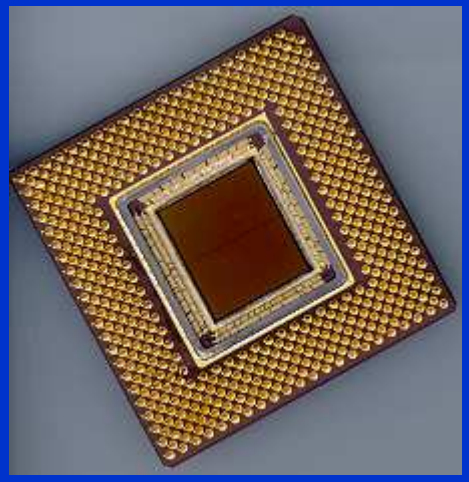


ECE 477 Digital Systems Senior Design Project

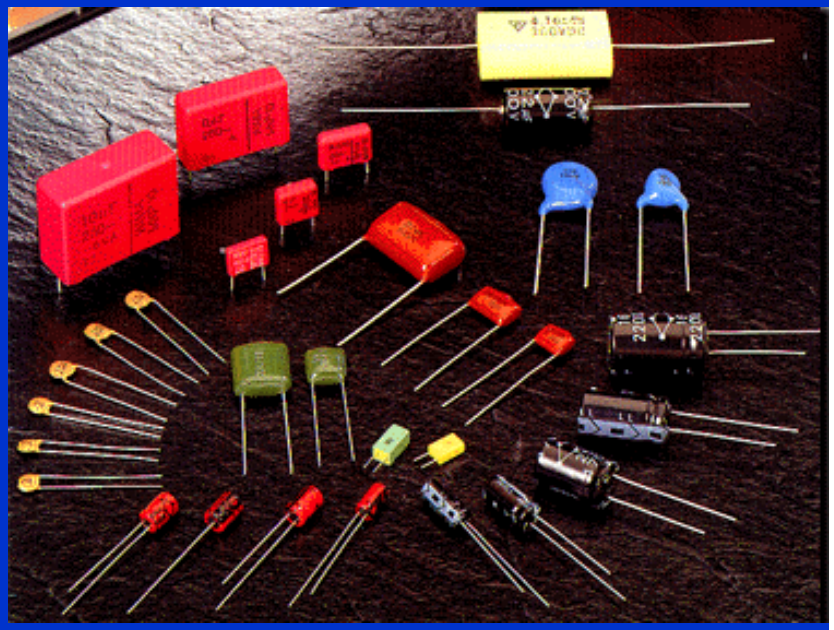
Module 6

Passive Component Selection Guidelines

Outline

- Capacitors
  - definitions
  - parameters and form factors of interest
  - film
  - ceramic
  - electrolytic
  - supercapacitors
  - miscellaneous
- Resistors
- Inductors
- Diodes
- Other Passive Components

Definitions



- ESR – equivalent series resistance
- ESL – equivalent series inductance
- Xc – capacitive reactance
- R_{dc} – DC leakage current through the dielectric
- R_{ac} – describes the AC losses in dielectric
- K - relative permittivity / dielectric constant

***Permittivity* is the ability of a dielectric to store electrical potential energy under the influence of an electric field**

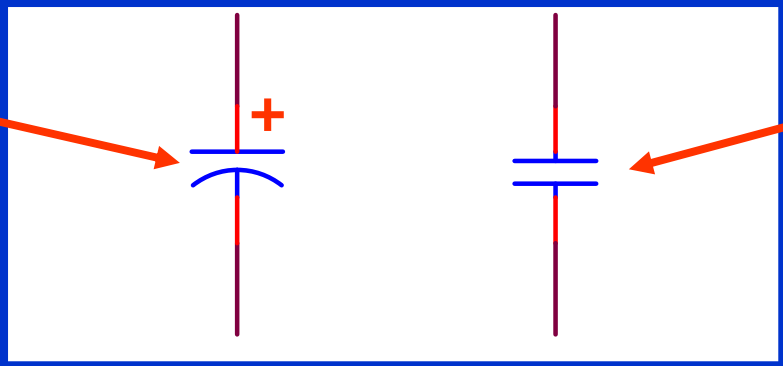
Physics

$$C = k\frac{A}{d}$$

Volume ~ Q = CV

Symbols

polarized



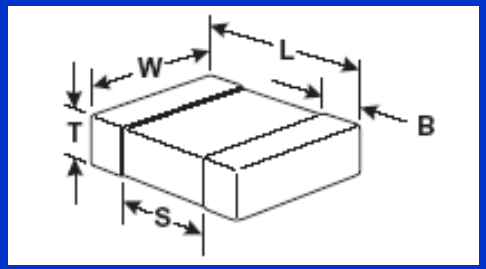
non-polarized

Parameters of Interest

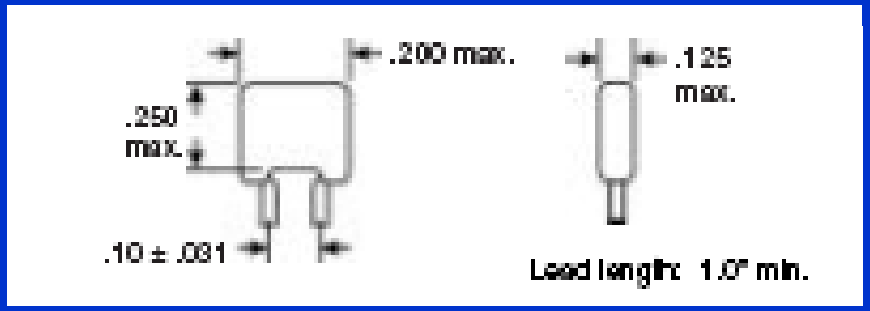
- ESR – equivalent series resistance
  - measure of in-phase resistance
  - affects Q
  - affects ripple current flowing through capacitor
- ESL – equivalent series inductance
  - caused by inductance of leads/electrodes
  - limiting factor in decoupling effectiveness
  - sets resonate point of capacitor
- Xc – capacitive reactance = $1/(2\pi fC)$
  - function of current that flows through capacitor as it is continuously charged/discharged (in response to applied AC signal)
  - varies with frequency (Xc decreases as frequency increases)
- working voltage (WV)
  - maximum DC voltage that should be across capacitor
  - behavior can change as maximum WV is approached

Form Factors of Interest

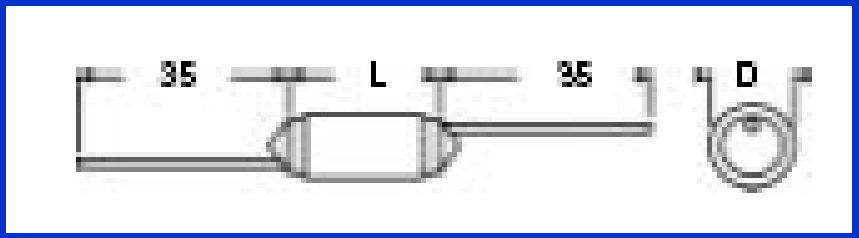
- **surface mount** (**type 1206** **applicable to our designs)**



- **radial lead**



- **axial lead**



Capacitor Types: Film

- Two types film: foil and metallized film
- Polymers such as polyester, polycarbonate, Teflon, polypropylene, polystyrene (all low “K”)
- Typical values < 10μF
- Superior longevity to electrolytic
- Typically large in packaging
- Not typically available in surface mount

Capacitor Types: Film-Foil

- Made of alternating layers of plastic film and metal foil
- Uses thick dielectrics
- Used where precision is needed

85°C AXIAL 5% POLYSTYRENE CAPACITORS

Comprised of polystyrene dielectric material fused to foil, these capacitors are highly resistant to humidity and provide excellent capacitance stability.

Specifications:

- ±5% tolerance
- Dissipation factor (@ 100kHz):
  DF < 0.1% C ≥ 330pF
  Q > 1000 C < 330pF
- Operating temperature: -40°C to +85°C
- Temperature coefficient: N150 ±ppm/°C
- Insulation resistance (@25°C): 100GΩ min.
- 50 WVDC

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Value (pF)	D x L (mm)	Price Each			
			1	100	500	1000
23PS110	100	5.5 x 12	.24	.12	.11	.10
23PS112	120	5.5 x 12	.24	.12	.11	.10
23PS115	150	5.5 x 12	.24	.12	.11	.10
23PS118	180	5.5 x 12	.24	.12	.11	.10
23PS122	220	5.5 x 12	.24	.12	.11	.10
23PS127	270	5.5 x 12	.24	.12	.11	.10
23PS133	330	5.5 x 12	.22	.11	.10	.09
23PS139	390	5.5 x 12	.22	.11	.10	.09
23PS147	470	5.5 x 12	.22	.11	.10	.09
23PS156	560	5.5 x 12	.22	.11	.10	.09
23PS168	680	5.5 x 12	.22	.11	.10	.09
23PS182	820	6.0 x 12	.22	.11	.10	.09
23PS210	1000	6.0 x 12	.22	.11	.10	.09

Features:

- Excellent electrical characteristics
- High reliability and stability
- Low temperature coefficients
- Small dissipation factor

DIMENSIONS (mm)

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Value (pF)	D x L (mm)	Price Each			
			1	100	500	1000
23PS212	1200	6.0 x 12	.24	.12	.11	.10
23PS215	1500	6.0 x 12	.24	.12	.11	.10
23PS218	1800	6.0 x 12	.24	.12	.11	.10
23PS220	2000	6.5 x 12	.24	.12	.11	.10
23PS222	2200	6.5 x 12	.24	.12	.11	.10
23PS227	2700	7.0 x 12	.25	.12	.11	.10
23PS233	3300	7.0 x 12	.26	.13	.12	.11
23PS239	3900	7.5 x 12	.26	.13	.12	.11
23PS247	4700	8.0 x 12	.28	.14	.13	.12
23PS250	5000	8.0 x 12	.30	.15	.14	.12
23PS268	6800	9.0 x 12	.32	.16	.14	.13
23PS282	8200	9.5 x 12	.34	.17	.16	.14
23PS310	10,000	10 x 12	.38	.19	.17	.16

Metallized Film

- Conductive film metallized onto the dielectric directly
- Self-healing (arcing through pinhole)
- Reduced fire risk for high voltage applications where arcing may occur
- Utilize much thinner dielectric films (1.5μm)

Type 930, Polypropylene Film Capacitors

Metallized
Axial Leads

High Voltage/High Frequency
Switching Power Supplies

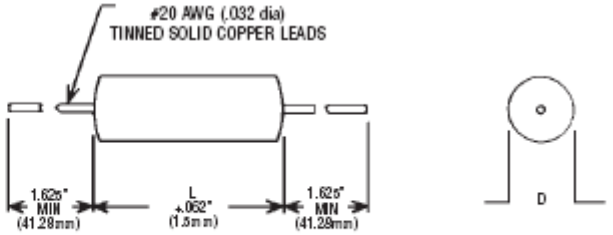
Type 930 axial-leaded, metallized polypropylene capacitors are available in a wide range of capacitance values in reduced sizes. Flame-retardant tape wrap and epoxy end seals provide moisture resistance. Used most frequently in high-voltage/high-frequency switching power supplies where superior stability and AC performance characteristics are important. This non-protected film capacitor has Underwriters Laboratories, Inc. recognition for construction only. U.L. File Number assigned is E128034(N).

Specifications

Voltage Range: 100-630 Vdc (70-275 Vac)
Capacitance Range: .022-10 µF
Capacitance Tolerance: ±10% (K) standard
±5% (J) optional
Operating Temperature Range: -55°C to 105°C*
*Full-rated voltage at 85°C–Derate linearly to 50%-rated voltage at 105°C

Pulse Capability				
Rated Volts	Body Length			
	.750	1.000	1.250	≥1.750
	dV/dt—volts per microsecond, maximum			
100	25	14	10	6
250	37	21	15	9
400	49	28	20	13
630	74	43	30	19

Dielectric Strength: 200% (1 minute)
Dissipation Factor: .10% Max. (25°C, 1kHz)
Insulation Resistance: 200,000 MΩ x µF
400,000 MΩ Min.
Life Test: 1,000 Hours at 85°C at 125% Rated Voltage



NOTE: Other capacitance values, sizes and performance specifications are available. Contact us.

Capacitor Types: Ceramic

- Largest family of capacitors
- Types are multi-layer (monolithic) or single-layer (disc)
- Values range from ~1 pF to >1000 μF
- Suitable for surface mounting due to their heat resistance
- Fast response time (~12 ps)
- No self-healing mechanism

Capacitor Types: Ceramic

- High dielectric constant
  - wide range of electrical properties
  - approach ideal in some cases, far from it in others
- Trade-off:
  - size / C / WV / temperature dependence
- Some non-ideal behaviors NOT well documented in data sheets

Capacitor Types: Ceramic (C0G)

- Best in all features except permittivity – most ideal of ceramics
- Very good capacitor (tight tolerance and temperature coefficient, suitable for use in “tuning” circuits)
- Temperature compensated
- Trade-off: physically large
- Typical values 4.7 pF to 0.047 μF
- Generally 5% tolerance or ±0.5 pF for small values

Capacitor Types: Ceramic (C0G)

Significant Figure	Multiplier	Tolerance
C: 0.0	0: -1	G: ±30
B: 0.3	1: -10	H: ±60
L: 0.8	2: -100	J: ±120
A: 0.9	3: -1000	K: ±250
M: 1.0	4: +1	L: ±500
P: 1.5	6: +10	M: ±1000
R: 2.2	7: +100	N: ±2500
S: 3.3	8: +1000	
T: 4.7		
V: 5.6		
U: 7.5		

EIA codes for temperature-compensated capacitors – type C0G will have 0 drift with an error of ±30 ppm/°C

Capacitor Types: Ceramic (X5R / X7R)

- Higher dielectric constant
- Temperature characteristics are non-linear:
  - 10% tolerance for X7R
  - 20% for X5R
- Cheaper than C0G
- Values range from 3300 pF to 10 μF
- Generally 10% or 20% initial tolerance

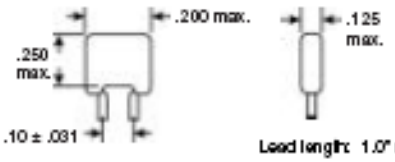
Capacitor Types: Ceramic (Z5U)

- Even higher dielectric constant
- Relatively large temperature coefficient (+22%/-56%)
- Cheap and small!
- Classic bypass/decoupling caps
- 0.01 μF to 2.2 μF
- Generally 20% initial tolerance
- DC bias effect

MONOLITHIC CERAMIC RADIAL CAPACITORS

TEMPERATURE CHARACTERISTICS	C0G	X7R	Z5U
Temperature range, °C	-55°C to +125°C	-55°C to +125°C	+10°C to +85°C
Capacitance change without DC voltage	0±30 PPM/°C	±15%	+22%, -56%

DIMENSIONS (IN.)



For quantities 5000 and up, call for quote.

MOUSER STOCK NO.		Value	Price Each			
Mfr.	Mfr. Part No.		1	100	500	1000
50 WVDC 5% Tolerance						
75 –	1C10C0G100J050B	10pF	.21	.18	.15	.12
75 –	1C10C0G220J050B	22pF	.21	.18	.15	.12
75 –	1C10C0G330J050B	33pF	.21	.18	.15	.12
75 –	1C10C0G470J050B	47pF	.21	.18	.15	.12
75 –	1C10C0G101J050B	100pF	.21	.18	.15	.12
75 –	1C10C0G331J050B	330pF	.21	.18	.15	.12
75 –	1C10C0G471J050B	470pF	.21	.18	.15	.12
75 –	1C10C0G102J050B	1000pF	.21	.18	.15	.12
100 WVDC 5% Tolerance						
75 –	1C10C0G100J100B	10pF	.21	.18	.15	.12
75 –	1C10C0G220J100B	22pF	.21	.18	.15	.12
75 –	1C10C0G330J100B	33pF	.21	.18	.15	.12
75 –	1C10C0G470J100B	47pF	.21	.18	.15	.12
75 –	1C10C0G101J100B	100pF	.21	.18	.15	.12
75 –	1C10C0G221J100B	220pF	.21	.18	.15	.12

For quantities 5000 and up, call for quote.

