2 Important Notes

2.1 Safety instructions

2.1.1 Preventing electrical accidents

Safety class

This instrument belongs to safety class I as defined in VDE 0409 or IEC Publ. 1010-1. The supplied power cord has a protective ground. The AC line connector shall not be inserted into AC outlets without a protective ground contact, except in specially certified areas. Do not interrupt the protective conductor inside or outside the instrument.

Checks before repairs and maintenance

Checking the instrument's construction

No modification that reduces the safety of the instrument shall be made.

Checking the protective ground

Check the line cord for visible signs of damage and poor connections. Measure the resistance of the conductor between the protective ground contact of the line cord plug and the instrument enclosure (earthing socket). The resistance should be less than 0.1 Ω. Shake the line cord during the measurement; resistance variations mean that the line cord is faulty.

Insulation test

Measure the insulation resistance by connecting a 500 V DC insulation tester between the AC conductor terminals of the instrument's line plug (shorted together) and the protective ground conductor terminal of the same. The instrument's ON/OFF switch should be in the ON position. The insulation resistance should be greater than 2 MΩ.

Opening the instrument

When panels or components are removed, live parts may be exposed. Connection points may also be live.

Disconnect all power sources from the instrument before opening it.
Should it be necessary to carry out calibration, servicing or repairs on an instrument under power afterwards, such work should only be carried out by competent technicians aware of the hazards involved.
Capacitors do not always discharge immediately, even if the instrument has been disconnected from all power sources; always check the circuit diagrams.

Fuses

Use specified fuses only.

Repairs, replacing components

Repairs must be carried out by a competent technician. Do not modify the instrument in any way that would reduce its safety.
This applies to creepage paths and component spacings in particular.
Always use original parts. If the use of other spare parts is unavoidable, instrument safety shall not be reduced under any circumstances.

Checks after repairs and maintenance

Chacking the protective ground

Check the protective ground for visible signs of damage and poor connections. Measure the resistance of the conductor between the protective ground contact of the line plug and the instrument enclosure (earthing socket). The resistance should be less than 0.1 Ω. Shake the line cord during the measurement; resistance variations mean that the line cord is faulty.

Insulation test

Measure the insulation resistance by connecting a 500 V DC insulation tester between the AC conductor terminals of the instrument's line plug (shorted together) and the protective ground conductor terminal of the same. The instrument's ON/OFF switch should be in the ON position. The insulation resistance should be greater than 2 MΩ.

2.2 Anti-static Measures

Electrostatic charges and fields may damage or destroy semiconductor components.

It is, therefore, essential to protect all semiconductor components in the instrument from electrostatic charges and fields.

When the instrument is in its enclosure, there are no problems. When the instrument is opened, the DIN 40 021 warning symbol on

- boards and
- assemblies

that are sensitive to STATIC reminds you that special protective measures have to be taken.

warning symbol according to DIN 40 021

Special measures

Grounded person

Only grounded persons using an anti-static workstation shall work on the instrument.

Grounded bracelet

A grounded bracelet is used to earth technicians working at anti-static workstations.

Conducting work surface

The STATIC workstation comprises a conducting work surface with terminals for the bracelet and ground cable.

Ground cable

The ground cable is connected to ground potential. The following reference points provide ground potential:

- the instrument ground connector,
- the protective ground connector,
- other points at ground potential.

Soldering station

The soldering station must be connected to ground. The soldering station must be specially designed for semiconductor components that are sensitive to static (zero-voltage circuit, grounded soldering iron bit).

Spare parts

Until they are needed, components that are sensitive to static should be left in their protective packaging.

They should only be removed from their protective packaging by a grounded person at an anti-static workstation.

2.3 Handling Microwave Subassemblies

Special test equipment and tools are used during production and repair of the microwave subassemblies. For example, the contacts on the ceramic substrate in the microwave subassemblies are made using bonded wires. The semiconductor components used are extremely sensitive to electrostatic charges. For this reason, no components in the microwave circuits should be removed, nor should the power supply (control) board fitted to some modules be removed. Opening these modules will likely result in irreparable damage.

If a fault is present in a microwave module, the module should be replaced completely.

