KEMET Surface Mount Tantalum Chip Capacitors

KEMET's family of solid tantalum chip capacitors are designed and manufactured with the requirements of surface mount technology in mind. These devices extend the advantages of solid tantalum technology to today's surface mount circuit applications.

Operating Temperature Range: -55°C to +125°C

T491 Series — Industrial

The leading choice in surface mount designs. This product meets or exceeds the requirements of EIA standard 535BAAC. The physical outline and dimensions of this series conform to this global standard.

This product was designed specifically for highly automated surface mount processes and equipment.

T494 Series — Low ESR, Industrial Grade

The T494 is a low ESR series that is available in all the same case sizes and CV ratings as the T491 Series. The T494 offers low ESR performance with the economy of an industrial grade device. This series is targeted for output filtering.

T495 Series — Low ESR, Surge Robust

Designed primarily for output filtering in switch-mode power supplies and DC-to-DC converters, the standard CV T495 values are an excellent choice for battery-to-ground input filter applications.

This series offers several important advantages: Very low ESR, high ripple current capability, excellent capacitance stability and improved ability to withstand high inrush currents.

T496 Series — Fused

KEMET also offers a "fail-safe" fused solid tantalum chip capacitor. The built-in fuse element provides excellent protection from damaging short circuit conditions in applications where high fault currents exist. Protection from costly circuit damage due to reversed installation is offered with this device.

T510 Series — Ultra-Low ESR

KEMET's T510 Series offers the industry's lowest ESR in the popular EIA 7343-43 case size. The ultra-low ESR and high ripple current capability make it an ideal choice for SMPS filtering and power decoupling.

KEMET has developed an innovative construction platform that incorporates multiple capacitor elements, in parallel, inside a single package.

T520 Series — KO-CAP Polymer Tantalum

The KO-CAP in a Tantalum capacitor, with Ta anode and Ta2O5 dielectric. A conductive, organic, polymer replaces the MnO2 as the cathode plate of the capacitor. This results in very low ESR and improved cap retention at high frequency. The KO-CAP also exhibits a benign failure mode, which eliminates the ignition failures that can occur in standard MnO2 Tantalum types.

KO-CAPs may be operated at voltages up to 80% of rated voltage with equivalent or better reliability than standard tantalums operated at 50% of rated voltage.

The T520 series captures the best features of multilayer ceramic caps (low ESR and high frequency cap retention), aluminum electrolytics (benign failure mode), and proven solid tantalum technology (volumetric efficiency, surface mount capability, and no wearout mechanism).

The KO-CAP can reduce component counts, eliminate through-hole assembly by replacing leaded aluminum capacitors, and offer a more cost effective solution to high-cost high-cap ceramic capacitors.

NEW! T530 Series — KO-MAT Polymer Tantalum

The KO-MAT is an extremely low-ESR, volumetrically efficient, organic tantalum chip capacitor that offers high capacitance retention while preventing thermal events (ignition failures).

Organic polymer does not give up oxygen if the dielectric fails short, thus preventing ignition. Organic polymer is more conductive than MnO2 — lower ESR.

Higher capacitance retention at higher frequencies means fewer parts are required to achieve the desired capacitance.

The KO-MAT allows tantalum capacitors to be used in circuits never considered possible before, such as input filters.

Initial focus is for power supplies and microprocessor circuits

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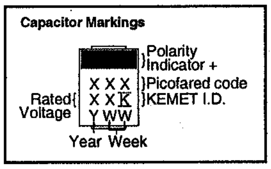

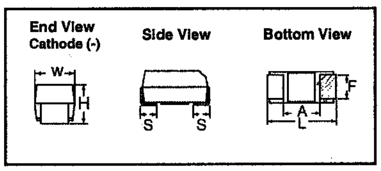

Size Code	EIA Code	L	W	H	F ±0.1 ±(.004)	S ±0.3 ±(.012)	A (Min.)
A	3216-18	3.2±0.2 (.126±.008)	1.6±0.2 (.063±.008)	1.6±0.2 (.063±.008)	1.2 (.047)	0.8 (.031)	0.8 (.031)
B	3528-21	3.5±0.2 (.138±.008)	2.8±0.2 (.110±.008)	1.9±0.2 (.075±.008)	2.2 (.087)	0.8 (.031)	1.1 (.043)
C	6032-28	6.0±0.3 (.236±.012)	3.2±0.3 (.126±.012)	2.5±0.3 (.098±.012)	2.2 (.087)	1.3 (.051)	2.5 (.098)
D	7343-31	7.3±0.3 (.287±.012)	4.3±0.3 (.169±.012)	2.8±0.3 (.110±.012)	2.4 (.094)	1.3 (.051)	3.8 (.150)
E	7260-38	7.3±0.3 (.287±.012)	6.0±0.3 (.236±.012)	3.6±0.2 (.142±.008)	4.1 (.161)	1.3 (.051)	3.8 (.150)
V	7343-20	7.3±0.3 (.287±.012)	4.3±0.3 (.169±.012)	2.0 (0.079)	2.4 (.094)	1.3 (.051)	3.8 (.150)
X	7343-43	7.3±0.3 (.287±.012)	4.3±0.3 (.169±.012)	4.0±0.3 (.157±.012)	2.4 (.094)	1.3 (.051)	3.8 (.150)