MOUSER STOCK NO.		Value	Price Each			
Mfr.	Mfr. Part No.		1	100	500	1000
100 WVDC 5% Tolerance (cont.)						
75 –	1C10C0G331J100B	330pF	.21	.18	.15	.12
75 –	1C10C0G471J100B	470pF	.21	.18	.15	.12
75 –	1C10C0G102J100B	1000pF	.26	.22	.19	.15
75 –	1C10C0G222J100B	2200pF	.31	.27	.22	.18
75 –	1C10C0G332J100B	3300pF	.47	.40	.33	.27
50 WVDC 10% Tolerance						
75 –	1C10X7R102K050B	1000pF	.13	.11	.09	.07
75 –	1C10X7R103K050B	10000pF	.14	.12	.10	.08
75 –	1C10X7R473K050B	47000pF	.19	.17	.14	.11
75 –	1C10X7R104K050B	100000pF	.14	.12	.10	.08
100 WVDC 10% Tolerance						
75 –	1C10X7R102K100B	1000pF	.18	.16	.13	.10
75 –	1C10X7R222K100B	2200pF	.19	.17	.14	.11
75 –	1C10X7R332K100B	3300pF	.19	.17	.14	.11
75 –	1C10X7R472K100B	4700pF	.20	.17	.15	.12
75 –	1C10X7R103K100B	10000pF	.15	.13	.11	.09

For quantities 5000 and up, call for quote.

MOUSER STOCK NO.		Value	Price Each			
Mfr.	Mfr. Part No.		1	100	500	1000
100 WVDC 10% Tolerance (cont.)						
75 –	1C10X7R223K100B	22000pF	.20	.17	.15	.12
75 –	1C10X7R333K100B	33000pF	.20	.17	.15	.12
75 –	1C10X7R473K100B	47000pF	.20	.17	.15	.12
75 –	1C10X7R104K100B	100000pF	.23	.20	.17	.13
50 WVDC 20% Tolerance						
75 –	1C10Z5U103M050B	10000pF	.13	.11	.09	.07
75 –	1C10Z5U333M050B	33000pF	.15	.13	.11	.09
75 –	1C10Z5U104M050B	100000pF	.10	.08	.07	.06
75 –	1C10Z5U224M050B	220000pF	.25	.21	.18	.14
75 –	1C10Z5U334M050B	330000pF	.30	.26	.22	.17
100 WVDC 20% Tolerance						
75 –	1C10Z5U103M100B	10000pF	.16	.14	.12	.09
75 –	1C10Z5U223M100B	22000pF	.18	.15	.13	.10
75 –	1C10Z5U333M100B	33000pF	.19	.16	.14	.11
75 –	1C10Z5U473M100B	47000pF	.16	.14	.11	.09
75 –	1C10Z5U104M100B	100000pF	.19	.16	.14	.11

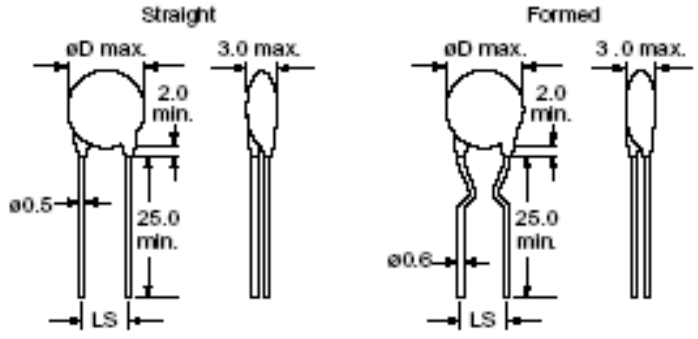
Capacitor Types: Ceramic (Y5V)

- Most common
- Even higher dielectric constant
- Huge temperature coefficient (+22%/-82%)
- Cheapest and smallest!
- Classic bypass/decoupling caps
- 0.01 μF to 22 μF+
- Generally +80%/-20% initial tolerance
- !! Undesirable behavior under DC bias !!

Ceramic Capacitor EIA Codes

Letter (low temp)	Digit (high temp)	Letter (change)
X= −55 °C (−67 °F)	2= +45 °C (+113 °F)	D= ±3.3%
Y= −30 °C (−22 °F)	4= +65 °C (+149 °F)	E= ±4.7%
Z= +10 °C (+50 °F)	5= +85 °C (+185 °F)	F= ±7.5%
	6=+105 °C (+221 °F)	P= ±10%
	7=+125 °C (+257 °F)	R= ±15%
	8=+150 °C (+302 °F)	S= ±22%
		T= +22 to −33%
		U= +22 to −56%
		V= +22 to −82%

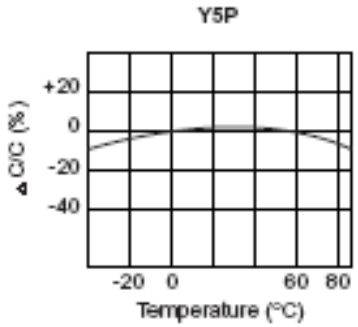
■ DIMENSIONS (mm), CAPACITANCE RANGES (pF)

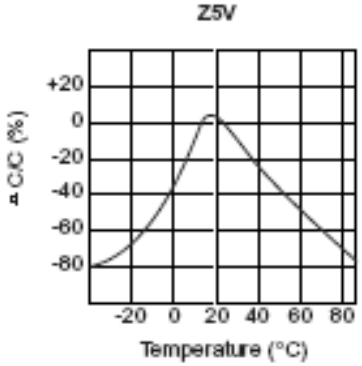


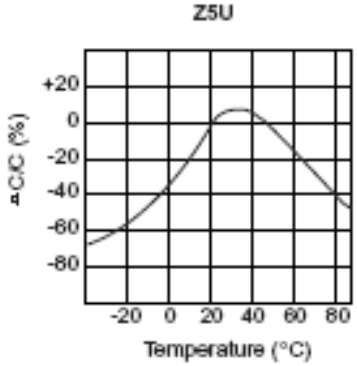
“Ceramic Disc”

Dimensions		Working Voltage (WV); Temperature Coefficient; Capacitance Range (pF)				
		50 and 100			500	
øD (mm)	LS (mm)	Y5P	Z5U	Z5V	Y5P	Z5U
5	2.5/5.0	200 ~ 2200	1000 ~ 5000	1000 ~ 10000	150 ~ 270	1000 ~ 2200
6	2.5/5.0	2700 ~ 3000	6800 ~ 8200	- - -	390 ~ 1200	3700 ~ 3900
7.5	2.5/5.0	3300 ~ 3900	10000	20000 ~ 22000	1500 ~ 2000	- - -
8.5	2.5/5.0	4700 ~ 5600	- - -	- - -	2200 ~ 2700	4700 ~ 5000
9.5	5.0	6800 ~ 8200	- - -	- - -	3000 ~ 3300	6800 ~ 8200
10.5	5.0	10000	20000 ~ 22000	- - -	3900	10000
14.5	9.5	- - -	- - -	33000 ~ 100,000	- - -	- - -

■ TYPICAL TEMPERATURE CHARACTERISTICS







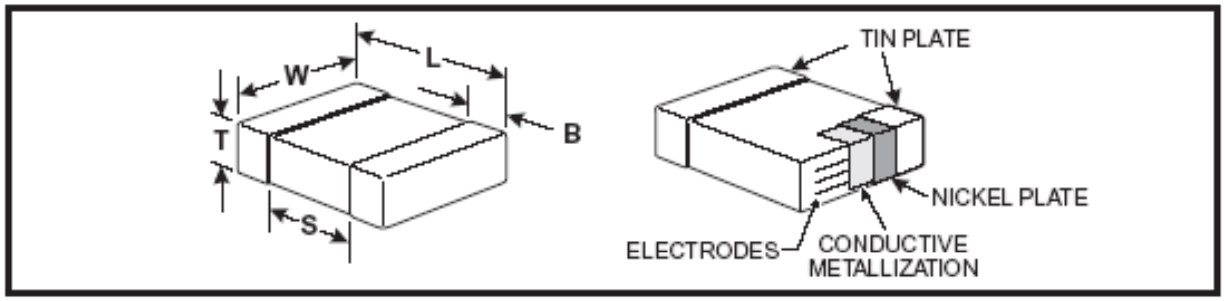
KEMET

CERAMIC CHIP/STANDARD

FEATURES

- C0G (NP0), X7R, X5R, Z5U and Y5V Dielectrics
- 10, 16, 25, 50, 100 and 200 Volts
- Standard End Metalization: Tin-plate over nickel barrier
- Available Capacitance Tolerances: ±0.10 pF; ±0.25 pF; ±0.5 pF; ±1%; ±2%; ±5%; ±10%; ±20%; and +80%-20%
- Tape and reel packaging per EIA481-1. (See page 59 for specific tape and reel information.) Bulk Cassette packaging (0402, 0603, 0805 only) per IEC60286-6 and EIAJ 7201.

CAPACITOR OUTLINE DRAWINGS



CAPACITOR ORDERING INFORMATION (Standard Chips - For Military see page 53)

C 0805 C 103 K 5 R A C*

CERAMIC

SIZE CODE

SPECIFICATION
C - Standard

CAPACITANCE CODE
Expressed in Picofarads (pF)
First two digits represent significant figures.
Third digit specifies number of zeros. (Use 9 for 1.0 through 9.9pF. Use 8 for 0.5 through 0.99pF)
(Example: 2.2pF = 229 or 0.50 pF = 508)

CAPACITANCE TOLERANCE

B – ±0.10pF	J – ±5%
C – ±0.25pF	K – ±10%
D – ±0.5pF	M – ±20%
F – ±1%	P – (GMV) – special order only
G – ±2%	Z – +80%, -20%

VOLTAGE

1 - 100V	3 - 25V
2 - 200V	4 - 16V
5 - 50V	8 - 10V
	9 - 6.3V

TEMPERATURE CHARACTERISTIC
Designated by Capacitance Change Over Temperature Range
G – C0G (NP0) (±30 PPM/°C)
R – X7R (±15%) (-55°C + 125°C)
P – X5R (±15%) (-55°C + 85°C)
U – Z5U (+22%, -56%) (+10°C + 85°C)
V – Y5V (+22%, -82%) (-30°C + 85°C)

FAILURE RATE LEVEL
A- Not Applicable

END METALLIZATION
C-Standard
(Tin-plated nickel barrier)

* Part Number Example: C0805C103K5RAC (14 digits - no spaces)

Electrolytic

- The dielectric is a very thin layer of oxide grown chemically on an electrode (0.01 μm)
- Electrolyte solution serves as the second electrode
- Effect is a very high density
- Can be *non-polarized* or *polarized*
- Polarized – small reverse voltage causes oxide breakdown → destruction of capacitor
- Reduction in effective capacitance realized as working voltage is approached

Aluminum Electrolytic

- Uses a wet electrolyte (prone to dry out, need for venting)
- Anodes are etched to provide greater surface area (to increase capacitance)
- Relatively short lifetime (3 to 20 years)
- Values range from (0.1 μF to several F)
- High voltage ranges available (> 400 V)
- Relatively slow response time (ns)

ALUMINUM ELECTROLYTIC CAPACITORS

nichicon

UD series

Chip Type, Low Impedance

- Chip type, low impedance temperature range up to +105°C.
- Designed for surface mounting on high density PC board.
- Applicable to automatic mounting machine using carrier tape.

UD | Low Impedance | WG

Specifications

Item	Performance Characteristics
Category Temperature Range	–55 – +105°C
Rated Voltage Range	6.3 – 50V
Rated Capacitance Range	1 – 1500μF
Capacitance Tolerance	± 20% at 120Hz, 20°C

Tantalum Electrolytic

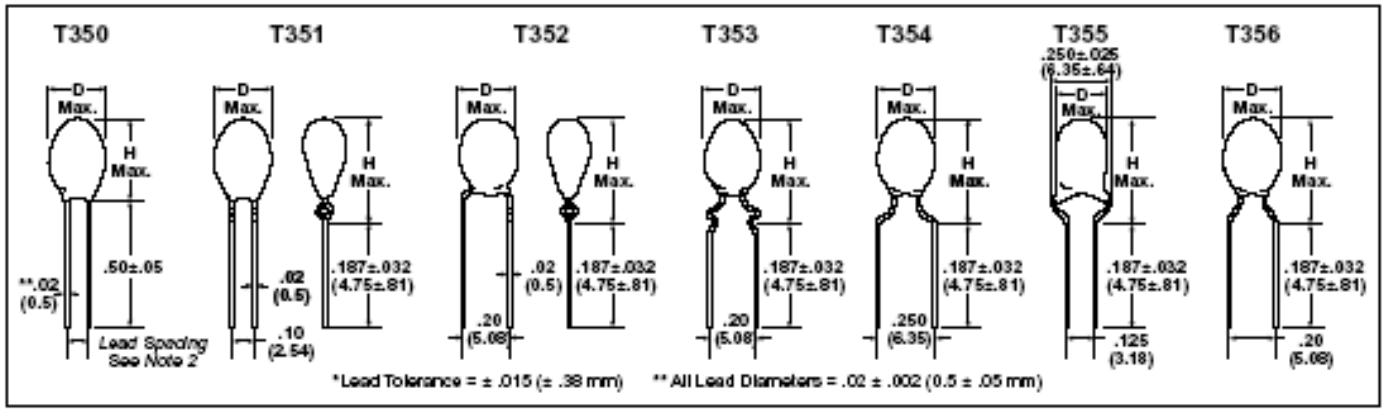
- Uses a dry electrolyte (longer lifetime)
- Extremely thin dielectric
- High capacitance with smaller form factor than aluminum electrolytic capacitors
- Values range from 0.047 μF to 330 μF
- Lower voltage ranges (50 V max)
- OK frequency response (100 ps)
- MOST types have high ESR – over-design or avoid use in high-reliability applications

Dipped Tantalums

Commercial T35X/T36X/T39X ESR (OHMS) at 100 kHz @ +25°C
(The ESR values provided below are for reference only. No warranty, as stated on page 3 and reincorporated here, is made as to the accuracy of these values for any particular T35X, T36X, T39X Series product.)

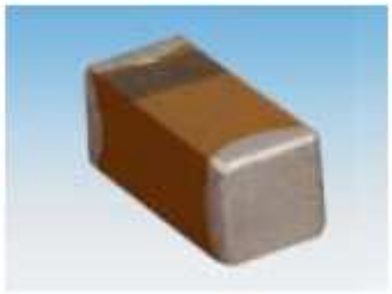
Cap. µF	6 Volt	10 Volt	16 Volt	20 Volt	25 Volt	35 Volt	50 Volt
0.10						26.0	26.0
0.15						21.0	21.0
0.22						17.0	17.0
0.33						15.0	15.0
0.47						13.0	13.0
0.68						10.0	10.0
1.00				10.0	10.0	8.0	8.0
1.50			10.0	9.0	8.0	6.0	5.0
2.20		13.0	8.0	7.0	6.0	5.0	3.5
3.30	13.0	10.0	6.0	5.5	5.0	4.0	3.0
4.70	10.0	8.0	5.0	4.5	4.0	3.0	2.5
6.80	8.0	6.0	4.0	3.6	3.1	2.5	2.0
10.0	6.0	5.0	3.2	2.9	2.5	2.0	1.6
15.0	5.0	3.7	2.5	2.3	2.0	1.6	1.2
22.0	3.7	2.7	2.0	1.8	1.5	1.3	1.0
33.0	3.0	2.1	1.6	1.4	1.2	1.0	
47.0	2.0	1.7	1.3	1.2	1.0	0.8	
68.0	1.8	1.3	1.0	0.9	0.8		
100.0	1.6	1.0	0.8	0.6			
150.0	0.9	0.8	0.6				
220.0	0.9	0.6					
330.0	0.7						

CAPACITOR OUTLINE DRAWINGS



TACmicrochip™

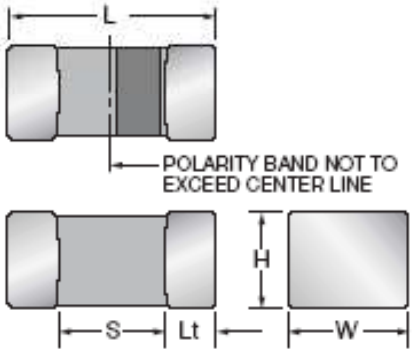
Standard Microchip



The world's smallest surface mount Tantalum capacitor, small enough to create space providing room for ideas to grow.

