Issue 6.

GQRP Component Data Book

How it all works.

This is a group project and is designed to grow over the years. It should definitely not be seen as the work of a few or even an individual but contributed to by any club member who can type or draw.
It doesn't even need to be a thing of beauty as you can submit a hand sketch if you wish or something that you have used software to design.
The only stipulation is that it is your own work or you have permission from the copyright holder to submit it to the compiler, Tony G4WIF.
The submission must contain your name (and callsign if you have one), and if it is the work of someone else, then acknowledgement that it is being reproduced with their kind permission.

How to Submit.

Two file formats are proposed because the club does not have all the software that you might have. You can send a Microsoft Word File or convert your work to Portable Document format. All PC's are capable of this - and if you need advice then contact Tony G4WIF.

The club website will host an example Word template if you would like to use it but it isn't mandatory, just as long as the work carries credit to the author.

Finally ...

This document may not be sold and the club would very much appreciate that it is not hosted on any other website.

GQRP Component Data Book - Index

Useful Transistor pin-outs
OP-Amps
PIC Chips
Regulators
Mixers

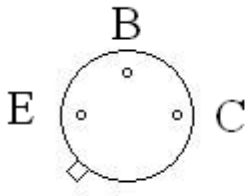
} *Mervyn Stanton - G4CCQ*

Handyman's Guide to Capacitors – Paul Harden NA5N

Popular Valve pin-outs – Bob Burns - G3OOU

TTL Pin-outs – Steve Harvey - N6QBQ

2N2222

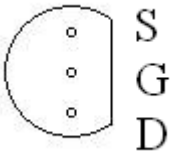


PN2222

Underside View

2N3819

2N7000



Underside View

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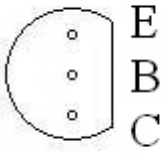

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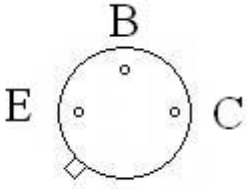

Underside View

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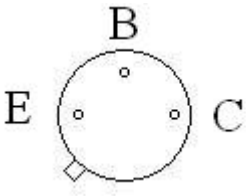

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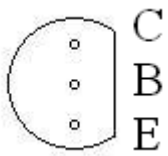

Underside View

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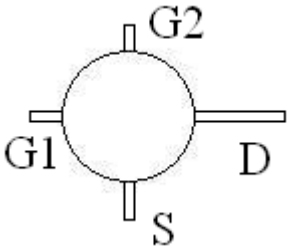

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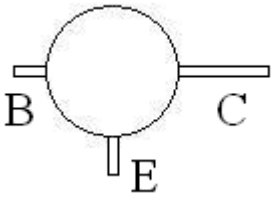
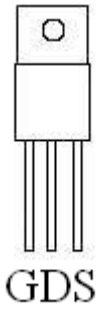


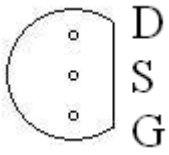
Top View

IRF510



Top View

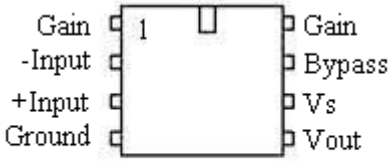
J304
J310



Underside View

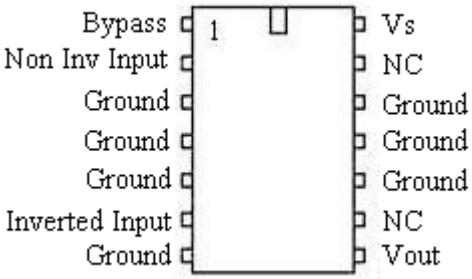
Title: Useful Transistor pin-outs – version 2 Author: Mervyn G4CCQ Page 2 of 2	GQRP Club Datasheet

LM386



Top View

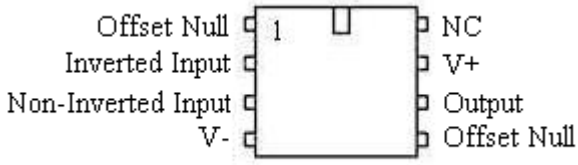
LM380 (14 pin version)



Top View

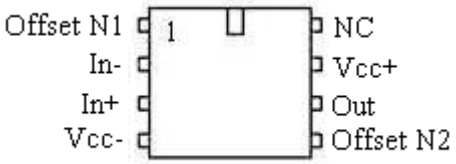
Note Pins 3, 4, 5, 10, 11, 12 are used as Heatsink pins

LM741



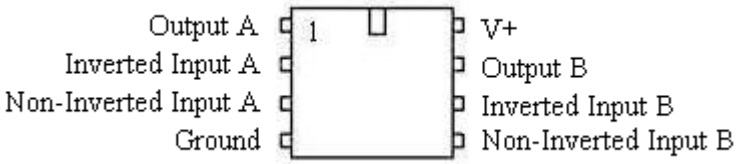
Top View

TL071



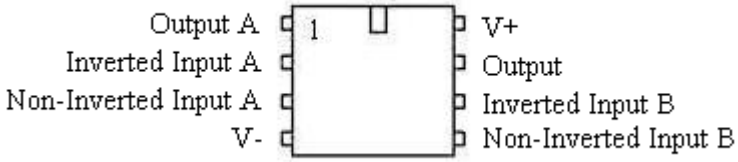
Top View

LM358



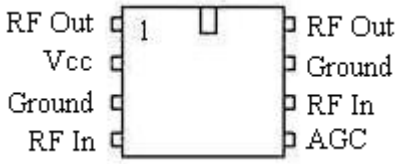
Top View

CA3240 (8 Pin Package)



