

## B4

## HV switches with fixed on-time, low on-resistance, MOSFET

- HV switch in Trench-FET technology for extremely low on-resistance
- Very EMC tolerant
- Low control power also at higher switching frequencies
- Available with on-time options from 100ns to 100µs

Note: The model number contains coded information about voltage, current and turn-on behavior. The first digits stand for the voltage in kV, the last digit before the dash indicates the turn-on behavior (0 = fixed on-time, 1 = variable on-time). The digits after the dash indicate the current in Amperes x10. Special features are coded by the letters after a second dash.  
**Example HTS 40-06-B:** HTS = HV Transistor Switch, 4 = 4 kV, 0 = fixed on-time, 06 = 60 Ampere, B = Trench-FET

| Model [sorted by dimensions] | Description / Comment<br>• Preferred stock type ◦ Limited stock X Not for new development | Dimensions [mm <sup>3</sup> ] | Voltage [kV] | Pk. Current [A] | On-Resist. [Ω] | On-Time [ns] |
|------------------------------|---|-------------------------------|--------------|-----------------|----------------|--------------|
| HTS 40-06-B                  | • Tubular housing with pigtail connectors. Cooling options not available.                 | 135 x 20 x 20                 | 4.8          | 60              | 1.52           | 150          |
| HTS 40-12-B                  | • LED indicators. Very compact design - CF options partly not applicable!                 | 79 x 38 x 25                  | 4.8          | 120             | 0.76           | 150          |
| HTS 90-06-B                  | • LED indicators. Very compact design - CF options partly not applicable!                 | 79 x 38 x 25                  | 9.6          | 60              | 3.04           | 150          |
| HTS 40-26-B                  | • LED indicators. Very compact design - CF options partly not applicable!                 | 79 x 38 x 25                  | 4.8          | 260             | 1.3            | 220          |
| HTS 90-13-B                  | • LED indicators. Very compact design - CF options partly not applicable!                 | 79 x 38 x 25                  | 9.6          | 130             | 0.65           | 220          |
| HTS 100-12-B                 | •   | 89 x 64 x 27                  | 10.8         | 120             | 1.71           | 200          |
| HTS 30-60-B                  | •   | 89 x 64 x 31                  | 3            | 600             | 0.19           | 150          |
| HTS 60-30-B                  | •   | 89 x 64 x 31                  | 6            | 300             | 0.38           | 150          |
| HTS 70-30-B                  | • Compact design - CF options partly not applicable!                                      | 89 x 64 x 31                  | 7.2          | 300             | 0.46           | 150          |
| HTS 40-60-B                  | •   | 122 x 64 x 31                 | 4.8          | 600             | 0.3            | 150          |
| HTS 90-30-B                  | •   | 122 x 64 x 31                 | 9.6          | 300             | 0.6            | 150          |
| HTS 60-60-B                  | •   | 153 x 64 x 31                 | 6            | 600             | 0.38           | 150          |
| HTS 120-30-B                 | •   | 153 x 64 x 31                 | 12           | 300             | 0.76           | 150          |
| HTS 160-48-B                 | • LED indicators & Sync. I/O. CF options partly not applicable!                           | 174 x 103 x 35                | 16.8         | 480             | 0.67           | 150          |
| HTS 90-96-B                  | • LED indicators & Sync. I/O for parallel connection.                                     | 204 x 103 x 35                | 9            | 960             | 0.71           | 150          |
| HTS 180-48-B                 | • LED indicators & Sync. I/O for parallel connection.                                     | 204 x 103 x 35                | 18           | 480             | 0.71           | 150          |
| HTS 120-96-B                 | • LED indicators & Sync. I/O for parallel connection.                                     | 253 x 103 x 35                | 12           | 960             | 0.48           | 150          |
| HTS 240-48-B                 | • LED indicators & Sync. I/O for parallel connection.                                     | 253 x 103 x 35                | 24           | 480             | 0.95           | 150          |
| HTS 240-104-F                | • LED indicators & Sync. I/O for parallel connection                                      | 253 x 103 x 35                | 24           | 1040            | 0.4            | 250          |