WV (DC)	Cap. (µF)	Cap. Tol. (%)	DC Leakage µA@+25°C Max.	DF % @+25°C 120Hz Max.	ESR Ω @+25°C 100KHz Max.	Size Code	Digi-Key Part No.	Cut Tape Price Each 1	10	100	Digi-Key Part No.	Tape and Reel Size	Pricing	Kemet Part No.
							T491 Series — Industrial							
	68	±10	2.7	6.0	0.8	D	399-1549-1-ND	.83	.72	.63	399-1549-2-ND	500	150.00	T491D686K004AS
4	100	±20	4.0	8.0	1.0	B	399-3000-1-ND	.93	.81	.71	399-3000-2-ND	2,000	315.00/M	T491B107M004AS
	100	±20	4.0	8.0	0.8	D	399-1550-1-ND	.83	.72	.63	399-1550-2-ND	500	150.00	T491D107M004AS
	10	±10	0.6	6.0	4.0	A	399-1551-1-ND	.23	.20	.18	399-1551-2-ND	2,000	78.00/M	T491A106K006AS
	10	±20	0.6	6.0	4.0	A	399-1552-1-ND	.23	.20	.18	399-1552-2-ND	2,000	78.00/M	T491A106M006AS
	10	±10	0.6	6.0	3.5	B	399-1553-1-ND	.29	.25	.22	399-1553-2-ND	2,000	97.00/M	T491B106K006AS
	22	±10	1.4	6.0	3.5	B	399-1554-1-ND	.34	.30	.26	399-1554-2-ND	2,000	114.00/M	T491B226K006AS
	22	±10	1.4	6.0	1.8	C	399-1555-1-ND	.53	.46	.40	399-1555-2-ND	500	95.50	T491C226K006AS
6.3	47	±10	2.9	6.0	1.6	C	399-1556-1-ND	.59	.51	.45	399-1556-2-ND	500	106.50	T491C476K006AS
	68	±20	4.1	8.0	1.0	B	399-3001-1-ND	.93	.81	.71	399-3001-2-ND	2,000	315.00/M	T491B686M006AS
	68	±10	4.1	6.0	1.2	C	399-1557-1-ND	.75	.66	.57	399-1557-2-ND	500	136.50	T491C686K006AS
	68	±10	4.1	6.0	0.8	D	399-1558-1-ND	.83	.72	.63	399-1558-2-ND	500	150.00	T491D686K006AS
	470	±20	28.2	12.0	0.5	D	399-3002-1-ND	4.63	4.03	3.52	399-3002-2-ND	500	842.00	T491D477M006AS
	2.2	±10	0.5	6.0	8.0	A	399-1559-1-ND	.21	.18	.16	399-1559-2-ND	2,000	70.00/M	T491A225K010AS
	3.3	±10	0.5	6.0	6.0	A	399-1560-1-ND	.25	.22	.19	399-1560-2-ND	2,000	85.00/M	T491A335K010AS
	4.7	±10	0.5	6.0	6.0	A	399-1561-1-ND	.21	.18	.16	399-1561-2-ND	2,000	70.00/M	T491A475K010AS
	4.7	±20	0.5	6.0	6.0	A	399-1562-1-ND	.21	.18	.16	399-1562-2-ND	2,000	70.00/M	T491A475M010AS
	4.7	±10	0.5	6.0	3.5	B	399-1565-1-ND	.29	.25	.22	399-1565-2-ND	2,000	97.00/M	T491B475K010AS
	4.7	±20	0.5	6.0	3.5	B	399-1566-1-ND	.29	.25	.22	399-1566-2-ND	2,000	97.00/M	T491B475M010AS
	6.8	±10	0.7	6.0	3.5	B	399-1567-1-ND	.33	.29	.25	399-1567-2-ND	2,000	111.00/M	T491B685K010AS
	10	±10	1.0	6.0	4.0	A	399-1563-1-ND	.24	.21	.19	399-1563-2-ND	2,000	82.00/M	T491A106K010AS
	10	±20	1.0	6.0	4.0	A	399-1564-1-ND	.24	.21	.19	399-1564-2-ND	2,000	82.00/M	T491A106M010AS
	10	±10	1.0	6.0	3.5	B	399-1568-1-ND	.29	.25	.22	399-1568-2-ND	2,000	97.00/M	T491B106K010AS
	10	±20	1.0	6.0	3.5	B	399-1569-1-ND	.29	.25	.22	399-1569-2-ND	2,000	97.00/M	T491B106M010AS
	10	±10	1.0	6.0	1.8	C	399-1571-1-ND	.53	.46	.40	399-1571-2-ND	500	95.50	T491C106K010AS
