

StakPak

IGBT press-pack modules

StakPak is a family of high power IGBT press-packs and diodes in an advanced modular housing that guarantees uniform chip pressure in multiple-device stacks.



Although the most common package for IGBTs is the insulated module, for applications requiring series connection, press-packs are preferred because of the ease with which they can be connected electrically and mechanically in series and because of their inherent ability to conduct in the shorted state – an essential feature where redundancy is required.

Since IGBT modules feature multiple parallel chips, there is a challenge – with conventional press-packs – in assuring

uniform pressure on all chips. ABB has solved this problem with a new patented spring technology.

The StakPak, optimized for series connection, features a modular concept based on submodules fitted in a fibreglass reinforced frame (figure 1), which allows a flexible realisation of a range of products for different current ratings and IGBT / diode ratios.

ABB's StakPak portfolio is shown in table 1.

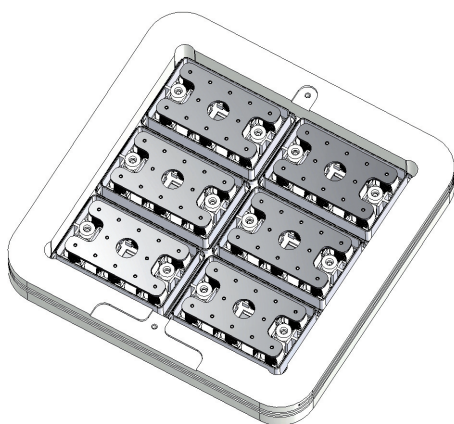


Fig. 1 Submodules in the StakPak module

StakPak product range

Unlike standard IGBT modules, StakPak modules fail into a stable short-circuit failure mode (SCFM). SCFM capable StakPaks are ideally suited for applications with series connections with redundancy; in such applications, additional devices are inserted in the series string so that a device's failure will not interrupt converter operation. The failed device will continue to conduct current for a time period greater than the planned service interval of the equipment. This period of time, during which load current must flow in the failed device without external degradation of the housing or internal degradation of

the electrical contact, is a function of the load-current time-dependence. ABB offers SCFM ratings for users requiring this feature and who are able to specify the load current waveforms and profiles. For applications not requiring a stable short over a longer period of time, ABB can provide non SCFM rated modules. Still also non SCFM rated StakPak modules fail into a short - but a stable short can only be guaranteed up to one minute. This is still sufficient time in order to engage an external bypass or take other measures.

The table 1 shows StakPak product range:

Part number	Voltage V_{CES} (V)	Current I_c (A)	IGBT / Diode ratio	Footprint (mm)	Number of submodules	SCFM rating
2.5 kV						
5SNR 10H2501	2500	1000	2:1	150.3 x 236.3	3	yes
5SNR 13H2501	2500	1300	2:1	150.3 x 236.3	4	yes
5SNR 20H2501	2500	2000	2:1	150.3 x 236.3	6	yes
4.5 kV						
5SNA 1300K450300	4500	1300	1:1	235.1 x 273.3	4	yes
5SNA 2000K450300	4500	2000	1:1	235.1 x 273.3	6	yes
5SNA 2000K451300	4500	2000	2:1	235.1 x 273.3	4	yes
5SNA 3000K452300 * New	4500	3000	2:1	235.1 x 273.3	6	no

Table 1

* Contact factory

Press-pack technologies

Two basic multichip press-pack technologies exist: chips contacted by common pole-pieces (figure 2: conventional technology) and chips contacted by individual springs (figure 3: ABB StakPak technology).

The individual spring contacts reduce the heat sink flatness tolerance and the pressure uniformity requirement within the stack that would otherwise be needed. This, in turn, reduces the mechanical construction costs of the stack and greatly increases field reliability. Thanks to this "independent suspension", only the correct force is applied to each chip allowing excess force to be transferred to the StakPak's housing wall (figure 4).

The force needed for a long stack may indeed be far higher than that tolerated by the silicon chips being contacted via their sensitive surface microstructures. The rigidity and stability of a stack subjected to shock or vibration in service or during transportation depends on a mounting force that may not always coincide with that required by the encapsulated chips. It is therefore important to decouple the two forces, allowing the optimal force on the chips to be lower than the optimal force on the stack: the individual springs of ABB's StakPak allow this.

