Hot lead		Connected to 3
		Stereophonic system			Hot lead of left-hand channel		Hot lead of right-hand channel
	Tape Recorder	Monaural system	Input signal		Output signal	Connected to 1	Connected to 3
		Stereophonic system	Input signal of left-hand channel		Output signal of left-hand channel	Input signal of right-hand channel	Output signal of right-hand channel

SCART CONNECTOR

The Scart connector, also known as the Euroconnector or Peri-Television connector, is part of a system for connecting television receivers and other home entertainment equipment. A Scart connector has 21 pins which provide for stereo audio and composite video in and out, RGB, two data lines and two control lines. A variation allows for separate chrominance and luminance signals.



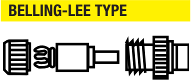
NOTES:

1. Pin 8 is used to select between an internal and external composite video signal. +12 volts applied to this pin will enable the composite video input on pin 20. Alternatively, this input may be enabled via a control on the video display device, e.g. an external AV select switch.
2. Pin 16 is a control line to select the external RGB inputs. +3 volts applied to this pin enables the RGB inputs on pins 15, 11 and 7.
3. When used for S-VHS signals, pin 15 carries chrominance and pin 20 luminance.
4. Pin 10 and 14 have been assigned for data for controlling and monitoring other appliances.

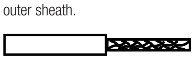
PIN	USE	LEVEL/IMPEDANCE
1	Audio Output (R)	0.5V/1kΩ
2	Audio Input (R)	0.5V/10kΩ
3	Audio Output (L)	0.5V/1kΩ
4	Audio Ground	
5	Blue Ground	
6	Audio Input (L)	0.5V/10kΩ
7	Blue	0.7Vp-p/75Ω
8	Status (CVBS)	L: 0-2V H: 10-12V/10kΩ
9	Green Ground	
10	Data D2B (Inverted)	
11	Green	0.7Vp-p/75Ω
12	Data D2B	
13	Red Ground	
14	D2B Ground	
15	Red	0.7Vp-p/75Ω
16	RGB Status/Fast Blanking	L: 0-0.4V H: 1–3V/75Ω
17	CVBS Video Ground	
18	RGB Status Ground	
19	Composite Video Output	1V/75Ω
20	Composite Video Input	1V/75Ω
21	Case/shield	

WIRING RF PLUGS

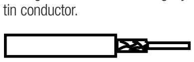
BELLING-LEE TYPE



Step 1.
Cut end of cable evenly and remove 22mm of outer sheath.



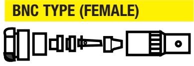
Step 2:
Remove 16mm of braid and dielectric, taking care not to damage centre conductor. Lightly tin conductor.



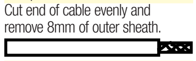
Step 3:
Slide cap and collet clamp over cable and slightly squeeze collet in position. Comb braid out and fan back over collet.

Step 4:
Solder tip of plug to centre conductor. Do not overheat. Push sub-assembly into body of plug, and screw cap onto body to complete assembly.

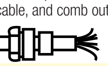
BNC TYPE (FEMALE)



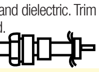
Step 1:
Cut end of cable evenly and remove 8mm of outer sheath.



Step 2:
Slide clamp nut and pressure sleeve over cable, and comb out braid.



Step 3:
Fold braid back and insert ferrule between braid and dielectric. Trim off excess braid.

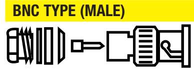


Step 4:
Remove 5mm of dielectric without damaging centre conductor. Tin conductor.

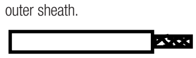
Step 5:
Slide rear insulator over conductor hard against rear insulator. Solder contact to conductor.

Step 6:
Fit front insulator in body and push sub-assembly onto body. Slide pressure sleeve into body and screw in the clamp nut to clamp cable.

BNC TYPE (MALE)



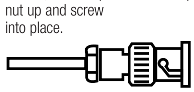
Step 1:
Cut end of cable evenly, and remove 7mm of outer sheath.



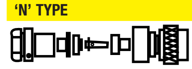
Step 2:
Slide clamp-nut, washer and rubber spacer over cable. Slide pressure sleeve over braid, and fan out braid.

Step 3:
Fold back braid against pressure sleeve and trim off excess. Strip 4mm of inside insulation off centre wire. Solder pin onto centre wire.