10	15	±10	1.5	6.0	3.5	B	399-1570-1-ND	.34	.30	.26	399-1570-2-ND	2,000	114.00/M	T491B156K010AS
	15	±10	1.5	6.0	1.8	C	399-1572-1-ND	.53	.46	.40	399-1572-2-ND	500	95.50	T491C156K010AS
	22	±10	2.2	6.0	1.8	C	399-1573-1-ND	.49	.43	.37	399-1573-2-ND	500	88.50	T491C226K010AS
	33	±10	3.3	6.0	0.8	D	399-1574-1-ND	.74	.64	.56	399-1574-2-ND	500	134.00	T491D336K010AS
	47	±20	4.7	8.0	1.0	B	399-3003-1-ND	.93	.81	.71	399-3003-2-ND	2,000	315.00/M	T491B476M010AS
	47	±10	4.7	6.0	1.2	C	399-1575-1-ND	.70	.61	.54	399-1575-2-ND	500	127.50	T491C476K010AS
	47	±20	4.7	6.0	1.2	C	399-1576-1-ND	.70	.61	.54	399-1576-2-ND	500	127.50	T491C476M010AS
	47	±10	4.7	6.0	0.8	D	399-1577-1-ND	.74	.64	.56	399-1577-2-ND	500	134.00	T491D476K010AS
	47	±20	4.7	6.0	0.8	D	399-1578-1-ND	.74	.64	.56	399-1578-2-ND	500	134.00	T491D476M010AS
	100	±10	10.0	8.0	0.7	D	399-1579-1-ND	.92	.80	.70	399-1579-2-ND	500	166.50	T491D107K010AS
	100	±20	10.0	8.0	0.7	D	399-1580-1-ND	.92	.80	.70	399-1580-2-ND	500	166.50	T491D107M010AS
	150	±20	15.0	8.0	0.7	D	399-1581-1-ND	1.13	.98	.86	399-1581-2-ND	500	205.00	T491D157M010AS
	220	±10	22.0	8.0	0.5	X	399-1582-1-ND	4.15	3.62	3.16	399-1582-2-ND	500	755.50	T491X227K010AS
	1.0	±10	0.5	4.0	10.0	A	399-1583-1-ND	.21	.18	.16	399-1583-2-ND	2,000	70.00/M	T491A105K016AS
	1.0	±20	0.5	4.0	10.0	A	399-1584-1-ND	.21	.18	.16	399-1584-2-ND	2,000	70.00/M	T491A105M016AS
	1.5	±10	0.5	6.0	8.0	A	399-1585-1-ND	.25	.22	.19	399-1585-2-ND	2,000	85.00/M	T491A155K016AS
	2.2	±10	0.5	6.0	6.0	A	399-1586-1-ND	.21	.18	.16	399-1586-2-ND	2,000	70.00/M	T491A225K016AS
	3.3	±10	0.5	6.0	3.5	B	399-1589-1-ND	.33	.29	.25	399-1589-2-ND	2,000	111.00/M	T491B335K016AS
	4.7	±10	0.8	6.0	6.0	A	399-1587-1-ND	.23	.20	.18	399-1587-2-ND	2,000	78.00/M	T491A475K016AS
	4.7	±20	0.8	6.0	6.0	A	399-1588-1-ND	.23	.20	.18	399-1588-2-ND	2,000	78.00/M	T491A475M016AS
16	4.7	±10	0.8	6.0	3.5	B	399-1590-1-ND	.29	.25	.22	399-1590-2-ND	2,000	97.00/M	T491B475K016AS
	4.7	±20	0.8	6.0	3.5	B	399-1591-1-ND	.29	.25	.22	399-1591-2-ND	2,000	97.00/M	T491B475M016AS
	6.8	±20	1.1	6.0	1.9	C	399-1592-1-ND	.53	.46	.40	399-1592-2-ND	500	95.50	T491C685M016AS
	10	±10	1.6	6.0	3.5	B	399-1593-1-ND	.34	.30	.26	399-1593-2-ND	2,000	114.00/M	T491B106K016AS
	10	±20	1.6	6.0	3.5	B	399-1594-1-ND	.34	.30	.26	399-1594-2-ND	2,000	114.00/M	T491B106M016AS
	10	±10	1.6	6.0	1.8	C	399-1595-1-ND	.49	.43	.37	399-1595-2-ND	500	88.50	T491C106K016AS
	10	±20	1.6	6.0	1.8	C	399-1596-1-ND	.49	.43	.37	399-1596-2-ND	500	88.50	T491C106M016AS
	22	±10	3.6	6.0	1.6	C	399-1597-1-ND	.59	.51	.45	399-1597-2-ND	500	106.50	T491C226K016AS
	22	±20	3.6	6.0	1.6	C	399-1598-1-ND	.59	.51	.45	399-1598-2-ND	500	106.50	T491C226M016AS