TACmicrochip™ is a major breakthrough in miniaturization without reduction in performance.

It offers you the highest energy store in an 0603 or 0805 case size; enhanced high frequency operation through unique ESR performance with temperature and voltage stability.



CASE DIMENSIONS: millimeters (inches)

Code	EIA Code	EIA Metric	Length (L)	Width (W)	Height (H)	Termination Spacing(S)	Termination Length (Lt)	Average Mass
K	0402	1005-05	1.00 +0.20 -0.00 (0.039 +0.008 -0.000)	0.50 +0.20 -0.00 (0.020 +0.008 -0.000)	0.50 +0.20 -0.00 (0.020 +0.008 -0.000)	0.40 min.	0.10 (0.004)	2.0mg
L	0603	1608-08	1.60 +0.25 -0.15 (0.063 +0.010 -0.006)	0.85 +0.20 -0.10 (0.033 +0.008 -0.004)	0.85 +0.20 -0.10 (0.033 +0.008 -0.004)	0.65 min.	0.15 (0.006)	8.6mg
R	0805	2012-12	2.00 +0.25 -0.15 (0.079 +0.010 -0.006)	1.35 +0.20 -0.10 (0.053 +0.008 -0.004)	1.35 +0.20 -0.10 (0.053 +0.008 -0.004)	0.85 min.	0.15 (0.006)	29.9mg
A	1206	3216-16	3.20±0.20 (0.126±0.008)	1.60±0.20 (0.063±0.008)	1.60±0.20 (0.063±0.008)	2.00 min.	0.15 (0.006)	44.6mg

HOW TO ORDER

TAC	L	226	M	004	R	**
Type TACmicrochip™	**Case Code** 0402=K 0603=L 0805=R 1206=A	**Capacitance Code** pF code: 1st two digits represent significant figures, 3rd digit represents multiplier (number of zeros to follow)	**Tolerance** K=±10% M=±20%	**Rated DC Voltage** 002=2Vdc 003=3Vdc 004=4Vdc 006=6.3Vdc 010=10Vdc 016=16Vdc	**Packaging** (see table below)	**Additional characters may be add for special requirements**

Packaging Suffix

Comparison Chart

	Film	Ceramic	Electrolytic
Capacitance	4.7pF-47uF	1pF-10uF	0.1uF-10000uF
Precision (typ)	+/- 5%	+/- 10%	+/- 20%
Stability (temp)	Good	Good-OK	OK
Leakage	Very low	Low	Low
Voltages	< 500	< 100	< 50
Cost	$.25-5.00	$.05-1.00	$.20-10.00
Available SMT	No	Yes	Yes (small C)
Polarized	No	No	Yes
Lifetime	100y	50y	5y

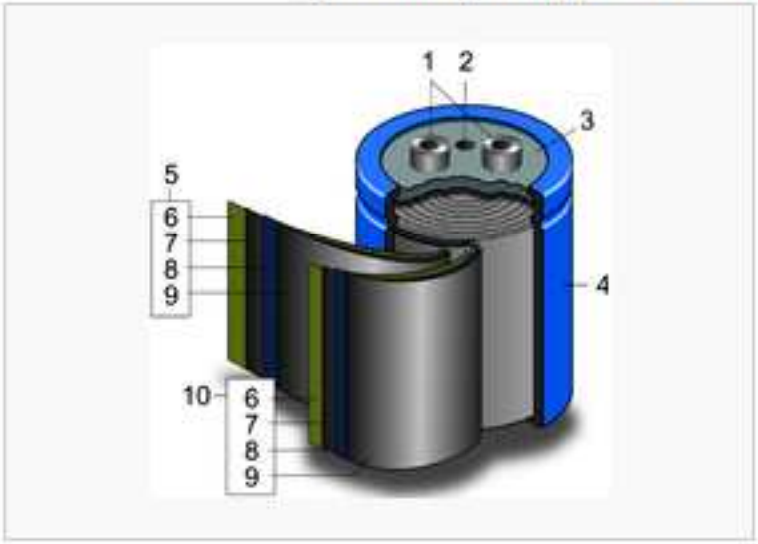
Supercapacitors (Ultracapacitors)

- Do not have a conventional solid dielectric
- Bridge gap between conventional capacitors and rechargeable batteries – store the most energy per unit volume or mass among capacitors
- Storage principles:
  - Electrostatic storage achieved by separation of charge in a Helmholtz double layer at the interface between the surface of a conductive electrode and an electrolyte. The separation of charge is of the order of a few ångströms (0.3–0.8 nm), much smaller than in a conventional capacitor
  - Faradaic electrochemical storage with electron charge-transfer, achieved by redox reactions, intercalation or electrosorption

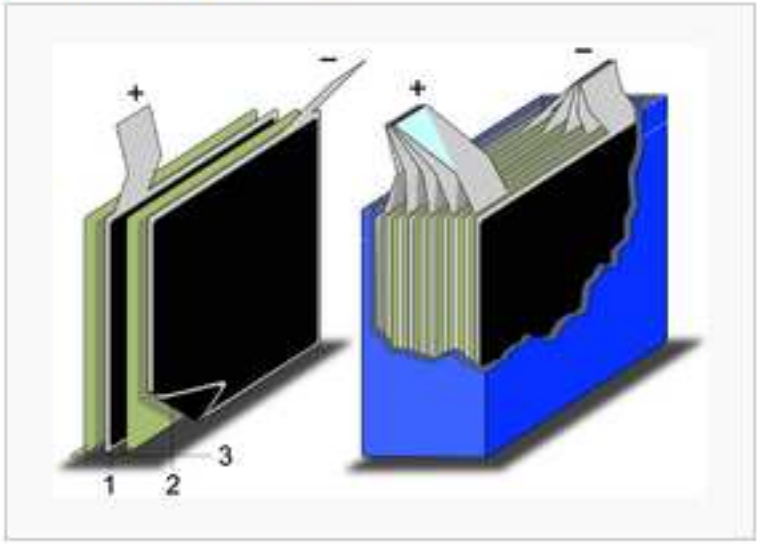
Supercapacitors (Ultracapacitors)

- Construction details

Styles of supercapacitors with activated carbon electrodes



Schematic construction of a wound supercapacitors
1.Terminals, 2.Safety vent, 3.Sealing disc, 4.Aluminum can, 5.Positive pole, 6.Separator, 7.Carbon electrode, 8.Collector, 9.Carbon electrode, 10.Negative pole



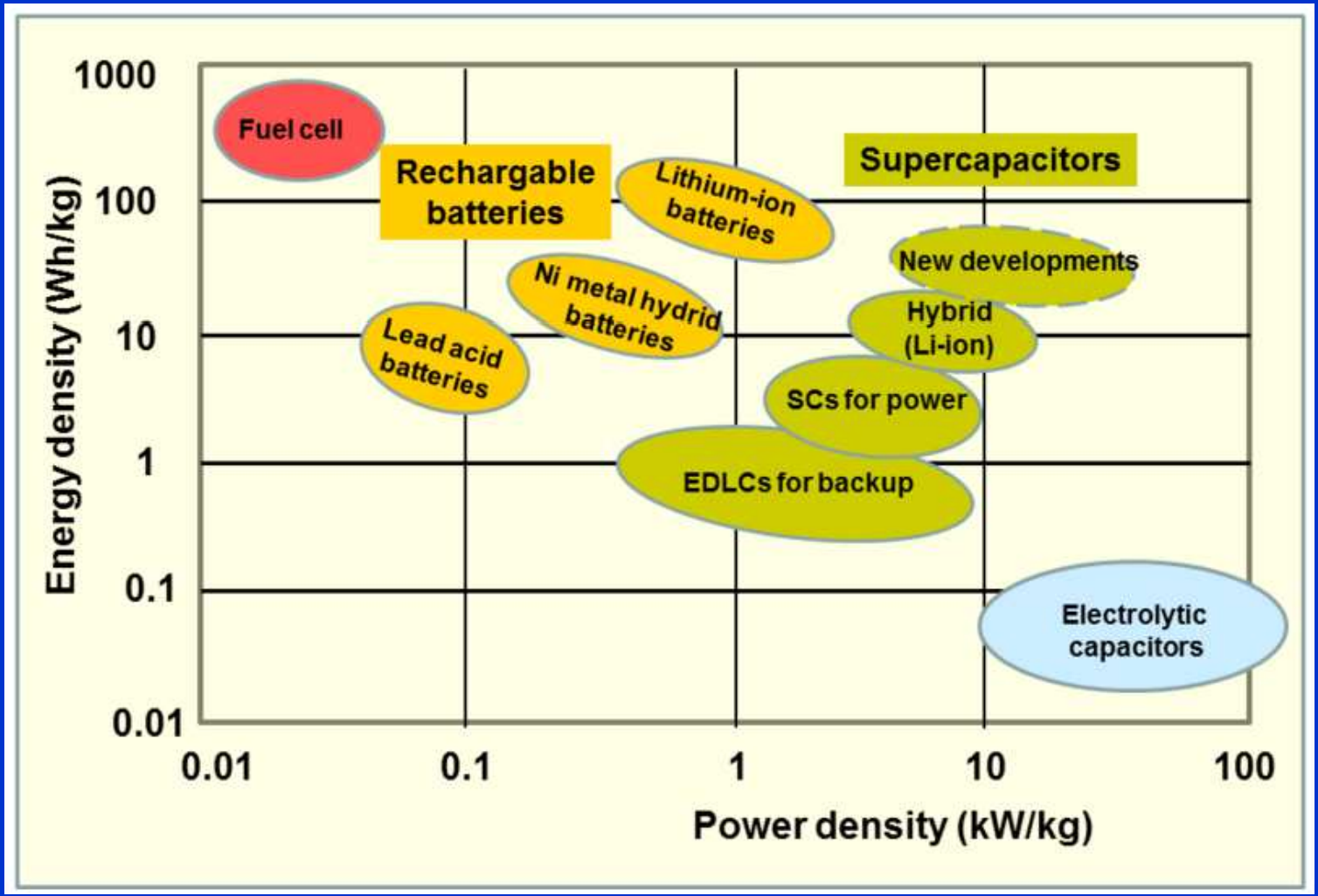
Schematic construction of a supercapacitor with stacked electrodes
1.Positive electrode, 2.Negative electrode, 3.Separator

Supercapacitors (Ultracapacitors)

- Store the most energy per unit volume or mass among capacitors (up to 10,000F/1.2 V), but deliver/accept less than half as much power per unit time (power density)
- Energy density approximately 10% of conventional batteries, but power density is generally 10 to 100 times greater – results in much shorter charge/discharge cycles than batteries (and ability to tolerate many more charge/discharge cycles than batteries)
- Applications:
  - SRAM backup
  - Energy recovery from braking (automotive)
  - Short-term energy storage
  - Burst-mode power delivery

Supercapacitors (Ultracapacitors)

- Supercapacitors vs. batteries



Miscellaneous

- Dielectrics such as glass, mica, porcelain, gas or vacuum
- Typically used in niche applications that need very specific electrical characteristic at potentially exotic ranges
- Most commonly used in (very) high frequency applications

Resistors

- Surface mount (0603, 0805, 1206) and through-hole (axial)
- Come in “packs” for busses, etc. (SOIC, DIP, SIP)
- Three main types
  - carbon film
  - thin film
  - metal film
- Specified by value, power, tolerance working voltage, temperature coefficient

Resistors (cont.)

- Power: P = IV
  - calculated power should not exceed rated power
- Temperature coefficient PPM/°C
  - change in resistance versus change in temperature
- Tolerance
  - deviation of initial value from that specified
- Working voltage
  - maximum voltage across part

Resistors (cont.)

- Carbon Film (Thick Film)
  - cheap, 5%~10% tolerance
  - higher temp coefficient (1000 ppm/°C+)
  - poor mechanical characteristics
- Thin film
  - better tolerance, temp coefficient
- Metal film
  - $$$, tolerances 1.0% ~ 0.01%
  - temp coefficient down to 25 ppm/°C
  - good mechanical properties

XICON 0603, 0805, 1206 - 5% SMD Film Resistors

THICK FILM

Features:

- High purity alumina substrate
- Wave or flow solderable
- Wrap around termination
- Excellent high frequency characteristics
- Tight temperature coefficient resistance
- Inner electrode protection
- Excellent mechanical strength
- Excellent electrical stability
- High quality thick film element
- Stable high frequency characteristics
- Reduced lead inductance

Common Specification:

- Temperature coefficient:
  100Ω and below: ±500ppm
  110Ω to 470KΩ: ±300ppm
  510KΩ to 3.3MΩ: ±500ppm
  3.6MΩ to 10MΩ: ±1000ppm

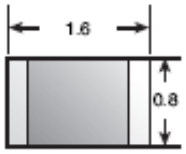
Resistor Pricing

Resistors ordered in lots of 1 reel per value can be combined with the same stock number range for lower price. Annual price agreements are also available. Call any Mouser Service Representative.

Available in Reels

0603 Case Style Specifications:

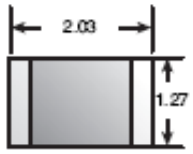
- Rated power: 1/16W
- Max working voltage: 50V DC
- Max overload voltage: 100V DC
- Operating temperature range: -55°C to +125°C



DIMENSIONS (mm)

0805 Case Style Specifications:

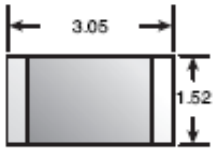
- Rated power: 1/10W
- Resistance tolerance: ±5%
- Max working voltage: 100V DC
- Max overload voltage: 200V DC
- Operating temperature: -55°C to +125°C



DIMENSIONS (mm)

1206 Case Style Specifications:

- Rated power: 1/8W
- Resistance tolerance: ±5%
- Max working voltage: 200V DC
- Max overload voltage: 300V DC
- Operating temperature: -55°C to +125°C



DIMENSIONS (mm)

TABLE OF STOCKED VALUES

0	1.8	3.6	6.8	13	27	51	100	200	390	750	1.5K	3K	5.6K	11K	22K	43K	82K	160K	330K	620K	1.2M	2.4M	4.7M	9.1M
1.0	2.0	3.9	7.5	15	30	56	110	220	430	820	1.6K	3.3K	6.2K	12K	24K	47K	91K	180K	360K	680K	1.3M	2.7M	5.1M	10M
1.1	2.2	4.3	8.2	16	33	62	120	240	470	910	1.8K	3.6K	6.8K	13K	27K	51K	100K	200K	390K	750K	1.5M	3M	5.6M	
1.2	2.4	4.7	9.1	18	36	68	130	270	510	1K	2K	3.9K	7.5K	15K	30K	56K	110K	220K	430K	820K	1.6M	3.3M	6.2M	
1.3	2.7	5.1	10	20	39	75	150	300	560	1.1K	2.2K	4.3K	8.2K	16K	33K	62K	120K	240K	470K	910K	1.8M	3.6M	6.8M	
1.5	3.0	5.6	11	22	43	82	160	330	620	1.2K	2.4K	4.7K	9.1K	18K	36K	68K	130K	270K	510K	1M	2M	3.9M	7.5M	
1.6	3.3	6.2	12	24	47	91	180	360	680	1.3K	2.7K	5.1K	10K	20K	39K	75K	150K	300K	560K	1.1M	2.2M	4.3M	8.2M	

Case Size	Bulk Packs Parts packed on SMD tape.				Tape and Reel				
	MOUSER STOCK NO.	Price Per Value			Reel Qty.	Price Each			
		1	100	1000		5000	10000	50000	100000
0603	301-Value	.11	.019	.009	5000	.008	.007	.006	.005
0805	260-Value	.08	.015	.007	5000	.005	.004	.003	.003
1206	263-Value	.08	.015	.007	5000	.005	.004	.003	.003

Recommend use of Type 1206 for our applications

Resistors (cont.)