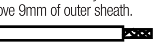
Step 4:
Fit assembly, pin first, into main receptacle. Push washer, rubber spacer and clamp nut up and screw into place.



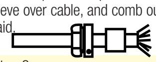
'N' TYPE



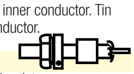
Step 1:
Cut end of cable evenly and remove 9mm of outer sheath.



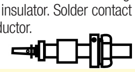
Step 2:
Slide clamp nut and pressure sleeve over cable, and comb out braid.



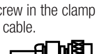
Step 3:
Fold braid back and insert ferrule between braid and dielectric. Trim off excess braid and remove 5.5mm dielectric without damaging inner conductor. Tin end of conductor.



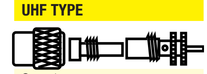
Step 4:
Slide rear insulator over conductor and position against end of dielectric. Slide contact over conductor until hard against rear insulator. Solder contact to conductor.



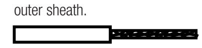
Step 5:
Fit front insulator in body and push sub-assembly into body. Slide pressure sleeve into body and screw in the clamp nut to clamp cable.



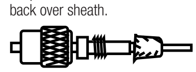
UHF TYPE



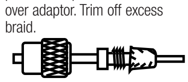
Step 1:
Cut end of cable evenly and remove 27mm of outer sheath.



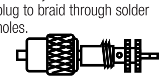
Step 2:
Slide coupling ring and adaptor onto sheath. Fan braid back over sheath.



Step 3:
Compress braid around cable and position adaptor so braid fans over adaptor. Trim off excess braid.



Step 4:
Remove 12.5mm dielectric and tin conductor. Screw the plug assembly onto cable and solder plug to braid through solder holes.

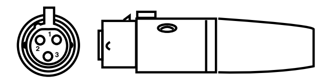


Step 5:
Solder conductor to centre pin and screw coupling ring onto assembly.

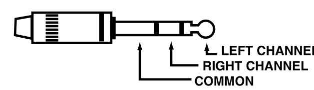
3 PIN XLR CONNECTORS

Widely used in professional audio applications these connectors generally offer a locking mechanism, very good cable clamping and low contact resistance. The pins are arranged so that when the connectors mate, one pin (used as the ground pin) always makes contact before the other two.

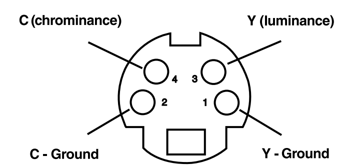
IEC STANDARD	COMMON ALTERNATIVE
1. Earth/Shield	1. Earth/Shield
2. In Phase (hot)	2. Out of Phase
3. Out of Phase (cold)	3. In Phase



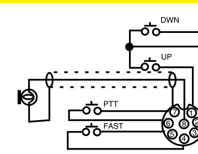
HEADPHONE PLUG



S-VIDEO CONNECTOR



YAESU 8-PIN MICROPHONE

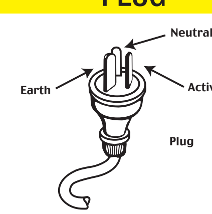


Commonly used on base and mobile transceivers

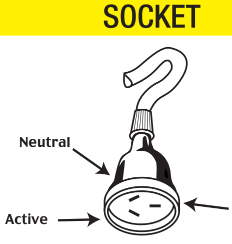
GET IT RIGHT!

Note the locations of the Active, Neutral and Earth pins, and their associated wire colours in the table below. If you are replacing a mains plug or socket on an extension cord, then follow exactly the wiring instructions supplied with the mains plug or socket.

PLUG



SOCKET



COLOUR CODE TABLE

CONDUCTOR	COLOUR	OLD COLOUR
Active	Brown	Red
Neutral	Blue	Black
Earth	Green/Yellow	Green

THE RS-232C INTERFACE

THE BASIC RS-232C ELECTRICAL SPECIFICATION

Communication rate:
0-20,000 bits per second

Driver output voltage levels maximum no load:
-25V logic 1, +25V logic 0

Driver output voltage ranges for loads
between 3k and 7kΩ
logic 1: -15V (7k) and -5V (3k)
logic 0: +15V (7k) and +5V (3k)

Driver output current, short circuit:
500mA maximum

Driver output impedance with power off:
300Ω minimum

Maximum driver output slew rate:
30V per microsecond

Receiver input resistance:
7kΩ maximum
3kΩ minimum

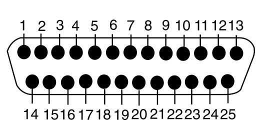
Effective receiver input capacitance:
2500pF maximum

Maximum receiver input voltage range:
-25V to +25V

The following table shows the nine most common signals used for serial communications and their pin allocations for nine and 25 pin connectors.