(Continued)

CMPE 174
SURFACE MOUNT TUTORIAL

The Mystique Behind Miniaturization—Surface Mount Technology

Pocket-size hand-helds, TVs the size of a watch—isn't it amazing? Here's a look at some of what makes this compactness possible.

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The electronic packaging revolution is upon us. Electronic equipment is getting smaller and smaller, with miniaturization being the name of the game. We now have hand-held transceivers that fit into a shirt pocket. Station transceivers that would have occupied an entire desktop 20 years ago, now are essentially portable radios. How has this all come about?

One of the major contributors to miniaturization is the use of surface-mount technology (SMT). Several years ago, electronics manufacturers began to mount miniaturized components directly on the surface of PC boards—an automated technique that evolved from thick-film hybrids. (Here, "hybrid" means an assembly built on a substrate using chip capacitors, resistors and so forth.) Today, surface mounting can meet the electronics industries' insatiable demand for boards that are smaller, cheaper and more reliable.

Surface mounting is changing most aspects of the electronic industry. For example, the electronic component industry must now create whole new families of tiny active, passive and electromechanical devices to meet the demand for surface-mountable components. Some of these devices are shown in the title photo. New kinds of automatic assembly and soldering machines currently used in production lines place and attach components to boards at fantastic rates. This automated equipment is constantly being improved.

In this article, I'll introduce you to some surface-mount components available from Motorola, and acquaint you with the terminology and manufacturing processes of the surface-mount world. Then, you'll have a better understanding of just how all that electronics power at your disposal is contained in such a small package.

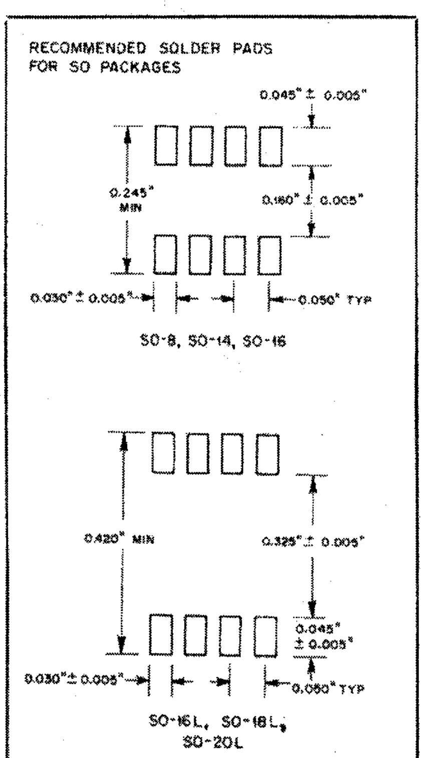

Fig 1—Typical surface-mount component footprints.

What is Surface Mounting?

Surface mounting involves soldering a component directly to a series of solder pads called a *footprint,* rather than inserting the component leads into holes on a PC board. The footprint is a series of pads that conform to the lead layout of the surface-mount device (SMD) or component (SMC); see Fig 1. Both old and new mounting techniques are shown in Fig 2.

Surface mounting has several advantages over the insertion method it is replacing. For example, the use of smaller components and the elimination of PC-board through holes can *triple* board density. The use of a smaller board with fewer layers cuts costs immediately. Additionally, circuit performance is improved. With the smaller boards, traces between components are shorter, lowering parasitic inductance and capacitance. Table 1 shows the benefits achieved by redesigning a board to use SMT. The table illustrates only the savings obtained by redesigning a *single* board. Approximately 65% of a unit's costs are related to component size. Some of the cost parameters related to component size include the number of PC boards, cabinet size, connectors and cabling, and cooling requirements.

Surface mounting allows components to be placed on *both* sides of a PC board—a major advantage. The use of chip capacitors, resistors and semiconductors can, in theory, give these boards densities equal to those of hybrids.