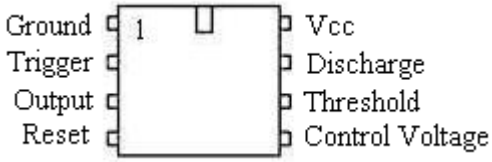
Top View

ML1350



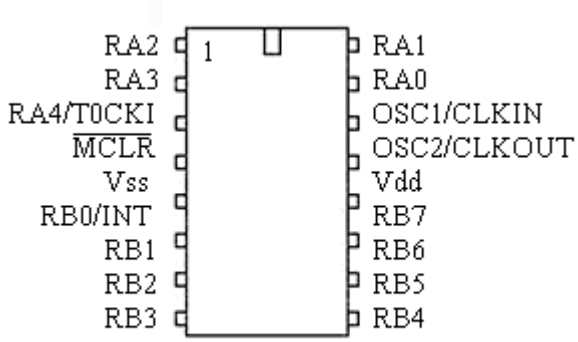
Top View

NE555



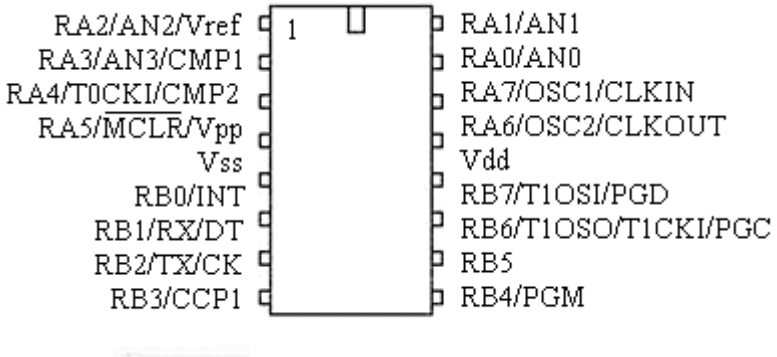
Top View

PIC16F84



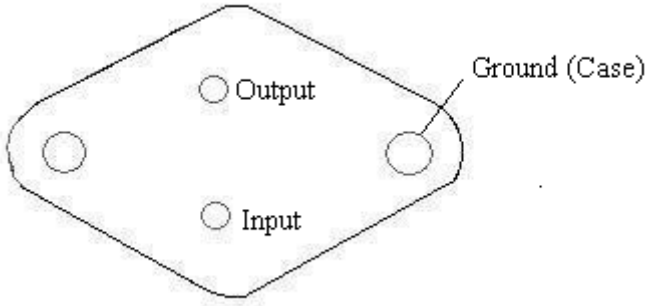
Top View

PIC16F628



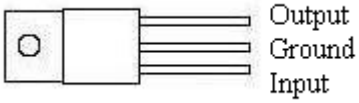
Top View

LM340 (5V and 12V TO3 Style)



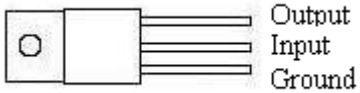
Underside View

LM7812 - LM7805 etc (TO220)



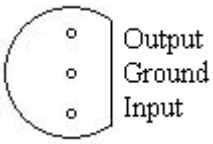
View from above

LM7905 etc



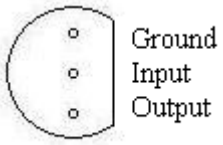
View from above

LM78L05 etc



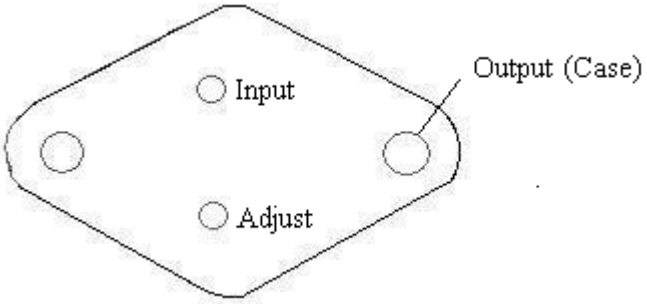
Underside View

LM79L05 etc



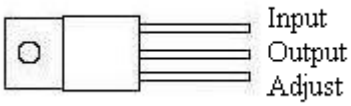
Underside View

LM317 (TO3 Style)



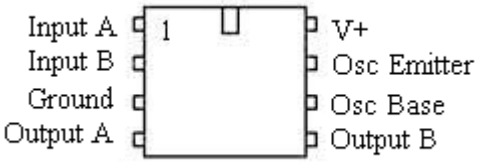
Underside View

LM317 (TO220 Style)



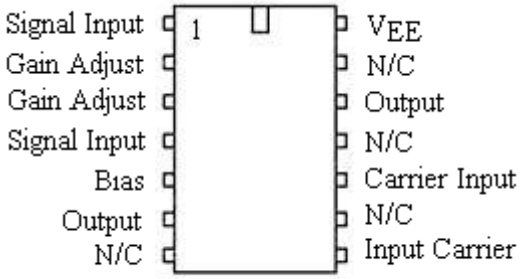
View from above

NE602



Top View

MC1496



Top View

The Handiman's Guide to
CAPACITORS

Paul Harden, NA5N (NA5N@Rt66.com)

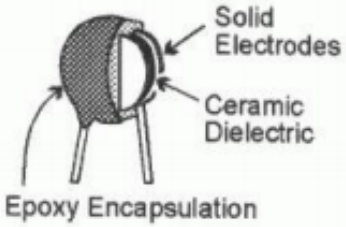
Capacitors comprise the *largest variety* of electronic components. There are many types of capacitors, great variations in their performance, many methods of packaging and marking, and dozens of major manufacturers, not to mention new types constantly being introduced with specific applications and performances. As a result, capacitors often cause lots of problems for homebrewers. Hopefully this article will take some of the mystery out of the myriad of capacitors available, plus present some of the classic "do's and don'ts."