- Current sensing resistors
  - VERY LOW resistance (0.005 Ω)
  - often four-terminal device “Kelvin connected”
  - often very expensive – hard to make low resistance to a tight tolerance
- R-packs
  - “bussed” and “isolated” types
  - watch total package power dissipation if using for LED current limit
- Power resistors
  - anything over ~1W

OHMITE 1% Wire Element Resistors - 2, 3 and 5 Watt

OHMITE

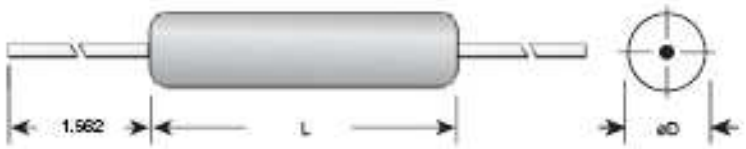
10 SERIES LO-MITE MOLDED SILICONE

Specifications:

- Overload: 5 times rated wattage for 5 seconds
- Dielectric withstanding voltage: 1000V$_{RMS}$ for 3W and 5W; 500V$_{rms}$ for 2W
- Temperature range: -55°C to 275°C

Features:

- Ideal for current sensing application
- Low inductance (non-inductive below .25Ω)



Wattage	Dimensions (IN)		Lead Gauge
	L	øD	
2	.406	.094	20
3	.560	.205	20
5	.925	.330	18

2 Watts

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Value (Ω)	Price Each					
		1	10	100	250	500	1000
588-12FR005	0.005	1.56	1.41	1.25	1.17	1.15	1.12
588-12FR010	0.010	1.56	1.41	1.25	1.17	1.15	1.12
588-12FR020	0.020	1.56	1.41	1.25	1.17	1.15	1.12
588-12FR025	0.025	1.54	1.39	1.23	1.16	1.14	1.11
588-12FR050	0.050	1.45	1.31	1.16	1.09	1.07	1.04
588-12FR080	0.080	1.56	1.41	1.25	1.17	1.15	1.12
588-12FR100	0.100	1.70	1.53	1.36	1.28	1.26	1.23

3 Watts

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Value (Ω)	Price Each					
		1	10	100	250	500	1000
588-13FR005	0.005	1.55	1.40	1.24	1.16	1.14	1.11
588-13FR010	0.010	1.46	1.31	1.17	1.10	1.08	1.04
588-13FR020	0.020	1.40	1.26	1.12	1.05	1.03	1.01
588-13FR025	0.025	1.40	1.26	1.12	1.05	1.03	1.01
588-13FR050	0.050	1.38	1.24	1.10	1.04	1.08	1.04
588-13FR070	0.070	1.55	1.40	1.24	1.16	1.14	1.11
588-13FR080	0.080	1.55	1.40	1.24	1.16	1.14	1.11
588-13FR100	0.100	1.55	1.40	1.24	1.16	1.14	1.11
588-13FR150	0.150	1.55	1.40	1.24	1.16	1.14	1.11
588-13FR200	0.200	1.55	1.40	1.24	1.16	1.14	1.11

5 Watts

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Value (Ω)	Price Each					
		1	10	100	250	500	1000
588-15FR005	0.005	1.85	1.67	1.48	1.39	1.36	1.33
588-15FR010	0.010	1.79	1.61	1.43	1.34	1.31	1.28
588-15FR020	0.020	1.79	1.61	1.43	1.34	1.31	1.28
588-15FR025	0.025	1.79	1.61	1.43	1.34	1.31	1.28
588-15FR050	0.050	1.75	1.58	1.40	1.31	1.31	1.28
588-15FR080	0.080	1.72	1.55	1.38	1.29	1.27	1.24
588-15FR100	0.100	1.72	1.55	1.38	1.29	1.27	1.24
588-15FR200	0.200	1.72	1.55	1.38	1.29	1.27	1.24
588-15FR250	0.250	1.72	1.55	1.38	1.29	1.27	1.24

MOUSER

2% SIP CONFORMAL COATED RESISTOR NETWORKS
4600X SERIES

Specifications:

- Standard resistance range: 22Ω to 1MΩ
- Standard resistance tolerance: 50Ω-5MΩ ±2% (<49Ω=1Ω)
- Operating temperature range: -55°C to +125°C
- Temperature coefficient of resistance: ±100ppm/°C (<50Ω = ±250ppm/°C)
- Operating voltage: 100VDC max.
- Insulation resistance: 10,000MΩ min.
- Resistor Tolerance: 10 ohms to 49 ohms = ±1 ohm, 50 ohms to 5 megohms = ±2%

Features:

- Low profile is compatible with dips
- Ammo-pak packaging available
- Recommended for rosin flux, and solvent clean or no clean flux process

For quantities of 2,000 and up, call for quote.

MOUSER STOCK NO.	Fig.	Power Dissipation (W @ 70°C)		No. of Pins	No. of Res.	Price Each				
		Per Circuit	Total Pkg. Max.			1	100	200	500	1000
652-4606X-101-Value	A	.20	.75	6	5	.19	.17	.15	.13	.11
652-4608X-101-Value	A	.20	1.00	8	7	.23	.21	.19	.17	.14
652-4610X-101-Value	A	.20	1.25	10	9	.29	.24	.22	.20	.17

For quantities of 2,000 and up, call for quote.

MOUSER STOCK NO.	Fig.	Power Dissipation (W @ 70°C)		No. of Pins	No. of Res.	Price Each				
		Per Circuit	Total Pkg. Max.			1	100	200	500	1000
652-4606X-102-Value	B	.30	.75	6	3	.19	.17	.15	.13	.11
652-4608X-102-Value	B	.30	1.00	8	4	.23	.21	.19	.17	.14
652-4610X-102-Value	B	.30	1.25	10	5	.29	.24	.22	.20	.17

MOUSER ELECTRONICS

DIMENSIONS (mm)

No. of Pins	6	8	10
"L" Max. (mm)	15.19	20.27	25.35

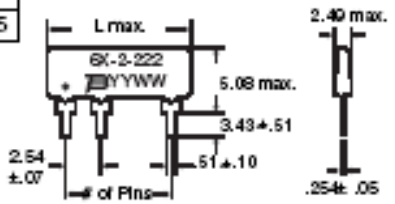
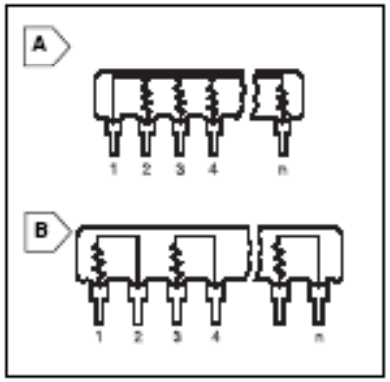


Table of Stocked Values (Ω)		
22	1K	33K
27	1.2K	39K
33	1.5K	47K
39	1.8K	56K
47	2K	68K
56	2.2K	82K
68	2.7K	100K
82	3.3K	120K
100	3.9K	150K
120	4.7K	180K
150	5.6K	220K
180	6.8K	270K
220	8.2K	330K
270	10K	390K
330	12K	470K
390	15K	560K
470	18K	680K
560	20K	820K
680	22K	1M
820	27K	



XICON 5% Cement Power Resistors - 5, 7, 10, 15 and 25 Watt

VERTICAL MOUNT

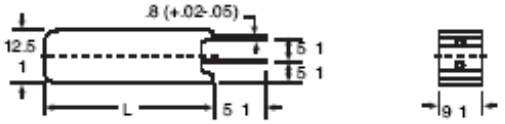
Features:

- Exceptionally small, sturdy, and reliable
- Sealed with a special cement
- Excellent moisture resistance
- High temperature stability
- Ceramic flame retardant package

Specifications:

- Tolerance: ±5%
- Temperature coefficient: ±350ppm/°C max; <20Ω ±400ppm/°C

DIMENSIONS (mm)



(5W leads centered 5mm1mm lead space. 7W and 10W are offset)

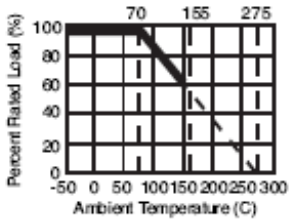


Table of Values in Ω for PRM Series					
0.1	0.68	6.8	20	100	1K
0.3	1	10	47	150	2K
0.47	3	15	75	680	10K

For quantities 1,000 and up, call for quote.

MOUSER STOCK NO.	Watts	Length (mm) L ± 1	Resistance Range		Price Each			
			Wirewound	Power Film	1	10	100	500
280-PRM5-Value	5	25	0.1Ω-47Ω	48Ω-100KΩ	.36	.31	.23	.19
280-PRM7-Value	7	38	0.1Ω-680Ω	681Ω-200KΩ	.51	.41	.31	.28
280-PRM10-Value	10	50	0.1Ω-910Ω	911Ω-200KΩ	.68	.54	.42	.37

AXIAL MOUNT

Features:

- Extremely small and sturdy
- Mechanically safe
- Self-extinguishing
- Excellent flame and moisture resistance

Specifications:

- Temperature coefficient: ±350
- Tolerance: ±5%
- Operating temperature: -40°C to +200°C

DIMENSIONS: (mm)

Watts	L	W	H
5	22	10	9
10	49	10	9
15	49	12.5	11.5
25	64	14.5	13.5

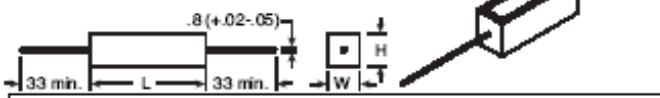


TABLE OF STOCKED VALUES												
0.1	0.47	1	2.4	5.1	12	27	62	160	350	680	1.6K	4.7K
0.15	0.5	1.1	2.7	5.6	13	30	68	180	360	750	1.8K	5.0K
0.2	0.51	1.2	3.0	6.2	15	33	75	200	390	820	2.0K	10K
0.22	0.56	1.3	3.3	6.8	16	36	82	220	430	910	2.2K	20K
0.27	0.62	1.5	3.6	7.5	18	39	91	240	470	1.0K	2.4K	25K
0.3	0.68	1.6	3.9	8.2	20	43	100	250	500	1.1K	2.7K	
0.33	0.75	1.8	4.0	9.1	22	47	120	270	510	1.2K	3.0K	
0.39	0.82	2.0	4.7	10	24	50	130	300	560	1.3K	3.3K	
0.43	0.91	2.2	5.0	11	25	56	150	330	620	1.5K	3.9K	

For quantities 25,000 and up, call for quote.

MOUSER STOCK NO.	Watts	Range of Values (Ω)	Price Each						
			1	10	100	500	1000	5000	10,000
280-CR5-Value	5	.1 to 25K	.39	.32	.24	.21	.17	.13	.11
280-CR10-Value	10	.1 to 25K	.55	.47	.35	.27	.24	.20	.18
280-CR15-Value	15	1.0 to 1.0K	.63	.57	.47	.33	.28	.20	Call
280-CR25-Value	25	2.0 to 1.0K	1.09	.99	.82	.58	.48	.34	Call

Inductors

- Not all inductors are created equal
  - wire gauge
  - core type (permeability / saturation)
- Parameters to watch
  - ESR (from wire gauge)
  - maximum current (from core material)
- Using an inductor with inferior characteristics will most likely result in failure of your SMPS
- Ferrite beads are NOT inductors

- Specified by value, tolerance, ESR, maximum current and (sometimes) Q

BACK NEXT

FASTRON Chokes and Coils

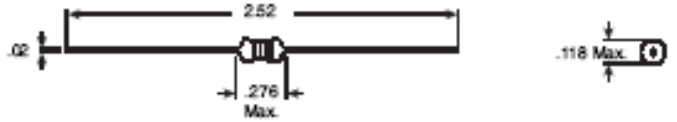
FASTRON EPOXY CONFORMAL COATED CHOKES

These choke coils are UL recognized and feature an inductance of 0.15µH to 1000µH, capable of handling currents from 55mA to 1.35 amps. They are more economical than molded chokes and require no more board space than a 1/2 watt resistor. Tape and reel, ammo pack, and formed leads are available upon request.

- EIA color coded
- Operating temperature:IEC climatic category: 55/125/56; DIN climatic category: FKF: -55 to 125°C, humidity category F

E169264

DIMENSIONS (IN.)



Miniature Choke Coils

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	L (µH)	Tol. %	Q Min.	Test Freq. (MHz)	Res. Freq. (MHz)	DCR Max. (Ω)	Max DC Current (mA)	Price Each 1	100	500	1000
434-22-R15	0.15	±10	35	25.2	500	0.13	1020	.20	.13	.10	.09
434-22-R22	0.22	±10	35	25.2	420	0.16	990	.20	.13	.10	.09
434-22-R27	0.27	±10	35	25.2	380	0.17	910	.20	.13	.10	.09
434-22-R39	0.39	±10	35	25.2	300	0.22	790	.20	.13	.10	.09
434-22-R47	0.47	±10	35	25.2	280	0.25	750	.20	.13	.10	.09
434-22-R56	0.56	±10	35	25.2	260	0.28	700	.20	.13	.10	.09
434-22-R68	0.68	±10	35	25.2	240	0.48	530	.20	.13	.10	.09
434-22-R82	0.82	±10	35	25.2	230	0.55	500	.20	.13	.10	.09
434-22-1R0	1	±5	35	25.2	180	0.25	630	.20	.13	.10	.09
434-22-1R2	1.2	±5	40	7.96	170	0.25	610	.20	.13	.10	.09
434-22-1R5	1.5	±5	40	7.96	150	0.3	570	.20	.13	.10	.09
434-22-1R8	1.8	±5	40	7.96	130	0.3	540	.20	.13	.10	.09
434-22-2R2	2.2	±5	40	7.96	120	0.35	520	.20	.13	.10	.09
434-22-2R7	2.7	±5	40	7.96	110	0.4	480	.20	.13	.10	.09
434-22-3R3	3.3	±5	40	7.96	110	0.5	420	.20	.13	.10	.09
434-22-3R9	3.9	±5	40	7.96	100	0.55	400	.20	.13	.10	.09
434-22-4R7	4.7	±5	40	7.96	90	0.65	380	.20	.13	.10	.09
434-22-5R6	5.6	±5	45	7.96	75	1.3	260	.20	.13	.10	.09
434-22-6R8	6.8	±5	45	7.96	70	1.45	250	.20	.13	.10	.09
434-22-8R2	8.2	±5	50	7.96	65	1.6	240	.20	.13	.10	.09
434-22-100	10	±5	50	7.96	60	1.7	230	.20	.13	.10	.09
434-22-120	12	±5	50	2.52	50	2.4	190	.20	.13	.10	.09
434-22-150	15	±5	50	2.52	45	2.7	185	.20	.13	.10	.09

Miniature Choke Coils (cont.)