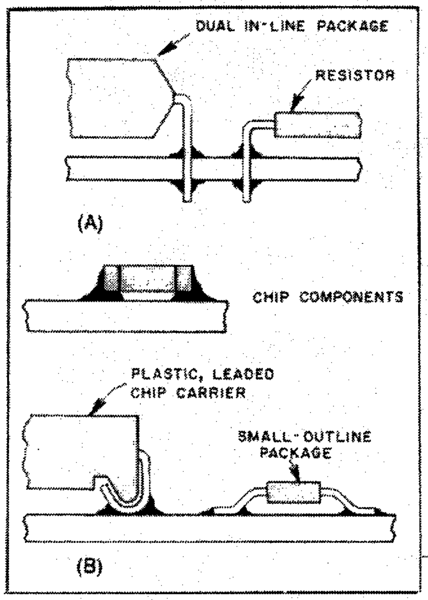

Fig 2—For years, the through-hole mounting of leaded components (A) has been common. Surface-mounting techniques (B) with leadless chip components and miniature IC packages are now being used in volume board assemblies.

Table 1
Assembly Technique Comparison

	Through hole	*Surface Mount*	*% Reduction*
Board size (inches)	11 × 14	6.5 × 9.6	59
Number of layers	6	4	33
Board cost (dollars)	150	75	50

The Surface Mount Assembly Process

Figs 3A and 3B show the top and bottom, respectively, of a surface-mount IC. Prior to mounting, the leads of the SMD are plated or tinned to provide a better solder joint. In addition to providing better solderability, the tinning adds a small amount of clearance between the package and the board, which permits automated cleaning of solder flux residue from the board.

Fig 3C shows the PC-board footprint to which the SMD is attached. Pretinned PC boards (provided by most PC-board manufacturers) aid SMD attachment. That's because the electrical and mechanical connections are made at the footprint pad by solder reflowing and joining the parts. Extra solder is required at this joint. Therefore, solder paste is "printed" onto the pads as shown in Fig 3D. This is normally done by a screen printer. The paste allows the required solder to form the joint fillets that are so important to electrical and mechanical connections. After the component is placed on the solder paste (Fig 3E), the operation is completed by means of a vapor phase reflow soldering process that melts the solder and bonds the SMD to the PC board as shown in Fig 3F. Then, the board is cleaned with a solvent and ready to be tested.

Component Packaging

All SMDs come packaged in one of the following forms: tape and reel, sleeves, bulk and in vials. With SMDs, it's no longer necessary to preform axial component leads. This eases the automated PC-board assembly process. Automated assembly lines for SMD boards occupy up to 50% less factory space than autoinsert lines do. Fig 4 shows how automation is used in assembly of a surface-mount board.

Surface-Mount Components

Components presently available in surface-mount packages include chip resistors, inductors, chip capacitors, ICs, switches, crystals, relays, transformers and connectors. New surface-mount components are being introduced every day.

Passive Components

A typical chip resistor and its construction are shown in Fig 5. The solder coating on the termination metallization provides a pretinned connection point suitable for reflow or other soldering techniques. The resistance element is a glass-passivated, thick-film element on a highly pure alumina substrate; the result is a reliable and precision component. Chip resistor values range from 10 Ω to 2.2 MΩ, with tolerances of 5 or 10%; power dissipation is 1/8 W.

Chip capacitors (Fig 6) are of monolithic construction and have a totally encapsulated electrode system and metallized terminations. The electrodes are deposited in the ceramic chip using an interleaved pattern, with two electrodes forming a single capacitive layer. The layers are stacked to increase capacitance. Chip capacitor values presently range from 1 pF up to 33 μF.

Discrete Low-Power Packages

There are several low-power packages in SMDs. These include the SOT-23, SOT-143, SOT-89 and SO-8; the SO prefix stands for "small outline." The SOT-23 (TO-236) shown in Fig 7A is 0.115 inch wide and 0.090 inch high. Such a package