NAME	SIGNAL	PIN NO. (9 PIN)	PIN NO. (25 PIN)
TD	Transmitted Data	3	2
RD	Received Data	2	3
RTS	Request to Send	7	4
CTS	Clear to Send	8	5
DSR	Data Set Ready	6	6
SG	Signal Ground	5	7
CD	Carrier Detect	1	8
DTR	Data Terminal Ready	4	20
RI	Ring Indicator	9	22

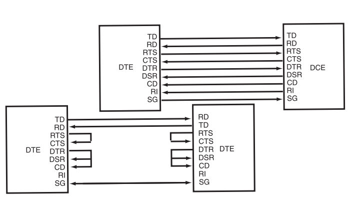
DB25 SERIAL MALE PLUG (FRONT VIEW)



COMMON RS-232C CONNECTIONS

Each signal (except ground) is either an input or an output depending whether it is on the Data Terminal Equipment 'DTE' (e.g. a computer terminal) or the Data Circuit Terminating Equipment 'DCE' (e.g. a modem). A typical connection is shown here.

When two computer terminals (DTEs) are connected together a 'null modem' hook-up is needed to fool each DTE into thinking that it is connected to DCE.A typical null modem connection is shown here.



ASCII CHARACTER CODES AS DEFINED IN ANSI X3.4

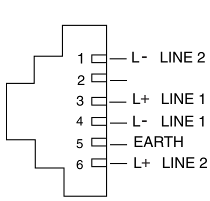
DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR
0	0	NUL	33	21	!	66	42	B	99	63	c
1	1	SOH	34	22	"	67	43	C	100	64	d
2	2	STX	35	23	#	68	44	D	101	65	e
3	3	ETX	36	24	$	69	45	E	102	66	f
4	4	EOT	37	25	%	70	46	F	103	67	g
5	5	ENQ	38	26	&	71	47	G	104	68	h
6	6	ACK	39	27	'	72	48	H	105	69	i
7	7	BEL	40	28	(	73	49	I	106	6A	j
8	8	BS	41	29	)	74	4A	J	107	6B	k
9	9	HT	42	2A	*	75	4B	K	108	6C	l
10	A	LF	43	2B	+	76	4C	L	109	6D	m
11	B	VT	44	2C	,	77	4D	M	110	6E	n
12	C	FF	45	2D	-	78	4E	N	111	6F	o
13	D	CR	46	2E	.	79	4F	O	112	70	p
14	E	SO	47	2F	/	80	50	P	113	71	q
15	F	SI	48	30	0	81	51	Q	114	72	r
16	10	DLE	49	31	1	82	52	R	115	73	s
17	11	DC1	50	32	2	83	53	S	116	74	t
18	12	DC2	51	33	3	84	54	T	117	75	u
19	13	DC3	52	34	4	85	55	U	118	76	v
20	14	DC4	53	35	5	86	56	V	119	77	w
21	15	NAK	54	36	6	87	57	W	120	78	x
22	16	SYN	55	37	7	88	58	X	121	79	y
23	17	ETB	56	38	8	89	59	Y	122	7A	z
24	18	CAN	57	39	9	90	5A	Z	123	7B	{
25	19	EM	58	3A	:	91	5B	[	124	7C	|
26	1A	SUB	59	3B	;	92	5C	\	125	7D	}
27	1B	ESC	60	3C	<	93	5D	]	126	7E	~
28	1C	FS	61	3D	=	94	5E	^	127	7F	DEL
29	1D	GS	62	3E	>	95	5F	-			
30	1E	RS	63	3F	?	96	60	‘			
31	1F	US	64	40	@	97	61	a			
32	20	SPACE	65	41	A	98	62	b			

