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PHILIPS

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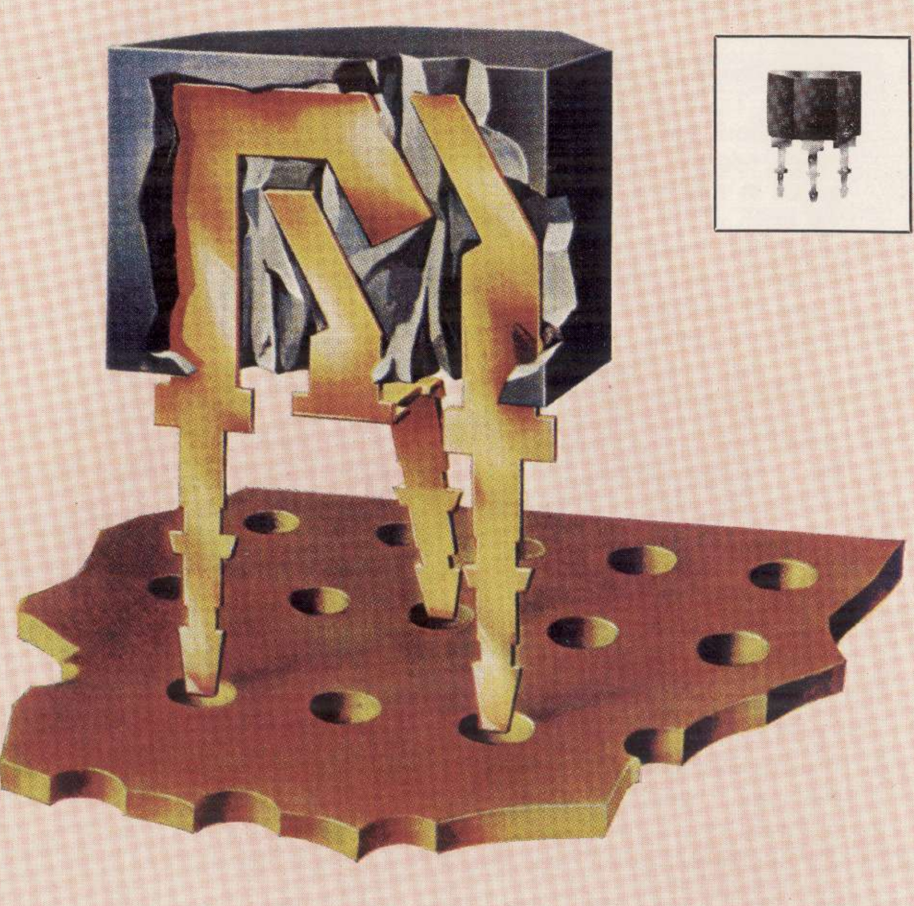
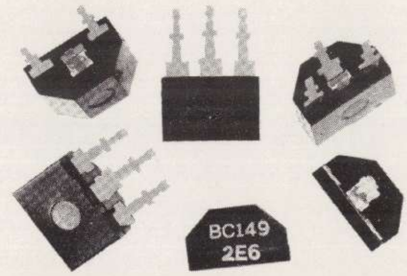


"Miniwatt" PLASTIC LOCK-FIT TRANSISTORS

"Miniwatt"

LOCK-FIT TRANSISTORS



Most every engineer and technician engaged in the Electronics Industry (and possibly in other fields where semiconductors are used) is familiar with the "Miniwatt" TRANSISTOR family BC107, BC108, BC109. There are probably more of these devices manufactured and used in Australia than any other transistor types!

These transistors are encapsulated in an hermetically sealed TO18 style metal can, the same as used throughout the world within the professional quality range, because, although this Company has been engaged in research work with plastics for many years, we were not completely satisfied with the properties of any of the several plastic encapsulations available on the world market. Consequently it was decided as a matter of Company Policy that until we could find a more suitable plastic encapsulation we would produce our entire range in the more extravagant but quality proven metal execution.

Some two years ago now the Philips Laboratories in the Netherlands found the breakthrough they were looking for, and with the experience passed on to us from the production of many millions of devices in plastic we are now able to announce the release from Australian production of the BC107 family of transistors in plastic lock-fit encapsulation, together with the types BF184, BF185 and the PNP type BC177 family.