PRINCIPAL CAPACITOR TYPES

There are many capacitor types, which usually refers to the material used for the electrodes, dielectric, and the packaging or sealing method. Here are some of the major capacitor types used by QRPers:

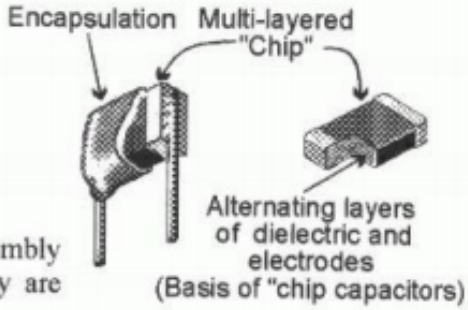
DISK CERAMIC CAPACITORS

Disk Ceramics consist of two metalic plates separated by a ceramic dielectric, whose area and spacing determines the capacitance.. These caps are low cost and suitable for many applications. Their main disadvantage is high capacitance changes with temperature (high temperature coefficient), except for the "NP0" varieties that are temperature stable. These caps are the most commonly used for general purpose circuits, but the *non-NP0 types* should be avoided in frequency determining circuits.



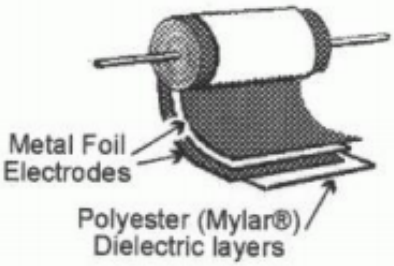
MONOLITHIC CERAMIC CAPACITORS

Alternating layers of electrodes and ceramic dielectric allow higher capacitances in physically smaller packages. Their characteristics are very similar to disk ceramics. They are encapsulated in epoxy to withstand insertion, soldering and solvent cleaning by the automatic PCB assembly machines. Introduced for mass production, they are inexpensive and available from surplus dealers.



POLYESTER FILM CAPACITORS

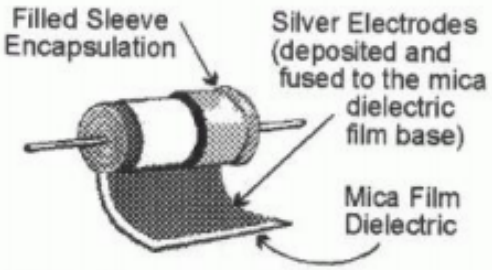
Polyester Films use layers of metal and polyester (Mylar®) dielectric to make a wide range of capacitances in relatively small packages at low voltages. These have become the standard caps for DC applications. The "rolled" film layers cause high dissipation and capacitance vs. temperature problems, and should be used carefully in high frequency or high current applications.



POLYPROPELENE FILM CAPACITORS

Polypropelene Films use layers of metal and polypropelene dielectric films virtually identical to Polyester Film caps. The polypropelene, however, is a dielectric offering a higher breakdown voltage than polyester, and thus more suitable for high voltage applications, such as switching power supplies. They also have low loss factors and good capacitance stability making them a good choice for high frequency applications, including oscillators and other frequency sensitive circuits. The main disadvantages are a slightly higher cost, and larger physical sizes over other film dielectric capacitors.

SILVER MICA CAPACITORS



This is a type of capacitor known as *metalized film* capacitor, in that the electrodes are a metal deposited by a sputtering process onto the dielectric film. **Silver Mica's** use a *mica* film dielectric with a thin layer of deposited silver forming the electrodes. These are *very* stable capacitors for high frequency circuits and the preferred choice for VFO and oscillator circuits. The main disadvantage are their higher cost, low operating voltages, and sometimes hard to find from hobby vendors.

POLYCARBONATE FILM CAPACITORS

These capacitors have become the standard for high stability MIL-SPEC film dielectrics. Their very low dissipation and extreme temperature stability make them almost the ideal capacitor *--at a price!* They are very expensive capacitors and not available from the hobby vendors, but listed here in the event you have the opportunity to appropriate some!

ELECTROLYTIC CAPACITORS

Aluminum Electrolytics are the most common, inexpensive electrolytic available from all hobby vendors. They are made similar to the polyester films, using aluminum foil electrodes and a dielectric material rolled into layers to increase the effective plate area to form high capacitances in small packages. The aluminum foil is "wetted" with a chemical agent to assist in conduction and increases the dielectric properties when a DC voltage is applied. This wetting agent can dry out after long periods of no use, or exceeding the rated voltage, causing a breakdown of the dielectric and component failure (usually a short circuit between the terminals). This is why electrolytics are often found shorted in older equipment that has not been powered for years. This is seldom a problem with equipment that is periodically powered up. These inexpensive aluminum electrolytic caps are suitable in all QRP applications.

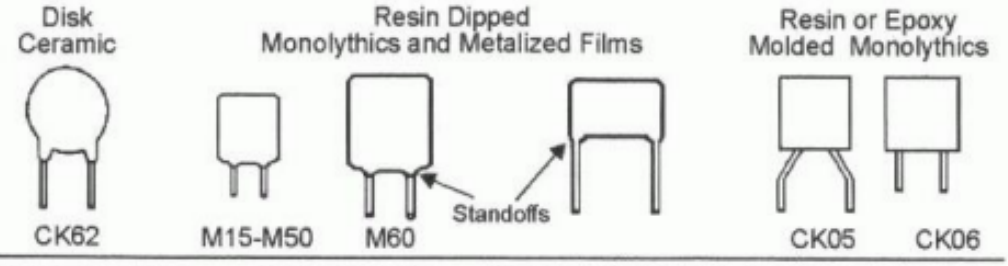
TANTALUM CAPACITORS

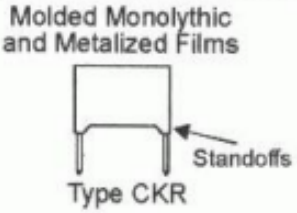
Tantalum's are a most unusual process that yeilds a high reliable electrolytic with a long life. Tantalum pentoxide powder is mixed with a manganese dioxide electrolyte and formed into a "pellet," forming *both* the dielectric and the positive electrode plate. Graphite or silver plating forms the negative plate. This "pellet" forms a *very large effective plate area,* and thus very high capacitances in very small packages. Both wet and dry electrolytes are used, and called *wet* or *dry* tantalums. There are few QRP applications where tantalum's would be *a must,* but if you have them -- use them! The chief disadvantages are higher cost due to the complicated manufacturing process, and ensuring you never reverse the polarity. A small positive voltage on the negative terminal can fuse the "pellet."