ASCII CONTROL CODES

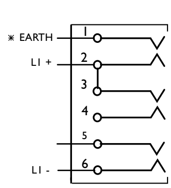
NUL	(Ctrl @)	Null	DLE	(Ctrl P)	Data Link Escape
SOH	(Ctrl A)	Start of Heading	DC1	(Ctrl Q)	Device Control 1
STX	(Ctrl B)	Start of Text	DC2	(Ctrl R)	Device Control 2
ETX	(Ctrl C)	End of Text	DC3	(Ctrl S)	Device Control 3
EOT	(Ctrl D)	End of Transmission	DC4	(Ctrl T)	Device Control 4
ENQ	(Ctrl E)	Enquiry	NAK	(Ctrl U)	Negative Acknowledge
ACK	(Ctrl F)	Acknowledge	SYN	(Ctrl V)	Synchronous Idle
BEL	(Ctrl G)	Bell	ETB	(Ctrl W)	End of Transmission Block
BS	(Ctrl H)	Backspace	CAN	(Ctrl X)	Cancel
HT	(Ctrl I)	Horizontal Tab	EM	(Ctrl Y)	End of Medium
LF	(Ctrl J)	Line Feed	SUB	(Ctrl Z)	Substitute
VT	(Ctrl K)	Vertical Tab	ESC	(Ctrl [)	Escape
FF	(Ctrl L)	Form Feed	FS	(Ctrl \)	File Separator
CR	(Ctrl M)	Carriage Return	GS	(Ctrl])	Group Separator
SO	(Ctrl N)	Shift Out	RS	(Ctrl ^)	Record Separator
SI (Ctrl O)	Shift In		US	(Ctrl _)	Unit Separator

COMMON TELEPHONE CONNECTIONS

FCC SERIES

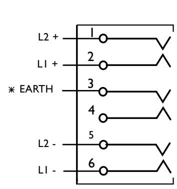


SIX POSITION SOCKET



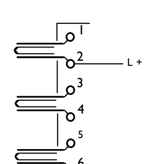
SINGLE LINE SOCKET

600 SERIES



✳ OPTIONAL EARTH

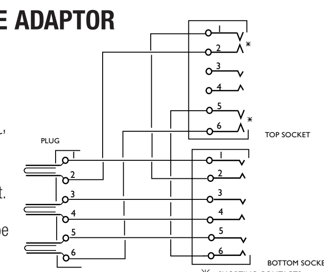
TWO LINE SOCKET



SINGLE LINE PLUG

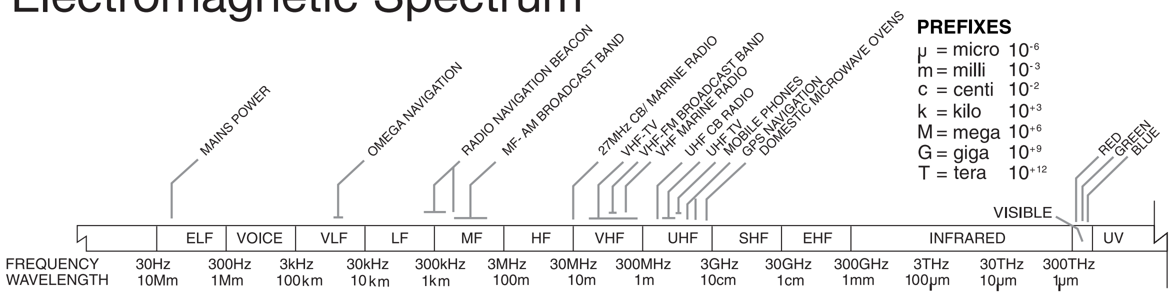
F 5114 MODE 3 DOUBLE ADAPTOR

The Mode 3 Double Adaptor is used with a fax machine or modem in the top socket, and an ordinary telephone in the bottom socket. The fax or modem, which must feature genuine 4-wire Mode 3 'change-over' line connection, can then switch the telephone in or out as part of its operation. Note the 'shorting contacts' in the top socket. These will allow the telephone to continue to work should the plug for the fax or modem be removed.



Front view of Socket

The Electromagnetic Spectrum



PREFIXES

μ = micro 10^{-6}
m = milli 10^{-3}
c = centi 10^{-2}
k = kilo 10^{+3}
M = mega 10^{+6}
G = giga 10^{+9}
T = tera 10^{+12}

AUSTRALIAN MF-AM BROADCAST STANDARDS

Frequency range: 526.5-1606.5kHz
Channel frequencies: 531, 540, 549 ... 1593, 1602 (Note: Some special services are located slightly above this band. Receivers may need modifications.)
Stereo signal: Compatible quadrature amplitude modulation (C-Quam) 25Hz +/- 0.1 Hz with a dev. of 3% to 5% of the quadrature ch
Frequency response: Within 2dB (50Hz-7.5kHz)
THD: Not exceeding 4% at 80% modulation (400Hz to 5kHz)
Stereo separation: 18dB min.