> ***Caution!***
>
> Opening the microwave modules invalidates the guarantee and repair of the modules in the factory is no longer possible.

Handling the microwave step attenuator line

The attenuator (ATTN) is assembled in a clean-room, since even very fine dust particles can adversely affect its performance. Repairs should therefore also be carried out only in a clean-room. Opening the attenuator invalidates the guarantee and repair of the attenuator in the factory is no longer possible.

Handling waveguide lines

When removing waveguide lines, the screw connectors at both ends of the line must always be undone to ensure that the SMA plugs and sockets and the waveguide itself are not subjected to mehanical stress. Under no circumstances should the waveguides be bent.

> ***Important:*** The coaxial SMA screw connectors on the microwave modules and waveguides must be tightened to the prescribed torque value. The torque wrench specified in chapter 1.3 should be used for this.

2.4 Repair of Circuit Boards Fitted with SMD Components

2.4.1 Introduction

To ensure maximum reliability after repair, particular care and attention are required when working on circuit boards fitted with SMDs[1]. Particular attention should be paid to the method used and the required tools and equipment.

Only persons familiar with SMT[1] should carry out such work.
The following rules should be observed:

a) Use the described test technique for SMDs (see chapter 2.4.2 on page 2-5)

b) Observe the SMD repair guidelines (see chapter 2.4.3 on page 2-6).

c) Use only the described SMT soldering and repair methods (see chapter 2.4.4 on page 2-6).

Important: If these guidelines are not followed, it is likely that the component or circuit board will be destroyed or damaged. If it is not possible to fulfil the requirements given, it is better to replace the entire board rather than attempt to repair it.

2.4.2 Test Techniques for SMD Boards

Never make direct connections (e.g. with a probe) to SMDs when you are checking them out. Instead, use tracks, test pads or vias.

If you are using a special probe with a sprung prod, only make contact at the foot of the component (see figure 2-1).

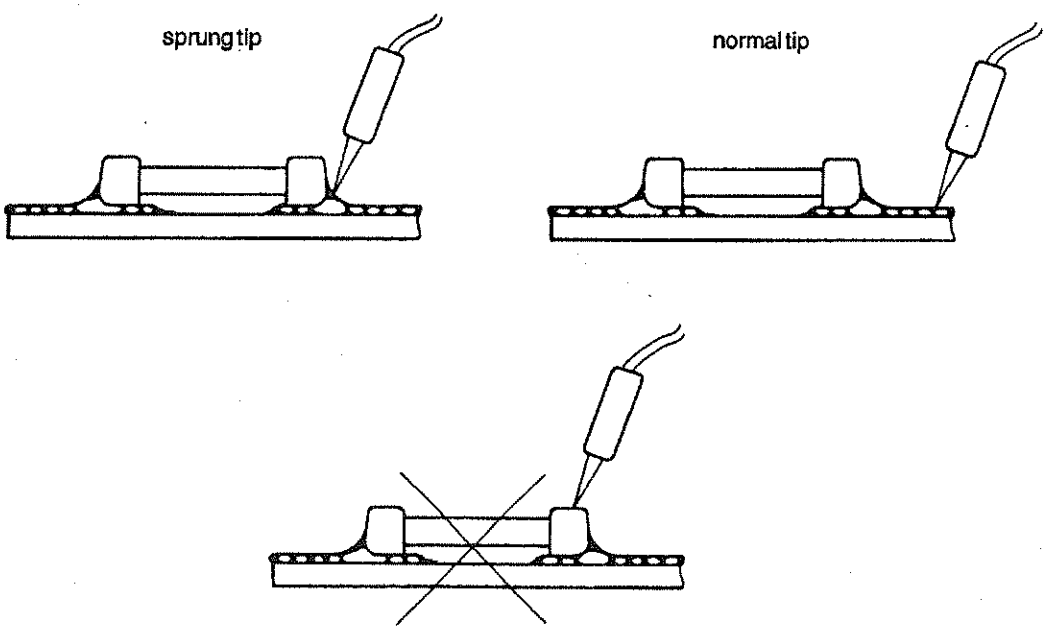

Fig. 2-1 Making measurements on SMD boards

1 Note:
SMD = Surface Mounted Device
SMT = Surface Mounted Technology

2.4.3 Repair Guidelines for Boards with SMDs

If SMDs are handled incorrectly, their properties may be adversely affected. Particular care should therefore be taken. For example, even minimal dirt or impurities on the SMD contacts (e.g. a fingerprint) will prevent wetting during soldering and result in dry joints. The spaces between contacts are often so small that short-circuits are easily caused by solder tracks between them due to the use of unsuitable tools.