PRINCIPAL PACKAGING STYLES

In addition to the capacitor types (ceramic, metalized films, etc.), the packaging *style* is also important, and often required when ordering. The major capacitor packaging styles are shown below, which can also be used as an aid in identifying unknown capacitors.

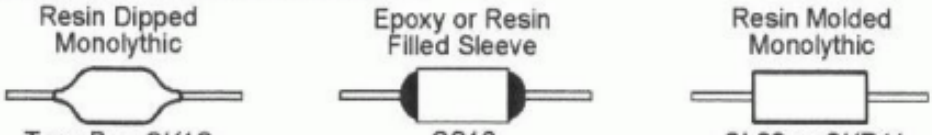
CAPACITORS WITH RADIAL LEADS





Conformal Coating is stated on modern data sheets, rather than specifying the actual encapsulation material. This means an epoxy or resin agent is used suitable for automatic insertion, wave soldering and industrial cleaners. Conformal coatings are more durable than coatings used on older capacitors.

CAPACITORS WITH AXIAL LEADS



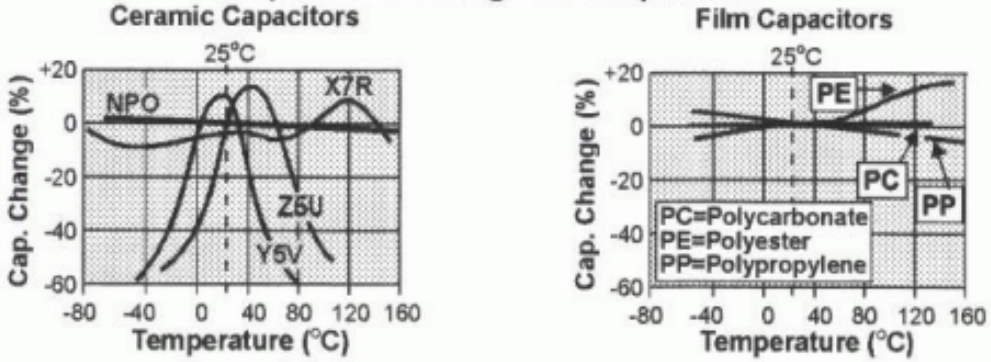
ORDERING/SPECIFYING CAPACITORS

When ordering capacitors, obviously the first concern is the capacitance, voltage rating and capacitor type needed. However, the ***temperature coefficient*** (TC) should be considered in frequency sensitive circuits (oscillators, VFO's, etc.) and the ***dissipation factor*** (DF) or ***Q*** when efficient energy transfer is needed (interstage coupling, active filters, etc.) or high peak-to-peak voltages (transmitter output filter caps).

TEMPERATURE COEFFICIENT

The **temperature coefficient (TC)** is the change in capacitance vs. a change in temperature. The ideal capacitor should have very little capacitance change with temperature, but as the charts show below, some capacitor types are far from ideal!

Capacitance Change vs. Temperature



25°C = 77°F = room temperature, where most electronic components, including capacitors, are specified.

The most common ceramic/monolithic ceramics are **X7R, Z5U and Y5V.** The **Z5U and Y5V** have a large temperature coefficient (and a large dissipation factor -- see below) and should not be used in frequency critical circuits or for coupling between stages. They are suitable for other general purpose applications and for DC and bypassing caps.

X7R's are the next best with moderate capacitance change vs. temperature and suitable as a general purpose capacitor, and can be used in oscillator circuits where moderate drift is acceptable.

NP0 (or C0G) are those ceramicsmade with a temperature stable dielectric which exhibits very little capacitance change with temperature. NP0's (N-P-zero) are recommended for oscillators and frequency sensitive circuits.

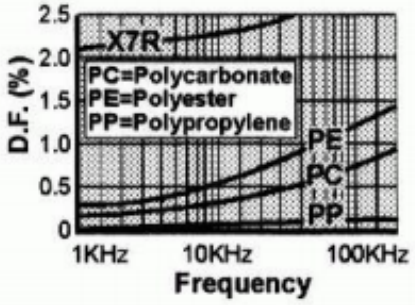
FILM CAPACITORS, such as the polyester and polypropylene, have much better capacitance stability vs. temperature than the general purpose ceramics, as also shown in the charts. Polyester caps are quite stable until about 120F.

DISSIPATION FACTOR (DF)

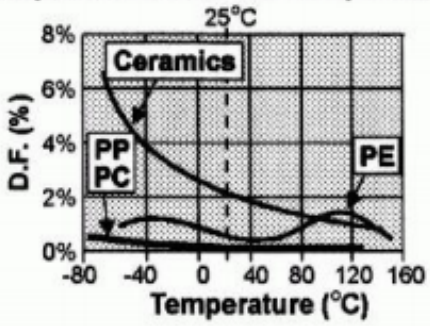
The **Dissipation Factor (DF)** is the ratio of the energy dissipated (lost) to the energy stored in the capacitor. The DF is frequency sensitive and specified at a certain frequency, such as 1KHz (for ceramics). The **Quality Factor (Q)** is the ratio of the energy stored vs. the energy dissipated - or the opposite of the dissipation factor. Film capacitors are usually specified by their "Q" factor.

Capacitors used for coupling small signals between stages, in active filters, the shunt caps on crystal filter, or in the transmitter output filter, should use low DF caps. Most all poly-film caps and some monolithic ceramics meet this requirement. Old ceramic caps in your transmitter output filter should be replaced with a low DF capacitor type, as a high DF cap here can absorb a surprising amount of your output power, and us QRPers need to get as much of that power to the antenna we can!

Dissipation Factor vs. Frequency



Dissipation Factor vs. Temperature



THE BOTTOM LINE

Ceramics that are not NP0 make good general purpose capacitors for bypass caps, etc. but should not be used for interstage coupling or in oscillators. When ordering new caps, I would recommend purchasing the monolithic ceramics for their lower cost.