WHAT IS A LOCK-FIT TRANSISTOR?

The lock-fit type plastic transistor represents a major advance from traditional encapsulation techniques and mounting arrangements. This is made possible by fully automatic machinery developed by Philips in the Netherlands.

The Body

The lock-fit transistor body is homogenously formed in high quality epoxy resin and has an assymmetrical but regular outline shape which simplifies handling and ensures immediate orientation by eye, jig, or machine.

The epoxy encapsulation is highly resistant to shock and vibration, provides excellent environmental protection for the crystal, and has a junction to ambient thermal conductivity superior to most metal encapsulations.

The Pins

Lock-fit transistors have flat, gold plated specially shaped connecting pins in place of conventional wire leads. The spring set of the pins in conjunction with the special shape provides a push to fit insertion into printed boards, which guarantees an intimate contact with the copper track, resulting in excellent solderability.

Pin Spacing and Shape

The main consideration in determining minimum pin spacing is the ability to satisfactorily solder to the printed board without the risk of short circuits occurring between adjacent pins.

Considerable research revealed that 0.1″ was too small and provided unsatisfactory results. Consequently a standard TO5 pin circle diameter with a centre to centre minimum of $\sqrt{0.2''}$ was chosen. See Fig. (1).

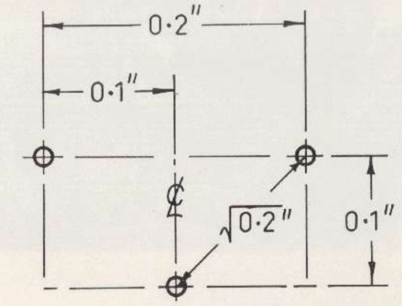


Fig. 1.

The pins are especially shaped as shown in Fig. (2) where it can be seen that each pin has four principal shoulders A, B, C, D. The shape of the pins has been designed to be self-locking with either of the two most commonly used printed board thickness used throughout the world.

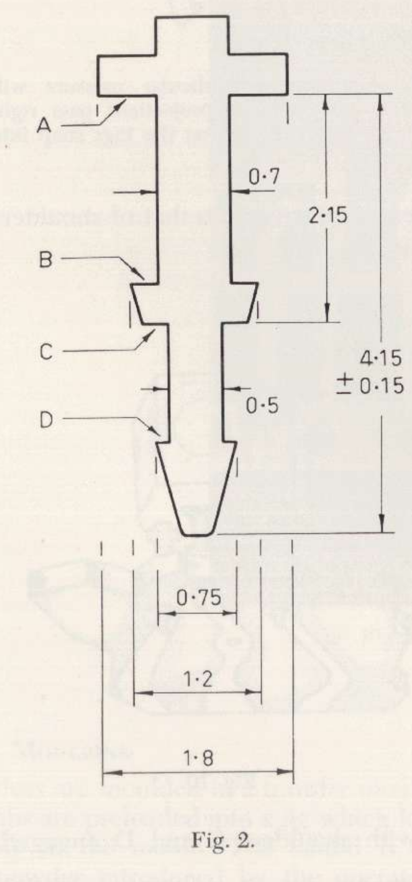


Fig. 2.

For printed boards of 1mm thickness board hole size should be 0.8mm (0.031″), and shoulders C and D act as buffer and lock respectively. Fig. (3).

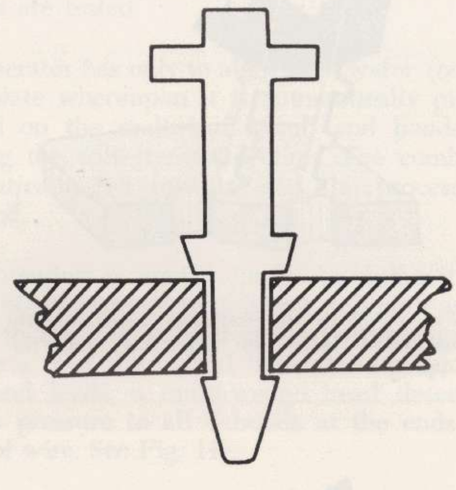


Fig. 3.