### Options (1)

|         |  |
|---------|--|
| HFB     | <b>High Frequency Burst:</b> Improved burst capability of driver by means of external buffer capacitors. Recommended if more than 10 pulses with less than 10 µs spacing are generated.  |
| HFS     | <b>High Frequency Switching:</b> External supply of auxiliary driver voltage (50-350 VDC according to type). Necessary if the specified "Maximum Operating Frequency" shall be exceeded. (2)   |
| LP      | <b>Low Pass:</b> Low pass filter at the control input. Propagation delay time will be increased by ~50 ns. Jitter + 500 ps. Improved noise immunity and less critical wiring in high speed applications. (3)                         |
| DT      | <b>Delayed Trigger:</b> "Total Turn-On Time" irreversibly increased to >1 µs. Required if national or international export restrictions apply ("dual use products"). (2)   |
| S-ON    | <b>Soft Turn-On:</b> Turn-On Rise Time increased by ~20%. Simplified EMC design and less critical wiring if the shortest possible edge steepness is not required. (3)  |
| S-OFF   | <b>Soft Turn-Off:</b> Turn-Off Rise Time increased by ~20%. Simplified EMC design and less critical wiring if the shortest possible edge steepness is not required. (3)  |
| S-TT    | <b>Soft Transition Time:</b> Turn-On Rise Time & Turn-Off Rise Time increased by ~20%. Simplified EMC design and less critical wiring if the shortest possible edge steepness is not required. (3)                                   |
| TT-C    | <b>Customized Transition Time:</b> Customized rise & fall times to meet individual design requirements. (2)  |
| TT-P    | <b>Programmable Transition Time:</b> Switching speed adjustable in certain limits by means of external programming resistors. (2)  |
| OT-1µ   | <b>On-Time Extension:</b> On-Time increased to 1 µs. Turn-Off Rise Time >500 ns.   |
| OT-10µ  | <b>On-Time Extension:</b> On-Time increased to 10 µs. Turn-Off Rise Time > 5 µs.   |
| OT-100µ | <b>On-Time Extension:</b> On-Time increased to 100 µs. Turn-Off Rise Time >50 µs.  |
| OT-C    | <b>Customized On-Time:</b> On-Time according to customer's specifications. Any value between 100 ns and 100 µs.  |
| OT-P    | <b>Programmable On-Time:</b> On-Time adjustable in certain limits by means of external programming resistors. (2)  |
| MIN-PS  | <b>Minimum Pulse Spacing:</b> Individually increased Recovery Time to ensure a minimum HV pulse spacing independently of control pulse spacing. For safety relevant circuits.  |
| ST      | <b>Stage Tapping:</b> Connectors at the individual stages of stack in order to utilize single power semiconductors. To achieve fast rise times also at very low operating voltages (<0.01xVo).                                       |
| LNC     | <b>Low Natural Capacitance:</b> C <sub>N</sub> reduced by approximately 30%. To minimize capacitive power losses in applications with high switching frequency and high switching voltage (P <sub>c</sub> = V <sup>2</sup> x C x f). |
| LL      | <b>Low Leakage Current:</b> Off-state current reduced to less than 10% of the specified value. Not available in connection with the cooling fin options and for switches of the UF series.   |
| ISO-25  | <b>25 kV Isolation:</b> Isolation Voltage increased to 25 kVDC. Housing dimensions may change for some models.   |
| ISO-40  | <b>40 kV Isolation:</b> Isolation Voltage increased to 40 kVDC. Housing dimensions may change for some models. Only in connection with option PT-HV.   |
| ISO-80  | <b>80 kV Isolation:</b> Isolation Voltage increased to 80 kVDC. Housing dimensions may change for some models. Only in connection with option PT-HV.   |
| I-PC    | <b>Integrated Part Components:</b> Integration of small part components according to customer's specifications (e.g. buffer capacitors, snubbers, damping resistors, diodes, opto couplers). (2)                                     |
| I-FWD   | <b>Integrated Free-Wheeling Diode:</b> Built-in parallel diode with short recovery time. In connection with inductive load only.   |
| I-FWDN  | <b>Integrated Free-Wheeling Diode Network:</b> Built-in parallel diode plus serial blocking diode with short recovery time. In connection with inductive load only.  |
| SEP-C   | <b>Separate Control Unit:</b> Control unit with LED indicators in a separate housing (dim. 79x38x17 mm). Linkage cable (<1m) with plug. Control unit with soldering pins or pigtails   |
| I-PC    | <b>Integrated Part Components:</b> Integration of small part components according to customer's specifications (e.g. buffer capacitors, snubbers, damping resistors, diodes, opto couplers). (2)                                     |
| LS-C    | <b>LEMO socket for Control Connection:</b> Input Z=100Ω. An assembled linkage cable (1m/3ft) with two plugs and one socket is included in supply. Improved noise immunity. (3)   |
| PT-C    | <b>Pigtail for Control Connection:</b> Flexible leads (l=75 mm) with PCB connector. This option is only relevant for switching modules with pins. Recommended for modules with options CF & GCF.                                     |
| PIN-C   | <b>Pins for Control Connection:</b> Gold plated pins for printed circuit board designs (special sockets available). This option is only relevant for switching modules which have pigtails as standard.                              |
| PT-HV   | <b>Pigtails for HV Connection:</b> Flexible leads with cable lugs. For increased creepage. PT-HV is standard for all types with >25 kV switching voltage. Not recommended in extremely fast circuits.                                |
| ST-HV   | <b>Screw Terminals for HV Connection:</b> Threaded inserts at the bottom of module (if not standard). For PCB design. Operation above 25 kV requires liquid insulation (Galden®/Oil) or potting.                                     |
| UL94    | <b>Flame Retardant Casting Resin:</b> Casting resin according to UL-94-VO. Minimum order quantity required. (2)  |
| TH      | <b>Tubular Housing:</b> Tubular instead of rectangular housing. Adaption to specific ambient conditions or in case of difficult assembly situations.   |
| FC      | <b>Fiat Case:</b> Height of standard plastic housings reduced to 19 mm or less. Not in combination with cooling options CF, GCF and DLC.   |