NP0 Ceramics (especially the mono's) are a good choice for oscillator circuits.

Film Dielectrics are a good choice for a general purpose capacitor with low dissipation factors and good temperature characteristics. With their reasonably low cost, and about the same as ceramics, they would be today's preferred choice when purchasing new capacitors due to the low cost and better performance characteristics.

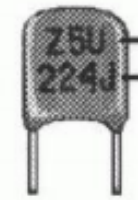
When ordering caps, look at the specifications carefully for TC and DF, along with the information and charts in this article, to make the best choice, performance vs. cost.

REFERENCE INFORMATION

The information on the following two pages is meant to be a general reference guide to assist in identifying capacitors, specifications and standard values.

CAPACITOR IDENTIFICATION

1. EIA IDENTIFICATION MARKINGS FOR CERAMICS



CERAMIC

EIA TEMPERATURE CHARACTERISTIC CODES

Z 5 U

Minimum Temperature
X=-55°C
Y=-30°C
Z=+10°C

Maximum Temperature
2=+ 45°C
4=+ 65°C
5=+ 85°C
6=+105°C
7=+125°C

Capacitance Change over the Temperature Range

A=±1.0%	P=±10%
B=±1.5%	R=±15%
C=±2.2%	S=±20%
D=±3.3%	T=-33,+22%
E=±4.7%	U=-56,+22%
F=±7.5%	V=-82,+22%

Example:
***Z5U** = Capacitance change is -56% to +22% over the temperature range +10°C to +85°C*

VALUE AND TOLERANCE

2 2 4 J

Capacitive Value in pF

Number of Zeroes

Tolerance Codes:

*C=±.25pF	J=± 5%	P= 0% to +100%
*D=±.50pF	K=±10%	W=-20% to + 40%
*F=±1Pf(±1%)	L=±15%	Y=-20% to + 50%
*G=±2PF(±2%)	M=±20%	Z=-20% to + 80%

* <10pF, tolerance in pF (codes C-G)
* >10pF, tolerance in % (codes F-Z)

Example:
***224J** = 220000pF*
= .22uF, 5% Tol.

EIA DECADE VALUES:

1R0 =	1pF	103 =	.01uF
100 =	10pF	104 =	.1uF
101 =	100pF	105 =	1uF
102 =	.001uF	106 =	10uF

Ex.: 203=.02uF, 473=.47uF, 503=.05uF, 5R1=5pF, 220=22pF, 221=220pF, etc.

2. DIRECT VALUE MARKING

Some manufacturer's mark the capacitance value directly on the case, along with other information. Ceramics will use the EIA codes (Z5U, X7R, etc.) while non-ceramics will use the industry codes (NPO, N150, etc.) for the temperature coefficient.

3. INDUSTRY MARKINGS FOR MONOLYTHIC & FILM CAPACITORS

Non-ceramic capacitors use the EIA markings for the capacitance value and tolerance. However, these dielectrics, such as polyester or polypropelene, have a *linear* change in capacitance per °C and thus the temperature coefficients are expressed in parts-per-million **(ppm)/°C** or in **%/°C**. A few of the common industry (non-ceramic) and EIA (ceramic) markings are shown in the following table.

Temperature Coefficients (TC) Ceramics (EIA) & Films Dielectrics

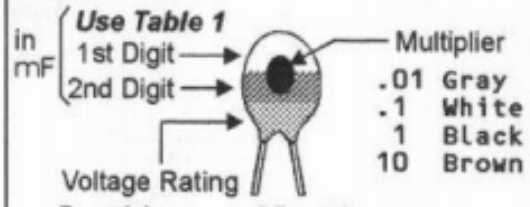
EIA#	INDUSTRY	T.C. (ppm/°C)
C0G	NP0	0ppm/°C
S1G	N033	- 33ppm
U1G	N075	- 75ppm
P2G	N150	- 150ppm
S2H	N330	- 330ppm
U2J	N750	- 750ppm
P3K	N1500	-1500ppm

4. COLOR CODING SCHEMES

Capacitor color coding schemes have all but disappeared except on some foreign made ceramics and dipped tantalums. The prevalent schemes are shown below.

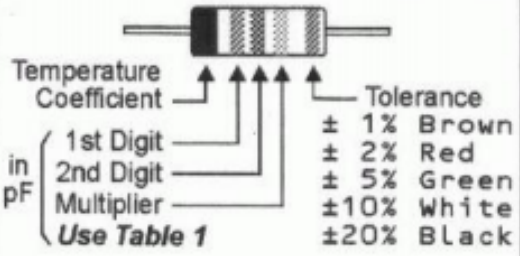
CURRENT COLOR SCHEMES (STILL IN USE)

DIPPED TANTALUM CAPACITOR



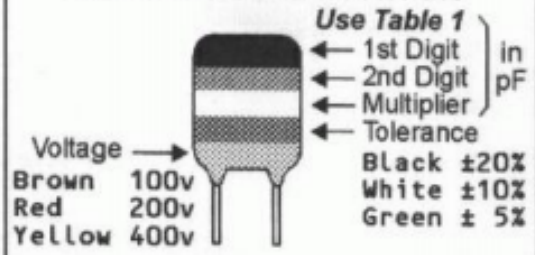
Multiplier		Voltage Rating		
.01	Gray	3v	White	20v Blue
.1	White	6.3	Yellow	25v Gray
1	Black	10v	Black	35v Pink
10	Brown	16v	Green	

TUBULAR CERAMIC CAPACITOR



Tolerance	
± 1%	Brown
± 2%	Red
± 5%	Green
±10%	White
±20%	Black

MONOLYTHIC CAPACITOR



Voltage		Tolerance	
Brown	100v	Black	±20%
Red	200v	White	±10%
Yellow	400v	Green	± 5%

CAPACITOR COLOR CODES

Color	1st-2nd Digit	Multiplier	% Tol.	T.C. ppm/°C
Black	0	1	±20%	- 0
Brown	1	10	± 1%	- 30
Red	2	100	± 2%	- 80
Orange	3	1K		-150
Yellow	4	10K		-220
Green	5	100K	± 5%	-330
Blue	6	1M		-470
Violet	7	--		-750
Gray	8	.01		+ 30
White	9	.1	±10%	+500

TABLE 1

Capacitance Values for all capacitor types

Temp. Coefficient and Tolerance for Ceramic/Monolythic types only

STANDARD CAPACITOR VALUES

These are the EIA **standard capacitor values.** These are the values available from most vendors. Non-polarized run from 1pF to 1uf, while electrolytics are available from 0.1uF and higher (not all electrolytic values listed here).