For printed boards of $\frac{1}{16}''$ thickness board hole size should be 1.3mm (0.051″), and shoulders A and B act as buffer and lock. Fig. (4).

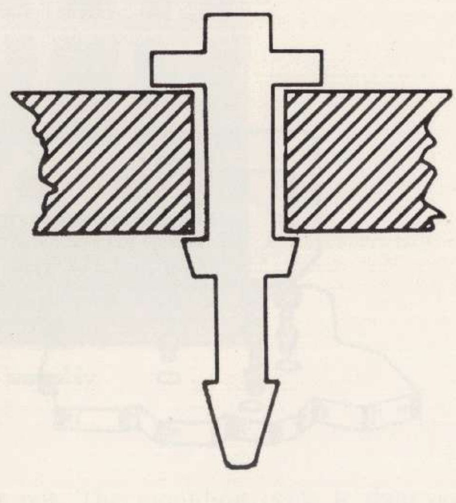


Fig. 4.

FITTING

Best use will be made of the Lock-fit property if Transistors are inserted in the following manner:

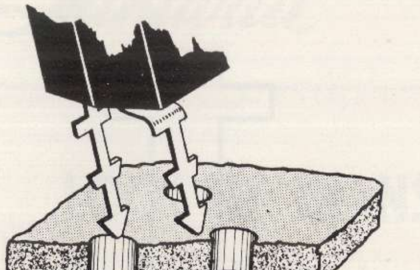


Fig. 5. With the transistor tilted slightly backward, insert the outer tags into the appropriate holes.

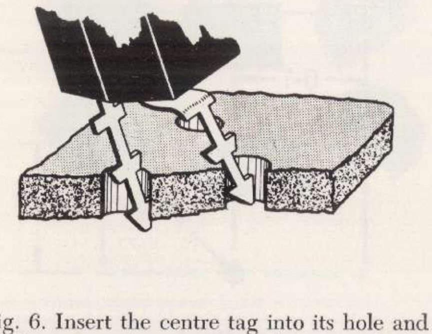


Fig. 6. Insert the centre tag into its hole and gently press the transistor down until the projections on the outer tags have engaged the hole.

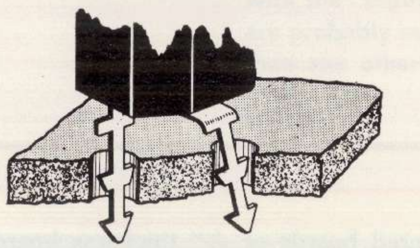


Fig. 7. Gently push the transistor forward until it is perpendicular to the board and the projection on the centre tag has engaged the hole.

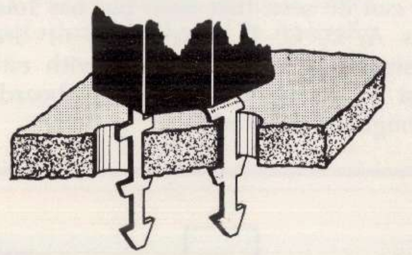


Fig. 8. Light perpendicular pressure will now ensure that the projections pass right through the holes so that the tags snap into the locked position.

Note that for $\frac{1}{16}''$ boards as per Figures 5 to 8 above the projection referred to is that of shoulders B-C. In these figures, the third tag has been omitted for clarity.

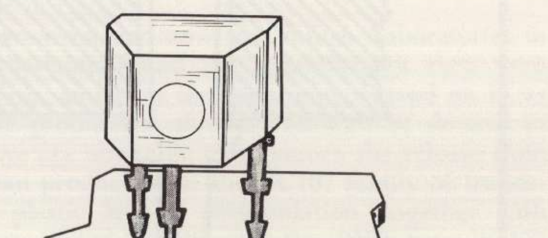


Fig. 9.

