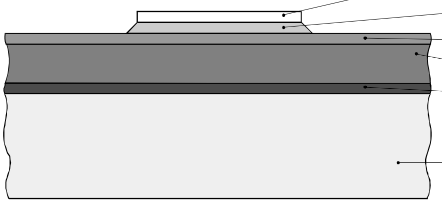

Figure 1.45 Basic structure of a TFC-power module [194]

TFC-technology can also be combined with standard thick film technology.
Since very low resistances may be produced by the paste materials which are usually applied in thick film technology, and since isolated tracks can be arranged one on top of the other and connected to each other, quite a number of system components may be integrated very closely together. However, the very filigree tracks (thickness e.g. 15 µm)will limit the current capability of such structures to about 10 A.

1.4.2 Features of power modules

The assessment of parameters relevant for module assemblies will always depend upon the specific application. The most important parameter with respect to railway drives, for example, will be reliability, whereas low costs are the decisive criterion for the production of consumer goods.
In this chapter, the applicability of a power module is to be regarded under the aspects of the following comprehensive criteria: "optimized" *complexity* of a module, *heat dissipation capability*, *isolation voltage and partial discharge stability*, *temperature resistivity and load-cycling capability of* the internal connections, *internal low-inductance structure, static and dynamic symmetry of the structure, electromagnetic stability, defined and safe failure behaviour, simple assembly and connection technology* and *favourable, non-polluting production and recyclability*.

1.4.2.1 Complexity

Optimized complexity cannot be defined in general. On the one hand, complex modules will reduce appliance costs and minimize problems encountered when several components are to be combined (parasitic inductances, interferences, wrong wiring).
On the other hand, increasing complexity will impair the universality of a module (reduced production lots). The number of tests and the costs per module will increase. With an increasing number of integrated components and connections the module will be more likely to fail and the efforts for repair will be higher. Drivers, sensors and protection facilities have to meet high demands for thermal and electromagnetic stability.

Up to now, none of the following module configurations has gained acceptance as a "world standard" with respect to the *integration of drivers*. The actual state of this development is described in chapter 1.6. The universality of power modules is greatly impaired by increasing the integration of driver functions, the module increasingly becomes a sub-system.
On the one hand, "intelligent" modules are aiming at real mass production markets (consumer, automotive), on the other hand markets are also involved, where many like applications can be supplied with innovative module systems consisting of similar basic elements. In spite of inevitable redundancies, the user may profit from reduced system costs due to the synergies achieved at the module manufacturer.
Regarding *the arrangement of IGBTs and diodes* in the most commonly used power modules, the configurations shown in Figure 1.46 have mainly gained a position in the market, meeting the

demands of most applications in power electronics and drive technology. Figure 1.46 is correspondingly applicable to modules with power MOSFETs, which are mainly applied in configurations for power supplies today.

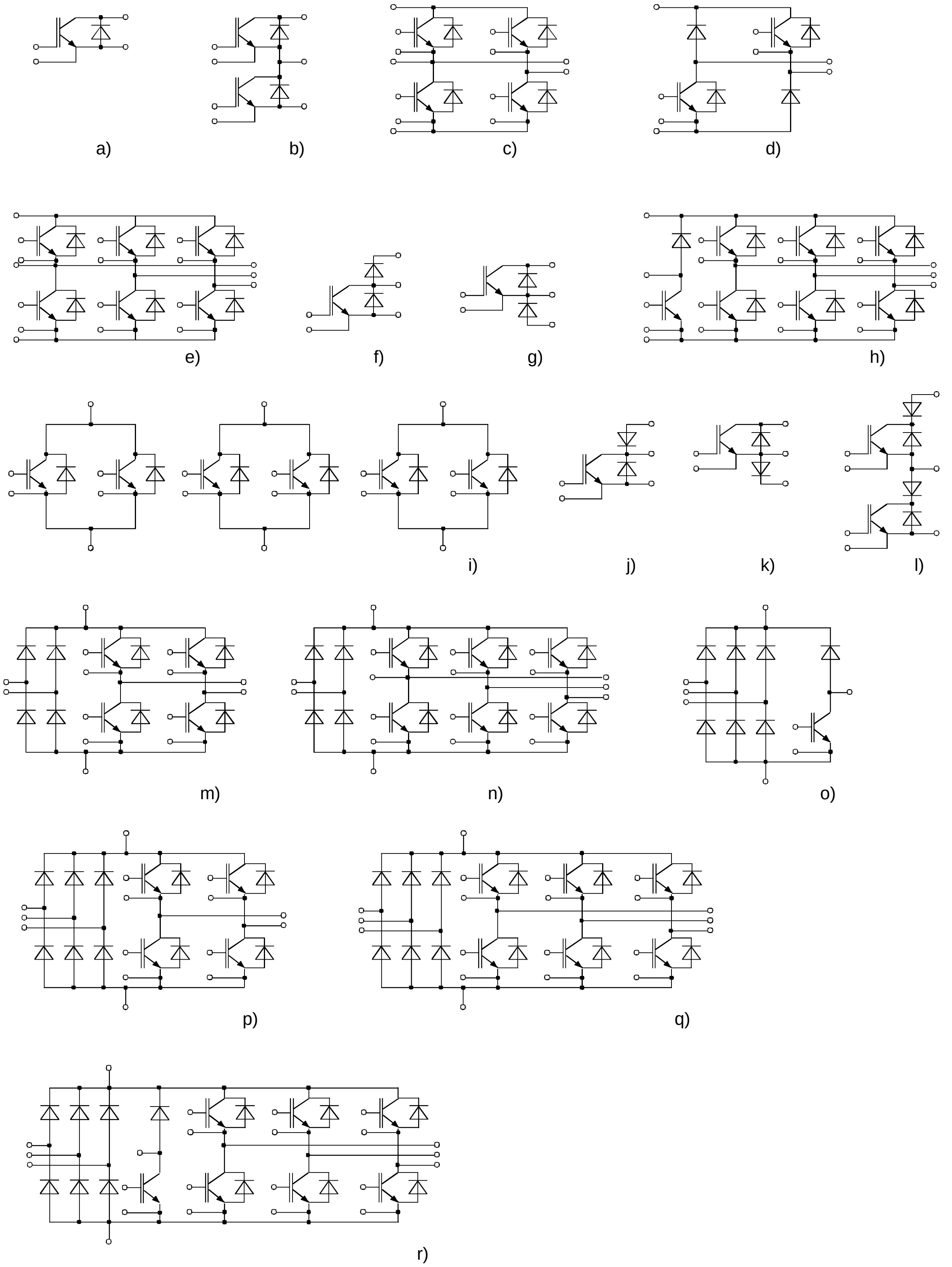

Figure 1.46 Important configurations of power modules with IGBTs and diodes