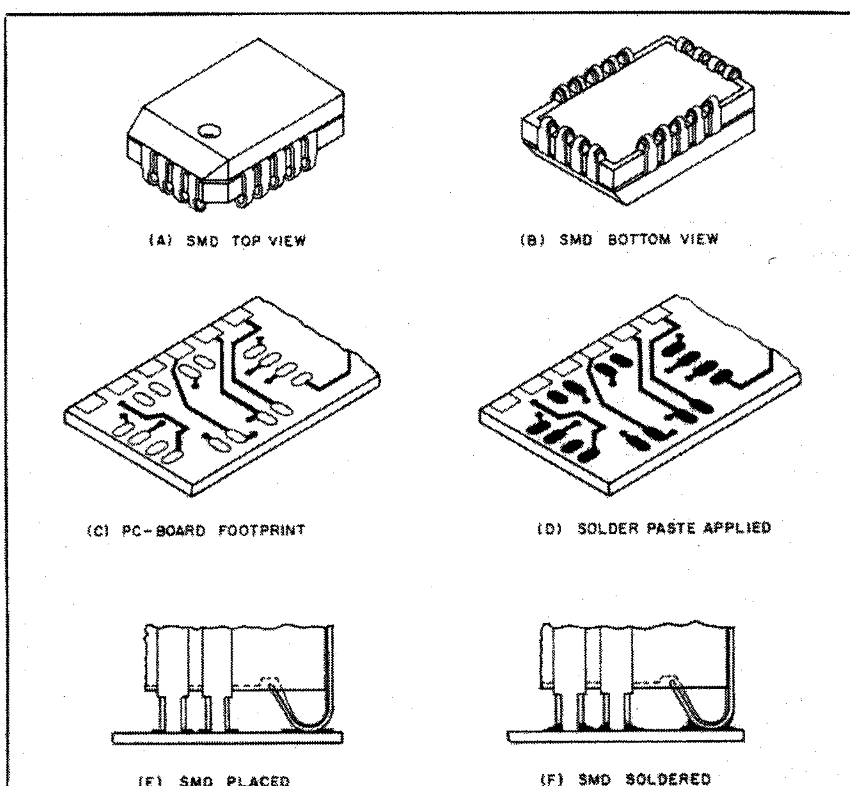

Fig 3—A pictorial description of the surface-mounting process. Close-ups of one corner of the SMD are shown at E and F. See text for more details.

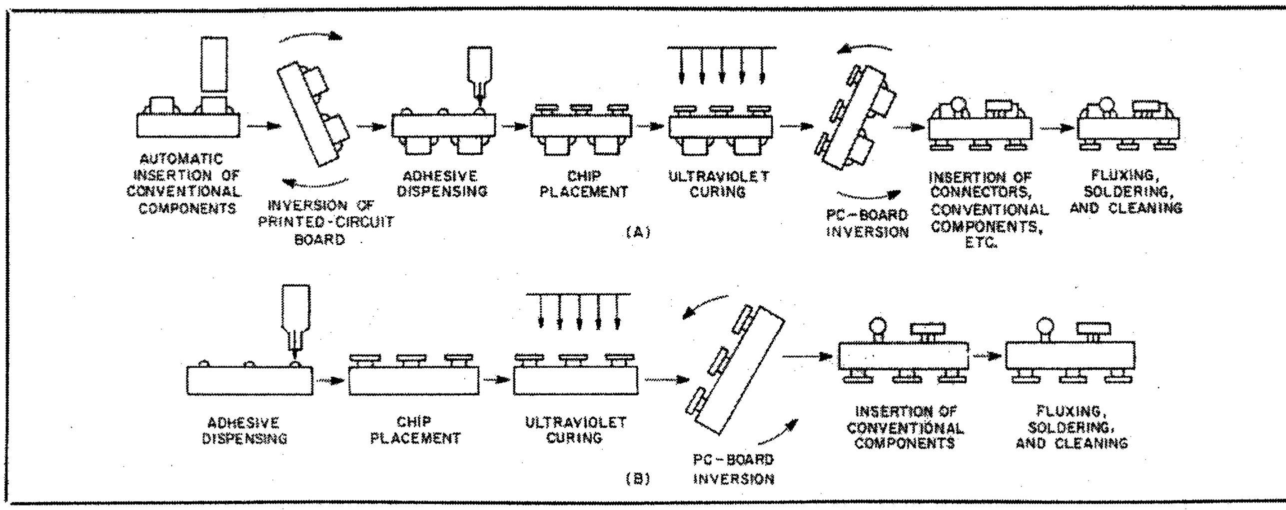

Fig 4—Surface-mount PC-board assemblies can be produced automatically (A) or semiautomatically (B). On semiautomatic assembly lines, the through hole leaded components are inserted manually.

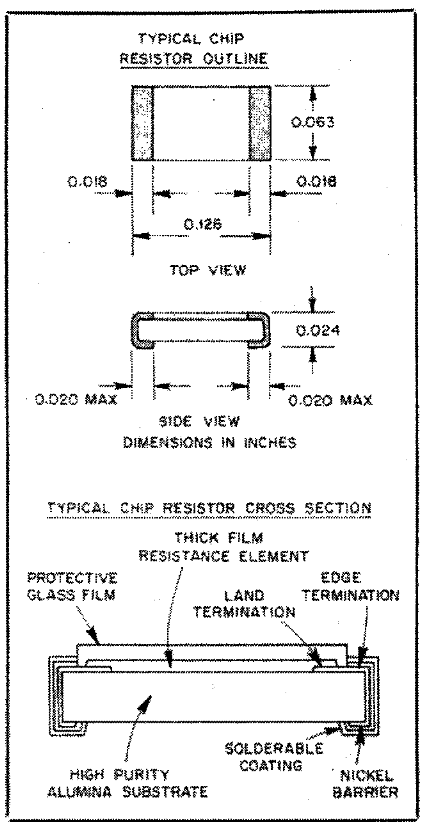

Fig 5—Typical surface-mount chip resistor construction.

can dissipate up to 200 mW in free air, or up to 350 mW when attached to a ceramic substrate. Products available in this package include small-signal transistors (bipolars and FETs), tuning, switching and Zener diodes, and SCRs. The SOT-143 is similar to the SOT-23 with the exception of having four leads. Bipolar RF transistors are available in this package.