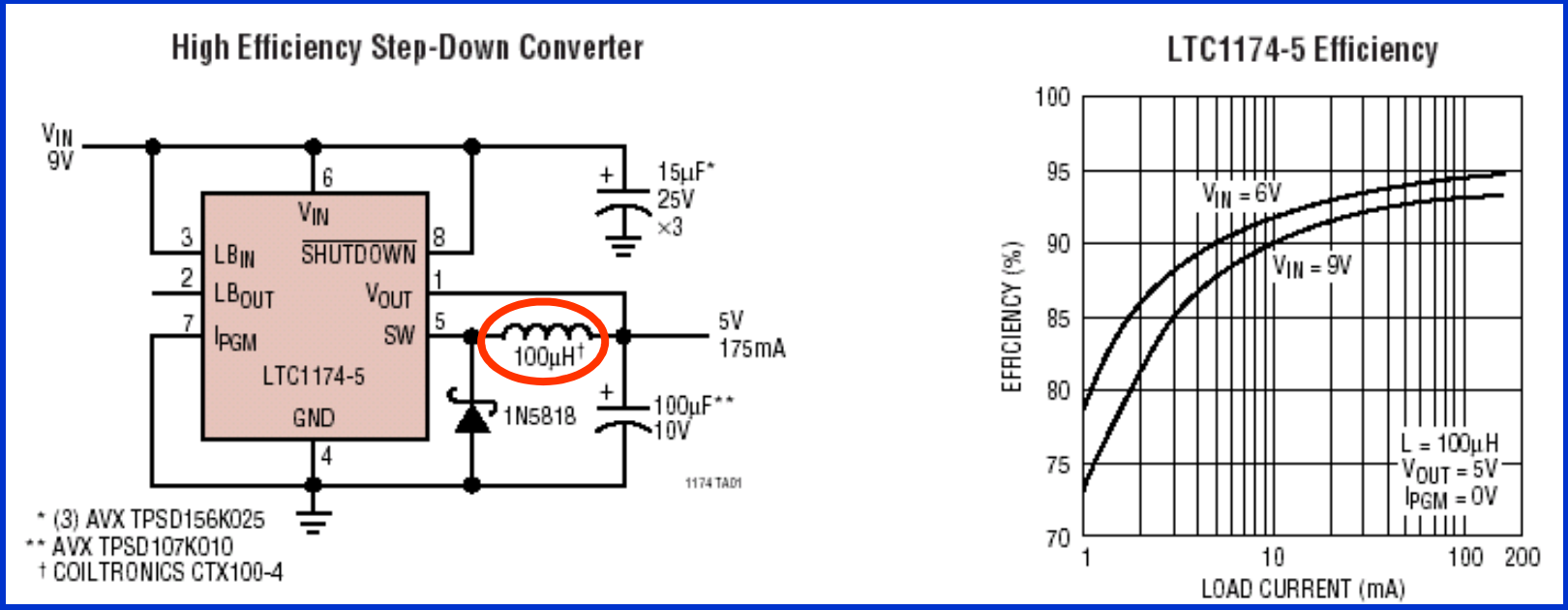
For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	L (µH)	Tol. %	Q Min.	Test Freq. (MHz)	Res. Freq. (MHz)	DCR Max. (Ω)	Max DC Current (mA)	Price Each 1	100	500	1000
434-22-180	18	±5	60	2.52	14	0.81	350	.20	.13	.10	.09
434-22-220	22	±5	60	2.52	12	0.9	335	.20	.13	.10	.09
434-22-270	27	±5	60	2.52	11	1	315	.20	.13	.10	.09
434-22-330	33	±5	60	2.52	10	1.12	300	.20	.13	.10	.09
434-22-390	39	±5	60	2.52	8.5	1.21	285	.20	.13	.10	.09
434-22-470	47	±5	60	2.52	7.7	2.4	200	.20	.13	.10	.09
434-22-560	56	±5	60	2.52	6.8	2.6	195	.20	.13	.10	.09
434-22-680	68	±5	60	2.52	5.7	2.9	185	.20	.13	.10	.09
434-22-820	82	±5	60	2.52	5.5	3.2	175	.20	.13	.10	.09
434-22-101	100	±5	60	2.52	5.3	3.5	170	.20	.13	.10	.09
434-22-121	120	±5	60	0.79	5	3.8	160	.20	.13	.10	.09
434-22-151	150	±5	60	0.79	4.6	4.3	150	.20	.13	.10	.09
434-22-181	180	±5	60	0.79	4.2	5.3	135	.20	.13	.10	.09
434-22-221	220	±5	60	0.79	3.8	5.8	130	.20	.13	.10	.09
434-22-271	270	±5	60	0.79	3.2	7.8	115	.20	.13	.10	.09
434-22-331	330	±5	60	0.79	3	8.7	105	.20	.13	.10	.09
434-22-391	390	±5	60	0.79	2.7	11	95	.20	.13	.10	.09
434-22-471	470	±5	60	0.79	2.3	12	90	.20	.13	.10	.09
434-22-561	560	±5	60	0.79	2.2	16.5	75	.20	.13	.10	.09
434-22-681	680	±5	60	0.79	2	22	65	.20	.13	.10	.09
434-22-821	820	±5	60	0.79	1.8	25	60	.20	.13	.10	.09
434-22-102	1000	±5	60	0.79	1.5	33	55	.20	.13	.10	.09

Inductors

Fastron

Flashback…



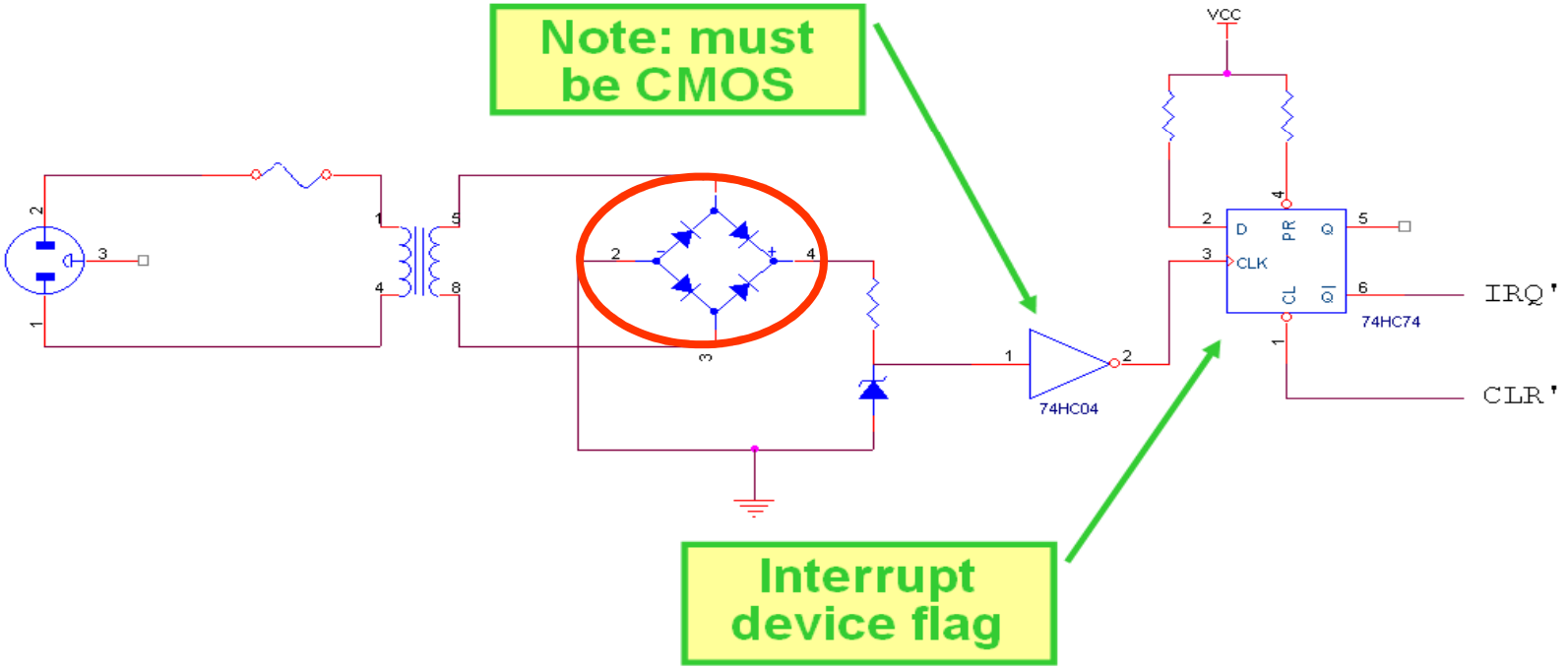
100 µH inductors come in many shapes, sizes, and current ratings – choose carefully, and have parts IN HAND before starting your PCB layout!

Diodes

- Silicon
  - general purpose rectifier (bulk AC rectifier)
  - can be slow due to junction capacitance
- Germanium
  - high-frequency, typically RF, V_F ~0.3
- Schottky
  - low V_F, typically fast switching time
  - typically low V_R, may be hard to find combination of V_F, I_F, V_R, t_{RR}, cost needed
- Zener
  - designed to have a specific V_R

Flashback…

Switching A.C. Loads



What's this? A bridge rectifier (can be constructed using discrete diodes or bridge rectifier module)

General-purpose diodes (switching, power supply)

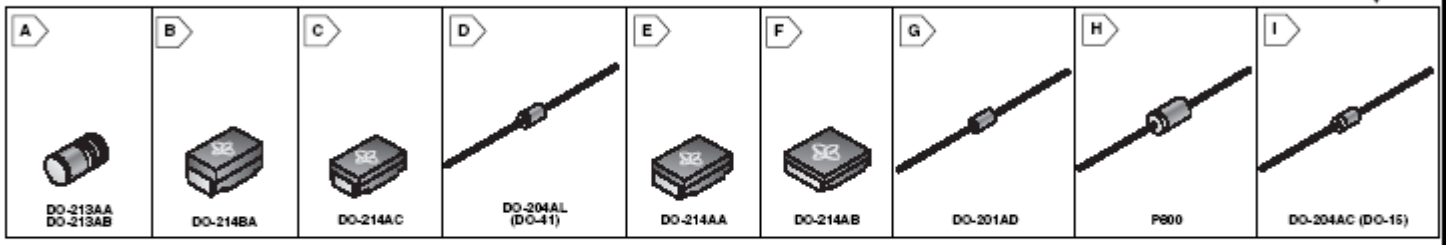
BACK NEXT

VISHAY Rectifiers

VISHAY

Diodes & Rectifiers

Vishay Semiconductors



VISHAY STANDARD SILICON

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Vishay Part No.	Fig.	PRV (V)	IFM Surge (A)	Price Each 1	100	500	1000
0.5 Amp - Surface Mount								
625-GL34A	GL34A/32	A	50	10	.24	.15	.10	.086
625-GL34B	GL34B/32	A	100	10	.24	.15	.10	.086
625-GL34D	GL34D/32	A	200	10	.24	.15	.10	.086
625-GL34G	GL34G/32	A	400	10	.24	.15	.10	.086
625-GL34J	GL34J/32	A	600	10	.24	.15	.10	.086
1.0 Amp - Surface Mount								
625-GF1A	GF1A/17	B	50	30	.31	.19	.12	.11
625-1N6478	1N6478/25	A	50	30	.20	.13	.082	.072
625-S1A	S1A/2P	C	50	30	.14	.085	.055	.048
625-GF1B	GF1B/17	B	100	30	.31	.19	.12	.11
625-1N6479	1N6479/25	A	100	30	.20	.13	.082	.072
625-S1B	S1B/11T	C	100	30	.14	.085	.055	.048
625-GF1D	GF1D/17	B	200	30	.31	.19	.12	.11
625-1N6480	1N6480/25	A	200	30	.20	.13	.082	.072
625-S1D	S1D/2P	C	200	30	.14	.085	.055	.048
625-GF1G	GF1G/17	B	400	30	.31	.19	.12	.11
625-1N6481	1N6481/25	A	400	30	.20	.13	.082	.072
625-S1G	S1G/2P	C	400	30	.14	.085	.055	.048
625-GF1J	GF1J/17	B	600	30	.31	.19	.12	.11
625-1N6482	1N6482/25	A	600	30	.20	.13	.082	.072
625-S1J	S1J/2P	C	600	30	.14	.085	.055	.048
625-GF1K	GF1K/17	B	800	30	.31	.19	.12	.11
625-1N6483	1N6483/25	A	800	30	.20	.13	.082	.072
625-S1K	S1K/2P	C	800	30	.14	.085	.055	.048
625-GF1M	GF1M/17	B	1000	30	.31	.19	.12	.11
625-1N6484	1N6484/25	A	1000	30	.20	.13	.082	.072
625-S1M	S1M/11T	C	1000	30	.14	.085	.055	.048
1.0 Amp - Thru-Hole								
625-1N4001	1N4001/1	D	50	30	.04	.026	.017	.014
625-1N4002	1N4002/1	D	100	30	.04	.026	.017	.014
625-1N4003	1N4003/1	D	200	30	.04	.026	.017	.014
625-1N4004	1N4004/1	D	400	30	.04	.026	.017	.014
625-1N4005	1N4005/1	D	600	30	.04	.026	.017	.014
625-1N4006	1N4006/1	D	800	30	.04	.026	.017	.014
625-1N4007	1N4007/1	D	1000	30	.04	.026	.017	.014
2.0 Amp - Surface Mount								
625-S2A	S2A/2	E	50	50	.22	.14	.088	.077
625-S2B	S2B/2	E	100	50	.22	.14	.088	.077
625-S2D	S2D/2	E	200	50	.22	.14	.088	.077
625-S2G	S2G/2	E	400	50	.22	.14	.088	.077
625-S2J	S2J/2	E	600	50	.22	.14	.088	.077
625-S2K	S2K/2	E	800	50	.22	.14	.088	.077
625-S2M	S2M/2	E	1000	50	.22	.14	.088	.077
3.0 Amp - Surface Mount								

VISHAY FAST RECOVERY

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Vishay Part No.	Fig.	PRV (V)	IFM Surge (A)	Price Each 1	100	500	1000
1.0 Amp - Thru-Hole								
625-1N4933	1N4933/1	D	50	200	.05	.034	.023	.02
625-1N4934	1N4934/1	D	100	200	.05	.034	.023	.02
625-1N4935	1N4935/1	D	200	200	.05	.034	.023	.02
625-1N4936	1N4936/1	D	400	200	.05	.034	.023	.02
625-1N4937	1N4937/1	D	600	200	.05	.034	.023	.02
3.0 Amp - Thru-Hole								
625-GI850	GI850/1	G	50	200	.27	.17	.11	.097
625-GI851	GI851/1	G	100	200	.27	.17	.11	.097
625-GI852	GI852/1	G	200	200	.27	.17	.11	.097
625-GI854	GI854/1	G	400	200	.27	.17	.11	.097
625-GI856	GI856/1	G	600	200	.27	.17	.11	.097
5.0 Amp - Thru-Hole								
625-GI820	GI820/1	H	50	300	.67	.41	.28	.24
625-GI821	GI821/1	H	100	300	.67	.41	.28	.24
625-GI822	GI822/1	H	200	300	.67	.41	.28	.24
625-GI824	GI824/1	H	400	300	.67	.41	.28	.24
625-GI826	GI826/1	H	600	300	.67	.41	.28	.24
625-GI828	GI828/1	H	800	300	.67	.41	.28	.24

VISHAY FAST RECOVERY GLASS PASSIVATED

For quantities of 2000 and up, call for quote.

1.0 Amp - Thru-Hole								
625-1N4933GP	1N4933GP/1	D	50	200	.10	.062	.043	.036
625-1N4934GP	1N4934GP/1	D	100	200	.10	.062	.043	.036
625-1N4935GP	1N4935GP/1	D	200	200	.10	.062	.043	.036
625-1N4936GP	1N4936GP/1	D	400	200	.10	.062	.043	.036
625-1N4937GP	1N4937GP/1	D	600	200	.10	.062	.043	.036

VISHAY ULTRA FAST

For quantities of 2000 and up, call for quote.