AUSTRALIAN VHF-FM BROADCAST STANDARDS

Frequency range: 88-108MHz
Channel frequencies: 88.1, 88.3, … 107.7, 107.9
Deviation: 75kHz
Pre-emphasis/De-emphasis: 50 microseconds
Stereo channel
Subcarrier frequency: 38kHz
Pilot frequency: 19kHz

NOTES:

1. Ancillary Communications Services may be included in the main program channel.
   Subcarrier frequency: 67kHz
   Maximum deviation: 7.5kHz
   Modulation: FSK or FM
   Pre-emphasis: up to150us
2. The frequencies 87.6, 87.7, 87.8, 87.9 & 88MHz have been released for use by certain Low Power Open Narrowcasting Services, such as Tourist Radio.

AUSTRALIAN ANALOGUE TV BROADCAST STANDARDS

Channel width: 7MHz vestigial sideband trans.
Vision carrier: 1.25MHz above lower frequency edge of channel
Primary sound carrier: 5.5MHz above vision carrier
Secondary sound carrier: 242.1875kHz above primary sound carrier
Vision modulation: Negative amplitude modulation
Lines per picture: 625 lines, interlaced 2:1
Line frequency: 15625Hz
Field frequency: 50Hz
Colour subcarrier Frequency: 4.43361875MHz
Aspect ratio: 4:3
Horizontal sync pulse Amplitude: 100% carrier amplitude
Front porch: 1.3 – 1.8us
Back porch: Line blanking interval – (front porch + sync pulse)
Line blanking interval: 11.8-12.3us
Black and blanking level: 76% peak carrier level
White level: 20% peak carrier level
Pre-equalisation Pulse interval: 2.5H (H=line period, 64 us)
Post-equalisation Pulse interval: 2.5H
Field sync pulse interval: 2.5H
Field blanking interval: 25H +12us
Ratio peak vision to peak sound carrier: Single sound carrier systems: 10dB
Dual sound carrier systems: Ch1: 13dB, Ch2: 20dB
Sound modulation: FM
Sound deviation: +/-50kHz
Audio pre-emphasis: 50us

AUSTRALIAN TV CHANNELS

CHANNEL NUMBERS AND FREQUENCY LIMITS			
CH	LIMITS (MHZ)	CH	LIMITS
0	45-52	41	617-624
1	56-63	42	624-631
2	63-70	43	631-638
3	85-92	44	638-645
4	94-101	45	645-652
5	101-108	46	652-659
5A	137-144	47	659-666
6	174-181	48	666-673
7	181-188	49	673-680
8	188-195	50	680-687
9	195-202	51	687-694
9a	202-209	52	694-701
10	209-216	53	701-708
11	216-223	54	708-715
12	223-230	55	715-722
27	520-526	56	722-729
28	526-533	57	729-736
29	533-540	58	736-743
30	540-547	59	743-750
31	547-554	60	750-757
32	554-561	61	757-764
33	561-568	62	764-771
34	568-575	63	771-778
35	575-582	64	778-785
36	582-589	65	785-792
37	589-596	66	792-799
38	596-603	67	799-806
39	603-610	68	806-813
40	610-617	69	813-820

Ch. 0-2 VHF Band I   Ch. 28-35 UHF Band IV
Ch. 3-5 VHF Band ii   Ch. 36-69 UHF Band V
Ch. 5A-12 VHF Band III   (MHz)

VHF MARINE FREQUENCIES

	FREQ (MHZ)			FREQ (MHZ)	
CH	SHIP	SHORE	CH	SHIP	SHORE
1	156.050	160.650	60	156.025	160.625
2	156.100	160.700	61	156.075	160.675
3	156.150	160.750	62	156.125	160.725
4	156.200	160.800	63	156.175	160.775
5	156.250	160.850	64	156.225	160.825
6	156.300	156.300	65	156.275	160.875
7	156.350	160.950	66	156.325	160.925
8	156.400	156.400	67	156.375	156.375
9	156.450	156.450	68	156.425	156.425
10	156.500	156.500	69	156.475	156.475
11	156.550	156.550	70	156.525	156.525
12	156.600	156.600	71	156.575	156.575
13	156.650	156.650	72	156.625	156.625
14	156.700	156.700	73	156.675	156.675
15	156.750	156.750	74	156.725	156.725
16	156.800	156.800	77	156.875	156.875
17	156.850	156.850	78	156.925	161.525
18	156.900	161.500	79	156.975	161.575
10	156.950	161.550	80	157.025	161.625
20	157.000	161.600	81	157.075	161.675
21	157.050	161.650	82	157.125	161.725
22	157.100	161.700	83	157.175	161.775
23	157.150	161.750	84	157.225	161.825
24	157.200	161.800	85	157.275	161.875
25	157.250	161.850	86	157.325	161.925
26	157.300	161.900	87	157.375	161.975
27	157.350	161.950	87A	157.375	157.375
28	157.400	162.000	88	157.425	162.025