For applications where high power dissipation is needed, there's the SOT-89 (Fig 7B). This package (only 0.178 inch across and 0.059 inch high) can dissipate 500 mW in free air and 1 W when mounted on an alumina substrate. Products in this package include bipolar, high-voltage, RF and Darlington transistors.

There are two packages available for use in RF applications: the SOT-143 and an SO-8 modified for RF use known as the SORF. The SORF package has a power dissipation of 1.5 W at 25°C. Currently, 870-MHz bipolar transistors are being offered in this package. Where the need arises for transistor and diode arrays, Motorola offers low-voltage quad transistor arrays in the SO-16 package and diode arrays in the SO-14 package.

Leadless Diodes

A wide variety of rectifiers and Zener diodes are produced in the small cylindrical glass package referred to as MELF (metallized electrode face), MINI-MELF and MLL (Motorola leadless). Two packages are offered—the MLL34 and MLL41. A full range of ¼, ½ and 1-W Zener diodes are made using the same die as products presently offered as DO-35 and DO-41 Zener diodes. The rectifier category includes 0.5- and 1-A general-purpose and Schottky rectifiers.

Power Devices

Until recently, SMDs have been primarily available in the low-power category. For applications requiring high-power components, there are two options: the DPAK and TO-220 cases.

The DPAK is a power package developed specifically for surface-mount applications; it resembles a miniature TO-220 case. The DPAK has a power dissipation of 1¼ W at 25°C in free air, and 1¾ W when

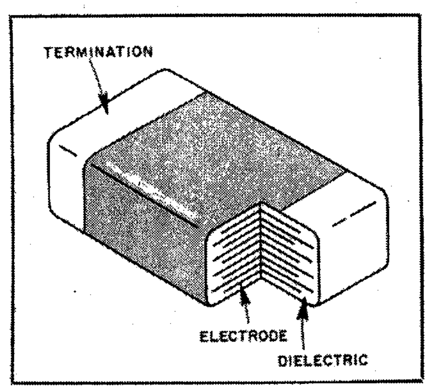

Fig 6—Chip capacitor construction.

mounted to a glass-epoxy PC board. DPAK product offerings will include bipolar power transistors, TMOS™ power MOSFETs, thyristors, rectifiers, Zener diodes and transient suppressors.

For power devices requiring a higher power rating and larger die size than DPAK can accommodate, there's the industry-standard TO-220 package. The TO-220 has a power dissipation rating of 4 W when mounted on a glass-epoxy PC board. Any existing TO-220 product can be lead-formed for surface-mount applications. The current Motorola TO-220 family includes bipolar power transistors, TMOS power MOSFETs, thyristors, rectifiers, Zener diodes, transient suppressors and RF power transistors.

Integrated Circuit Packages

ICs are produced primarily in two packages: the SOIC (standard outline integrated circuit) and the PLCC (plastic leaded chip carriers). The packages have pin counts dependent on the device functions. PLCCs offer the flexibility of higher pin count functions in a smaller package than its

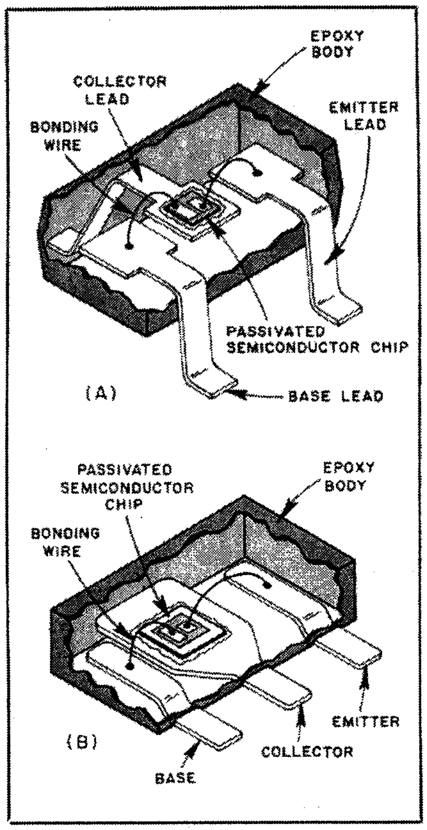

Fig 7—SOT-23 (A) and SOT-89 (B) package construction.

leaded equivalent. PLCCs take up approximately one-third the board space of their equivalent leaded device. A wide variety of digital-logic and linear ICs is produced as SMDs.