0.5 Amp - Surface Mount								
625-EGL34A	EGL34A/32	A	50	10	.18	.11	.077	.065
625-EGL34B	EGL34B/32	A	100	10	.18	.11	.077	.065
625-EGL34C	EGL34C/32	A	150	10	.18	.11	.077	.065
625-EGL34D	EGL34D/32	A	200	10	.18	.11	.077	.065
625-EGL34F	EGL34F/32	A	300	10	.18	.11	.077	.065
625-EGL34G	EGL34G/32	A	400	10	.18	.11	.077	.065
1.0 Amp - Surface Mount								
625-BYM12-50	BYM12-50/26	A	50	30	.19	.11	.079	.067
625-EGF1A	EGF1A/17-	B	50	30	.28	.17	.12	.10
625-EGL41A	EGL41A/46	A	50	30	.15	.10	.072	.067
625-ES1A	ES1A/11	C	50	30	.14	.10	.070	.065
625-US1A	US1A/11	C	50	30	.19	.12	.081	.069

Bridge Rectifiers

BACK NEXT

DIODES INC. Leaded Rectifiers

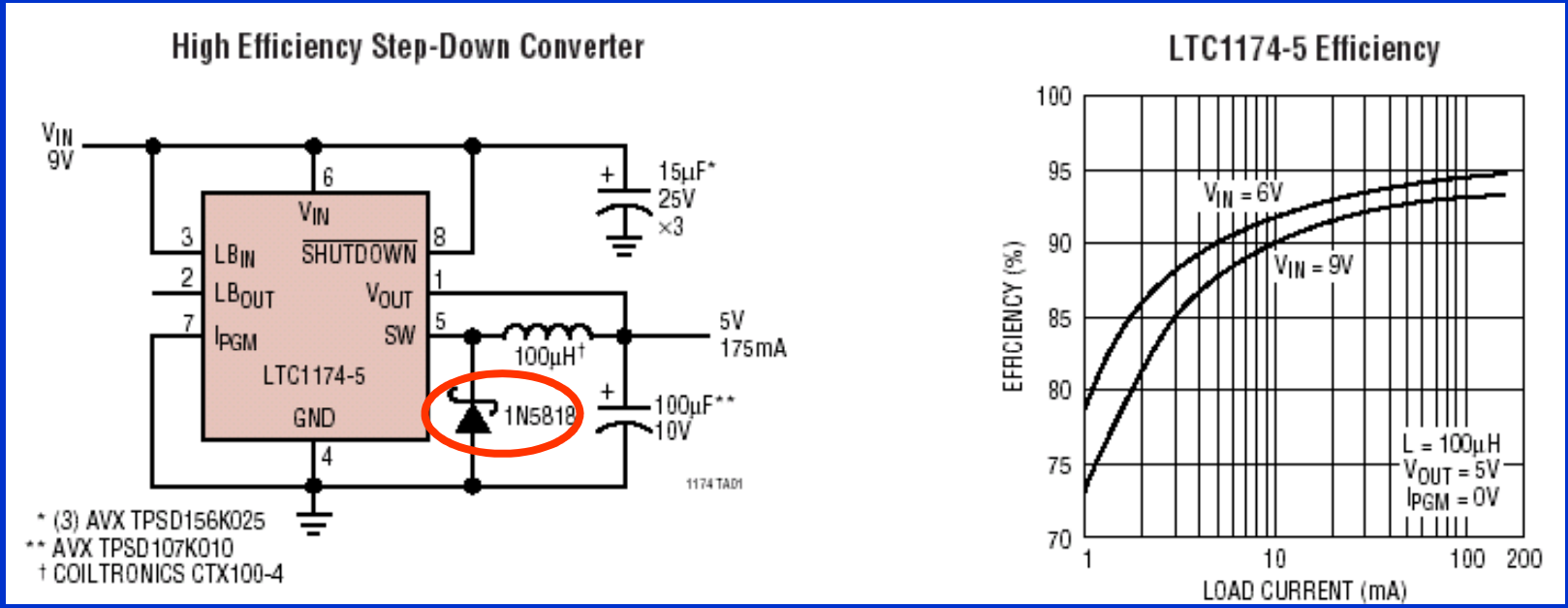
DIODES INCORPORATED

Bridge Rectifiers

For quantities of 500 and up, call for quote.

MOUSER STOCK NO.	Diodes Inc. Part No.	Package	Rectifying Current (A)	V_{RRM} (Max)	Max Surge Current (A)	Operating Temperature	Price Each			
							1	10	100	250
621-DF01M	DF01M	DFM	1A	100	50	-65°C to +150°C	.60	.48	.36	.30
621-DF04M	DF04M	DFM	1A	400	50	-65°C to +150°C	.60	.48	.36	.30
621-DF10M	DF10M	DFM	1A	1000	50	-65°C to +150°C	.80	.64	.48	.40
621-KBP04G	KBP04G	KBP	1.5A	400	40	-65°C to +150°C	1.22	.97	.74	.65
621-W04G	W04G	WOG	1.5A	400	50	-65°C to +150°C	.64	.52	.39	.33
621-KBP10G	KBP10G	KBP	1.5A	1000	40	-65°C to +150°C	1.62	1.28	.98	.85
621-W10G	W10G	WOG	1.5A	1000	50	-65°C to +150°C	.72	.58	.44	.37
621-KBP204G	KBP204G	KBP	2A	400	65	-65°C to +150°C	1.22	.97	.74	.65
621-KBP210G	KBP210G	KBP	2A	1000	65	-65°C to +150°C	1.62	1.28	.98	.85
621-GBU404	GBU404	GBU	4A	400	150	-65°C to +150°C	1.42	1.12	.86	.74
621-GBU410	GBU410	GBU	4A	1000	150	-65°C to +150°C	1.38	1.08	.85	.73
621-GBJ604	GBJ604	GBJ	6A	400	170	-65°C to +150°C	1.84	1.43	1.13	1.03
621-GBU604	GBU604	GBU	6A	400	175	-65°C to +150°C	1.62	1.28	.98	.85
621-GBJ610	GBJ610	GBJ	6A	1000	170	-65°C to +150°C	2.05	1.60	1.27	1.15
621-GBU610	GBU610	GBU	6A	1000	175	-65°C to +150°C	1.51	1.18	.93	.85
621-GBJ804	GBJ804	GBJ	8A	400	170	-65°C to +150°C	1.94	1.52	1.20	1.09
621-GBU804	GBU804	GBU	8A	400	200	-65°C to +150°C	1.46	1.14	.90	.82
621-GBJ810	GBJ810	GBJ	8A	1000	170	-65°C to +150°C	2.21	1.73	1.37	1.23
621-GBU810	GBU810	GBU	8A	1000	200	-65°C to +150°C	1.70	1.33	1.05	.96
621-GBJ1004	GBJ1004	GBJ	10A	400	220	-65°C to +150°C	2.03	1.58	1.25	1.16
621-GBU1004	GBU1004	GBU	10A	400	220	-65°C to +150°C	2.03	1.58	1.25	1.16
621-GBJ1010	GBJ1010	GBJ	10A	1000	220	-65°C to +150°C	2.38	1.85	1.46	1.33
621-GBU1010	GBU1010	GBU	10A	1000	220	-65°C to +150°C	2.38	1.85	1.46	1.33
621-GBJ1504	GBJ1504	GBJ	15A	400	240	-65°C to +150°C	2.21	1.73	1.37	1.23
621-GBPC1504	GBPC1504	GBPC	15A	400	300	-65°C to +150°C	2.88	2.32	1.88	1.76
621-GBJ1510	GBJ1510	GBJ	15A	1000	240	-65°C to +150°C	2.48	1.94	1.53	1.39
621-GBPC1510	GBPC1510	GBPC	15A	1000	300	-65°C to +150°C	3.22	2.59	2.10	1.96
621-GBJ2004	GBJ2004	GBJ	20A	400	240	-65°C to +150°C	2.27	1.77	1.40	1.27
621-GBJ2010	GBJ2010	GBJ	20A	1000	240	-65°C to +150°C	2.51	1.96	1.54	1.41
621-GBJ2504	GBJ2504	GBJ	25A	400	350	-65°C to +150°C	2.51	1.96	1.54	1.41
621-GBPC2504	GBPC2504	GBPC	25A	400	300	-65°C to +150°C	2.88	2.32	1.88	1.76
621-GBJ2510	GBJ2510	GBJ	25A	1000	350	-65°C to +150°C	2.35	1.89	1.53	1.43
621-GBPC2510	GBPC2510	GBPC	25A	1000	300	-65°C to +150°C	3.22	2.59	2.10	1.96
621-GBPC3504	GBPC3504	GBPC	35A	400	400	-65°C to +150°C	3.22	2.59	2.10	1.96
621-GBPC3510	GBPC3510	GBPC	35A	1000	400	-65°C to +150°C	3.57	2.87	2.33	2.18

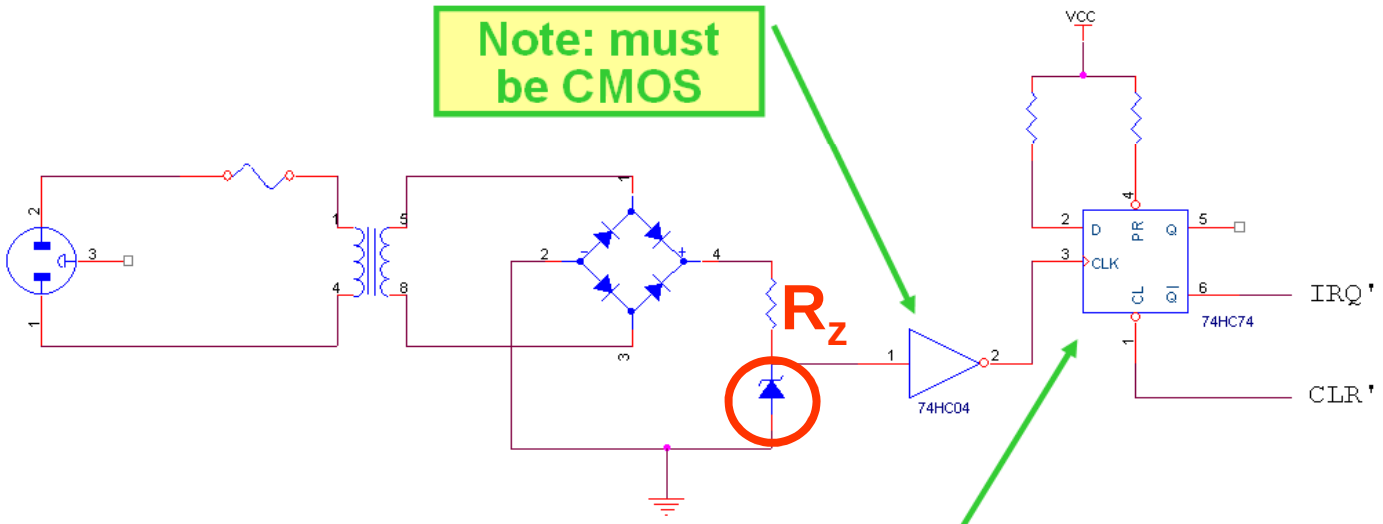
Flashback…



What's this? A Schottky Diode!

Flashback…

Switching A.C. Loads



What's this? A 4.7 V, 1 W Zener diode!!

VISHAY Zener Diodes

ZENER DIODES (CONT.)

For quantities of 2000 and up, call for quote.

MOUSER STOCK NO.	Vishay Part No.	Case Type	Nominal Voltage (V)	Power Rating (W)	Test Current (mA)	Price Each			
						1	100	500	1000
Thru-Hole									
625-1N5260B	1N5260B/D7	DO-35	43	0.5	3.0	.06	.038	.027	.022
78-1N5260B	1N5260B-TR	DO-35	43	0.5	3.0	.04	.024	.017	.014
625-1N5261B	1N5261B/D7	DO-35	47	0.5	2.7	.06	.038	.027	.022
78-1N5261B	1N5261B-TR	DO-35	47	0.5	2.7	.04	.024	.017	.014
78-1N5262B	1N5262B-TR	DO-35	51	0.5	2.5	.04	.024	.017	.014
625-1N5263B	1N5263B/D7	DO-35	56	0.5	2.2	.06	.038	.027	.022
78-1N5263B	1N5263B-TR	DO-35	56	0.5	2.2	.04	.024	.017	.014
625-1N5264B	1N5264B/D7	DO-35	60	0.5	2.1	.06	.038	.027	.022
78-1N5264B	1N5264B-TR	DO-35	60	0.5	2.1	.04	.024	.017	.014
625-1N5265B	1N5265B/D7	DO-35	62	0.5	2.0	.06	.038	.027	.022
78-1N5265B	1N5265B-TR	DO-35	62	0.5	2.0	.04	.024	.017	.014
625-1N5266B	1N5266B/D7	DO-35	68	0.5	1.8	.06	.038	.027	.022
78-1N5266B	1N5266B-TR	DO-35	68	0.5	1.8	.04	.024	.017	.014
625-1N5267B	1N5267B/D7	DO-35	75	0.5	1.7	.06	.038	.027	.022
78-1N5267B	1N5267B-TR	DO-35	75	0.5	1.7	.04	.024	.017	.014
625-1N4728A	1N4728A/D9	DO-41	3.3	1	76	.10	.065	.046	.038
78-1N4728A	1N4728A-TR	DO-41	3.3	1	76	.07	.042	.03	.025
625-1N4729A	1N4729A/D9	DO-41	3.6	1	69	.10	.065	.046	.038
78-1N4729A	1N4729A-TR	DO-41	3.6	1	69	.07	.042	.03	.025
625-1N4730A	1N4730A/D9	DO-41	3.9	1	64	.10	.065	.046	.038
78-1N4730A	1N4730A-TR	DO-41	3.9	1	64	.07	.042	.03	.025
625-1N4731A	1N4731A/D9	DO-41	4.3	1	58	.10	.065	.046	.038
78-1N4731A	1N4731A-TR	DO-41	4.3	1	58	.07	.042	.03	.025
625-1N4732A	1N4732A/D9	DO-41	4.7	1	53	.10	.065	.046	.038
78-1N4732A	1N4732A-TR	DO-41	4.7	1	53	.07	.042	.03	.025
78-1N4733A	1N4733A-TR	DO-41	5.1	1	49	.07	.042	.03	.025
78-1N4734A	1N4734A-TR	DO-41	5.6	1	45	.07	.042	.03	.025
625-1N4735A	1N4735A/D9	DO-41	6.2	1	41	.10	.065	.046	.038
78-1N4735A	1N4735A-TR	DO-41	6.2	1	41	.07	.042	.03	.025
625-1N4736A	1N4736A/D9	DO-41	6.8	1	37	.10	.065	.046	.038
78-1N4736A	1N4736A-TR	DO-41	6.8	1	37	.07	.042	.03	.025
625-1N4737A	1N4737A/D9	DO-41	7.5	1	34	.10	.065	.046	.038
78-1N4737A	1N4737A-TR	DO-41	7.5	1	34	.07	.042	.03	.025
625-1N4738A	1N4738A/D9	DO-41	8.2	1	31	.10	.065	.046	.038
78-1N4738A	1N4738A-TR	DO-41	8.2	1	31	.07	.042	.03	.025
625-1N4739A	1N4739A/D9	DO-41	9.1	1	29	.10	.065	.046	.038
78-1N4739A	1N4739A-TR	DO-41	9.1	1	29	.07	.042	.03	.025
625-1N4740A	1N4740A/D9	DO-41	10	1	25	.10	.065	.046	.038

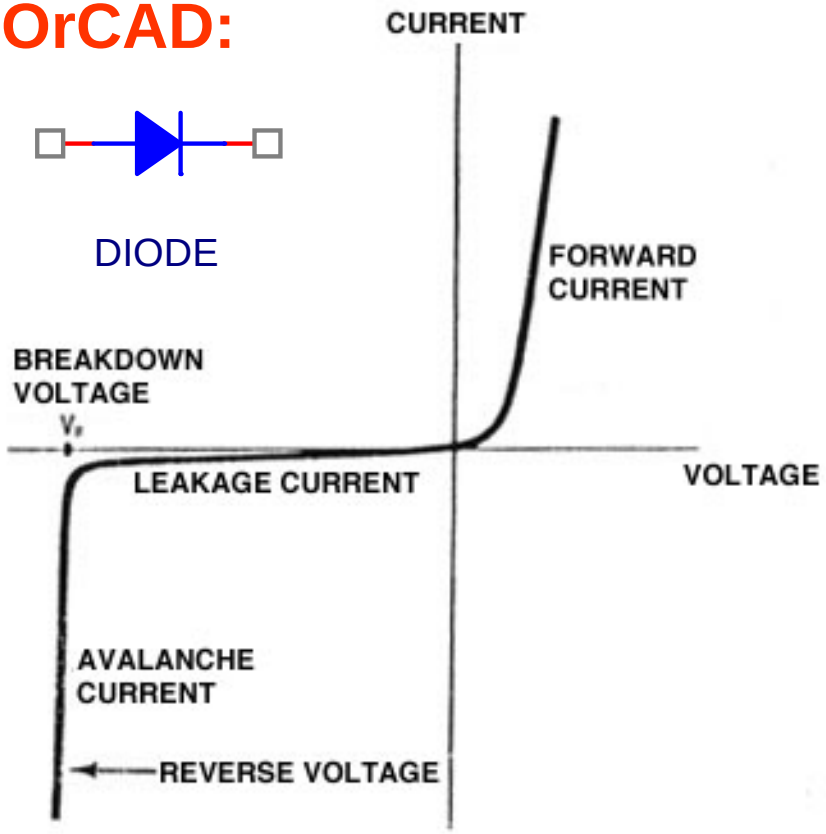
Differentiating Diodes

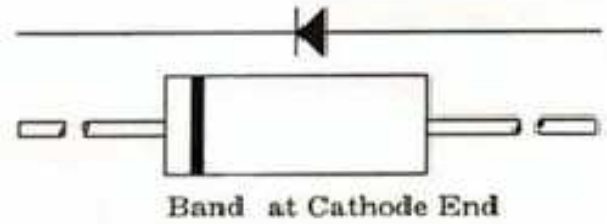
What's the difference between "PN junction", "Schottky", "Zener", and "small signal" diodes?