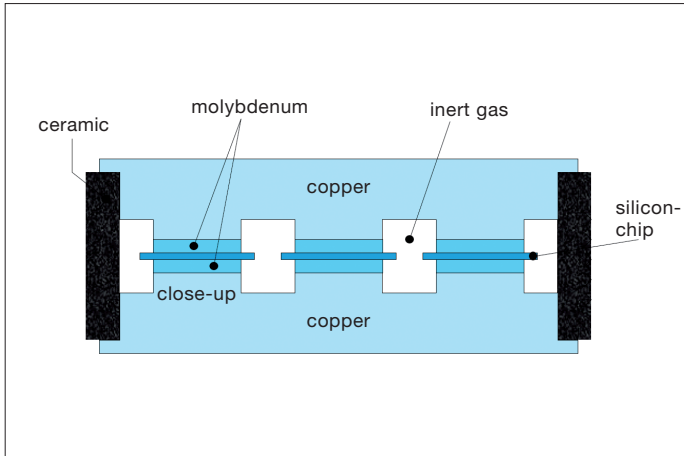


Fig. 2 Sectional view of classic multi-chip press-pack with common pole-pieces: each chip bears the device force divided by the number of chips.

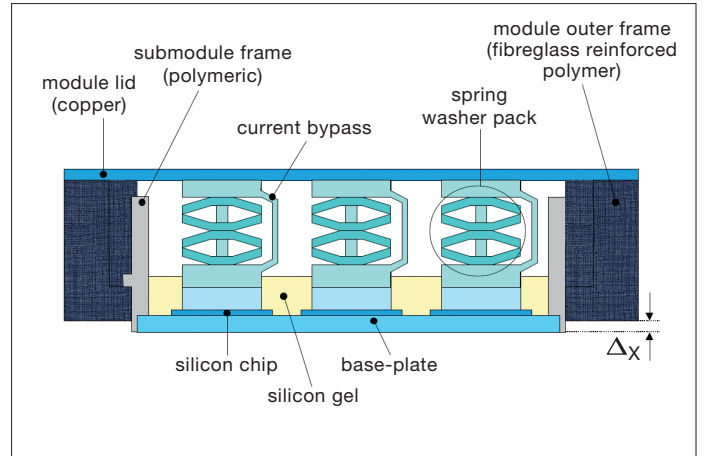


Fig. 3 Sectional view of ABB multichip press-pack with individual spring contacts: the chip bears the force determined by the spring; excess force is borne by the housing walls. The drawing illustrates one multichip submodule in one press-pack housing.

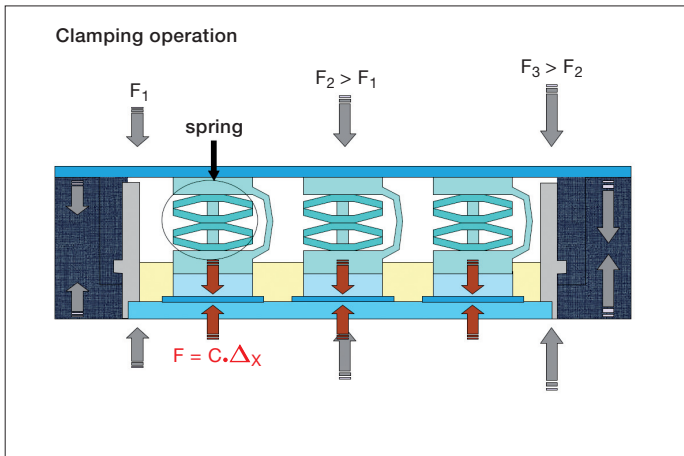


Fig. 4 Principle of individual emitter pressure contacts. F is the force, c the spring constant and Δx the travel distance.

Applications

Press-packs are favoured in applications where devices are series-connected mechanically and/or electrically and where redundancy is required. A classic example of a long stack requiring SCFM can be seen in the HVDC valve of figure 5.

Other press-packs applications include:

- HVDC & FACTS (Flexible AC Transmission Systems)
- Topologies in which open circuits are not possible (e.g. current-source systems)
- Multi-level inverters with 6 or more devices mechanically in series
- Frequency converters operated directly from the 15 or 25 kV AC traction catenary
- Pulse-power applications, such as thyatron replacement



Fig. 5 Standard IGBT valve for VSC, HVDC and STATCOM

Summary

StakPak technology is a well proven concept in IGBT press-pack technology, conceived to reduce cost and enhance reliability in systems requiring several press-packs in one stack. The modularity of StakPak allows the product range to be

configured from a number of standard parts allowing rapid response to market needs. The newly introduced 4500 V rated modules feature the state of the art SPT⁺ chip set for lowest system losses and highest ruggedness and reliability.

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