|               |  |
|---------------|--|
| <b>ITC</b>    | <b>Increased Thermal Conductivity:</b> Special moulding process to increase the thermal conductivity of the module. Pd(max) will be increased by approx. 20-30%. (2)                                       |
| <b>CF</b>     | <b>Non-Isolated Cooling Fins:</b> Standard sizes in categories I to VII according to model. Nickel plated copper 0.5 mm, fin height 35 mm. For air cooling and oil immersion.                              |
| <b>CF-1</b>   | <b>Non-Isolated Cooling Fins d=1mm:</b> Nickel plated copper 1.0 mm instead of 0.5 mm. The Max. Power Dissipation will be increased by ~80 %. For air cooling and oil immersion.                           |
| <b>CF-X2</b>  | <b>Non-Isolated Cooling Fins enlarged by x2:</b> Fin area enlarged by factor 2. Not relevant in connection with oil cooling.   |
| <b>CF-X3</b>  | <b>Non-Isolated Cooling Fins enlarged by x3:</b> Fin area enlarged by factor 3. Not relevant in connection with oil cooling.   |
| <b>CF-CS</b>  | <b>Non-Isolated Cooling Fins with customized shape:</b> Individual shape to meet specific OEM requirements. (2)  |
| <b>CF-LC</b>  | <b>Non-Isolated Cooling Fins optimized for liquid cooling:</b> Double fins, nickel plated copper, 0.5 mm thickness, height 20 mm.  |
| <b>CF-GRA</b> | <b>Non-Isolated Cooling Fins made of graphite:</b> Very light weight compared to copper at similar heat transfer, but reduced heat capacity. 0.5 or 1 mm thickness, height 35 mm.                          |
| <b>CF-CER</b> | <b>Isolated Cooling Fins made of ceramics:</b> Heat transfer properties similar to alumina. Forced convection recommended, height 35 mm.   |
| <b>CCS</b>    | <b>Ceramic Cooling Surface:</b> Top side of switching module made of special ceramics. Heat transfer properties similar to alumina. Forced convection recommended.   |
| <b>C-DR</b>   | <b>Cooling for Driver:</b> Extra cooling for the driver and control electronics. Recommended in combination with option HFS at higher switching frequencies. (2)   |
| <b>GCF</b>    | <b>Grounded Cooling Flange:</b> Nickel-plated copper flange for High Power applications. Max. isolation voltage 40kV. Increased coupling capacitance Cc.   |
| <b>GCF-X2</b> | <b>Grounded Cooling Flange,</b> Max. Continuous Power Dissipation increased by x2: Thermal resistance "Switch to Flange" reduced for twice the power capability. (2)                                       |
| <b>ILC</b>    | <b>Indirect Liquid Cooling:</b> Liquid cooling for all kind of conductive coolants including mains water. Internal heat exchanger made of ceramics. For medium power applications.                         |
| <b>DLC</b>    | <b>Direct Liquid Cooling:</b> Internal cooling channels around the power semiconductors. The most efficient cooling solution especially for high frequency applications. For non-conductive coolants only. |
| <b>HI-REL</b> | <b>High Reliability / MIL Versions:</b> Available on request. (2)  |

(1) New option code: Data sheets may differ from this coding system (especially older ones) and do not indicate all possible options as per above table. (2) Please consult factory for detailed information.  
(3) These options are EMC-relevant and are recommended for industrial power applications, difficult noise ambients, prototype experiments with flying leads and for users without special EMC design experience.

Further information, data sheets and drawings are available on request. All data and specifications subject to change without notice. BEHLKE POWER ELECTRONICS 07-11-2011