PN junction diode:

OrCAD:

DIODE





Minimal diode specifications are:

- maximum reverse voltage
- rated forward current
- maximum forward voltage drop
- maximum leakage current
- package style
- maximum reverse recovery time

Differentiating Diodes

What's the difference between "PN junction", "Schottky", "Zener", and "small signal" diodes?

Schottky diode:

- very low forward voltage drop
- very fast switching speed
- very fast reverse recovery time
- reverse leakage currents higher than PN junction diodes
- limited available reverse blocking voltage ratings

OrCAD:

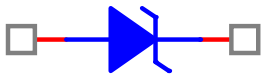
DIODE SCHOTTKY

Differentiating Diodes

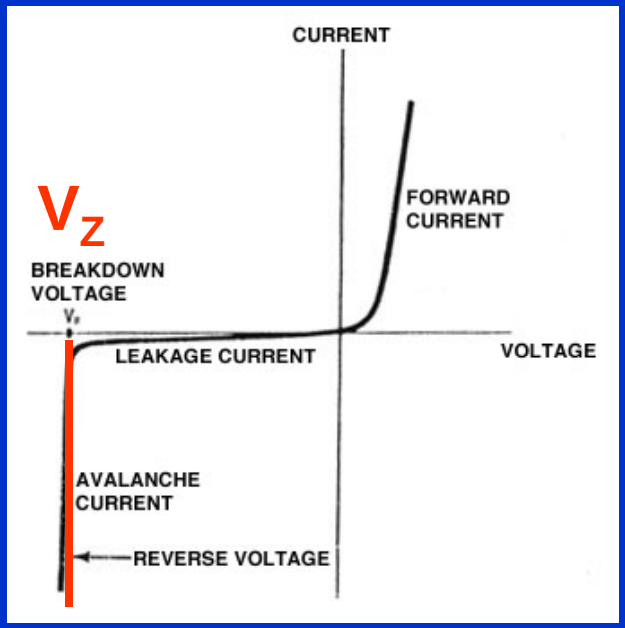
What's the difference between "PN junction", "Schottky", "Zener", and "small signal" diodes?

Zener diode:

OrCAD:



DIODE ZENER

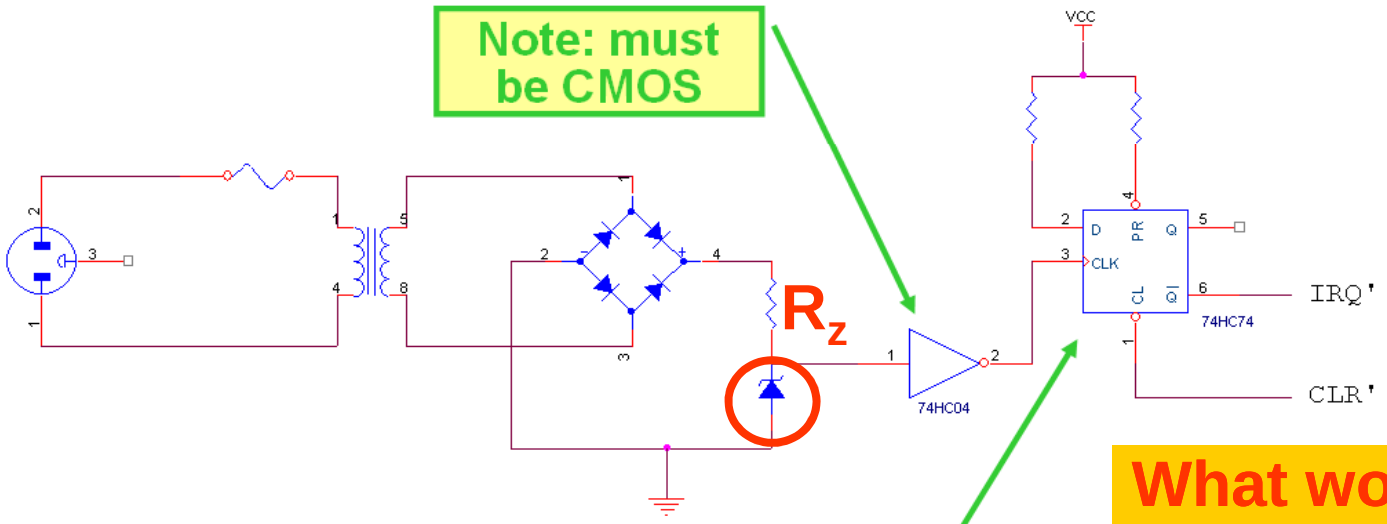


Zener diode specifications:

- operating voltage (typ range 3.3 V to 75 V)
- tolerance of specified voltage (typ 5-10%)
- test current (Iz) for rated voltage and tolerance
- power handling capability (typ 1/4, 1/2, 1 , 5, 10, and 50 W)

Flashback…

Switching A.C. Loads



Note how the Zener diode is connected!!

What would be an appropriate value for R_z?

What's this? A 4.7 V, 1 W Zener diode!!

Question: Why were "4.7 V" and "1 W" chosen?

Differentiating Diodes

What's the difference between "PN junction", "Schottky", "Zener", and "small signal" diodes?

"Small signal" diode:

- very low forward voltage drop
- often just Schottky diodes (except for low-leakage variety)

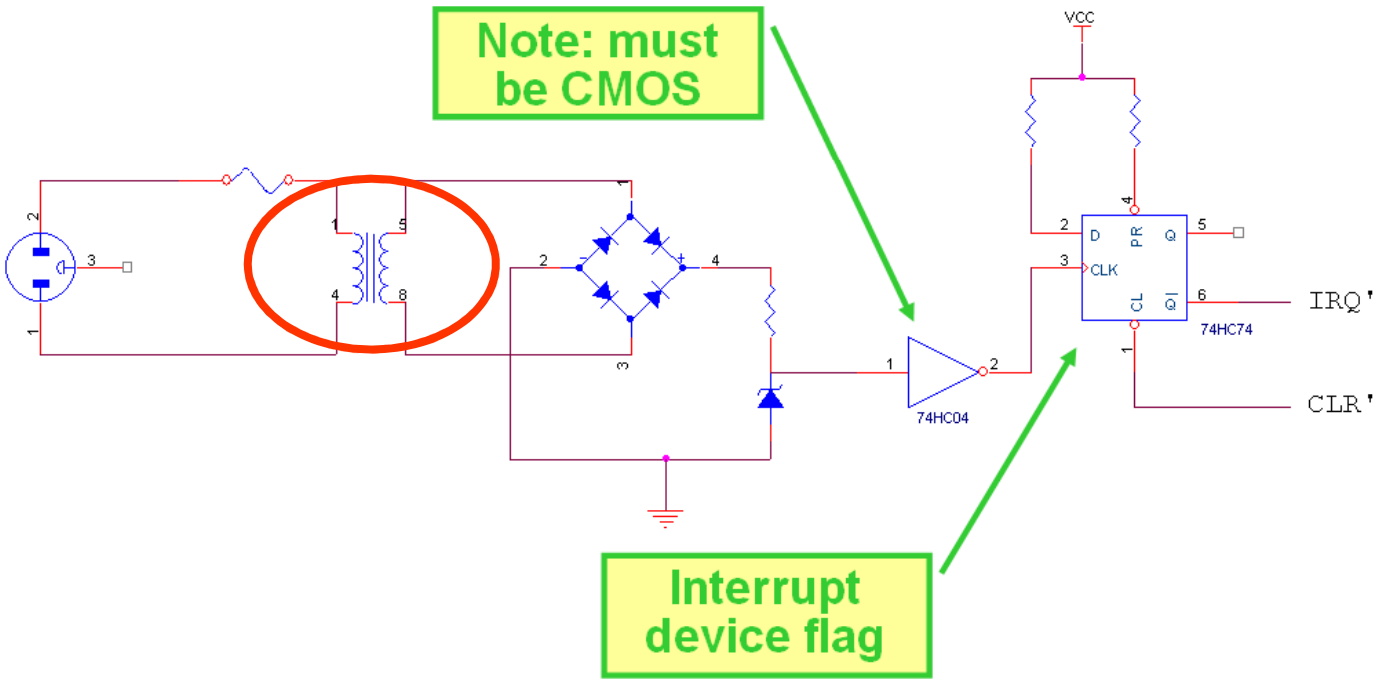
OrCAD:

DIODE

DIODE SCHOTTKY

Flashback…

Switching A.C. Loads



What's this? An A.C. step-down transformer

BACK NEXT

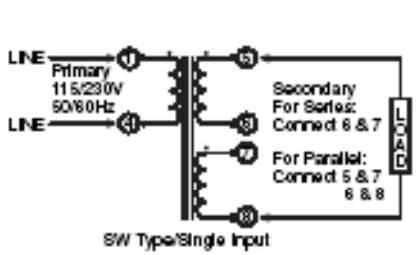
STANCOR Transformers

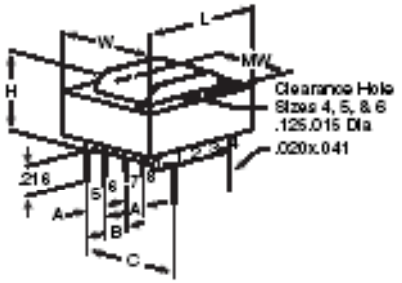
STANCOR.

"Low Boy" LB Series

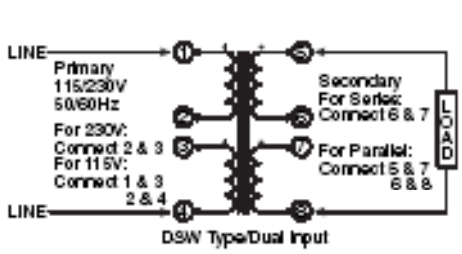
For quantities of 100 and up, call for quote.

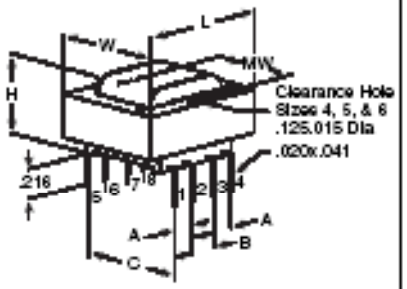
MOUSER STOCK NO.	Stancor Part No.	V.A.	Primary Winding	Rated Output						Dimensions (In.)							Wt. (Lbs.)	Price Each		
				Individual		Series		Parallel		H	W	L	Mounting W	Mounting L	A	B		1	10	50
				Volts	mA	Volts	mA	Volts	mA											
802-LB-620	LB-620	6	Dual	- - -	- - -	20.0 CT	300	10	600	0.88	1.56	1.88	0.88	1.62	1.60	0.38	0.34	9.97	9.16	8.62
802-LB-1224	LB-1224	12	Dual	- - -	- - -	24.0 CT	500	12	1000	1.06	2.00	2.50	1.00	2.00	2.00	0.50	0.72	10.51	9.66	9.09





Side-Winder (SW) Single Primary





Dual Side-Winder (DSW) Dual Primary

"Side Winder" SW/DSW Series

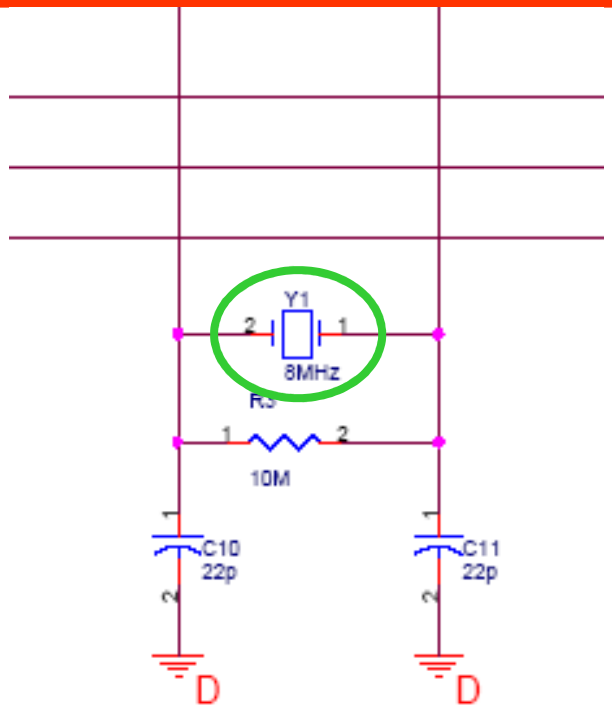
For quantities of 100 and up, call for quote.

MOUSER STOCK NO.	Stancor Part No.	V.A.	Primary Winding	Rated Output						Dimensions (In.)							Wt. (Lbs.)	Price Each		
				Individual		Series		Parallel		H	W	L	Mounting W	A	B	C		1	10	50
				Volts	mA	Volts	mA	Volts	mA											
802-DSW-310	DSW-310	2.50	Dual	5	250	10.0 CT	250	5	500	1.19	1.13	1.38	-	0.25	0.25	1.20	0.25	6.85	6.29	5.92
802-SW-316	SW-316	2.50	Single	8	150	16.0 CT	150	8	300	1.19	1.13	1.38	-	0.25	0.25	1.20	0.25	6.38	5.87	5.52
802-DSW-316	DSW-316	2.50	Dual	8	150	16.0 CT	150	8	300	1.19	1.13	1.38	-	0.25	0.25	1.20	0.25	6.85	6.29	5.92
802-SW-616	SW-616	20.0	Single	8	1250	16.0 CT	1250	8	2500	1.44	1.88	2.25	1.50	0.30	0.40	1.60	0.80	9.77	8.98	8.45
802-DSW-520	DSW-520	12.0	Dual	10	600	20.0 CT	600	10	1200	1.44	1.56	1.88	1.25	0.30	0.40	1.41	0.70	8.40	7.72	7.26

Transformers

- More than meets the eye
- Many configurations
  - single secondary
  - multiple secondaries
  - center-tapped
  - all of the above
- Specified (minimally) by primary voltage and secondary voltage(s) / current(s)
- Secondary voltage at no load can be much higher than specified

CRYSTALS



What's this? An 8 MHz crystal

ECS INC. CYLINDER TYPE CRYSTALS

This product represents our selection of miniature tubular high frequency crystals.
They feature outstanding shock/vibration resistance and environmental characteristics.

Features:

- Cost effective
- Excellent aging
- Load Cap.: 18pf
- Lead length: .394 in.
- Wide frequency range
- Excellent reliability

DIMENSIONS (mm)

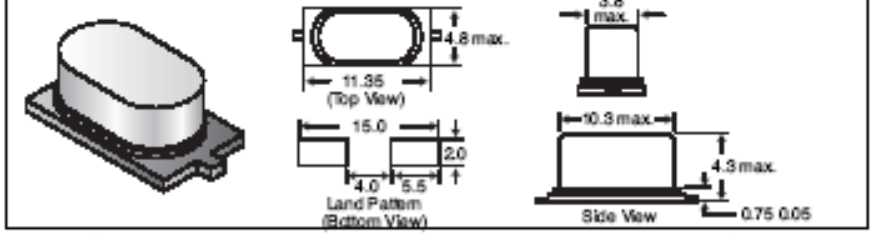
For quantities of 500 and up, call for quote.