1.0pF	10pF	100pF	.001uF	.01uF	.1uF	1.0uF	10uF
1.2pF	12pF	120pF	.0012uF	.012uF	.12uF	1.2uF	12uF
1.5pF	15pF	150pF	.0015uF	.015uF	.15uF	1.5uF	15uF
1.8pF	18pF	180pF	.0018uF	.018uF	.18uF	1.8uF	18uF
2.2pF	22pF	220pF	.0022uF	.022uF	.22uF	2.2uF	22uF
2.7pF	27pF	270pF	.0027uF	.027uF	.27uF	2.7uF	27uF
3.3pF	33pF	330pF	.0033uF	.033uF	.33uF	3.3uF	33uF
3.9pF	39pF	390pF	.0039uF	.039uF	.39uF	3.9uF	39uF
4.7pF	47pF	470pF	.0047uF	.047uF	.47uF	4.7uF	47uF
5.6pF	56pF	560pF	.0056uF	.056uF	.56uF	5.6uF	56uF
6.8pF	68pF	680pF	.0068uF	.068uF	.68uF	6.8uF	68uF

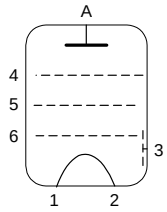
The capacitor information in this article was extracted from the *Data Book for Homebrewers and QRPers*, which contains data and information sheets on most all discrete components, hardware, IC's, etc. It is available for $20 each (which *includes* postage to US/VE addresses). Available from:

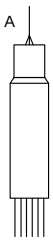
Quicksilver Printing
P.O. Box 757
Socorro, New Mexico 87801
(or info from: NA5N@Rt66.com)

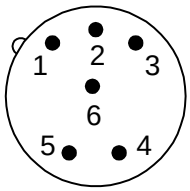
1J24B

Side view

Underside view



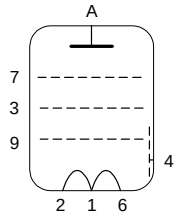


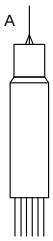


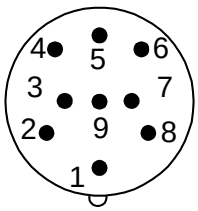
1P24B

Side view

Underside view

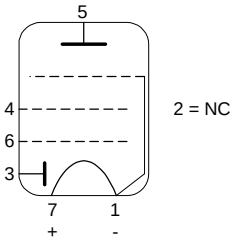


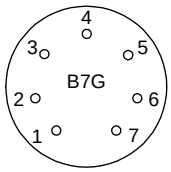




1S5

Underside view

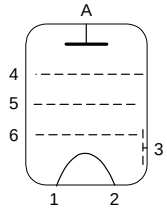


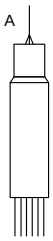


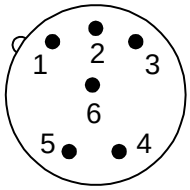
1SH24B

Side view

Underside View







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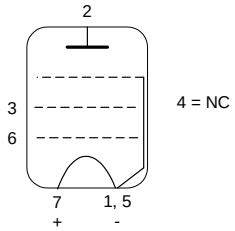
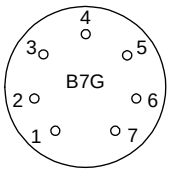
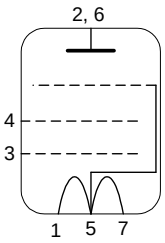


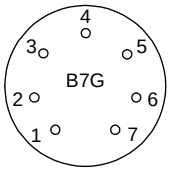
Underside view



3S4

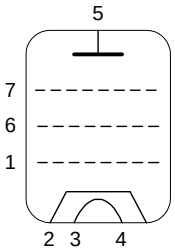
Underside view

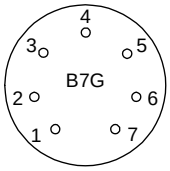




6AS6

Underside View





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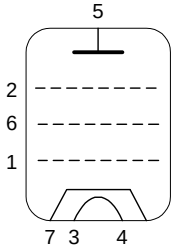
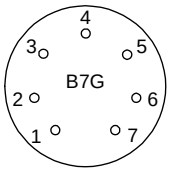
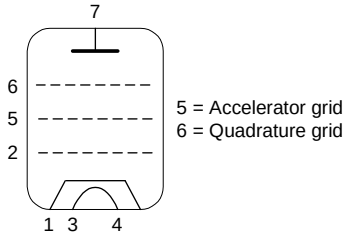
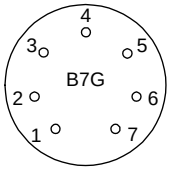


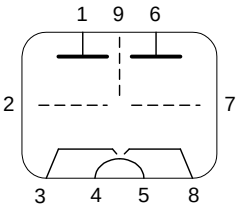


6BN6 Underside View

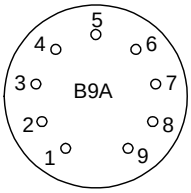




6BQ7A Underside View



Pins 6, 7 and 8 are section 1



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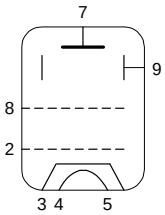
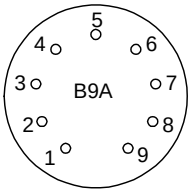


1 = IC
6 = NC



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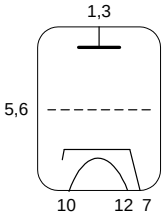