The following rules should therefore be observed:

- Only use tools and equipment specially designed for SMD.
- Preferably use special SMD tweezers.
- Do not modify the SMD in any way (use as supplied).
- Keep the SMD in its original packaging until required (the values are not marked on the components!).
- Never hold SMDs with your bare hands.
- Never touch the contacts of SMD with anything other than the special tools (tweezers, clips) intended for this purpose.
- If an SMD is dropped, it should be thrown away (hair-line cracks are likely, particularly in larger components).
- Use only special test tweezers, etc., for checking the value (R or C, etc.) or identity of SMDs which are not mounted on a board.

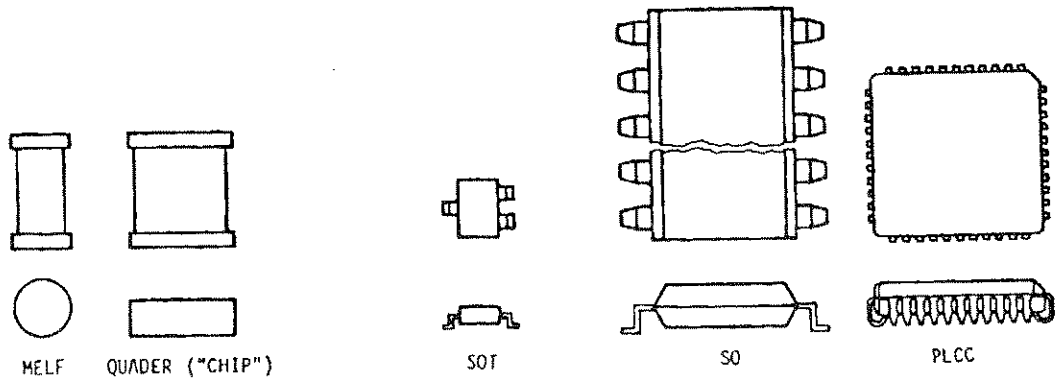

Fig. 2-2 Various SMD outlines

2.4.4 SMT Soldering and Repair Procedures

The object of these procedures is to eliminate soldering faults or to replace defective SMDs. Board faults are eliminated using conventional methods.

When you repair an SMD board, there is a considerably greater risk that components or the board will be damaged. The second eventuality is particularly important because if, say, soldering pads are torn off, it is impossible to mount any SMD without using special adhesive techniques. The board would, therefore, have to be thrown away (see under "Repairing torn-off soldering pads").

Observe the following special SMT rules when carrying out work of this kind

- Soldering iron temperature (bit) = 290 °C (max. 300 °C)
- Maximum temperature of hot gas equipment is 400 °C
- Maximum soldering time 3 s (time for which the solder liquefies)
- Only attempt to repair an SMD once; i.e. do not resolder SMDs which have been unsoldered by mistake, always replace them
- Flux may be used
- Solder paste may be used
- Wire solder may be used

Unsoldering SMDs

- SMDs without pins (Melf + chip) (see Figure 2-2)
  Unsoldering is carried out with hot gas or soldering tweezers. When the component has been removed, the pads must be sucked clear with a desoldering station (fine bit) or a hand desolderer.
- SMDs with a small number of pins (less than 6 pins, SOT, etc.).
- Hot gas is used or the pins can be cut through as with multi-pin ICs.
- SMDs with many pins (more than 6 pins, SO, PLCC)
  Hot gas is used. A simple hot gas station with small hot air jets is not sufficient. It is only possible to remove ICs of this kind, without damaging the board, by using expensive equipment which heats up all the pins at the same time. If you do not have soldering equipment of this type, cut through the pins directly at the component using a cutter, unsolder the pins in the board and suck the solder from the pads.