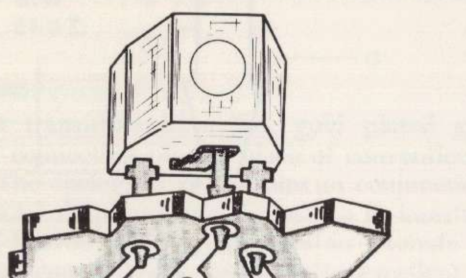
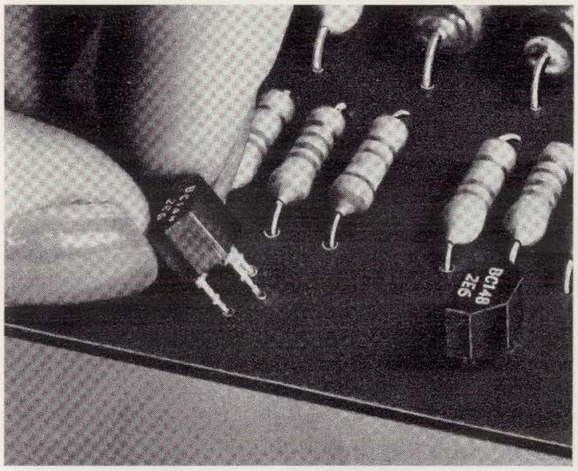


Fig. 10.

Figures 9 and 10 depict pin insertion into 1 mm Boards with shoulders C and D engaged.



LOCK-FIT TRANSISTORS— HOW THEY ARE MADE

The production of metal planar transistors was described in the *Miniwatt Digest* November 1965. The manufacture of plastic lock-fits is common with metal devices only to the point of crystal preparation, beyond which a completely new facility has been established alongside the metal production line at Hendon, South Australia, utilising highly automated techniques.

Wafer Bonding

To enable rapid process handling a stamped "comb" is used consisting of a number of gold plated lead wire assemblies held together by webs which are subsequently removed. The comb is assembled as a number of complete devices, through the wafer bonding, wire bonding, baking and plastic moulding, the webs finally being separated before the individual devices are tested.

The operator has only to align each wafer (or crystal) on a plate whereupon it is automatically picked up, located on the multi-lead comb and bonded to it, forming the collector connection. The comb is then automatically fed forward and the process rapidly repeated.

Wire bonding is again equally as automated. Two pieces of wire are accurately cut to length and transferred to the bonded wafer. On positioning the precut wires over the crystal base and emitter bonding pads and leads, a multi-wedge head descends and applies pressure to all 4 bonds at the ends of each piece of wire. See Fig. 11.

To ensure the highest attainable quality, the completed bonded comb assemblies are then 100% inspected.

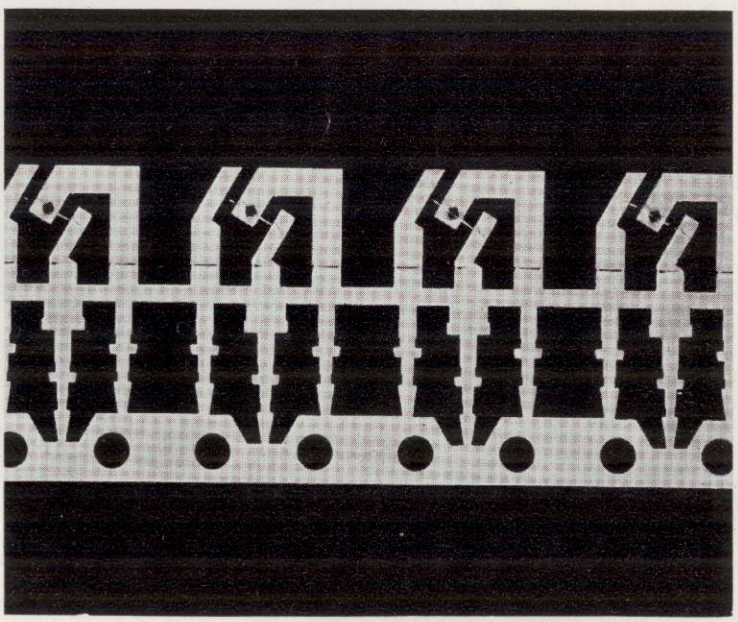


Fig. 11. Multi-lead bonded comb assembly.