Ch	Use	Ch	Use
6	SAR, Port Operations, Commercial	72	Yachts, Commercial, Professional Fishing, Port Operations
8	Port Operations, Commercial		
9-14	Port Operations	73	Non-Commercial, Yachts, etc.
16	Distress and Safety	74	Commercial
20	Port Operations	77	Yachts, Professional Fishing
23-28	Public Correspondence (Seaphone)	78	Commercial
		79	Port Operations
67	Distress and Safety	87	Public Correspondence (Seaphone)
68	Port Operations		
71	Professional Fishing	87A	Withdrawn 31-3-92

NZ VHF TV CHANNELS

CH	VISION (MHZ)	SOUND (MHZ)	CH	VISION (MHZ)	SOUND (MHZ)
1	45.25	50.75	7	196.25	201.75
2	55.25	60.75	8	203.25	208.75
3	62.25	67.75	9	210.25	215.75
4	175.25	180.75	10	217.25	222.75
5	182.25	187.75	11	224.25	229.75
6	189.25	194.75	12	231.25	236.75

AUSTRALIAN AND NZ

Aust HF Ch	UHF (MHz)	NZ HF (MHz)	(MHz)
1	26.965	476.425	26.330
2	26.975	476.450	26.340
3	26.985	476.475	26.350
4	27.005	476.500	26.370
5	27.015	476.525	26.380
6	27.025	476.550	26.390
7	27.035	476.575	26.400
8	27.055	476.600	26.420
9	27.065	476.625	26.430
10	27.075	476.650	26.440
11	27.085	476.675	26.450
12	27.105	476.700	26.470
13	27.115	476.725	26.480
14	27.125	476.750	26.490
15	27.135	476.775	26.500
16	27.155	476.800	26.520
17	27.165	476.825	26.530
18	27.175	476.850	26.540
19	27.185	476.875	26.550
20	27.205	476.900	26.570
21	27.215	476.925	26.580
22	27.225	476.950	26.590
23	27.255	476.975	26.620
24	27.235	477.000	26.600
25	27.245	477.025	26.610
26	27.265	477.050	26.630
27	27.275	477.075	26.640
28	27.285	477.100	26.650
29	27.295	477.125	26.660
30	27.305	477.150	26.670
31	27.315	477.175	26.680
32	27.325	477.200	26.690
33	27.335	477.225	26.700
34	27.345	477.250	26.710
35	27.355	477.275	26.720
36	27.365	477.300	26.730
37	27.375	477.325	26.740
38	27.385	477.350	26.750
39	27.395	477.375	26.760
40	27.405	477.400	26.770

EMERGENCY CHANNELS		CALLING CHANNELS	
Aust HF (AM)	Ch. 9	Aust HF (AM)	Ch.11
Aust UHF	Ch. 5/35	Aust HF (SSB)	Ch.16
NZ HF	Ch.15	Aust UHF	Ch.11
		NZ HF (AM)	Ch.15

NOTES: NZ HF Channels 1-24 are for AM use only.
NZ HF Channels 25-40 are for SSB use only.

AUSTRALIAN 27MHZ MARINE FREQUENCIES

MHz	Use
27.680	Commercial organisations. Calling and working ship-ship and ship-shore.
27.720	Professional fishing. Calling and working ship-ship and ship-shore.
27.820	Professional fishing. Calling and working ship-ship and ship-shore.
27.860	Distress, safety and calling, supplementary to 27.880
27.880	Distress, safety and calling.
27.900	Non-commercial organisations. Calling and working ship-shore.
27.910	Non-commercial organisations. Calling and working ship-shore.
27.940	Non-commercial organisations. Calling and working for club events, ship-shore and ship-ship.
27.960	Non-commercial organisations. Calling and working, ship-ship.
27.980	Recognised rescue organisations, e.g. Surf rescue. Calling and working. Ship-ship and ship-shore.