Gull-Wing and J Bends

SMDs are supplied with the two lead configurations shown in Fig 8. SOICs, SOTs and plastic flatpacks have gull-wing leads; PLCCs have the J bend. There are advantages and disadvantages to both lead types. Gull-wing leads can be probed easily by test leads and gull-winged packages are more easily handled by "pick and place" equipment. Packages with J-bend leads have smaller footprints and take up less real estate on the PC board. Their solder joints, however, are not inspected easily and test points must be provided to access the leads.

Surface-Mount Devices and You

Although surface-mount technology is benefiting Amateur Radio in commercially produced equipment, it's probably not well suited for use by the casual experimenter. Many of the components are designed to be placed on circuit boards by high-speed automated pick-and-place equipment and cannot be manipulated easily by hand. Additionally, most of the SMDs are presently not available in small quantities: One must purchase an entire reel of components, which could contain as many as 10,000 pieces! If you want to try hand

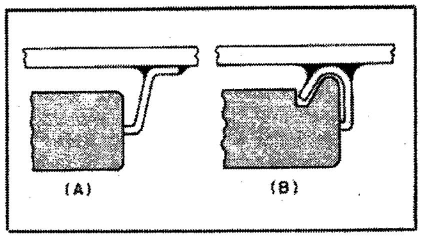

Fig 8—SMD lead variations. Gull-wing leads (A) are inspected easily; they can be accessed with test probes. The J-shaped counterparts (B) have a smaller PC-board footprint and are handled easily by automatic feeding machines.

assembly with SMDs, here are some ideas on how to go about it.

First, you'll need some sort of magnifying glass because most of the components are extremely small. The PC boards must be laid out with footprints to accommodate the devices to be used. Recommended footprints for SMDs can be found in most manufacturer's data books, data sheets or surface-mount guides.

The techniques for laying out and etching an SMD PC board are much the same as you've always used, except that no through holes are necessary for mounting SMDs. When determining component placement on the board, anchor the board so it is free from vibration. If you sneeze or bump the board before the components are glued in place, you'll not only have to start over, you may have a difficult time finding the missing components! Prior to component placement, all pads should be tinned. Glue the component into location. Although I've not done so, you might try using Super Glue™ as it can be dissolved with acetone or nail polish remover (take proper precautions when using these materials) if a component is placed incorrectly.

To handle the small components, you'll need tweezers, perhaps of different sizes. The tweezers should preferably be the type that are normally closed, as they will retain the component easier than standard tweezers. Once all the components are in place, proceed with the soldering. Use as little heat as possible on components with metallized ends (chip capacitors, diodes, and so on) as too much heat can cause the metallization to leach off, which renders the component unusable.

After soldering, clean the boards of remaining flux. Inspect the board with a magnifying glass. Look for solder bridges, cracks in traces, leads or components, cold solder joints, missed connections and so on. Remember: For SMDs, the solder joint provides the mechanical *and* electrical connection of the component lead to the board. Too little solder results in a weak joint that can cause problems later.

To remove a misplaced or defective component from the board, use solder wick and an adhesive remover. Dispense the adhesive remover using a small syringe to keep the liquid confined to the component being removed.

Summary

Surface-mount assemblies are becoming more common every day. These assemblies increase the potential of fully automated assembly lines and lead to size and cost reductions as well. How much smaller can your radio be? Only time will tell!

Dave Hollander's interest in radio dates back to 1961, when he built a crystal set. About the same time, his father, then unlicensed, gave Dave an old Hallicrafters S-41W receiver. SWLing kindled Dave's interest in Amateur Radio and DXing. Dave obtained his Novice license, WN6IWX, in 1963, and immediately began operating. The DX bug bit hard when a KM6 called Dave early one morning on the 80-m Novice band. In 1965, Dave acquired his General class license and the call WB6NRK, which he held until 1977 when he received N7RK. Dave's also held the calls ZM0AJN and VK2ERK.

Over the years, Dave's interests in Amateur Radio have included building equipment and antennas, CW operation, HF and VHF DXing, and HF mobile operation. Dave has 320 countries to his DXCC credit, but claims his biggest accomplishment in the DX realm is receiving WAZ No. 23 on 75-m phone—the sixth such certificate issued in the US, and the first one to be issued outside of California.

There are several hams in his family. Dave's wife, Jo Ann, is KA7LRG; his dad is N6UC (another DXer) and his brother-in-law is WA6SOJ.

Dave holds a BSET from Arizona State University and has worked at Motorola in the Discrete Semiconductor Group for over 13 years. That experience includes having worked five years in the RF Power Transistor group (100-MHz to 1-GHz power devices), three years in the Low Frequency Power Transistor group (he was involved in the start-up of TMOS Power MOSFETs) and the past three years in Discrete Product Marketing.

Dave's other interests include downhill skiing, camping, model railroading and antique cars—he owns a 1947 Plymouth coupe that he restored. Dave has published articles in QST *and several of the electronic trade journals, and he has published several application notes at Motorola.*