Plastic Moulding

The devices are moulded in a transfer moulding press. The combs are preloaded into a jig which locates them accurately in the mould. The mould is closed and plastic powder introduced by the operator into the transfer pot. The moulding cycle is then completely automatic, the press opening, as shown in Figure 12 with the devices ready to break off the runners. To separate the devices, the webs are then cut, dividing the comb into separate transistors.

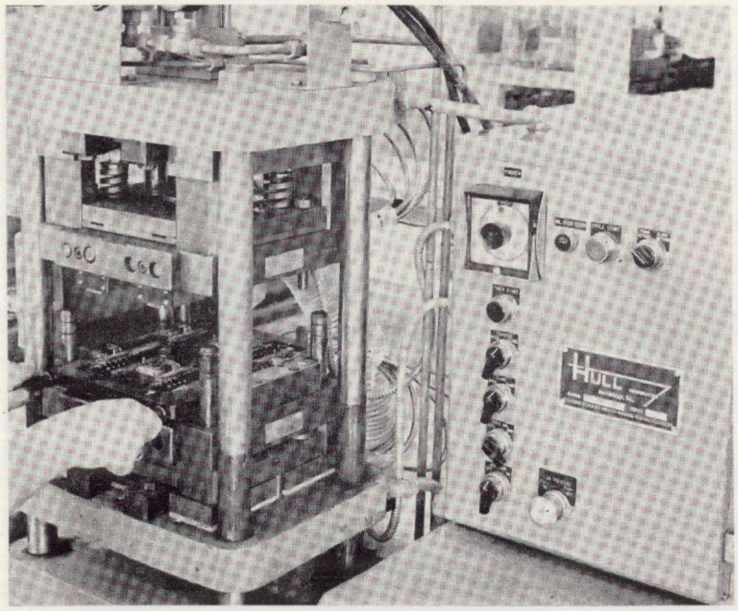
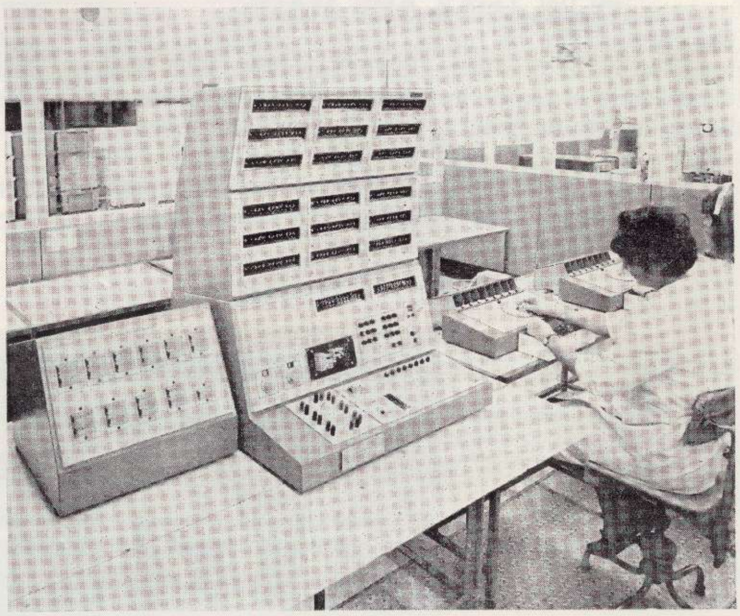


Fig. 12.
The Transfer Moulding Press.

Fig. 13.
The Digitally Programmed Automatic Tester, showing 2 operators with the selection bins behind.