MOUSER STOCK NO.	ECS Part No.	Frequency (MHz)	Dimensions			Price Each		
			D	L	L/L	1	10	100
520-ECS-357-18-10	ECS-35-18-10	3.579545	3.2	10.5	10	.58	.53	.47
520-ECS-368-18-10	ECS-36-18-10	3.686400	3.2	10.5	10	.58	.53	.47
520-ECS-400-18-10	ECS-40-18-10	4.000000	3.2	10.5	10	.58	.53	.47
520-ECS-491-18-10	ECS-49-18-9	4.915200	3.2	10.5	10	.58	.53	.47
520-ECS-600-18-10	ECS-60-18-9	6.000000	3.2	10.5	10	.58	.53	.47
520-ECS-737-18-10	ECS-73-18-9	7.372800	3.2	10.5	10	.58	.53	.47
520-ECS-800-18-10	ECS-80-18-9	8.000000	3.2	10.5	10	.58	.53	.47
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
520-ECS-983-18-10	ECS-98-18-9	9.830400	3.2	10.5	10	.58	.53	.47
520-ECS-1000-18-9	ECS-100-18-9	10.000000	3.2	9	10	.58	.53	.47
520-ECS-1105-18-9	ECS-110.5-18-9	11.059000	3.2	9	10	.58	.53	.47
520-ECS-1200-18-9	ECS-120-18-9	12.000000	3.2	9	10	.58	.53	.47
520-ECS-1431-18-9	ECS-143-18-9	14.318180	3.2	9	10	.58	.53	.47
520-ECS-1474-18-9	ECS-147-18-9	14.745600	3.2	9	10	.58	.53	.47
520-ECS-1600-18-9	ECS-160-18-9	16.000000	3.2	9	10	.58	.53	.47
520-ECS-1843-18-9	ECS-184-18-9	18.432000	3.2	9	10	.58	.53	.47
520-ECS-1966-18-9	ECS-196-18-9	19.660800	3.2	9	10	.58	.53	.47
520-ECS-2000-18-9	ECS-200-18-9	20.000000	3.2	9	10	.58	.53	.47
520-ECS-2400-18-9	ECS-240-18-9	24.000000	3.2	9	10	.58	.53	.47
520-ECS-2457-18-9	ECS-245-18-9	24.576000	3.2	9	10	.58	.53	.47
520-ECS-2500-18-9	ECS-250-18-9	25.000000	3.2	9	10	.58	.53	.47
520-ECS-2700-18-9	ECS-270-18-9	27.000000	3.2	9	10	.58	.53	.47
520-ECS-3200-18-9	ECS-320-18-9	32.000000	3.2	9	10	.58	.53	.47
520-ECS-3276-18-9	ECS-327-18-9	32.768000	3.2	9	10	.58	.53	.47
520-ECS-4000-18-10	ECS-400-18-9	40.000000	3.2	10.5	10	.58	.53	.47
520-ECS-5000-18-9	ECS-500-18-9	50.000000	3.2	9	10	.58	.53	.47
520-ECS-6000-18-9	ECS-600-18-9	60.000000	3.2	9	10	.58	.53	.47
520-ECS-6666-18-9	ECS-666-18-9	66.666000	3.2	9	10	.58	.53	.47

CSM-7

The CSM-7 is an excellent choice for the SMD version of the HC-49UB leaded crystal. The CSM-7 has a case height of 4.3mm maximum in a resistance weld metal package.

DIMENSIONS (mm)



Specifications:

- Frequency tolerance: ±30 ppm
- Extended temperature: +25°C to ±90 ppm
- Shunt capacitance: 7.0pF
- Load capacitance: specified or series
- Operating temp. Range: -10°C to +70°C
- Industrial Range: -40°C + 85°C (50 ppm)
- Storage temperature: -30°C to +85°C

Features:

- Cost effective
- Space saving design
- Low profile

For quantities of 1000 and up, call for quote.

MOUSER STOCK NO.	ECS Part Number	Frequency (MHz)	Load Cap.	Price Each			
				1	10	100	500
520-CSM357-17	ECS-35-17-5P	3.579545	17pf	.68	.58	.46	.41
520-CSM368-S	ECS-36-S-5P	3.6864	Series	.68	.58	.46	.41
520-CSM368-20	ECS-36-20-5P	3.6864	20pf	.68	.58	.46	.41
520-CSM400-20	ECS-40-20-5P	4.0000	20pf	.68	.58	.46	.41
520-CSM403-20	ECS-40.3-20-5P	4.032000	20pf	.68	.58	.46	.41
520-CSM409-20	ECS-41-20-5P	4.096000	20pf	.68	.58	.46	.41
520-CSM419-12	ECS-42-12-5P	4.194304	12pf	.68	.58	.46	.41
520-CSM491-S	ECS-49-S-5P	4.9152	Series	.68	.58	.46	.41
520-CSM491-20	ECS-49-20-5P	4.9152	20pf	.68	.58	.46	.41
520-CSM500-20	ECS-50-20-5P	5.000000	20pf	.68	.58	.46	.41
520-CSM500-S	ECS-50-S-5P	5.000000	Series	.68	.58	.46	.41
520-CSM600-32	ECS-60-32-5P	6.000000	32pf	.68	.58	.46	.41
520-CSM600-S	ECS-60-S-5P	6.000000	Series	.68	.58	.46	.41
520-CSM614-32	ECS-61-32-5P	6.144000	32pf	.68	.58	.46	.41
520-CSM655-S	ECS-65.5-S-5P	6.553600	Series	.68	.58	.46	.41
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
520-CSM800-18	ECS-80-18-5P	8.0000	18pf	.68	.58	.46	.41
520-CSM800-32	ECS-80-32-5P	8.0000	32pf	.68	.58	.46	.41
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
520-CSM921-S	ECS-92.1-S-5P	9.216000	Series	.68	.58	.46	.41
520-CSM983-S	ECS-98.3-S-5P	9.8304	Series	.68	.58	.46	.41
520-CSM1000-S	ECS-100-S-5P	10.000000	Series	.68	.58	.46	.41
520-CSM1105-32	ECS-110.5-32-5P	11.0592	32pf	.68	.58	.46	.41
520-CSM1105-20	ECS-110.5-20-5P	11.0592	20pf	.68	.58	.46	.41
520-CSM1105-S	ECS-110.5-S-5P	11.0592	Series	.68	.58	.46	.41
520-CSM1200-S	ECS-120-S-5P	12.000000	Series	.68	.58	.46	.41
520-CSM1201-18	ECS-120.003-18-5P	12.000393	18pf	.68	.58	.46	.41
520-CSM1228-20	ECS-122.8-20-5P	12.288000	20pf	.68	.58	.46	.41
520-CSM1228-S	ECS-122.8-S-5P	12.288000	Series	.68	.58	.46	.41
520-CSM1431-S	ECS-143-S-5P	14.318180	Series	.68	.58	.46	.41
520-CSM1600-20	ECS-160-20-5P	16.000000	20pf	.68	.58	.46	.41
520-CSM1600-S	ECS-160-S-5P	16.000000	Series	.68	.58	.46	.41
520-CSM1843-S	ECS-184-S-5P	18.432000	Series	.68	.58	.46	.41
520-CSM2000-20	ECS-200-20-5P	20.000000	20pf	.68	.58	.46	.41
520-CSM2048-20	ECS-204.8-20-5P	20.480000	20pf	.68	.58	.46	.41
520-CSM2457-20	ECS-245.7-20-5P	24.576000	20pf	.68	.58	.46	.41
520-CSM2500-18	ECS-250-18-5P	25.000000	18pf	.68	.58	.46	.41
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

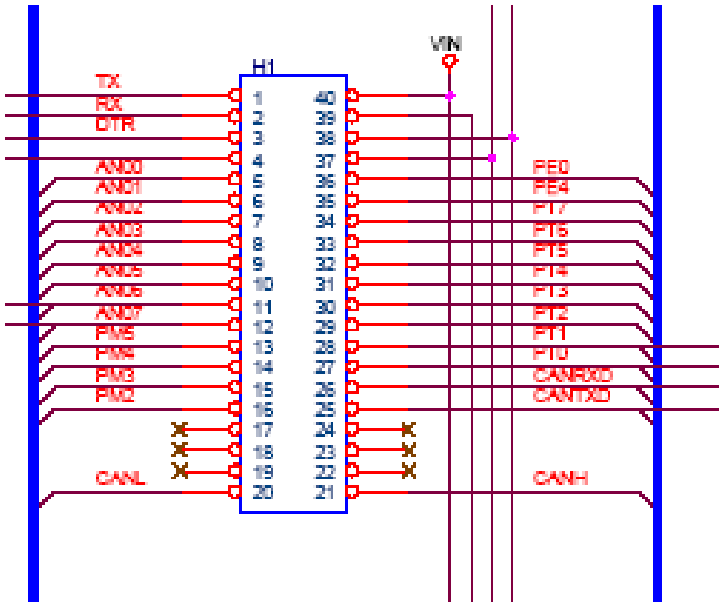
Crystals

- **Used for generating accurate time-base for timing applications, ethernet and other applications**
- **Usually require external load capacitors**
- **Layout guidelines supplied by μC manufacturer are of utmost importance – parasitic capacitance can cause the clock circuit to fail**

Other timing devices

- **Resonator**
  - **ceramic, looser tolerance, cheaper, typically can be purchased with built-in load capacitance**
- **Oscillator (crystal oscillator)**
  - **crystal and drive circuit in one box, typically a logic-level, square-wave output, often with output enable pin**
- **VCXO**
  - **voltage controlled crystal oscillator**

HEADERS



What's this? A (standard) 0.100" header

AMPMODU™ Breakaway Headers and AMP-LATCH

tyco Electronics

AMPMODU™ BREAKAWAY HEADERS - SINGLE AND DOUBLE ROW

Material:

- Housing: 94V-0 black thermoplastic
- Post: phosphor bronze
- .100" (2.54mm) Centers
- Unshrouded

Contact Plating:

Plating A = Duplex plated .000030 min. gold on contact area. .0001 - .0002 min. tin-lead on solder area, with entire post underplated .00005 min. nickel.
Plating B = Duplex plated .000015 min. gold on contact area. .0001 - .0002 min. tin-lead on solder area,with entire post underplated .00005 min. nickel.
Plating C = .0001 - .0002 min. tin-lead over .00005 nickel on entire post.

.025" Square Straight Posts

For quantities of 1000 and up, call for quote.

MOUSER STOCK NO.	AMP Part No.	Fig.	No. of Pos.	Length		Plating	Price Each		
				Post	Tail		1	100	500
Vertical - Single Row, .100 Centerline									
571-1032392	103239-2	A	2	0.230	0.120	A	.19	.16	.13
571-1032393	103239-3	A	3	0.230	0.120	A	.29	.24	.19
571-1032394	103239-4	A	4	0.230	0.120	A	.30	.26	.24
571-1032395	103239-5	A	5	0.230	0.120	A	.39	.32	.26
571-1032396	103239-6	A	6	0.230	0.120	A	.45	.37	.30
571-1032398	103239-8	A	8	0.230	0.120	A	.65	.54	.43
571-11032390	1-103239-0	A	10	0.230	0.120	A	.79	.65	.52
571-21032390	2-103239-0	A	20	0.230	0.120	A	1.09	.97	.92
571-41032390	4-103239-0	A	40	0.230	0.120	A	.87	.78	.74
571-1031852	103185-2	A	2	0.230	0.120	B	.18	.15	.12
571-1031853	103185-3	A	3	0.230	0.120	B	.28	.23	.19
571-1031854	103185-4	A	4	0.230	0.120	B	.38	.31	.25
571-1031855	103185-5	A	5	0.230	0.120	B	.39	.32	.26
571-1031856	103185-6	A	6	0.230	0.120	B	.45	.37	.30
571-1031857	103185-7	A	7	0.230	0.120	B	.55	.47	.40
571-21031850	2-103185-0	A	20	0.230	0.120	B	1.09	1.02	.97
571-41031850	4-103185-0	A	40	0.230	0.120	B	.72	.65	.62
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571-1033273	103327-3	A	3	0.230	0.120	C	.27	.22	.19
571-1033274	103327-4	A	4	0.230	0.120	C	.37	.30	.24
571-1033275	103327-5	A	5	0.230	0.120	C	.39	.32	.26
571-1033276	103327-6	A	6	0.230	0.120	C	.45	.37	.30
571-1033278	103327-8	A	8	0.230	0.120	C	.60	.50	.40
571-11033270	1-103327-0	A	10	0.230	0.120	C	.79	.65	.52
571-41033270	4-103327-0	A	40	0.230	0.120	C	.98	.71	.61
571-1029762	102976-2	A	2	0.318	0.125	A	.18	.16	.15
571-1029763	102976-3	A	3	0.318	0.125	A	.29	.244	.19
571-1029764	102976-4	A	4	0.318	0.125	A	.37	.30	.24
571-1029765	102976-5	A	5	0.318	0.125	A	.39	.32	.26
571-1029766	102976-6	A	6	0.318	0.125	A	.45	.37	.30
571-11029760	1-102976-0	A	10	0.318	0.125	A	.79	.65	.52
571-21029760	2-102976-0	A	20	0.318	0.125	A	1.11	1.05	1.00
571-41029760	4-102976-0	A	40	0.318	0.125	A	.96	.87	.82
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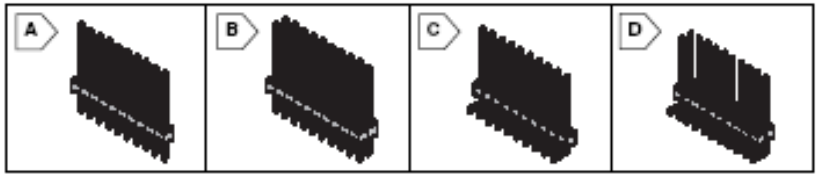

For quantities of 1000 and up, call for quote.

MOUSER STOCK NO.	AMP Part No.	Fig.	No. of Pos.	Length		Plating	Price Each		
				Post	Tail		1	100	500
Vertical - Double Row, .100 x .100 Centerline (Cont.)									
571-1031864	103196-4	B	8	0.230	0.120	B	.58	.48	.38
571-1031865	103196-5	B	10	0.230	0.120	B	.72	.60	.48
571-1031866	103196-6	B	12	0.230	0.120	B	.87	.72	.58
571-1031868	103196-8	B	16	0.230	0.120	B	.82	.74	.70
571-11031860	1-103196-0	B	20	0.230	0.120	B	1.03	.93	.88
571-21031860	2-103196-0	B	40	0.230	0.120	B	2.05	1.85	1.75
571-41031860	4-103196-0	B	80	0.230	0.120	B	1.38	1.25	1.18
571-1033282	103328-2	B	4	0.230	0.120	C	.27	.25	.23
571-1033283	103328-3	B	6	0.230	0.120	C	.44	.36	.29
571-1033284	103328-4	B	8	0.230	0.120	C	.56	.46	.37
571-1033285	103328-5	B	10	0.230	0.120	C	.49	.44	.42
571-1033286	103328-6	B	12	0.230	0.120	C	.60	.53	.50
571-1033287	103328-7	B	14	0.230	0.120	C	.69	.62	.59
571-1033288	103328-8	B	16	0.230	0.120	C	.79	.71	.67
571-21033280	2-103328-0	B	40	0.230	0.120	C	1.86	1.67	1.58
571-41033280	4-103328-0	B	80	0.230	0.120	C	1.33	1.20	1.13
571-1029773	102977-3	B	6	0.318	0.125	A	.33	.30	.28
571-1029774	102977-4	B	8	0.318	0.125	A	.56	.46	.37
571-1029775	102977-5	B	10	0.318	0.125	A	.70	.58	.46
571-1029776	102977-6	B	12	0.318	0.125	A	.87	.72	.58
571-1029777	102977-7	B	14	0.318	0.125	A	.97	.81	.64
571-1029778	102977-8	B	16	0.318	0.125	A	.89	.80	.75
571-21029770	2-102977-0	B	40	0.318	0.125	A	2.10	1.88	1.78
571-41029770	4-102977-0	B	80	0.318	0.125	A	1.74	1.56	1.48
571-1029733	102973-3	B	6	0.318	0.125	B	.44	.36	.29
571-1029738	102973-8	B	16	0.318	0.125	B	.82	.74	.70
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