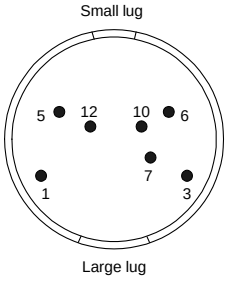

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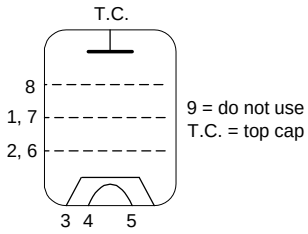

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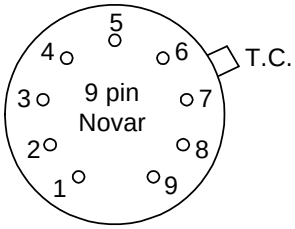

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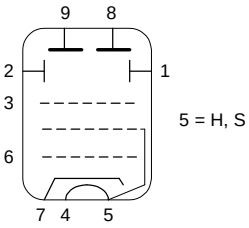

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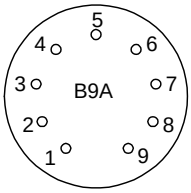

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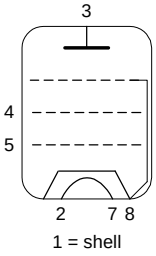
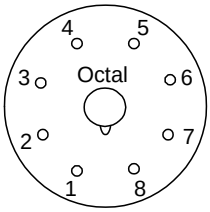
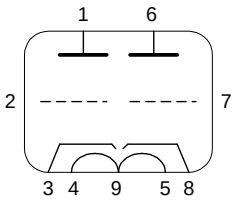


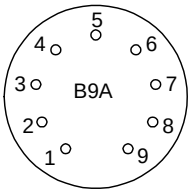
Underside View



12AT7 (ECC81), 12AU7 (ECC82), 12AX7 (ECC83)



Underside View



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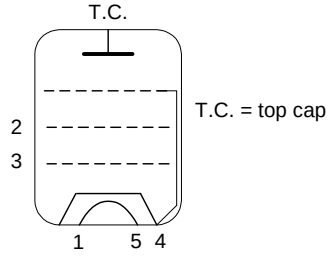

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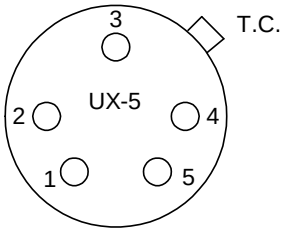
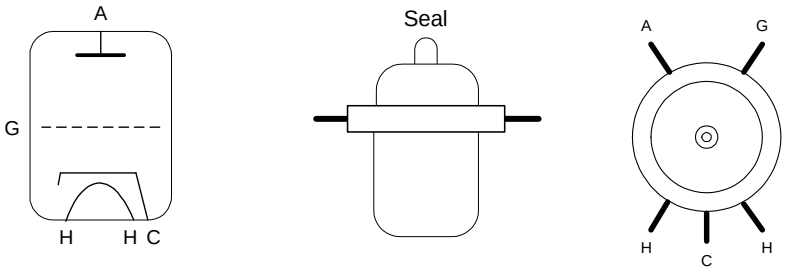


955

Viewed looking at the seal



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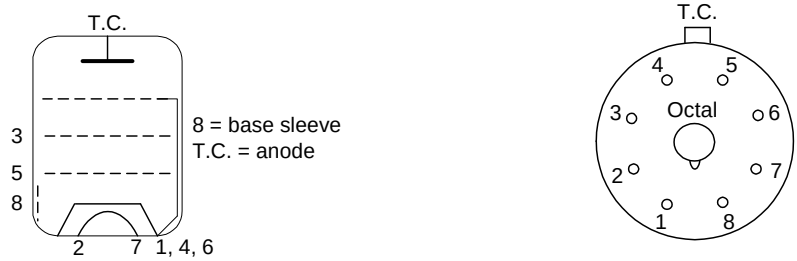
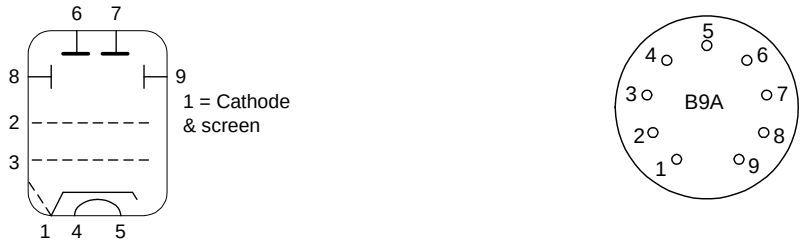
Underside View

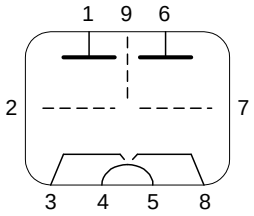


7360

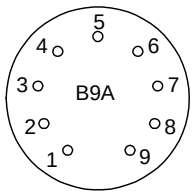
Underside view



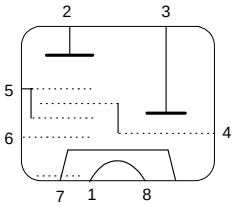
ECC85



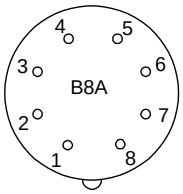
Underside View



ECH42



Underside View



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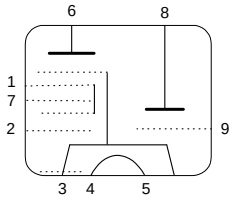
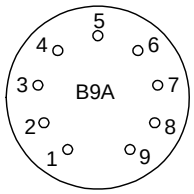
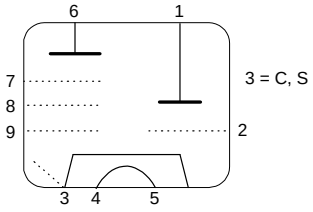