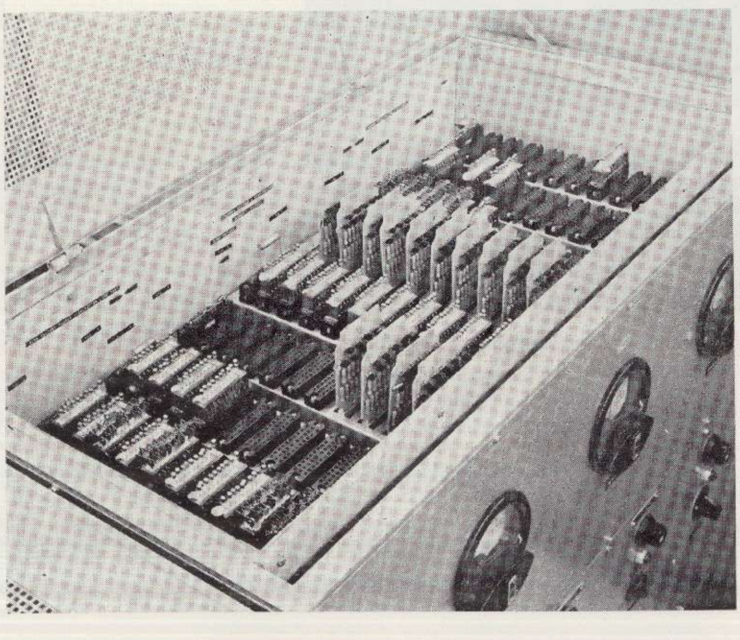


Fig. 14.
The Thermal Fatigue and Dissipation Life Test Set-up, showing the plastic encapsulated devices mounted onto printed cards.

Fig. 15.
Quality Control checking of static parameters after life testing.

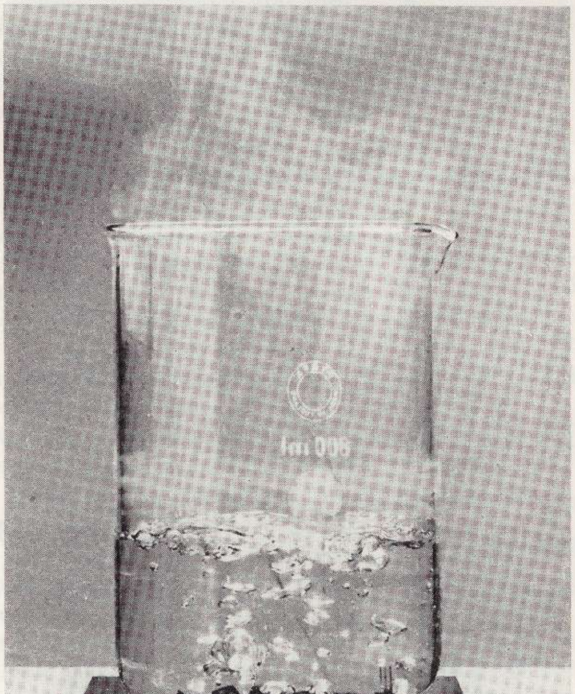


Fig. 16.
Lock-fit Transistors immersed in boiling water. Subsequent to the boiling cycle, the Transistors are tested to guarantee positive sealing.

Testing and Branding

Parameter testing is performed on a digitally programmed automatic tester, as shown in Figure 13. This tester permits the classification into eight different groups in any one test, and can accommodate up to five operators working at a rate that is determined only by the time that it takes to insert and remove the transistors. The tester can be programmed to test any dc parameter, and lights behind the test socket indicate the bin into which the device is to be placed for a particular type.

Any ac tests such as noise or frequency response are then carried out and the device branded with the appropriate type number.

Before delivery, each box has a statistical sample removed and checked on all parameters. Should the sample show any failures, the box is completely retested 100%. This ensures that the highest attainable quality is enjoyed by the customer.

Quality Control

Quality and yield go hand in hand, and yield determines cost. It is then to the advantage of both the manufacturer and the customer to obtain the highest possible quality.

Quality checks are maintained on incoming components, materials and chemicals. During manufacture all operations are checked for quality levels and all machines are checked on an hourly or daily routine. Finally, extensive quality control is applied to the completed product.

Thermal fatigue, high temperature storage and dissipation life tests are carried out statistically on a weekly basis. The dissipation life tester is shown in Figure 14. To facilitate correlating and measuring the devices are plugged into printed wiring board connectors and tested 10 at a time as in Figure 15.

Many parameters not published are also checked to ensure that the device will meet the performance requirements laid down for that type. Mechanical and climatic tests such as humidity, vibration, bomb testing and susceptibility of the plastic to ambients is carried out. Figure 16 shows a standard quality control check of plastic sealing by immersing the devices in boiling water.