Soldering SMDs into position

- SMDs without pins
  Use hot gas. The solder must be flowing on both pads simultaneously.
- SMDs with pins
  Use a miniature soldering iron or hot gas. Diagonally opposite IC pins must be soldered alternately.
- Check the joint with a magnifying glass (see Figure 2-3) for bridging, dry joints, cracks and holes, the soldering surface (smooth and evenly shiny), solder drops, splashes and the correct positioning of the SMD.

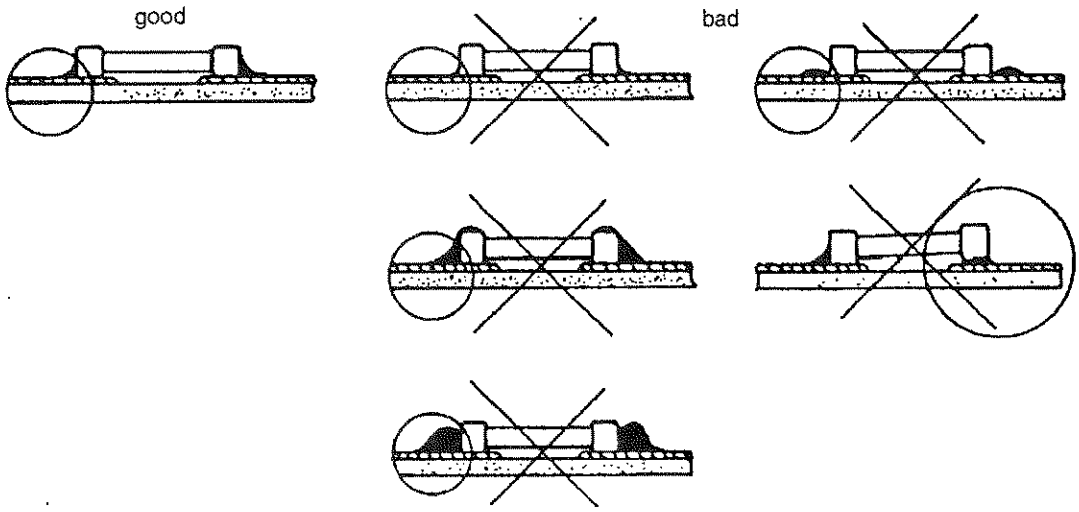

Fig. 2-3 Examples showing soldered SMDs

Repairing torn-off soldering pads

If a soldering pad for an SMD component with pins (IC, PLCC, SOT etc.) has been torn off, solder the component to the board following the usual guidelines and repair the defective pad in the following way:

A varnished wire (d = 0.2 mm) is connected from the component pin to a place of contact near the pad. It is best to use a via. If this is not possible, the wire can be soldered to a soldering pad (as large as possible) of an SMD component.

In the case of SMDs without pins (mini melf / melf resistors, diodes tantalum/multi-layer capacitors, chip resistors, C trimmers, etc.), measures must be taken to ensure the mechanical stability of the soldered joint if a soldering pad is missing.

1 Solder one side of the component to a soldering pad. Connect the other side to a via or an SMD soldering pad which should be as large as possible with a wire (d = 0.6 mm, if necessary insulated). The wire should not be longer than 10 mm.
2 If the method of repair described in 1. cannot be used, the component is held in place with an adhesive.
   - Dot the adhesive on the board.
   - Place component on board.
   - Cure adhesive (100 °C, 20 min).
   - Solder wire (varnished, 0.2 mm) to SMD pin and connect to suitable contact point.

If there is no suitable contact point near the repair, or it is essential to use connections of minimum length, any wide tracks can be used or the solder resist and the black oxide can be scratched from any convenient area and the wire soldered to it.

Recommended solder: wire solder, SnPb 63 d = 0.6 mm or d = 0.3 mm with FSW-32 flux.

2.5 Cleaning the Front Panel and Casing

Never use organic solvents or proprietary cleaning fluids for cleaning the front panel and casing.

The best cleaning fluid is warm water to which a drop of detergent has been added. Use this to slightly dampen a clean cloth. Make sure that no water enters the instrument. To ensure that drying marks are not present, wipe the instrument with a dry cloth after cleaning it.