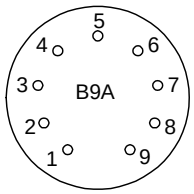
Underside View



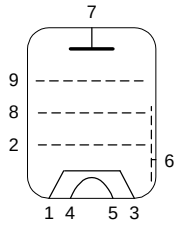
ECL80

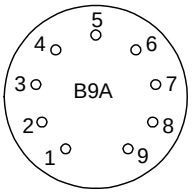


Underside View

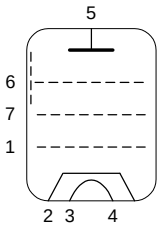


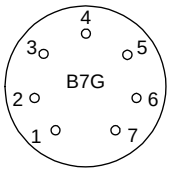
EF184 Underside View



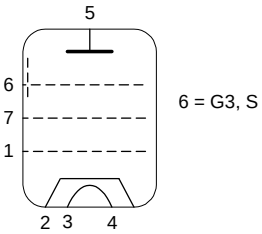


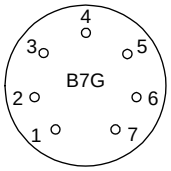
EF91 (6AM6) Underside View



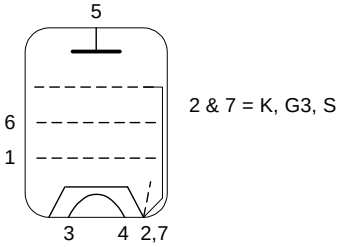


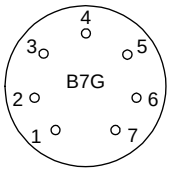
EF92 Underside View



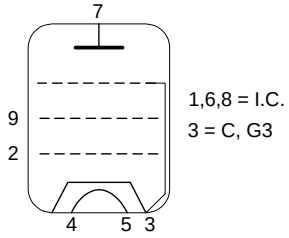


EF95 Underside view

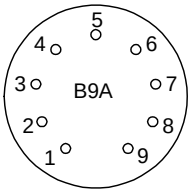




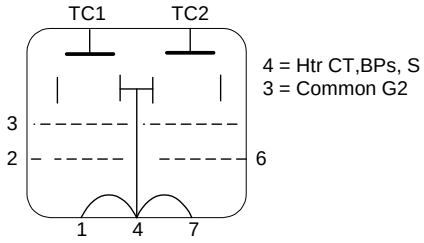
EL84



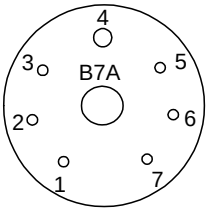
Underside view



QQZ06-40

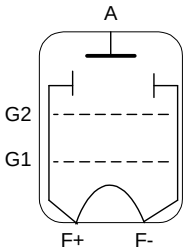


Underside View

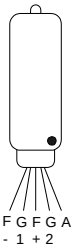


This valve has two anode pins at the top end of the envelope

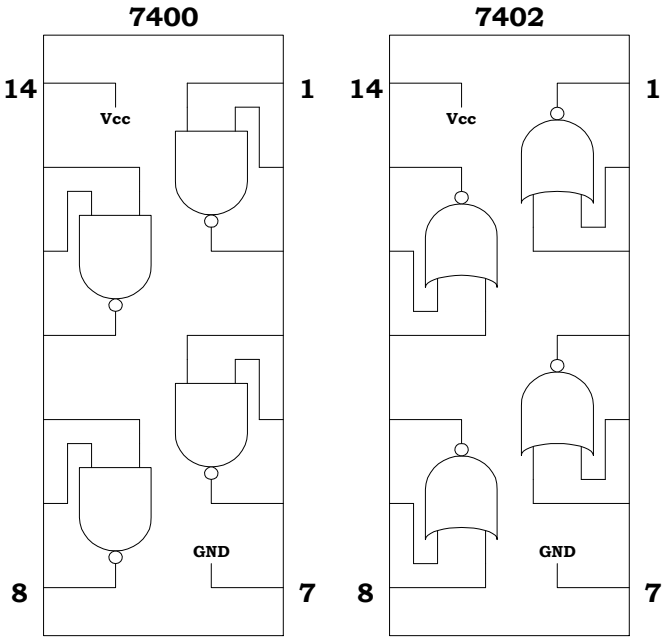
XFY43



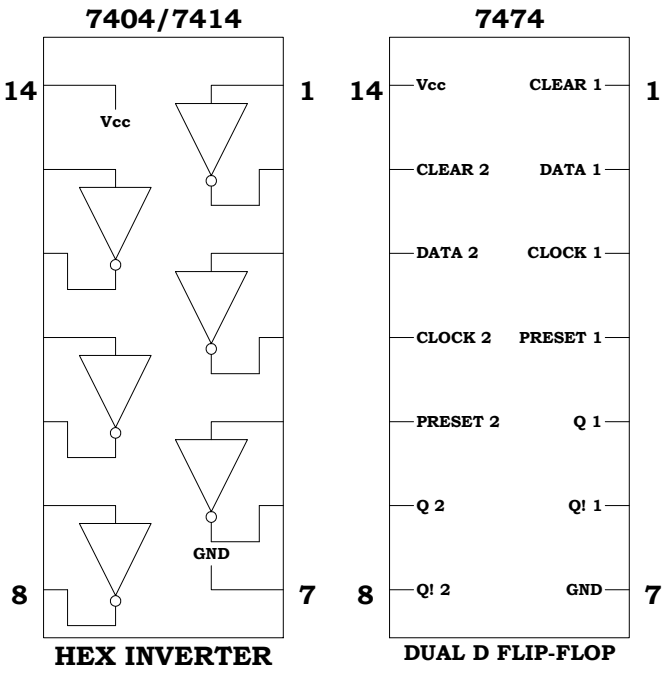
Side view



B5A (spot = pin 1)



View from below.



Title: TTL IC'S FOR RF OSCILLATORS AND FREQUENCY DIVISION, "DEAD-BUG" VIEW

Author: S. HARVEY N6QBQ

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